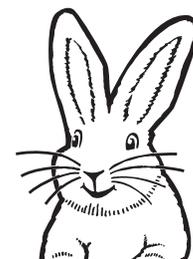




Growing School Gardens

Annie's How-to Guide for
Five Kinds of Children's Gardens

• **Written for Annie's by the Center for Ecoliteracy**





Growing School Gardens

Cultivating a garden with children offers a life-affirming context for strengthening child-to-child, child-to-adult, and human-to-nature relationships. When working or playing in a garden, we all learn to slow down and connect with each other and our surroundings.

Whether your garden is a seed in a cup or an acre of fruit trees, gardening includes us in the cyclical rhythms of nature. Nature becomes our teacher as it continually demonstrates complex, subtle, and elegant life-sustaining practices.

Through gardening, we link the uncultivated world to our human place and absorb the evergreen lesson that we cannot control nature. By forming relationships with our uncultivated and cultivated places based upon a spirit of cooperation and reverence, our garden will do what nature does best: provide sustenance for all living beings.

We offer five examples of different gardens—from simple to complex—that can flourish at schools and other learning environments. It is our hope that at least one of these examples will fuel your motivation to garden with kids.

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The simplicity of a seed in a cup sitting on a windowsill belies its capacity to elicit wonder and delight. A seed, a cup, soil, water, and sun are all that is required to start.

2. Vertical Gardens..... 17

In tight spaces, gardens can be structured to grow up and out. Vertical gardens teach that gardening is possible in very limited spaces and encourage thinking about growing food as infill even where space is at a premium.

3. Raised Beds and Container Gardens..... 27

When space is available but healthy soil is not—such as in rocky soils or locations where asphalt or concrete covers a schoolyard—intensive gardening can occur in generous amounts of soil in raised beds and containers.

4. Cold Frames, Tunnels, and Greenhouses..... 39

Each of these structures is designed to provide weather protection, extend the growing season, and maximize solar efficiency. Students are exposed to the notion that plants can grow all year in most locations across the country, even in northern and snowy climates.

5. Large-Scale Gardens..... 49

When there is sufficient commitment, land, and funding, a large-scale garden offers opportunities to grow a wide diversity of plants, introduce farm animals into the mix, and produce enough food to help nourish students or even the wider community.

Getting Started

For creating most gardens, you will have better success if you engage the community from the beginning. Consider holding a gathering to generate design ideas and build commitment from students, parents, teachers, and community members as well as gardening experts. We suggest that you start small, keep the kids at the center of the process, and seek out parents and other community members who can help locate materials and construct the garden.

Becoming an Urban Farmer

Even if you start with an old garbage can as your garden container, you are beginning down the path of urban farming. We hope these garden ideas will help fuel your enthusiasm for gardening with children. Once you and the kids harvest your first crop—which may be no more than a handful of strawberries—and realize that you can grow some of your own food, you will join the ranks of those who are yearning to increase their self-sufficiency, and find joy and satisfaction in the simple act of feeding themselves and their community.

Harvesting

Harvest time is when you will reap the satisfaction of all your hard work and deep attention to the garden. If plants are harvested properly, they will continue to produce delicious fruits and vegetables over a longer period of time. Each time you gather your bounty, wash, weigh, and store it, so you can enjoy it later. Harvesting the garden sounds simple — and it is — but it also requires some familiarity with how to harvest each plant. These steps can help you with your harvest:

- When harvesting, clean up the plants in the ground as you go. For instance, remove any dead, damaged, or decomposed parts of the plant to allow for successful regeneration of the plant.

- Root vegetables are probably the easiest to harvest. Look at the bottom of the stem and make sure that a healthy-sized carrot, beet, radish, or turnip has developed, and then pull the entire plant out of the ground. If they are not going to be eaten right away, cut off the greens and place the plant in a refrigerator or root cellar.
- Herbs are also easy to harvest. They all have different harvesting requirements, but in general they are vigorous, can be harvested frequently, and will regenerate quickly.
- Arugula and mesclun mixes of salad greens can be cut to about one inch above the soil and they will regenerate. Farmers refer to these as “cut and come again” crops because they will produce up to three different harvests before becoming less palatable.
- Lettuce is a different story. If you want lettuce to keep producing, harvest leaves starting with the outside leaves. Of course, you can harvest the whole head by cutting the main stem below the point where all the leaves join.
- Other greens such as kale, chard, and collard can also be harvested from the outermost leaves inward. The leaves should be snapped off at the stem and pulled straight downward for a clean cut. The leaves should not be cut or broken, as a short stem that is easy prey for mold and disease will remain. Make sure to leave at least four or five leaves in the middle, for the plant to regenerate.
- Fruit is easy to harvest when ripe. For instance, a ripe apple should come off in your hand with a quarter turn of the stem. A ripe peach should almost fall off in your hand. A ripe raspberry or strawberry is easy to identify as well.

Chapter 1

Windowsill Gardens

A windowsill garden is a delightful addition to a classroom, a kitchen, or a balcony. The natural beauty of plants provides a splash of color and stimulation. Plants growing in our homes and classrooms remind us of our inherent connectedness with the Earth as they provide us with clean air to breathe.

Just as a kitchen windowsill overflowing with herbs or flowers inspires us to cook more creatively, a windowsill garden in a classroom evokes curiosity and daily observation. Not only do indoor gardens offer a rich context for learning, they are resourceful options for schools with limited space, extreme seasonal weather conditions, and minimal funding.



What are Windowsill Gardens?

Windowsill gardens are small container gardens on windowsills or on ledges of buildings. They are usually inside and can range in shape and size. A windowsill or ledge can be effective for starting seeds before transplanting to an outdoor garden. Windowsill gardens can also be used to grow some plants that thrive in small environments with diffused light and slight changes in temperature.

Advantages

Manageable

If you don't have an ideal place for a traditional, in-the-ground garden, if the seasons are too extreme to grow outside year-round, or if you want to start plants from seed and don't have a greenhouse, a windowsill garden could be perfect for you. They take up very little space and can still be quite productive, if plants are chosen and cared for properly. Windowsill gardens grow well year-round as long as they have plenty of light.

Great for Cooking

Delicious herbs, edible sprouts, and baby lettuces can thrive indoors.

Convenient to Classroom

Windowsill gardens are invaluable instructional tools for hands-on learning about life systems without having to leave the classroom.

Brings Outside Indoors

Windowsill gardens can serve as bridges to the outside world, bringing the pleasures of nature inside as a calming focal point.

Disadvantages

Sometimes Difficult to Transplant Outdoors

Plants will often grow "leggy" — or grow too tall too fast — developing weak stems as they reach for light. Consequently, plants that are started in windowsill gardens can be too weak to be transplanted outdoors.

Hard to Water Properly

Windowsill gardens are difficult to water properly. Small containers quickly dry out over weekends and holidays, and students tend to enthusiastically overwater small pots in the classroom. Also, if the plants don't get enough direct light and the temperature fluctuates greatly, they will not thrive.

Can Easily Outgrow Container

Most large vegetables and flowers, such as squash, beans, corn, tomatoes, and sunflowers, will sprout in a windowsill garden, but will quickly outgrow their containers and need more full-spectrum sunlight.

Limited Planting Options

Windowsill containers will likely not be deep enough for taproot or root vegetables, which also don't like to be transplanted.

Designing the Garden

1. Choosing a Location

- Before you settle on a place to establish your windowsill garden, have the kids observe how the sunlight moves through the classroom, keeping a record of their observations for at least a week. They can repeat this each season and notice how the sun's arc changes throughout the year.
- Determine which direction the windowsill is facing. The windowsill garden will need at least 4–6 hours of sunlight on most days. In the Northern Hemisphere, windowsill gardens facing north will generally not get quite enough light to grow healthy plants from seed. However, other shade-tolerant indoor plants will do fine if properly cared for. East-facing and west-facing windowsills are the best bet, as they tend to receive the right amount of direct sun. Windowsills that face directly to the south can flourish, but they must be monitored carefully since the light may be too intense and the soil in the containers may dry out quickly.

2. Selecting Materials

- Decide if the plants are intended for eventual transplanting to a larger, outdoor garden or are going to grow to maturity inside, and if you and the kids want to grow flowers, vegetables, herbs, or indoor houseplants. Think about how students will interact with the garden. Will they be moving the garden from the windowsill to the middle of the classroom, where it is accessible and visible to all, or to students' desks? These factors will help you decide what kinds of containers to use.
- If the garden will be moved from one classroom to another, consider using rigid trays and containers to minimize problems in transportation. Also, a cart or table with casters would be useful for moving the garden to different rooms or through the hallways.

- If you plan to use the windowsill garden primarily for germinating seeds, small containers work the best. Six-cell packs from a nursery work well, as do empty egg cartons or eggshells.
- For growing plants such as herbs and lettuces that you will eventually transplant outdoors, use a medium-size container. A 2 x 2 or 3 x 3 inch pot or an equivalent size is ideal. Consider unusual but attractive containers like baskets, coffee mugs, or empty tea tins.
- If you plan to keep the plants indoors throughout their life cycle, choose a larger container that is at least 6 x 6 inches. Reused nursery pots and repurposed flower vases work well in windowsills. A miniature version of an outdoor container or raised bed, with a bottom and drainage tray, will work well, such as a small wooden box.
- Whatever receptacle you choose for your windowsill garden, be sure that water can drain away from the plants. Punch or drill holes in the bottom and place a plate underneath the receptacle or place pebbles in the bottom so water will drain through them and away from the roots. How will water that drains out of the containers be captured and not cause damage to the windowsill, furniture, books, and other surfaces?

3. Selecting Soil

- For windowsill gardens, it is easiest to use an organic soil mix from a nursery. When sprouting seeds, use a lightweight seed-starting mix. When filling a container for growing lettuces and/or herbs, a richer potting mix is most suitable.

4. Choosing Plants for the Garden

- ☛ If you are planning to use the windowsill for germinating seeds in containers, consider starting with big seeds such as beans, corn, sunflowers, or nasturtiums. Keep in mind that these crops will quickly outgrow their containers and will need to be planted in an outdoor garden within a couple weeks of germinating.
- ☛ If you want to grow seeds to maturity in the windowsill, consider growing herbs (dill, parsley, cilantro/coriander) as well as lettuces and baby greens such as arugula and mâche.

5. Maintaining a Windowsill Garden

Maintaining your windowsill garden is like maintaining an outdoor garden under a microscope. The soil moisture should be checked every day. If you are sprouting seeds, you can water a little bit every day to keep it moist. Once the seeds sprout, check the moisture with your finger to see if it is cool and moist below the surface, and then decide if it's time to add more water. Windowsill gardens that receive lots of direct light need more water than those exposed to diffused light.

If you are growing herbs, or lettuces and baby greens, make sure to harvest them when they are ready to eat. (See "Harvesting" sidebar in the Introduction.)

If you are sprouting seeds with the intention of transplanting them to a larger outdoor garden, make sure to wait until the plants have their first set of "true leaves" before disturbing them. Then, place the young starts outside for 4–7 days in their original pots before planting them in the garden. This is called "hardening off" and will allow them to gradually adjust to the outdoor conditions.

Kids also enjoy vermicomposting, so consider setting up a worm bin in the classroom for disposal of organic waste and use it to replenish the nutrients in your windowsill garden. (See "Composting" sidebar in Chapter 3.)

Checklist of Materials

Windowsill Gardens

You will need at least one of the following:

- Small container for starting seeds, such as repurposed cups, egg cartons, egg shells, used nursery cell trays, nursery pots, tea tins, or coffee mugs
- A planter box or tray that fits the windowsill space
- Glass or plastic sprouting jar (for growing edible sprouts)

You will also need:

- Low-nutrient potting soil
- Compost to add to the soil each time you plant
- A plate or tray to catch the water that will drain out of the containers
- Water
- Small watering cans
- Seeds

Chapter 2

Vertical Gardens

Kids love to climb and watch others — both people and animals — climb. They are often thrilled to realize that they can train plants to climb too. Vertical gardens provide a venue for them to experiment with an infinite number of strategies for encouraging plants to go up.

Soil is optional in some vertical gardens, and it is an exciting lesson in botany to learn how to grow plants without it. Most kids have seen plants forcing their way through a crack in the sidewalk or floating on the surface of a lake, but they may not realize that some plants can flourish in mediums other than soil.



What are Vertical Gardens?

A vertical garden is a garden that grows up rather than out. Usually, people install vertical gardens to save space, but they also can offer fascinating aesthetics. They work well in small areas and urban environments with little outside space for a garden. These gardens can be very productive, considering the minimal space they require to thrive.

Plants in a vertical garden can grow up a trellis, arbor, or pergola, or even up a wall, fence, light pole, or drainpipe. Sometimes containers such as garden pots hooked on a trellis or fence are attached to the vertical structure. There are also commercial vertical gardens that include planter pockets and hydroponic systems.

Advantages

Small Space, Big Results

They take up very little space and can be quite productive.

Great for Climbing Plants

They are ideal for growing plants that climb naturally, like runner beans, peas, gourds, chayote, passion fruit, kiwi, grapes, and flowering vines.

Visually Stimulating

They add height to horizontal gardens, making them more visually thought-provoking.

Covers Unsightly Walls and Fences

Hanging wall gardens can beautify unattractive walls and fences.

Cozy, Shady Spaces

They can create intimate space in larger gardens and provide shade on hot, sunny days.

Disadvantages

Limited Growing Options

Not all plants do well in vertical gardens. For example, plants that do not climb tend to struggle in a vertical garden, and large plants such as corn, squash, and tomatoes need wider spaces for their roots to spread.

Tall for Kids

Vertical gardens are often difficult for children to access.

Space Is Limited

They are not ideal for working with large groups of students.

Can Be an Incomplete Teaching Tool

Hydroponic hanging wall gardens are very productive, but they also leave out a very important piece of the biological puzzle in a garden: soil.

Can Be Expensive

Vertical gardens can be expensive when purchased as a kit or a custom-made design.

Designing the Garden

1. Choosing a Location

- Before you begin to develop your vertical garden, observe how the sunlight moves through the space.
- Vines that grow on trellises, arbors, or pergolas will need at least 6–8 hours of direct sunlight per day.
- In general, east-, west-, and south-facing walls will be the best for growing vegetables, herbs, and flowers in the Northern Hemisphere, but hanging gardens can grow well with different orientations as long as you make sure that you choose a more shade-tolerant type of planting for north-facing walls.
- Consider other activities that may impact the garden, such as sports or other play, as well as the configuration of the space. For example, narrow corridors with heavy traffic may not work for a hanging wall or fence garden.
- Think about the average height of your students. Will they be able to reach the garden without a ladder?
- Will they be able to help build it without much technical knowledge?
- How many kids will be able to engage with the vertical garden at one time?

2. Selecting Materials

- Trellises can be built out of many different materials such as wood, bamboo, iron, and reinforcement steel. They can be purchased or made by hand.

- Hanging wall gardens can also be purchased or built by hand. If you want to build a wall garden, consider making hanging containers out of wood, recycled plastic, repurposed lightweight containers such as watering cans, or breathable felt cloth like the material used to make “Woolly Pockets.”
- Whatever you use, make sure the containers are securely fastened to the wall or fence.

3. Selecting Soil

- For trellised gardens, it is easiest to use an organic soil mix from a nursery, local topsoil straight out of the ground, or a combination of the two. Regardless of the source, apply a fertilizer, such as organic compost or decomposed animal manure, that is appropriate for the types of plants you will grow.
- For most hanging wall gardens, you’ll need to use a growing medium such as soil. Choosing which type to use will depend on the type of garden you are building. A hanging container or pocket garden should have organic soil mix, similar to that in raised beds or container gardens.
- A hydroponic hanging wall does not need soil. It does, however, need a system for adding nutrients to the water and cycling water from the bottom of the wall garden to the top after it percolates down. It needs a water reservoir, pump, and a nearby power source to plug in the pump. Unless you have carpentry skills, purchasing this equipment is advisable. Many hanging hydroponic garden kits have solar panels connected to them so that when the sun shines, the solar energy pumps water from the reservoir back up to the top of the garden.

4. Choosing Plants

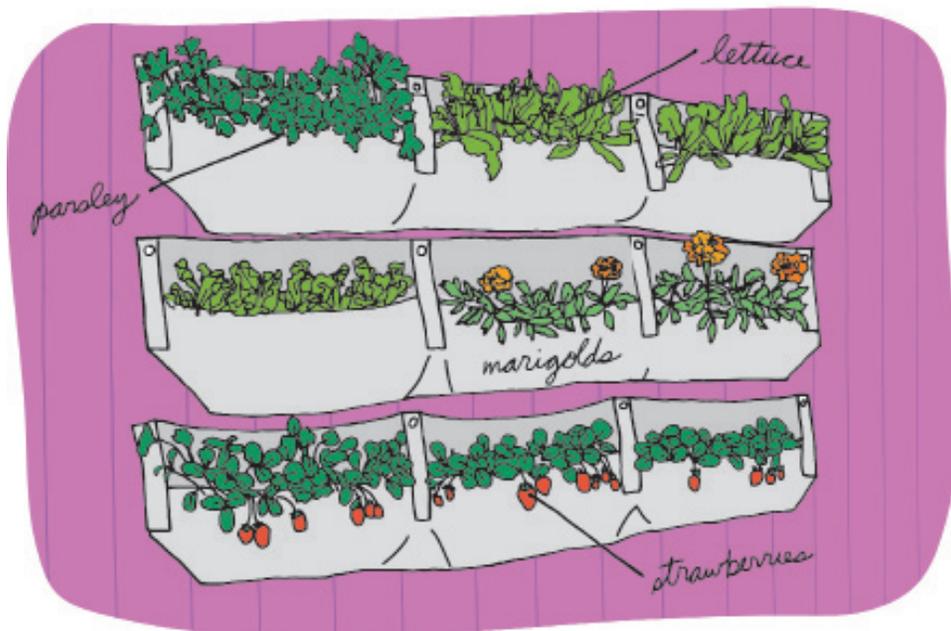
- Climbing plants such as runner beans, peas, gourds, chayote, passion fruit, kiwi, grapes, and flowering vines are best for trellis gardens.
- Smaller plants such as herbs, lettuces, and leafy greens grow well in hanging wall gardens, whether in a container with soil or grown hydroponically.

Irrigating Your Garden

All types of gardens — windowsill, vertical, in containers, or in the ground — will require irrigating. It's a good idea to develop a way to irrigate your garden before you plant anything. You may start by hand-watering with a hose and later install a drip irrigation system, but your plants will be happiest if you have some method of providing them with water from the minute you put them in the soil. Below are basic irrigation tips:

- Watering is fun for kids but can lead to clothes getting soaked and children either laughing hysterically or in tears. If you want to avoid this kind of chaos, have one or two children water at a time and show them where to water and how much water the plants need.
- In general, germinating seeds and small transplants need soaking every day or every other day for just a few minutes. At this stage, kids are so excited about the potential of raising a plant that they tend to overwater. More mature plants with deeper roots and perennials of all kinds need less frequent, deeper irrigation depending on the season and climate.

- Read the back of the seed packet or the directions that accompany a nursery seedling to find out its watering needs. If you get seeds from other gardeners, be sure to ask them about the necessary growing conditions.
- Group plants with similar watering needs together. Some plants require soil that is always moist, while others prefer that soil dry out before the next deep watering.
- Many plants vary in their needs for watering throughout their life cycles. For example, beans and peas are particularly susceptible if insufficiently watered when flowering, while root crops are susceptible when establishing their root systems. Talk to other gardeners about the idiosyncrasies of various plans.
- Water by hand when you are watering seeds and smaller plants, and remember always to water them immediately after transplanting. Many gardeners prefer to hand-water all the time because it allows time to pay more attention to the particular needs of the plants.
- If you lack time and want to save water, think about installing a drip irrigation system, especially for deeper-rooted, longer-season plants such as tomatoes, squash, flowers, and perennials. As you lay out the drip emitters (small tubes that carry water throughout the garden), put them near the plants but not right next their main stems. Making plants reach for water helps them develop more vigorous root systems.
- Sprinklers can also be useful as they can reach a large area using minimal water. Unfortunately, much of the water is often lost to evaporation. Sprinklers are ideal for larger perennial beds that don't need frequent watering. And, they are fun to run through!



5. Maintaining a Vertical Garden

Maintaining a vertical garden is similar to maintaining any garden.

For information on maintenance, see the sidebars “Harvesting” in the Introduction, “Irrigating Your Garden” in this chapter, “Composting” in Chapter 3, and “Weeding” and “Controlling Pests” in Chapter 4.

Maintaining hydroponic vertical gardens is different, however. They must be checked regularly and the water level in the reservoir must be closely monitored, since water is lost to the plants and evaporation. Since they use an electrical power pump, remember to clean it on a regular basis and to replenish the nutrients in the water regularly. Plants often grow very quickly in hydroponic agricultural systems, so frequent harvesting and replanting is also necessary.

Checklist of Materials

Vertical Gardens

When building a trellis garden you will need:

- ?
- A premade trellis, arbor, pergola, or the building materials to make one (bamboo, wood, reinforcement steel); a light pole or vertical drainpipe
- ?
- Tools to work with the building materials (saws, drills, hammers, nails/screws, level, welding tools, etc.)
- ?
- Soil
- ?
- Plants that like to climb

When building a hanging wall garden you will need:

- ?
- Containers to attach to the wall or fence (either wooden, plastic, burlap, or woven recycled plastic such as “Woolly Pockets”)
- ?
- Brackets and screws/bolts to attach containers to the wall or fence
- ?
- Plants that will thrive in a small container (see illustration, previous page)

When building a hydroponic hanging wall garden you will need:

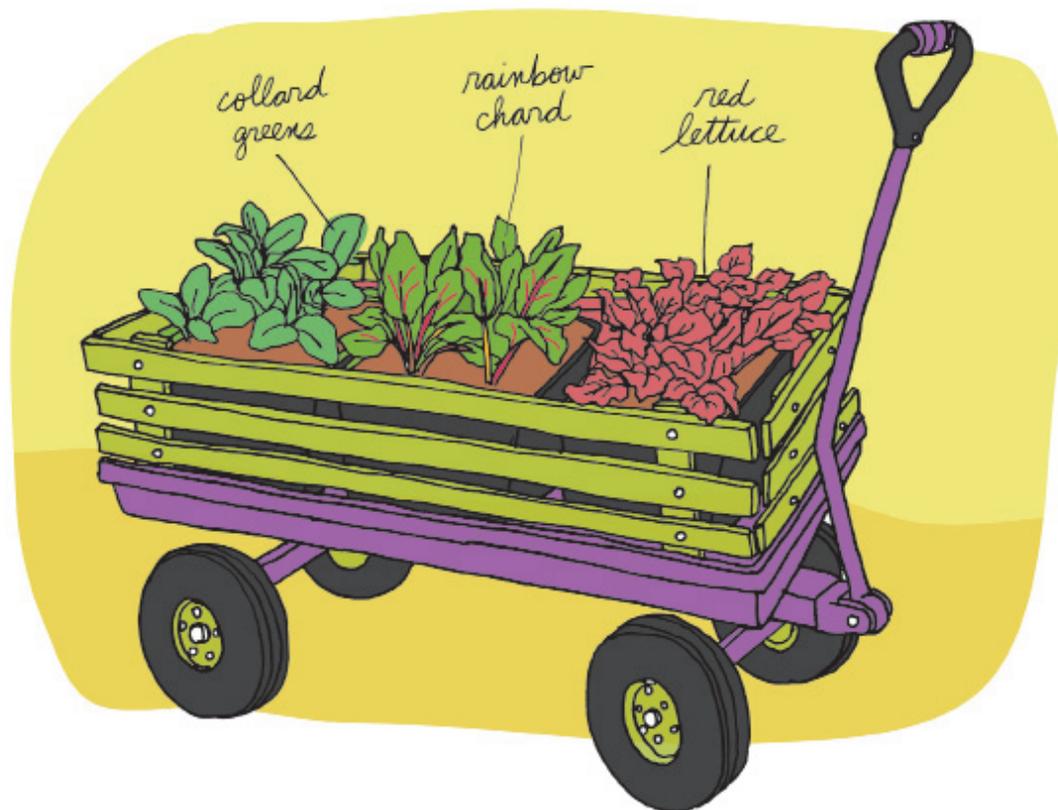
- ?
- A premade hydroponic hanging wall kit or the materials to make one
- ?
- Plants that will thrive in a hydroponic garden

Chapter 3

Raised Beds and Container Gardens

We all know how much kids love sandboxes. They can spend hours digging, sifting, pouring, and building as they create and recreate dynamic mini-environments. Within this small and defined space, children immerse themselves while nurturing their senses and imagination.

Raised beds and container gardens take the attraction of sandboxes to a whole new level. They offer an added quality of complexity and variation as children create microfarms to observe, cultivate, and reap the resulting harvest throughout the seasons.



What are Raised Beds and Container Gardens?

Raised beds and container gardens are above the ground in a defined space full of rich, healthy soil in which plants can thrive. While container gardens are enclosed in receptacles — which can be anything from a child's outgrown wagon to an old bathtub — raised beds may or may not have sides. Sometimes raised beds are merely mounds of soil sitting on top of the original soil, and they can take many shapes. Others are framed by borders of wood, stone, or other rigid material and are often rectangular or

square. Container gardens and raised beds are ideal for turning areas that appear unsuitable for gardening — such as narrow corridors, busy courtyards and playgrounds, and school building rooftops — into abundant and attractive spaces for children to experience gardening. These types of gardens can be custom-built or made from a kit and can be sized and shaped to fit the needs of the site and people who will use them. They are also relatively easy to take care of and can be both beautiful and bountiful.

Advantages

Works on Any Surface

You can create a lovely garden in an area where the soil or subsurface is not amenable to gardening, such as asphalt, concrete, compacted clay, rock, or where there is heavy-metal contamination.

Surface-Friendly

Wherever you have 4–6 hours of direct sunlight on most days, you can place a productive and inspirational garden, no matter how small the space.

Easily Accessible to All

Raised beds and containers are accessible to people of all ages and physical conditions. They can easily be wheelchair accessible.

A Good Size for Kids

They provide a manageable area for children to cultivate.

Won't Get Stepped On

Raised beds prevent people from walking in the garden, which is beneficial when young children and large groups of students visit.

Controls the Pests

It's easier to keep pests such as snails, slugs, gophers, or birds out of raised beds and containers.

Opportunity to Recycle

Container gardens in particular can be made from a variety of discarded and repurposed items, keeping them out of the landfill.

Year-Round Usage

If you live where there are cold winters, you can convert a raised bed into a cold frame or low-tunnel type garden for four-season production.

Mobile

Container gardens can easily be mounted onto casters or wheels and made into mobile gardens for bringing into classrooms and demonstrating how gardens grow with differing amounts of light.

Disadvantages

Needs Frequent Irrigation

The soil in a raised bed or container can dry out quickly and may need to be irrigated more frequently than in a traditional garden.

Can Be Expensive

While container gardens can be made out of a whole range of materials, enclosed raised beds can be expensive to build. If you are buying lumber or bricks for one large bed or many beds, the costs add up quickly!

More Difficult to Maintain

An unenclosed raised bed is easier to establish but may be more difficult to maintain in the long run. It is more vulnerable to people, animals, and wind that can disturb its borders.

Even if you buy bagged soil that claims it's nutritious, the only way to build and maintain healthy soil is by mulching, amending the soil with minerals and compost, and growing cover crops.

Possible Flooding

Raised beds and containers drain directly onto the surface on which they are placed, which can lead to flooding and a muddy mess. If your garden will be on an asphalt or concrete surface, make sure the beds and containers are near a drain or are uphill from an area that can absorb the runoff.

Isolated Environment

Enclosed raised beds and container gardens are a somewhat controlled environment within a physical boundary that separates them from the surrounding natural world, making it difficult for children to experience the myriad of complex interconnections among plants, animals, and the landscape.

Space Is Limited

They may not be large enough to engage more than a few kids at the same time.

Designing the Garden

1. Choosing a Location

- Before you settle on a place to develop your garden, take the children to visit potential sites at different times of day. Have them keep a record of their observations.
- The area will need at least 4–6 hours of sunlight on most days.
- Note if the area is windy at times and, if so, the direction that the wind tends to blow.
- Check whether buildings or trees shade some or all of the space. If the garden is next to a building, note the direction it is facing.
- Ask kids to observe the animals that visit the space and determine if any of them are “residents” that stay all year.
- Make sure there is a source of water nearby.
- Identify what will have to be removed if you convert this space to a garden.
- Brainstorm other elements you would like to include in the garden, such as a toolshed, a compost bin, a propagation area, or chickens or other farm animals.
- Determine the ideal size of your container garden or raised bed. Do you and the kids plan to create more than one, either now or in the future? If so, is there room to expand?
- Should there be walking paths or enough space for kids to push a wheelbarrow between the raised beds or containers?
- Will all sides of the container or bed be accessible? Will children be able to reach to at least the middle of the bed from one or more sides?
- How will people travel to, from, and around your container or bed? Is it easily accessible, yet not a barrier to traffic flow?



2. Selecting Materials

Container Garden

- When choosing a container, select something that has the potential to be attractive and is made to last for many years, such as an old enameled bathtub or sink or a repurposed galvanized animal-watering trough. You and the children can brainstorm ideas and choose from your list.
- If you plan to cultivate a variety of plants, your container or bed should be at least 3 feet deep so you can grow plants with moderate root extension. The deeper your container, the more options you have. Keep in mind that the children will want to help construct the garden, so choose a design that will allow for them to be involved. (See sidebar “Children and Tools” in this chapter.) And, of course, make sure the material is safe for children and other living things, with no sharp edges, protruding nails or splinters, or rust.
- Make sure that you can move the container when it’s empty. Using a wagon or some other container on wheels is an innovative solution to that problem.
- Wine or whiskey barrels, cut in half, are some of the best containers for gardening. They are a recycled material, a good size for children to work in, and are made out of oak, which is a long-lasting hardwood.
- Make sure there is a way to allow water — but not soil — to drain out of the container.

Raised Bed

- Raised beds can be made from many different materials, including wood, broken concrete (“urbanite”), brick, stone, or recycled plastic lumber. Think about what is accessible, attractive, economical, and easy to work with.
- Raised beds are most often made out of redwood because it is resistant to rot. However, unless the redwood has been salvaged from another structure, it is not considered a renewable resource, so consider using something else.

- Other woods, such as pine and fir, come from forests that renew quickly. Therefore, they are considered to be more renewable than redwood. They are also often less expensive. Unfortunately, they break down faster than other building materials and must be replaced within 5–10 years, depending on the climate.
- Pressure-treated wood, including railroad ties, should be avoided even if free of arsenic, because it contains harsh chemicals.

Children & Tools

Constructing and maintaining a garden is a perfect way to teach kids how to use a variety of tools. Just like adults, children do best with tools that are of good quality, not too heavy, and in good condition. Below are some tips to teach kids the proper use of tools:

- Avoid dull edges on tools like hoes and shovels; dull tools are less safe because when they don’t perform properly the child may become frustrated and resort to using too much force, which can result in injury.
- Start by demonstrating how to properly and safely use, transport, clean, and store each tool. After your demonstration, invite responsible students to practice under close supervision. Use your judgment when deciding when each child is ready to try using each tool.
- If you are going to build an enclosed raised bed or other container, you will likely be using hammers, screwdrivers, drills, nails, screws, and various other types of hardware. When maintaining the garden, you will probably use hoses and nozzles, hand hoes or hula hoes, digging forks, hand rakes, and pruning shears. Develop a system for distributing tools, making sure that children know to wait for permission before using any tools.

3. Selecting Soil

- For container gardens and raised beds, it is easiest to use an organic soil mix from a nursery, local topsoil, or a combination of the two.
- Regardless of the source, mix in some compost or apply an organic fertilizer that is appropriate for the types of plants you plan to grow. If the soil is dense, add some sand or rice hulls to improve drainage.
- Kids love to pour water through jars of soil and compare the rates at which they drain. This is a way to involve students in selecting the best soil for their garden.

Soil Testing

To determine the health of your soil, you can test it for its nutrient content and for contamination. To test for the levels of important nutrients, such as nitrogen, phosphorus, and potassium, you can buy an inexpensive soil testing kit at your local nursery. You may also determine the pH of your soil (its level of acidity), which can be useful to know when selecting some plants. If you suspect that your soil may be contaminated with lead, toxic runoff, or other harmful substances, contact a local university, which may provide testing services at a reasonable cost. There are also similar services offered on the Internet. It is a good idea to take a soil test before and after the application of compost, manure, or cover crops. In this manner, you will get a much better idea of what nutrients you have added and which are still necessary.

Composting

“Vermicomposting” — using worms to turn waste into compost — is perfect for small gardens and provides children a living example of how nature recycles organic matter.
To set up a worm bin:

1. Use a box with a lid that is at least 2 feet deep and 3 feet long.
2. Using a hammer and nail or a drill, punch holes in the sides and top.
3. Fill it with soil, a colony of “red wiggler” worms (available online and at bait shops), and shredded newspaper.
4. Sprinkle with water so the newspaper is damp but not soggy. You can add coffee grounds and most organic waste, but avoid bread, cheeses, citrus, and woody material.

5. Keep your bin in a place that stays between 50°F and 80°F and out of direct sunlight.
6. Whenever you add waste, check the bin to make sure it is damp but not soggy. In 3–5 months, you will have compost.
7. Sort the worms from the compost, remove any organic matter that didn’t break down, add the compost to your garden, and start a new worm bin.

Hot compost is created either in open piles or in large bins. They generate heat as the organic waste breaks down, which can happen quickly if properly managed. In hot compost systems garden waste is chopped up and layered with animal manure and straw or dried leaves in a pile. It should be at least 3 cubic feet in size, be watered like a garden bed, and turned every two weeks. Check after about 12 weeks to see if the original pile is fully decomposed and ready to add to the garden.

4. Choosing Plants for the Garden

- Do you plan to grow food in your garden, or perhaps flowers to attract hummingbirds, or create a mini-garden of plants that are native to your area? Regardless of what kind of garden you want to create, the plants that will grow successfully are determined by the size of your container or raised bed.
- Also, remember that some plants have deep root systems and may not have enough room to expand downward in their search for water and nutrients. If your container is at least 1½–2 feet deep, you can grow vegetables like radishes, lettuce greens, and herbs. If your container is at least 2–5 feet deep, you can add beans, cucumbers, and peas. If you want to include tomatoes, asparagus, pumpkins, or other plants with deep root systems, your container or bed should be at least 3 feet deep.
- Younger kids will enjoy tasting various fruits and vegetables that grow well in your area and deciding which ones they want to grow. Older students can research various plants to determine their space requirements and practice their measuring skills to determine which plants have the potential to thrive.

5. Maintaining a Raised Bed or Container Garden

Maintaining your container garden or raised bed is similar to maintaining any garden. Just remember, you and your kids will need to add nutrients and water more frequently than with a traditional, in-the-ground garden, because the nutrients leach out as the soil drains and the water dries up more rapidly. Compost is an ideal source of nutrients and can be periodically mixed in with the first few inches of topsoil. Depending on the type of plants, you can also use fish emulsion, powdered eggshells, or organic powdered fertilizers. Kids enjoy vermicomposting, so consider setting up a worm bin. (See “Composting” sidebar in this chapter.)

Checklist of Materials

Container Garden or Raised Bed

You will need at least one of these:

- A receptacle to convert into a container garden that will allow water to drain
- A large box or other structure that will hold an enclosed raised bed and will allow soil to drain. To build one, you will need:
 - Recycled lumber, urbanite, bricks, or other material to frame the bed
 - Electric saw
 - Drill and drill bit to make drainage holes
 - Gopher wire
 - Corner supports
 - Tools to construct the enclosed raised bed

For either type of garden you will need:

- Nutrient-rich soil that drains well
- Drainage rocks (especially important in a container)
- Water
- A system for getting water from a faucet to the garden container or bed
- Compost or other substances that replenish the nutrients in soil
- Plants selected for the space of your container and your geographic region
- Simple gardening tools, such as gardening gloves, trowels, a hand weeder, a watering can, a hose, a hose nozzle, and a wheelbarrow or wagon

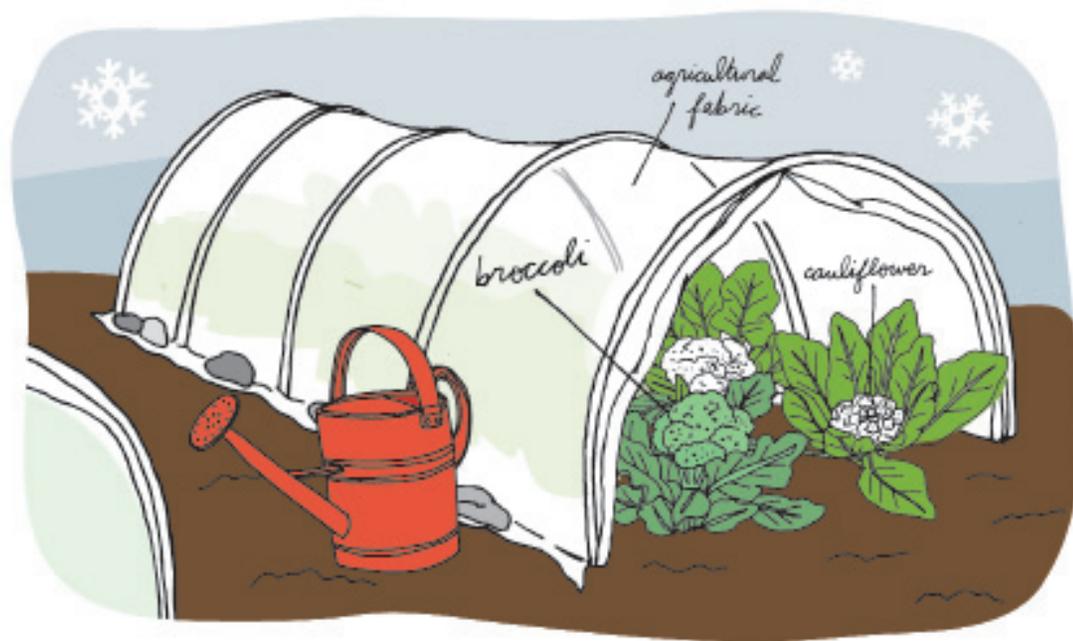
Chapter 4

Cold Frames, Tunnels, and Greenhouses

Extending the Growing Season

Most kids love to build structures and take great pride in contributing to the vitality of their gardens. They also are inherently attracted to special places within a garden, particularly if they have had a hand in creating them. Especially in the early years (ages three to seven) when children learn primarily through interacting with and influencing their environment, special places within a garden provide a safe, positive bridge to the natural world.

Imagine being able to grow food year-round. In most places outside of the tropics, this is a challenge, for which there are some innovative solutions. Cold frames, tunnels, and greenhouses make growing year-round possible for those living in climates with distinct seasons. Even in temperate climates without severe winters, structures that extend the growing season can make a moderately productive garden bountiful throughout the year.



What are Cold Frames, Tunnels, and Greenhouses?

A garden that insulates plants from outside elements creates an environment for growing plants all year. Three examples are especially suited for the schoolyard: cold frames, tunnels or "hoop houses," and greenhouses. The choice of a particular design depends on the purpose of the garden (food production, education, etc.) and the funding resources available.

If it seems like a big endeavor to build a structure, start with a small cold frame or tunnel and see if you like the results. Designs can range from very simple to very complex. Regardless of the design, garden structures that extend the growing season allow for the production of a wide array of fruits, vegetables, and flowers throughout the year.

Advantages

Year-Round

They allow gardeners to grow food year-round.

They help gardeners start plants from seed when the air and soil temperatures outside are too cold for seeds to germinate.

Can Save Money

They help gardeners save money by growing plants from seed instead of buying seedling “starts.”

Always Growing

They increase productivity.

Disadvantages

Can Be an Eyesore

Unless they are well made, these garden structures can be unsightly.

Can Be Expensive

They can be expensive to purchase or build.

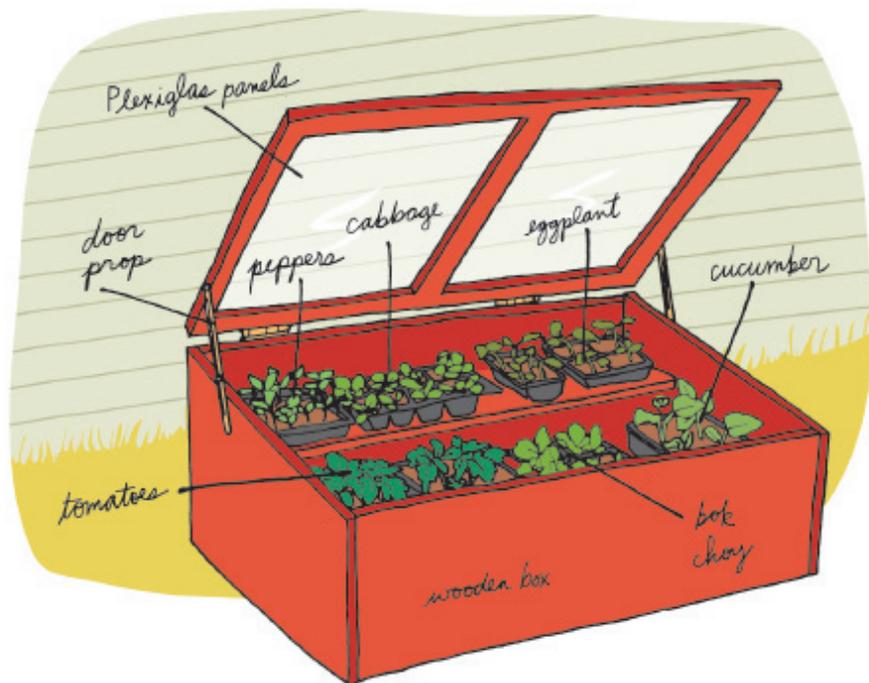
Not Always Earth-Friendly

Unless you are building with 100 percent repurposed materials, they usually include nonrenewable, nonrecyclable materials such as plastics.

Designing the Garden

1. Choosing a Location

- Before you settle on a place to develop your garden, take the children to visit potential sites at different times of day. Over time, have them note the arc of the sun throughout the four seasons.
- Determine if the area gets at least 4–6 hours of sunlight on most days.
- Determine the wind direction, and locate the structures in such a way that they will not blow over.
- What animals visit the space? Are there residents that stay all year?
- Make sure there is a source of water nearby.
- Identify what will have to be removed if you convert this space to a garden.
- Think about where you will locate other elements in the garden, such as a toolshed, a compost bin, a seed-starting area, or chickens or other farm animals.
- Determine if foot traffic in the area will be compatible with your structures and if you will need a fence to prevent invaders.
- Will your community be able to help build it without much technical knowledge?



2. Selecting Materials

Cold Frames

- Cold frames can be built out of many different materials, such as wood, concrete blocks, etc. They must have a container or box at the base (a minimum of 1–2 feet tall and 4 x 6 feet wide), a clear glass or plastic lid framed with wood and attached to the box with a hinge (insulated polycarbonate is an effective material for the lid, although it is not very “green”), a prop for keeping the lid open when the weather is warm, and a small bench or stand inside to keep plants off the ground. If possible, consider building the box with an angle so that the lid is inclined toward the sunny side (south in the Northern Hemisphere).

Tunnels

- Tunnels or “hoop houses” are usually constructed from a series of pipes (either metal conduit pipe or flexible PVC [polyvinyl chloride] plastic) that

are bent into an arc and spaced evenly down the length of a growing row or “bed.” The pipe “hoops” are then covered with clear plastic or woven agricultural fabric, which is fastened to the ground around the perimeter of the hoop structure by using either metal stakes (pipe slips over the stakes) or a wooden frame (pipe is attached to wood with metal brackets).

- Tunnels can be low to the ground, covering only the width of one growing bed (3–4 feet wide) and only a couple of feet high, or they can be quite large, although a maximum size of 20 feet wide and 48 feet long will facilitate good ventilation. These structures are generally used for lengthening the production season of crops being grown directly in the soil. Seeds can be sown earlier than they can be outside the tunnel, and crops will continue to produce inside the tunnel well after the first frosts have damaged crops outside.
- A tunnel that covers only one small garden bed is referred to as a “low tunnel,” while a tunnel that an average adult can walk into without hitting their head is called a “high tunnel.”

Greenhouses

- Greenhouses are translucent glass or plastic buildings framed with wood, metal, or plastic. They can be built by hand, preferably with repurposed materials, or purchased as a kit. In either case make sure they have a solid perimeter foundation, such as concrete or concrete block. They should also have a floor surface that drains well and does not allow weeds to grow. Pea gravel works well. Greenhouses need to have good air circulation; there should be vents on either end of the house and on the roof. If possible, choose vents that open automatically when the temperature reaches a certain threshold.
- Automatic irrigation is handy in a greenhouse, because germinating seeds need to stay moist. In some climates, heating and air conditioning are included to further extend the season. For example, heating the bottom of the seedling flat with a heat mat will make cold-sensitive plants like tomatoes and peppers germinate more quickly.

3. Selecting Soil

- When sprouting seeds in a cold frame or greenhouse, a less nutrient-rich mix is ideal (mostly peat moss, or coconut fiber, some perlite and/or vermiculite, and a little bit of light soil is best).
- When “potting up” or transferring small plants into larger containers, a more nutrient-rich potting soil is ideal, similar to a sprouting mix with added richness of more garden soil and some organic compost.
- In tunnel gardens, it is easiest to use the soil upon which it is built. If the soil needs improvement, consider combining an organic soil mix from a nursery, with local topsoil and organic compost or decomposed animal manure. (See “Maintaining Fertility” sidebar in Chapter 5.)

4. Choosing Plants for the Garden

- Cold frames and greenhouses are ideal for starting the seeds of long-season annual vegetables before they are able to grow outside. The most common examples of these crops are tomatoes, peppers, eggplant, squash, cucumbers, and okra. Cold frames and greenhouses are also useful for starting herbs, flowers, and cool-season vegetables such as chard, kale, collard greens, broccoli, cauliflower, and lettuce. Root vegetables do not do well when started in a cold frame or greenhouse — they grow best when sown directly into the soil.
- Tunnels are excellent for just about any vegetable crop. In general, tunnels allow you to successfully sow seeds or place seedlings directly into the soil earlier or later in the season.

5. Maintaining Cold Frames, Tunnels, and Greenhouses

When maintaining cold frames, tunnels, and greenhouses, irrigation and ventilation are the highest priorities. Inside a cold frame or greenhouse, the moisture level of the soil should be checked every day. Low tunnels are best irrigated by drip irrigation. High tunnels can be watered by hand, but drip irrigation is better if you can, since hand-watering consumes lots of time.

When the temperature inside the cold frame or greenhouse reaches 80°F, open the lid of the cold frame or the vents of the greenhouse. Ventilating a tunnel is easy: just roll up the plastic or fabric that covers the hoops and allow air to move through the tunnel. Of course, ventilation will only be effective if there are openings to air on opposite sides of the tunnel. If there is only one air opening at one end of the tunnel, air will not flow.

Paying close attention to the weather will help you know when to irrigate or ventilate your cold frame or greenhouse. Ventilation is also important in order to avoid stagnant air, which allows pathogenic fungi and other diseases to flourish in the moisture of a greenhouse or cold frame. This is when you will be glad you installed automatic vents, as they will address these problems for you.

For other tips on maintaining cold frames, tunnels and greenhouses, see the sidebars “Harvesting” in the Introduction, “Irrigating Your Garden” in Chapter 2, “Composting” in Chapter 3, and “Weeding” and “Controlling Pests” in this chapter.

Weeding

Believe it or not, weeding is an art. Most people think of weeding as a tedious task, but if done at the right time and with the right tools, it can be easy, enjoyable, and satisfying. Here are some ideas to consider when weeding the garden:

- After preparing a bed for planting, consider watering the bed and letting the weeds germinate before planting. That way you can scrape the weeds off the bed with a hoe and then plant in soil with far fewer weeds competing for water and nutrients.
- Know which crops will need to be weeded more or less than others. In general, slower-growing crops such as carrots need weeding on a more frequent basis than a faster-growing crop such as lettuce.
- When pulling out a weed, try to remove all the roots so it won't reproduce. Work by hand or use a hand hoe or hula hoe.
- Make sure the soil is moist before attempting to weed (sometime this means watering the bed the day before). It is frustrating to try to pull roots out of hard, dry soil.
- Pull weeds before they bolt or go to seed and produce thousands of more weeds for you to yank out next year.
- Add a layer of light mulch such as straw or dried leaves to the bed after it has been weeded in order to delay or suppress the next "flush" of weeds and retain moisture in the bed.

Controlling Pests

Most gardeners are curious about what other living things take up residency or visit their garden. Some critters such as bees, hummingbirds, butterflies, and other pollinators are welcome. Others have the potential to wreak havoc on your wonderful creation. Here are some tips for controlling pests in an environmentally friendly way:

- If you notice that some of your crops are damaged, do a little sleuthing and discover the culprit. Usually, it is a snail, slug, rodent, bird, or fungus. If you are not sure what is causing the damage, look up some images online of crop damage by some of these common pests. Also, consider consulting with a local farmer or gardener or the regional farm bureau.
- We encourage you to garden with nature, rather than against it. When you do, the first question to ask once you have identified the pest is: What are the natural predators of this pest? In the case of rodents, for example, predatory birds such as hawks and falcons are natural predators. Constructing a predatory bird perch might be a good idea, so that you can lure an avian guard to keep rodents away.
- If introducing a natural predator is not an option, then consider a physical barrier. A ring of copper tape around the edge of a raised bed will deter the snails and slugs. Gopher wire stapled to the bottom of the container will deter the gophers, and netting over the whole bed will keep birds out.
- Trapping and spraying pests are last resorts but are sometimes the only option if you have a major pest problem. Many humane traps and organic-approved sprays exist for common garden pests. Just ask at a local nursery for advice on specific products for your pest control needs.

Checklist of Materials

Cold Frame

- A rectangular container or box made of wood or concrete block (minimum 1–2 feet tall, 4 x 6 feet wide); ideally the container will be built so that the lid is inclined toward the sun when it is closed (i.e., the back side of the container will be taller than the front side)
- A glass or plastic lid framed with wood, attached to the box with hinges on one side
- A prop to hold the lid open (e.g., a stick or other mechanism)

Low Tunnel

- Bamboo, heavy-duty wire, or PVC “hoops” that span the width of the bed (when bent) and allow plenty of space for the plants to grow
- Metal stakes to anchor the hoops into the ground. If you want a more durable tunnel and if pipes are being used as the hoop structure, the pipes can be placed over the metal stakes once they are pounded into the ground (make sure that the stake you are using has a smaller diameter than the pipe; otherwise the pipe will not fit over the stake)
- Heavy-duty twine to tie the hoops together lengthwise in order to keep the hoops vertical
- Clear plastic or agricultural fabric to cover the hoops
- Wooden stakes to tie the twine and plastic/fabric down on either end of the tunnel
- Soil or irrigation staples to pin the edges of the plastic or fabric to the ground around the perimeter of the tunnel

High Tunnel

- PVC or metal conduit pipe hoops spanning the width of the desired area

with enough height for an adult to comfortably work inside; when building a high tunnel, you should have at least one hoop every 10–12 feet

- Straight PVC or metal conduit pipe to hold the hoops together lengthwise (there should be at least three sets of pipes running the length of the tunnel, one on each side and one at the top or ridgeline of the tunnel)
- Plenty of PVC connecting parts (“T”s and “couplers”) to join the hoops to the pipes running the length of the tunnel
- Metal stakes or a wooden frame and pipe clamps to anchor the hoops into the ground; when building very large high tunnels in windy areas, a concrete pier block foundation will be necessary
- Clear plastic or agricultural fabric to cover the hoops
- A way to fasten the fabric or plastic around the perimeter of the tunnel during cold weather, such as a clip, a clamp, or a scoop of soil over the excess plastic or fabric
- A system for rolling the plastic or fabric up and down both sides of the hoops for ventilation

Greenhouse

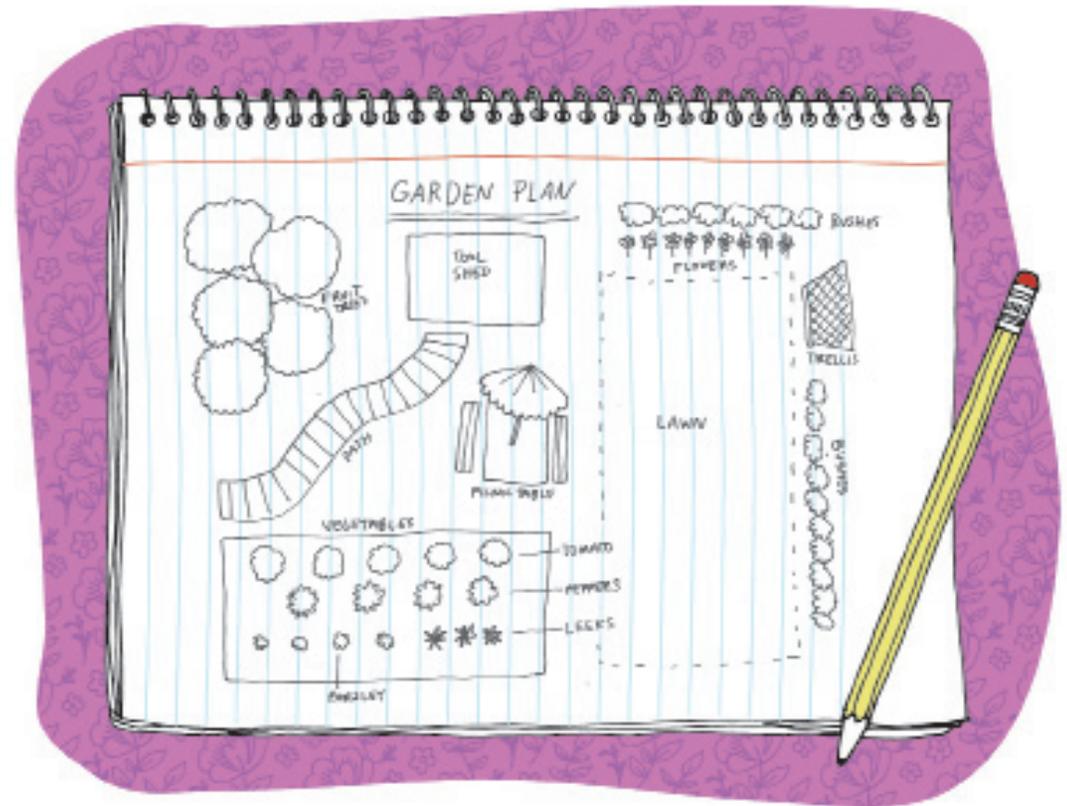
- A greenhouse kit, or someone in the community who can build a greenhouse by hand
- Unless the greenhouse is very small and in a very protected place, it will need to be anchored to the ground with metal stakes, a concrete foundation, or other method of attachment
- Include vents at both ends of the greenhouse and at least one at the top of the greenhouse, every 10 feet of its length
- An irrigation system on a timer
- Slatted greenhouse tables or benches

Chapter 5

Large-Scale Gardens

Large-scale gardens can offer an array of different spaces for children to explore, experiment, and transform. If developed wisely and managed properly, large-scale gardens also have the potential to become thriving ecosystems and to produce significant amounts of food.

Given that a large-scale garden is really a mini-farm, kids have the opportunity to learn about a revitalized career option. The need for farmers is growing tremendously, and this offers the opportunity to transform our food system from one that is highly dependent on fossil fuels for pesticides, transportation, etc., to one that mimics nature by including diverse kinds of vegetation, avoiding pesticides, and completing the food cycle through composting.



What Are Large-Scale Gardens?

By definition, large-scale gardens encompass more physical space than the other four gardens in this guide. Although large-scale gardens can contain vertical gardens, containers and raised beds, cold frames, low and high tunnels, and/or greenhouses, they do not have to include any of these features. In addition, while the

specific attributes of large-scale gardens will vary from site to site, the most important feature of these gardens is that they are usually created upon existing soil. The preservation and development of soil is the foundation of any large-scale garden's development, productivity, and overall success.

Advantages

Harvest Potential

Large-scale gardens have the potential to grow an enormous amount of food.

Range of Teaching Tools

Large-scale gardens often provide natural resources useful for a learning garden (like natural shade for a meeting area, dried leaves for making compost, or perhaps a stream or pond that children will enjoy).

Encourages Plant, Animal, and Insect Diversity

Large-scale gardens offer space for a wide diversity of plant, animal, and insect communities.

Nobody Sits on the Bench

Large-scale gardens usually have plenty of tasks for a group of children, so no one is left standing around.

Immersive Environment

Large-scale gardens in urban areas offer kids the rare experience of being fully immersed in the natural (albeit cultivated) world.

Disadvantages

Plenty of Work

Due to their size, large-scale gardens are more challenging to manage. Irrigating, weeding, and harvesting large gardens is a lot of work.

At least one full-time gardener is usually necessary to run a large-scale garden effectively. This is a cost that is often the biggest stumbling block for schools.

Can Be Expensive

Large-scale gardens can be costly to create and maintain. They usually require more tools and they lend themselves to creating garden structures, which can add wonderful features but also add expenses. In addition, they require an ongoing supply of plants, seeds, water, and human labor.

Designing the Garden

1. Choosing a Location

- Before you settle on a place to develop your garden, take the students to visit potential sites at different times of day. Have them keep a record of their observations.
- The area will need at least 4–6 hours of sunlight on most days.
- Notice if there are windy areas within the garden and, if so, the direction the wind tends to blow.
- Check whether buildings or trees shade some of the space. If part of the garden is next to a building, note the direction it is facing.
- Ask kids to observe the animals that visit the space and determine if any are residents that stay all year.
- Make sure that there are sources of water nearby that can reach the entire garden.
- Identify what will have to be removed if you convert the space to a garden.
- Brainstorm other elements you would like to include in the garden, such as a toolshed, a compost bin, a propagation area, or chickens or other farm animals.
- Will there be walking paths?
- Is the area fenced in? Does it need to be fenced to prevent pest damage (from deer, gophers, and so on) or vandalism?

- How much of the maintenance labor will be performed by the students?
- Are there community volunteers willing to help with garden maintenance and garden development workdays?
- Are people around in the summertime to water the garden?
- Is there a central meeting place where classes can be conducted?
- Is the garden accessible to people with physical disabilities?
- Is this a learning garden, a production garden, or both?
- Will your community be able to help build it without much technical knowledge?

2. Selecting Materials

- You may include elements from other gardens described in this guide, such as raised beds, cold frames, and greenhouses. In addition, consider where you will store tools, wheelbarrows, and other equipment necessary for maintaining a large-scale garden.
- You may also want to consider constructing a propagation area where you can sow seedlings and plant cuttings, both of which will save you the cost of continually purchasing seedlings from a nursery.

3. Building Soil

- In large-scale gardens, building soil is the highest priority. In nature, it can take hundreds of years for an inch of topsoil to form. When cultivating the soil in a garden, we need it to happen a little faster than that. Here are a few tips for building good soil without spending much money:
 1. Clear the area of weeds and debris.
 2. If you have a way to chip the woodier materials uprooted from the garden space, compost them or set them aside for using as mulch in the future.
 3. If there are a lot of noxious weeds in the area, do your best to pull them all out by hand without dropping seeds on the ground. Dispose of weed seeds off-site and do not add them to a compost pile. If they are impossible to eradicate, consider “sheet mulching” for a few months before continuing with the following steps. (See the “Maintaining Fertility” sidebar in this chapter.) Break up the soil by hand with digging forks, a rototiller, or with a tractor disc or spade implement when the soil is moist but not wet. After a second good rainfall is usually an opportune time.
 4. Spread organic compost liberally to cover the soil. Spread decomposed animal manure (e.g., horse, cow, pig, or chicken) sparingly, adding a light sprinkle over the entire garden area.
 5. Select a cover crop to plant that will add nutrients to the soil. You can ask a local farmer or a plant nursery about an optimal mix for your climate and season, but most will include nitrogen-fixing vegetation such as legumes. (See the “Maintaining Fertility” sidebar in this chapter for more information on growing cover crops.)
 6. Broadcast the cover crop mix over the entire field. Then lightly turn the seeds into the soil using digging forks and rakes, so that the seeds end up covered by about ½ inch of soil. If you are using a tractor for the job, turn the seeds into the soil using a harrow.
 7. Unless rain is on its way, water the garden every day or two until the seeds germinate, then water less frequently and more deeply. (See the “Irrigating Your Garden” sidebar in Chapter 2.)
 8. Allow the cover crop to grow for a few months or until the majority of the legumes are 50 percent in flower.
 9. Cut down the cover crop material and turn it into the soil by hand or with a tractor.
 10. Leave the cover crop material to decompose for about a month.
 11. Prepare planting beds by digging small furrows with shovels and piling the soil into mounded rows of raised beds.

Maintaining Fertility

Maintaining fertility is crucial in any garden that produces food. Anytime food is harvested or weeds are pulled, nutrients are removed from the soil. As long as an active composting program is part of maintaining the garden, nutrients will not be depleted too quickly. Additionally, fertility can be maintained in the garden through the following techniques:

Cover Cropping

Grow nitrogen-fixing crops such as fava beans, clover, vetch, and alfalfa in combination with grasses such as rye, oats, wheat, and barley. Turn them into the soil when they are 50 percent in flower. The plant material is left to decompose and then turned in once more before planting. This practice provides the soil with additional nitrogen — the most important element in plant growth — increasing organic matter, which all soil organisms feed upon. Cover cropping and turning the soil also aerates the soil and increases drainage for water.

Tip: If seeds are difficult to find, consider buying raw seeds from the bulk section in a natural foods store or from a feed store. Make sure they are untreated. They can also be purchased online.

Mulching

Apply organic matter such as straw, leaves, woodchips, or garden waste to the garden, either in pathways or around the plants in the garden. In general, a more carbon-rich mulch, such as woodchips, is best for perennial areas. Mulch that decomposes faster, such as straw and leaves, is better for annual vegetable areas. Mulch feeds the microorganisms in the soil, which in turn feed the plants. It also keeps the weeds from having access to sunlight and helps retain moisture in the soil.

Sheet Mulching

If weeds are a severe problem, consider “sheet mulching” that area. Sheet mulching refers to covering the ground with card-

board, then adding a thick layer (4 inches to 1 foot) of manure, compost and straw/woodchips over the entire area. Let the mulch decompose for a few months and pull out any weeds that grow through. Continue this process as many times as necessary until the weeds are no longer a problem. Then the area can be used for gardening.

Fallowing

Let the garden rest. This is an ancient practice used to let gardens regenerate. In general, fallowing is not an option in a raised bed or container garden because we want them to be beautiful and full of plants all the time. It is, however, a time-tested method of retaining fertility in the soil.

4. Choosing Plants

- Nearly any kind of plant that thrives in your geographic area can be grown in large-scale gardens. When considering what kinds of fruit trees, perennial flowers, herbs, and vegetables to grow, consult with local farmers and nurseries before choosing varieties, so you know the specific requirements of each species.
- When planting the garden, plant fertility-building cover crops first, then plants that take the most space (trees and large perennial shrubs), and then the smaller annual plants that will be planted in rotations throughout the growing seasons to come. Here is an easy-to-remember planting sequence:
 1. Cover crops
 2. Fruit trees and woody perennials
 3. Perennial herbs and flowering shrubs
 4. Annual vegetables, herbs, and flowers

5. Maintaining a Large-Scale Garden

When maintaining large-scale gardens with children, consider dividing the kids into small groups in order to address the many needs of the garden. For ideas of what kind of work to do, refer to the sidebars “Harvesting” in the Introduction, “Irrigating Your Garden” in Chapter 2, “Children and Tools” and “Composting” in Chapter 3, “Weeding” and “Controlling Pests” in Chapter 4, and “Maintaining Fertility” in this chapter.

Start a “Family Farmer” program that allows families to harvest food while maintaining the garden over holidays and the summer. For summer garden maintenance, start recruiting families in early spring by sending out an announcement inviting families to volunteer to care for the garden for one week over the summer. Spell out the expectations and the benefits. In late spring, hold a short training for families, demonstrating how and when to water, weed, and harvest. Create and distribute a calendar that identifies who is responsible for caring for the garden each week. If possible, arrange a phone tree to remind families just prior to their week.

Checklist of Materials

Large-Scale Garden

When building a large-scale garden you will need:

Tools:

- Flat shovels
- Round shovels
- Digging forks
- Rakes
- Hoes
- Wheelbarrows
- Sledgehammer
- Posthole digger
- Pickax
- Pry bar
- Harvest buckets/baskets
- Handheld weeding tools
- Hand trowels
- Hand shears
- Loppers (heavy duty)
- Socket wrench set
- Battery-operated screwdriver/drill set
- Handsaw
- Pruning saw
- Watering cans (metal is best)
- Pliers
- Gloves
- Wire
- Hoses
- Watering wand
- Oscillating sprinklers

- A toolshed or some other way of storing tools safely and out of the elements
- Organic compost (roughly 3 cubic yards per 500 square feet)
- Decomposed animal manure (roughly 3 cubic yards per 1,000 square feet)
- Cover-crop seed
- Fruit trees (appropriate for your climate)
- Perennial shrubs, herbs, and flowers (appropriate for your climate)
- Annual vegetable, herb, and flower seeds
- A greenhouse (if funding allows)

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- *How to Grow a School Garden*, by Arden Buckin-Sporer and Rachel Pringle

Garden Curriculum

- *Big Ideas: Linking Food, Culture, Health, and the Environment*, by the Center for Ecoliteracy
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- *The Growing Classroom*, by Life Lab
- *Growing Food*, by Teachers College Columbia University
- *Life Lab Science K–5 Garden Based Curriculum*, by Life Lab
- *Math in the Garden*, by the University of California Botanical Garden

Soil Life

- *Compost Critters*, by Bianca Lavies
- *Teeming with Microbes*, by Jeff Lowenfels and Wayne Lewis
- *Worms Eat Our Garbage!* by Mary Appelhof, Mary Frances Fenton, and Barbara Loss Harris

Botany

- *Botany for Gardeners*, by Brian Capon
- *Roots Demystified*, by Robert Kourik
- *Seed to Seed*, by Suzanne Ashworth

Philosophy and Inspiration

- *Gardening at the Dragon's Gate*, by Wendy Johnson
- *The One Straw Revolution*, by Masanobu Fukuoka
- *Smart by Nature: Schooling for Sustainability*, by Michael K. Stone/Center for Ecoliteracy
- *What Matters*, by Wendell Berry

Credits

Growing Goodness

At Annie's our mission is to cultivate a healthier and happier world by spreading goodness through nourishing foods, honest words and conduct that is considerate and forever kind to the planet.

About Annie's

Annie's is a natural and organic food company that offers great-tasting products in large packaged food categories. Annie's products are made without artificial flavors and synthetic colors and preservatives regularly used in many conventional packaged foods. Today, Annie's offers over 125 products which are present in over 25,000 retail locations in the United States and Canada. Founded in 1989, Annie's is committed to operating in a socially responsible and environmentally sustainable manner.

www.annies.com

About the Center for Ecoliteracy

The Center for Ecoliteracy supports and advances education for sustainable living. Best known for its work in school food reform and integrating sustainability into K–12 curricula, the Center has engaged since 1995 with thousands of educators from across the United States and six continents.

The Center's food-related Rethinking School Lunch suite of projects includes an extensive online Rethinking School Lunch Guide, workshops and professional development seminars, and consulting with schools and districts.

Among our other Rethinking School Lunch publications are a cookbook and professional development guide (*Cooking with California Food in K–12 Schools*); a conceptual framework for integrating learning in K–12 classrooms (*Big Ideas: Linking Food, Culture, Health, and the Environment*); discussion guides for films such as *Food, Inc.* and *Nourish: Food + Community*; and essays on the Center for Ecoliteracy website.

The Center authored or co-authored the books *Ecoliterate: How Educators Are Cultivating Emotional, Social, and Ecological Intelligence*; *Smart by Nature: Schooling for Sustainability*; and *Ecological Literacy: Educating Our Children for a Sustainable World*. The Center provides seminars, academic program audits, coaching for teaching and learning, in-depth curriculum development, keynote presentations, technical assistance, and a leadership training academy.

www.ecoliteracy.org

About the Authors

Growing School Gardens was co-authored by Carolie Sly, education program director at the Center for Ecoliteracy, and Benjamin Eichorn founder of Grow Your Lunch. Carolie has coauthored several books, including the award-winning *California State Environmental Education Guide* and the Center's *Big Ideas: Linking Food, Culture, Health, and the Environment*. She also coauthored the Center's discussion guide for the Oscar-nominated film, *Food, Inc.* Ben assists schools and other youth-based organizations to develop successful educational gardening programs throughout California.