Gardening Basics

Humans have been growing plants for thousands of years. Farmers and horticulturists make their living growing food and other plants, while other people grow gardens for pleasure. Botanists and agricultural scientists study plants and how they grow.

To be a good gardener, you will need to understand the science of growing plants—how to prepare the soil, how to select and plant seeds, and how to care for the growing plants. When the plants have grown up, or matured, you can harvest their flowers, fruits, or vegetables—called produce—and sell or keep the produce.

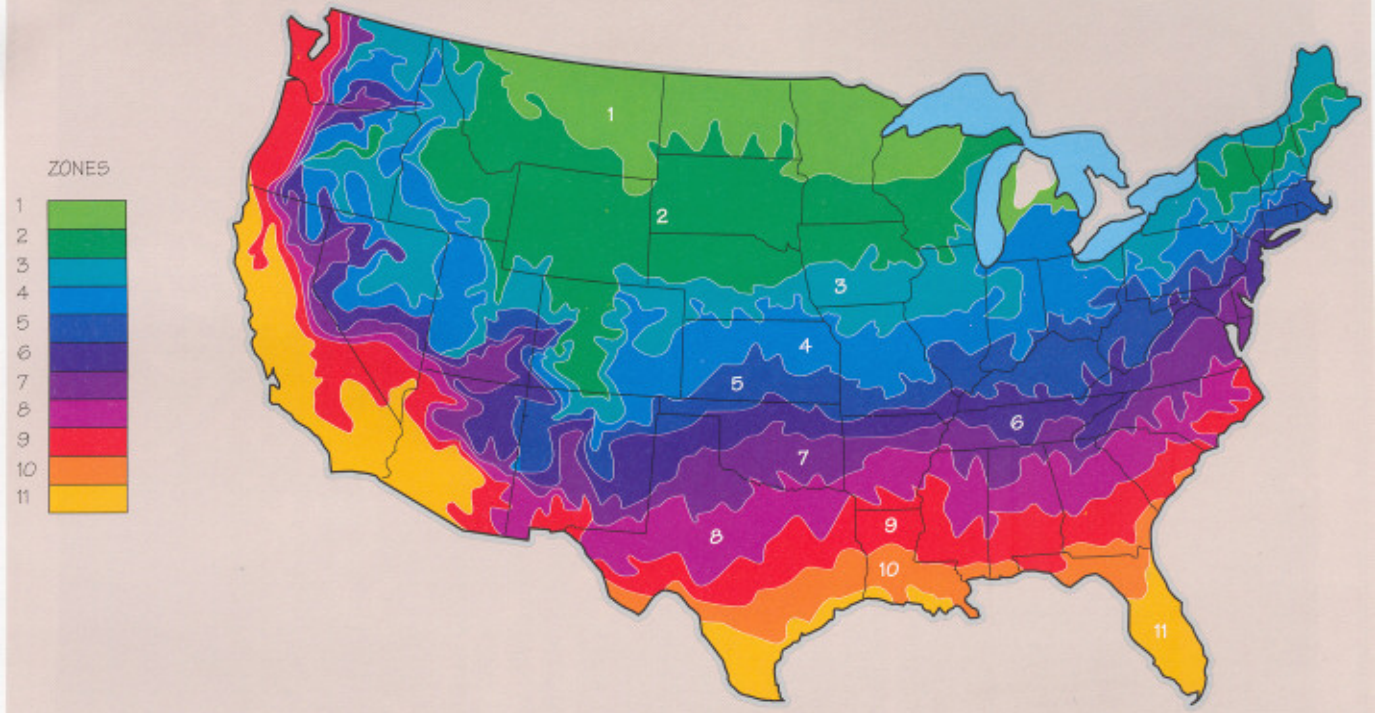
Gardens feed us, heal our bodies, and give us beautiful flowers. Whatever kind of garden you choose to grow today, and whatever you want to be when you grow up, gardens will always be a part of your life.

Regions of the United States

Before you plan your garden, find out about the agricultural region where you live. Knowing the region in which your garden is located will help you select the right types of plants to grow. For example, the directions for growing a particular seed packet may say that the plant will be winter hardy through zone 3. That means that anyone who lives in zones 1, 2, or 3 can grow that particular plant outside without fear of it succumbing to the cold of winter.

You can get a map (more detailed than the one shown here) of the agricultural regions for the United States from the U.S. Department of Agriculture (see the resources section at the end of this pamphlet). Use the map to locate your town and region.

Agricultural Zones for the United States



The frost dates in table 1 are the averages for a light freeze (32 degrees); average temperatures in your local area may vary from those listed here. The possibility of frost occurring after the spring dates and before the fall dates is 50 percent. The following classification of freeze temperatures is usually based on the temperatures' effect on plants:

- **Light freeze:** 29 degrees to 32 degrees—tender plants killed, with little destructive effect on other plants
- **Moderate freeze:** 25 degrees to 28 degrees—a great amount of damage to most vegetation, with heavy damage to fruit blossoms and tender plants
- **Severe freeze:** 24 degrees and colder—most plants damaged or destroyed

Once you have determined the last frost date for your region, you can plan your garden. Your plants will need good sunlight, water, food, and soil. Most vegetables and fruits grow best in full sunlight. You will need to decide whether to grow your garden in the ground or in containers. If you live in a house, find a nice sunny place in your yard. If you live in an apartment, use a barrel or large plastic or clay flowerpots to grow your garden. Then you can decide what kind of plants you want to grow, and what kind of plant food, called fertilizer, will help them grow. Table 2 provides a list of sample plants by USDA growing region.

Table 1. Average growing seasons in the United States*

Growing Season

City, State	No. of Days	Last Frost Spring	First Frost Fall
Mobile, Ala.	272	Feb. 27	Nov. 26
Juneau, Alaska	133	May 16	Sept. 26
Phoenix, Ariz.	308	Feb. 5	Dec. 15
Tucson, Ariz.	273	Feb. 28	Nov. 29
Pine Bluff, Ark.	234	Mar. 19	Nov. 8
Eureka, Calif.	324	Jan. 30	Dec. 15
Sacramento, Calif.	289	Feb. 14	Dec. 1
San Francisco, Calif.	**	**	**
Denver, Colo.	157	May 3	Oct. 8
Hartford, Conn.	167	April 25	Oct. 10
Wilmington, Del.	198	April 13	Oct. 29
Miami, Fla.	**	**	**
Tampa, Fla.	338	Jan. 28	Jan. 3
Athens, Ga.	224	March 28	Nov. 8
Savannah, Ga.	250	March 10	Nov. 15
Boise, Idaho	153	May 8	Oct. 9
Chicago, Ill.	187	April 22	Oct. 26
Springfield, Ill.	185	April 17	Oct. 19
Indianapolis, Ind.	180	April 22	Oct. 20
South Bend, Ind.	169	May 1	Oct. 18
Atlantic, Iowa	141	May 9	Sept. 28
Cedar Rapids, Iowa	161	April 29	Oct. 7
Topeka, Kan.	175	April 21	Oct. 14
Lexington, Ky.	190	April 17	Oct. 25
Monroe, La.	242	March 9	Nov. 7
New Orleans, La.	288	Feb. 20	Dec. 5
Portland, Maine	143	May 10	Sept. 30
Baltimore, Md.	231	March 26	Nov. 13
Worcester, Mass.	172	April 27	Oct. 17
Lansing, Mich.	140	May 13	Sept. 30
Marquette, Mich.	159	May 12	Oct. 19
Duluth, Minn.	122	May 21	Sept. 21
Willmar, Minn.	152	May 4	Oct. 4
Columbus, Miss.	215	March 27	Oct. 29
Vicksburg, Miss.	250	March 13	Nov. 18
Jefferson City, Mo.	173	April 26	Oct. 16
Fort Peck, Mont.	146	May 5	Sept. 28
Helena, Mont.	122	May 18	Sept. 18
Blair, Neb.	165	April 27	Oct. 10
North Platte, Neb.	136	May 11	Sept. 24
Las Vegas, Nev.	259	March 7	Nov. 21
Concord, N.H.	121	May 23	Sept. 22
Newark, N.J.	219	April 4	Nov. 10
Carlsbad, N.M.	223	March 29	Nov. 7
Los Alamos, N.M.	157	May 8	Oct. 13
Albany, N.Y.	144	May 7	Sept. 29
Syracuse, N.Y.	170	April 28	Oct. 16
Fayetteville, N.C.	212	April 2	Oct. 31
Bismarck, N.D.	129	May 14	Sept. 20
Akron, Ohio	168	May 3	Oct. 18

*This information was taken from the USDA Web site.
**Frosts do not occur every year in these locations.

City, State	No. of Days	Last Frost Spring	First Frost Fall
Cincinnati, Ohio	195	April 14	Oct. 27
Lawton, Okla.	217	April 1	Nov. 5
Tulsa, Okla.	218	March 30	Nov. 4
Pendleton, Ore.	188	April 15	Oct. 21
Portland, Ore.	217	April 3	Nov. 7
Carlisle, Pa.	182	April 20	Oct. 20
Williamsport, Pa.	168	April 29	Oct. 15
Kingston, R.I.	144	May 8	Sept. 30
Charleston, S.C.	253	March 11	Nov. 20
Columbia, S.C.	211	April 4	Nov. 2
Rapid City, S.D.	145	May 7	Sept. 29
Memphis, Tenn.	228	March 23	Nov. 7
Nashville, Tenn.	207	April 5	Oct. 29
Amarillo, Texas	197	April 14	Oct. 29
Denton, Texas	231	March 25	Nov. 12
San Antonio, Texas	265	March 3	Nov. 24
Cedar City, Utah	134	May 20	Oct. 2
Spanish Fork, Utah	156	May 8	Oct. 12
Burlington, Vt.	142	May 11	Oct. 1
Norfolk, Va.	239	March 23	Nov. 17
Richmond, Va.	198	April 10	Oct. 26
Seattle, Wash.	232	March 24	Nov. 11
Spokane, Wash.	153	May 4	Oct. 5
Parkersburg, W.Va.	175	April 25	Oct. 18
Green Bay, Wis.	143	May 12	Oct. 2
Janesville, Wis.	164	April 28	Oct. 10
Casper, Wyo.	123	May 22	Sept. 22

Table 2. USDA growing regions and suggested plants*

Growing Regions

USDA Zone, Low Temperature, Example Cities	Plant by Botanical Name (and Common Name)
Zone 1 Below -50 degrees F Fairbanks, Alaska	*Betula glandulosa* (Dwarf birch) *Empetrum nigrum* (Crowberry) *Populus fremuloides* (Quaking aspen) *Potentilla pensylvanica* (Pennsylvania cinquefoil) *Rhododendron lapponicum* (Lapland rhododendron) *Salix reticulate* (Netleaf willow)
Zone 2 -50 to -40 degrees F Prudhoe Bay, Alaska Unalakleet, Alaska Pinecreek, Minn.	*Arctostaphylos uva-ursi* (Bearberry) *Betula papyrifera* (Paper birch) *Cornus canadensis* (Bunchberry dogwood) *Elaeagnus commutata* (Silverberry) *Larix laricina* (Eastern larch) *Potentilla fruticosa* (Bush cinquefoil) *Ulmus americana* (American elm) *Viburnum trilobum* (American cranberry bush)
Zone 3 -40 to -30 degrees F International Falls, Minn. St. Michael, Alaska Tomahawk, Wis. Sidney, Mont.	*Berberis thunbetgii* (Japanese bayberry) *Betula pendula* (European white birch) *Cornus alba* (Tatarian dogwood) *Elaeagnus angustifolia* (Russian olive) *Junipercus communes* (Common juniper) *Lonicera tatarica* (Tatarian honeysuckle) *Malus baocata* (Siberian crabapple) *Rhododendron* southern Indian hybrids (Indian azalea) *Syringa vulgaris* (Common lilac) *Thuia occidentalis* (American arborvitae)

*This information was taken from the USDA Web site.

Zone 4

-30 to -20 degrees
Minneapolis/
St.Paul, Minn.
Lewistown, Mont.
Northwood, Iowa
Omaha, Neb.

Acer saccharum (Sugar maple)
Acer platanoides (Norway maple)
Aristolochia durior (Dutchman's pipe)
Forsythia ovata (Early forsythia)
Hydrangea paniculata (Panicle hydrangea)
Juniperus chinensis (Chinese juniper)
Ligustrum amurense (Amur river privet)
Parthenocissus quinquefolia (Virginia creeper)
Spiraea x vanhouttei (Vanhouffe spirea)

Zone 5

-20 to -10 degrees F
Des Moines, Iowa
Chicago, Ill.
Columbia, Mo.
Mansfield, Penn.

Cornus florida (Flowering dogwood)
Deutzia gracilis (Slender deutzia)
Forsythia suspensa (Weeping forsythia)
Ginkgo biloba (Ginkgo, Maidenhair tree)
Hibiscus syriacus (Shrub althea)
Iberis sempervirens (Evergreen candytuft)
Lagerstroemia indica (Crape myrtle)
Ligustrum vulgare (Common privet)
Mahonia aquitolium (Oregon hollygrape)
Metasequoia glyptostroboides (Dawn redwood)
Rhododendron "America" (Hybrid rhododendron)
Paithenocissus tricuspidata (Boston ivy)
Rosa multiflora (Japanese rose)
Taxus cuspidata (Japanese yew)
Viburnum burkwoodii (Burkwood viburnum)

Zone 6

-10 to 0 degrees F
St. Louis, Mo.
Lebanon, Penn.
McMinnville, Tenn.
Branson, Mo.

Acer palmatum (Japanese maple)
Buxus sempervirens (Common boxwood)
Cercis chinensis (Chinese redbud)
Chamaecyparis lawsoniana (Lawson cypress)
Cytisus x praecox (Warminster broom)
Euonymus follunei (Winter creeper)
Hedera helix (English ivy)
Ilex opaca (American holly)
Ligustrum ovalifolium (California privet)
Pieris japonica (Japanese andromeda)
Prunus yedoensis (Yoshino cherry)

Zone 7

0 to 10 degrees F
Oklahoma City, Okla.
South Boston, Va.
Little Rock, Ark.
Griffin, Ga.

Acer macrophylium (Bigleaf maple)
Rhododendron Kurume hybrids (Kurume azalea)
Cedrus atlantica (Atlas cedar)
Cotoneaster microphylla (Small-leaf cotoneaster)
Ilex aquifolium (English holly)
Taxus baccata (English yew)

Zone 8

10 to 20 degrees F
Tifton, Ga.
Dallas, Texas
Austin, Texas
Gainesville, Fla.

Arbutus unedo (Strawberry tree)
Choisya temata (Mexican orange)
Olearia haastii (New Zealand daisy bush)
Pittosporum tobira (Japanese pittosporum)
Prunus laurocerasus (Cherry laurel)
Viburnum tinus (Laurestinus)

Zone 9

20 to 30 degrees F
Houston, Texas
St. Augustine, Fla.
Brownsville, Texas
Fort Pierce, Fla.

Asparagus setacous (Asparagus fern)
Eucalyptus globulus (Tasmanian blue gum)
Syzygium paniculatum (Australian bush cherry)
Fuchsia hybrids (Fuchsia)
Grevillea robusta (Silk oak)
Schinus molle (California pepper tree)

Zone 10

30 to 40 degrees F
Naples, Fla.
Victorville, Calif.
Miami, Fla.
Phoenix, Ariz.

Bougainvillea spectabilis (Bougainvillea)
Cassia fistula (Golden shower)
Eucalyptus citriodora (Lemon eucalyptus)
Ficus elastica (Rubber plant)
Ensete ventricosum (Ensete)
Roystonea regia (Royal palm)

Zone 11

Above 40 degrees F
Honolulu, Hawaii

Bougainvillea spectabilis (Bougainvillea)
Cassia fistula (Golden shower)
Eucalyptus citriodora (Lemon eucalyptus)
Ficus elastica (Rubber plant)
Ensete ventricosum (Ensete)
Roystonea regia (Royal palm)

Soil

The earth in which plants grow is called soil. The upper layers of soil are usually made up of decaying plant material such as leaves, mulch, and grass clippings. The lower layers of soil are made up of rocks and minerals that have crumbled with age and wear. Rain, earthworms, fungi, bacteria, and other small animals help the upper layers break down. When the upper and lower layers combine, soil is formed. Sometimes, a gardener may need to help the layers mix. This is called tilling, or turning the soil.

There are many different kinds of soil. The soil at your local playground might be different than the soil at your house. Some kinds of soil contain materials that are better for garden plots, and some kinds of plants grow only in certain kinds of soil.

Soil Types

Here are some of the kinds of soil you might find in your neighborhood.

Sandy loam soil is good for most plants. It contains a good mixture of sand and decaying materials. However, too much sand will dry out quickly and is not good for gardens. If the area where you want to plant a garden is purely sand, add topsoil, organic humus, or compost, and then till the plot before planting.

Clay loam soil is heavy and makes gardening difficult. It dries out slowly and sometimes forms a crust on top. Clay is not good for gardening unless you add sand and organic material, such as compost, to make it easier for plant roots to grow and water to drain. If the area where you want to plant a garden contains hard clay, add sand, topsoil, organic humus, or compost, and then till the plot before planting.

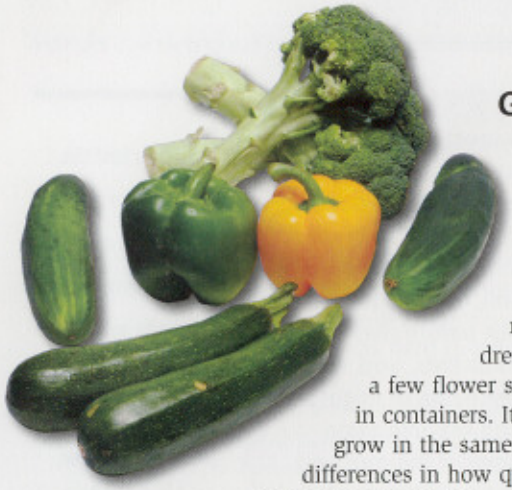
Mucky soil is dark, rich in nutrients, and very good for growing many different kinds of vegetables. The nutrients from decaying organic material provide a lot of food for plants. If the mucky soil in the area where you want to plant a garden does not drain well, add sand and then till the plot before planting.

Peat soil contains decaying vegetable matter, usually from a forest floor, that is high in carbon. Carbon is a nutrient that helps plants grow. Peat soil is light and almost dusty. If the area where you want to plant a garden contains only peat, add topsoil, organic humus, or compost, and then till the plot before planting.

Topsoil is made up of decaying vegetable matter, sand, and peat. It dries out quickly and should be mixed with heavier soils to add nutrients. Vegetables should not be grown in topsoil alone. If the area where you want to plant a garden contains only topsoil, add organic humus or potting soil, and then till the plot before planting.

Potting soil is commercially prepared and packaged soil that you buy at a garden center. It is available in different mixtures for specific gardening purposes. You can even buy potting soil with the fertilizer already mixed into it. However, if you want an organic garden, or one that grows without synthetic fertilizers and additives, use only certified organic potting soil.

You can test the soil in your garden plot if you are unsure whether it needs to be improved with compost, topsoil, humus, fertilizer, or other additive. Inexpensive soil test kits are available at your local garden center. For a more detailed test, your county extension service will test your soil samples for free or at a minimal cost.



Vegetables like cucumbers, broccoli, peppers, and zucchini bear above the ground.

Garden Types

As you learned earlier, people grow gardens for different reasons. Flower gardens provide flowers for many different uses. Vegetable and fruit gardens provide food. Orchards, or gardens of fruit or nut trees, also provide food. You can dress up your food garden by planting a few flower seeds around the edges of the plot or in containers. It is fun to watch food and flowers grow in the same garden because you can see the differences in how quickly each grows and how long each takes to mature.

Food Gardens

You can grow many different crops in a food garden. Some of the most popular and easiest to grow are tomatoes, strawberries, beans, carrots, corn, collards, and broccoli. Fruit and nut trees and vines take years to grow. Beans, corn, and tomatoes grow quickly and can be harvested within a couple of months. They are often called summer crops because they need warm soil and a lot of sunlight to grow. Strawberries, collards, and broccoli need cool weather to grow well. They often are called winter crops because they grow during the winter months in warmer agricultural regions.

Food gardens can be grown in the ground or in containers of soil or water. The kind of water garden where you grow food without using soil is called a *hydroponic* garden.

Turnips, carrots, potatoes, and radishes are examples of root and tuber vegetables, which bear below the ground.

Flower Gardens

You can grow flowers in many different ways. Containers or flower pots allow you to arrange flower gardens in different ways and places. Flower beds are permanent displays. You can plant a flower bed directly in the ground or in a raised area surrounded by landscaping timbers or stone. Flower gardens provide color, texture, and seasonal variety. They also provide homes for wildlife. Birds, insects, amphibians, and reptiles thrive in natural areas like flower gardens.

Alternative Gardening

You can have a garden anywhere. If you live in an apartment, you can grow plants in containers. If you live in a city, you might be able to grow crops in a community garden. If you live in the desert, you can use water-wise growing methods to cultivate strong plants. And if you like to experiment, you might try hydroponics, aquaculture, or a water garden.

Succulents

Aloe vera

If you live in an arid location, succulents may be the solution to your gardening challenge. Succulents are ideal for growing in dry areas because they do not require a lot of water. They have stems that store water in times of drought. Thick skin and spines discourage animals and insects. Many succulents have beautiful flowers; some even bear delicious fruits.

Cacti will range in size from a few inches to giant varieties such as the saguaro and yucca, which can grow to more than 50 feet in height and weigh up to eight tons. (Sadly, the effects of humankind, the environment, and disease often prevent these natural wonders from reaching their full size.)

Almost all cacti are native to the American continents, from Canada to the southernmost reaches of Brazil. Some succulents, such as *Portulaca afra* (moss rose), *Crassulaceae* (jade plant), and *Echeveria* (sedum, hens and chicks) are native to Africa and have shrubby rather than spiney branches. Their plump leaves hold lots of water, making them—fittingly—"succulent!"

URBAN GARDENING

Living in a city does not mean that you cannot earn your Gardening merit badge. Urban, or city, gardening can be just as rewarding as a garden in your own backyard. An urban garden is confined within a city or an area that contains a lot of buildings, streets, and very little soil or public garden space.

Most major cities, such as New York City, Chicago, Philadelphia, and Los Angeles, have urban gardening programs, and many smaller cities have active community gardens. These city programs allow a gardener or group of gardeners to grow crops on a small plot of unused land. Most times, these plots are vacant fields that have become overwhelmed with weeds or litter. The gardeners clean up the plot and build vegetable gardens. They share the harvested crops with one another and with less fortunate people, including soup kitchens that feed homeless people.

In Philadelphia, more than 12,000 people participate or benefit from Philadelphia's community gardens. More than 300 families share a 15-acre garden in Los Angeles, where the wait time to join the program is 15 months. These kinds of programs ensure the continuation of community-managed gardens and open space in low- and moderate-income neighborhoods. Your county agricultural extension agent or parks department can help you learn about urban gardens in your city.

To learn more about how to preserve land for community gardens in your city, contact the Trust for Public Land. (Contact information can be found in the resources section.)

CONTAINER GARDENING

Container gardening is simply growing plants in anything but the ground. It is the easiest kind of gardening because it can be done anywhere at any time of year. You can grow plants in almost any container that will hold soil. Some examples include:

- **Clay**—the inexpensive reddish-brown pots made of terra-cotta that you see in every garden center
- **Ceramic or glass**—fancier containers purchased for their beauty
- **Concrete**—heavy-duty planters that are often large and difficult to move
- **Plastic**—low-cost alternative to ceramic or glass containers
- **Wood**—old barrels and livestock water troughs that add a casual look to a garden
- **Synthetic**—relatively new to the garden market, containers that look like heavy terra-cotta or concrete containers but are in fact made of heavy-duty foam and are very lightweight

Other fun containers include old leather work boots, old bath and wash tubs, old wooden boxes or dresser drawers, and recycled plastics such as 2-liter drink bottles or gallon milk jugs.

WATER-WISE GARDENING

One of the easiest ways to foolproof a garden is to grow plants that will survive if you forget to water them. The term *water wise* means being smart about water conservation by applying water in well-controlled amounts and locations in your garden. The concept of water-wise gardening is based on the following seven rules:

1. **Plan and design for water conservation** and beauty from the start. A little research into what grows where, and what combinations work well, can create a colorful year-round garden.

2. **Create practical grassy areas** of manageable sizes, shapes, and appropriate grasses. Natural areas require less water. Use them as widely as possible.

3. **Choose plants that have low water requirements.** Group plants of similar water needs. Then experiment to determine how much and how often to water the plants.

Caution: Do not use arsenic-treated wood containers or timbers to grow fruits or vegetables that you or wildlife will eat. This kind of wood leeches, or leaks, poisons into the soil. In turn, plant roots absorb the poisons and become toxic to people and wildlife. This kind of wood is used to build wooden decks, some outdoor furniture, and some outdoor playground equipment. If you cannot find a label that says the wood is untreated, do not use it. Find an alternative.

4. **Prepare the soil.** Use compost or manure as needed by the site and the type of plants used.

5. **Use rocks or organic mulch,** such as chips or pine straw, to reduce evaporation and to keep the soil cool.

6. **Irrigate efficiently** using properly designed systems (including hose attachments) and by applying the right amount of water at the right time. Early morning is best for watering plants because it reduces evaporation and the spread of plant disease.

7. **Maintain your landscape properly** by mowing, weeding, pruning, and fertilizing at the right time of year.

The trees and plants listed here grow successfully with limited water. They will grow in most areas of North America, but check with your local extension service to verify which ones are best suited to your agricultural region.

Trees

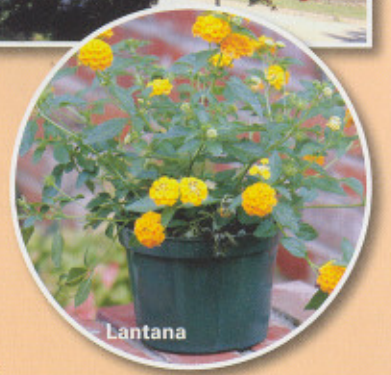
Ash, crape myrtle, cypress, firethorn, juniper, oak, pine


Crape myrtle


Butterfly bush

Shrubs

Butterfly bush, chaste tree, cotoneaster, heavenly bamboo, mallow, pomegranate, shrub juniper


Lantana

Ground Covers, Vines

Carolina Jessamine, creeping juniper, gazania, ice plant, lantana, verbena, wisteria (after established)


Zinnia

Perennials, Bulbs, Annuals

Agave, aloe, blanket flower, blue fescue, cactus, coreopsis, daylily (when established), desert marigold, fountain grass, iris (bearded), lamb's ear, lily of the Nile, red valerian, sage, zinnia

AQUACULTURE

Aquaculture is the practice of growing plants and fish as sources of food in a controlled freshwater, saltwater, or brackish water environment. Most aquaculture farmers grow seaweed, fish, or crustaceans like crabs or shrimp.

Hydroponics. Hydroponics is the science of growing plants without dirt. The term *hydroponics* means "water working." Growing plants in a water and nutrient solution, without soil, allows a gardener to grow plants more efficiently with less labor and time. There are many benefits to growing plants using hydroponics:

- Most hobby hydroponic gardens require less work than soil gardens because there is no soil to till or weeds to pull.
- Eliminating the soil in a garden also eliminates all soil-borne diseases.
- A hydroponic garden does not use as much water as a soil garden does because weeds do not grow in a hydroponic garden.
- In a hydroponic garden, plants can grow closer together, thereby increasing your harvest from the same size garden.
- A small hydroponic garden can be set up almost anywhere.
- Some studies suggest that hydroponic produce is higher in nutritional value than field-grown crops because the nutrients are controlled and environmental factors like pollution and drought are eliminated.
- Hydroponic plants can be grown year-round indoors.

Tomatoes, peppers, cucumbers, lettuce, and beans often are grown using hydroponics. In a soil garden, plants get most nutrients from the soil. In hydroponics, plants get nutrients directly from the water in which they grow. Some systems use an inert growing medium, such as perlite (a lightweight volcanic rock) or expanded clay pebbles (artificial absorbent stones) in place of soil. These growing media support the roots and retain and circulate nutrients to allow the plants to absorb them easily. Inert growing mediums also eliminate the need for soil and the plant diseases it can carry. In other hydroponic systems, plant roots are suspended in a grow channel in which water and nutrients flow.

Hydroponics is divided into active and passive systems. Active systems use pumps to circulate a nutrient solution through the plants' root tips. This method is preferred by large-scale growers to cultivate fast-growing crops like lettuce. Passive systems work without pumps. The plants' root tips are set in a nutrient solution or growing medium, and the roots draw nutrients from the solution or surrounding medium to nourish the plant. This method is best for slow-growing crops, such as tomatoes, and is used by hobbyists and small-scale growers.

The following are four common hydroponic gardening techniques:

Ebb and Flow. The nutrient solution is pumped to all plants at the same time, left in the grow channel for a specific period of time, then pumped out of the grow channel. This method is similar to the flow of ocean tides into and out of river basins, harbors, and bays.

Drip Method. The nutrient solution drips slowly into the plant pots, usually on a timed basis such as 10 minutes every hour. The drip system is used most often with a growing medium. Tomatoes, peppers, and cucumbers often are grown using this method.

Nutrient Film Technique (NFT). This method floods the grow channel with a nutrient solution and then drains it about every 15 minutes. The root tips are exposed to the nutrient solution while the root tops stay exposed to air. Most plants grown this way are fed on a frequent timed cycle. Lettuce and other leafy crops are often grown using this method.

Passive System. This method uses a stationary pool of nutrient solution. The plants' root tips dangle in the nutrient solution and pull what they need from it. The plants' roots stay mostly exposed to air, giving the plants access to oxygen. This method is slower, so harvesting takes longer. Tomatoes, peppers, and cucumbers can be grown using this method.

Cooler Float Grower

Try this floating system, made with plastic foam coolers that cost about $3 each.

Materials Needed

- ☐ Two clean plastic foam coolers with tapered sides, large enough to hold several liters of water
- ☐ Heavy-duty trash can liners or plastic sheeting
- ☐ Duct tape
- ☐ Seed-starting trays and seeds (or purchased starter plants) in six 2-by-2-inch compartments. Basil and loose-leaf lettuce (fancy types—not heading lettuce) work well and are easy to grow in the cooler grower.
- ☐ Utility knife and scissors
- ☐ One 3-watt aquarium pump and tubing
- ☐ T-valve to split the tubing for the two coolers
- ☐ Air stones (used in fish aquariums to aerate water)
- ☐ HID (high intensity discharge) garden lamp (optional)
- ☐ Growing medium (a mixture with a 2-1 ratio of perlite to vermiculite is suggested)
- ☐ Nutrient (Contact your local hydroponics supplier for a mixture suitable for the plants you plan to grow. For plants that do not fruit, such as basil and lettuce varieties, you will only need a "vegetative" or "grow" hydroponic nutrient solution. Many varieties are available and all are similar and suitable for this project. Mix the nutrient solution according to the instructions on the label.)

How to Make Your Hydroponic System

Because the plastic foam will gradually permit liquids to seep out, line the inside of each cooler with two layers of strong plastic sheeting, such as a heavy-duty trash can liner, secured with duct tape along the outside rim.

Flip the lids over and, using a utility knife, cut six spaces on each lid to accommodate the plants. Cut the spaces to the size of the starter plant containers for a snug fit. Because the lids are domed, the top edges of the lid rest several inches below the rim of the cooler when the lids are flipped upside down.

If you are starting from seed, plant the seeds in a loose mixture of perlite and vermiculite in the seed-starting trays. Feed the seeds with plain tap water until the plants come up, then switch to a diluted vegetative growth solution—a three-part powdered mix that is sold as a package. You usually mix 1/4 teaspoon of calcium nitrate, 1/4 teaspoon "grow" mix, and 1/8 teaspoon magnesium sulfate with one gallon of water per batch. Another popular source of vegetative nutrient solution is a concentrated liquid mix that has everything already added to it for good vegetative growth.

Sterilize your scissors by rinsing them with a mixture of 1 part chlorine bleach and 20 parts water and then flushing well with clean water.

When the young seedlings are ready, separate the cells of the seed-starting trays, cut off the bottom of each cell with sterilized scissors, gently shake out the growing medium (it falls right out), and insert the individual cells into the holes in the cooler lids.

The cells fit snugly into the holes and the plant roots easily dangle into the nutrient solution from. The bottom leaves of the plants should be large enough to prevent the plants from slipping into the cooler.

Cut a hole in the side of each cooler near the top to accommodate an air tube connected to an air stone at the bottom of each cooler. An aquarium pump provides constant, gentle, bubbling oxygen.

Split the air line coming out of the pump and run air tubes to both coolers. One 3-watt pump will provide enough oxygen for two coolers. Both coolers will easily fit under a 250-watt metal halide light that is connected to a timer set for a 12-hour photoperiod. Position the light about a foot or so from the plants to make sure they are not exposed to too much radiant heat.

Most salad greens and lettuce plants go from seed to harvest in just over a month. If you selectively harvest when the plants start to mature, pull off enough greens to make a few salads each day for the next few weeks. Do not wait too long to harvest because overly mature greens can become bitter. Greens will stay fresh in the refrigerator for about a week. If you harvest all at once, you will have enough greens for a few mighty salads. If you have new starts continually going and regularly replace old plants with new ones, you can always have enough greens for the table.

Reprinted with permission from *The Growing Edge* magazine, Corvallis, Oregon, published by New Moon Publishing Inc. The plan was adapted from a system first profiled in "A Beginner's Guide to Hawaiian Hydroponics," which was adapted from the instructional manual "Hydroponics in Hawaii Using Black Lava Rock: 'Eze Gro Kit'" by Charles E. Musgrove, *The Growing Edge*, Vol. 11, No. 4.

Self-Watering Potted Plant

This clever and simple hydroponic system makes a good starter project.

Materials Needed

- ☐ 8-inch plastic pot
- ☐ 10-inch watering saucer or shallow plastic tray
- ☐ Starter plant (Coleus works well.)
- ☐ Growing medium, such as expanded clay or perlite
- ☐ Nutrient (Contact your local hydroponics supplier for a mixture suitable for the plants you plan to grow. For plants that do not fruit, such as basil and lettuce varieties, you will only need a "vegetative" or "grow" hydroponic nutrient solution. Many varieties are available and all are similar and suitable for this project. Mix the nutrient solution according to the directions on the label.)

How to Make Your Hydroponic System

Fill the plastic pot with growing medium. Gently rinse it with tap water, allowing the surplus to drain. Set the pot on the water-saucer. Place a germinated plant into the pot and carefully arrange the roots so that they are distributed through the growing medium. Pour a small quantity of the prepared nutrient solution into the saucer or tray. The plant will absorb the nutrients via capillary action, in which the higher pressure zone on one side of the plant draws a substance from the lower pressure side in order to equalize the pressure. In this case, the medium in the upper container wants more nutrient solution as it dries out, so the material between the medium and the nutrient solution serves as a conduit for the transfer of water and nutrients as needed.

Check the saucer daily to make sure the mix does not dry out. Never pour the nutrient solution into the top of the pot; always add the nutrient to the tray or saucer. It's better for the roots to be fed from the bottom rather than the top, and you reduce the risk of overflow out of the saucer by applying too much nutrient solution to the top of the plant. By allowing the nutrient solution to sit in the saucer, the medium will absorb only what the plant needs. If the saucer is regularly topped off with nutrient solution, the plant will always have a reserve to soak up when necessary.

Reprinted with permission from *The Growing Edge* magazine, Corvallis, Oregon, published by New Moon Publishing Inc. This easy hydroponic system was first featured in "The Growing World of Hydroponics," by Rob Smith, in *The Growing Edge* magazine, Vol. 11, No. 1.

Water Gardening. The difference between water gardening and hydroponics is that a water garden mimics a natural area at or just beyond the edge of a body of water, like a beach. Think about the edge of a pond or lake you might have visited. Do you remember how many different kinds of plants were growing along the water's edge?

A water garden brings those kinds of plants to your home, patio, or yard. Indoor water gardens offer a peaceful, pretty, and different kind of garden for you to enjoy. Outdoor water gardens bring the same elements to your yard, and also provide a home and feeding area for wildlife, such as birds, insects, fish, amphibians, and reptiles.

You can grow a water garden in any container that holds water without leaking. Plastic and heavy glass bowls make the best water gardens. Wooden tubs, concrete bowls, or terra cotta pots that have been sealed with a waterproofing agent are also suitable. You can grow floating plants, such as water lilies, or you can add a soil basket and grow plants that require more support for their roots, such as bamboo or cattails.

Make a Water Garden

To build a water garden, you will need the following supplies:

- ☐ Waterproof container at least 6 inches deep for floating plant water garden, 24 inches deep for water gardens that will contain soil baskets and large plants
- ☐ Water plants
- ☐ Soil and soil baskets for large plants (baskets should be twice as large as the plant's root ball)
- ☐ Chlorine neutralizer (the same kind used for aquariums to counteract the chlorine added to tap water)
- ☐ Gravel, clean stones, or decorative marbles for the bottom of the container
- ☐ Nutrient solution, if required (Ask the garden center whether any is required for the plants you choose.)
- ☐ Recycled gallon milk container or a clean 2.5 gallon bucket

It is best to build your water garden where it will reside permanently, rather than moving it after it is completed. Once you have decided how large the water garden will be, and where you will place it, complete the following steps:

Step 1—Wash the container with a gentle dish soap. Do not use detergent or antibacterial soaps, as they might harm delicate plants.

Step 2—Place any decorative stones, gravel, or marbles in the bottom of the container.

Step 3—Fill the container with tap water to 2 inches from the top.

Step 4—Add the correct amount of chlorine neutralizer for your container. For small containers about the diameter of a dinner plate, one drop is sufficient.

For large containers, mix the neutralizer and tap water in the milk jug or bucket according to the instructions per gallon. Fill your container with the neutralized water.

Step 5, small garden—Add the floating plants, arranging them however you like. Add the nutrient solution if required.

Step 5, large garden—Fill soil baskets half full of soil. Place large plant roots into soil baskets. Cover the roots with soil to approximately 1 inch from the top of the container.

Step 6—Slowly submerge the soil baskets into the water garden, allowing air bubbles to dissipate as you sink the basket.

Step 7—Add any floating plants.

Growing Fruits and Vegetables

Fruits and vegetables grow on plants, vines, and trees. Most grow seasonally, but some plants, such as herbs, will grow year-round in a sunny indoor location like a windowsill. In warm climates, beets, carrots, squash, and tomatoes grow year-round.

Cool-season fruits

Cool Season

Fruits and vegetables that grow best during fall and winter are called cool-season plants. They need cool temperatures for their crops to ripen. Examples of cool-season fruits and vegetables are apples, broccoli, brussels sprouts, cabbage, celery, collards, grapefruit, kale, lettuce, okra, peas, potatoes, spinach, and strawberries.

Cool-season vegetables

Warm Season

Fruits and vegetables that grow best during spring and summer are called warm-season plants. They need warm temperatures for their crops to ripen. Examples of warm-season fruits and vegetables are beans, blackberries, blueberries, cantaloupe, carrots, corn, cucumber, okra, peppers, squash, tomatoes, and watermelon.

Warm-season crops

Any Season: Growing Herbs

Herbs have been used for thousands of years to cure illness, flavor foods, dye cloth, make cosmetics and perfumes, and freshen the air. You probably have pepper, garlic, and parsley in your kitchen right now. These and many other herbs are grown for their flavor, aroma, and beauty. Herbs are fun and most are easy to grow. Many herbs will grow year-round in a sunny window.

Other herbs and growing suggestions are listed here.

Basil

- **Basil** *(Ocimum basilicum)* will grow to height of 2 to 3 feet; a dwarf variety does well in containers. Basil needs moist soil and full sun; an east or south windowsill is best.
- **Coriander** *(Coriandrum sativum)*, also known as **Chinese parsley** or **cilantro.** This herb (the leaves) and spice (the seeds) give Mexican and Chinese dishes their oomph. In fact, you can grow coriander right from the seeds in your spice rack! Coriander grows 12 to 15 inches high. Transplant it outdoors in the spring alongside a few tomatoes, scallions, and peppers, and you will be growing salsa before you know it. Full sun and moderate water will sustain coriander through its early months.

Cilantro

- **Lavender** *(Lavandula)* is a woody evergreen shrub grown for its fragrant oil. It grows to a height of 1 to 3 feet. Lavender oil is used to make soaps, lotions, perfumes, and air fresheners. You can use the dried flowers in arts and crafts projects. Lavender plants need a sunny location with good drainage and average soil. Lavender grows in containers but does better in the ground.
- **Parsley** *(Apiaceae)* is an excellent choice for an indoor herb garden. Mature plants range from 6 to 12 inches in height. Like basil, parsley grows best in moist soil with full sun in winter. Transplanted to the outdoor garden, parsley needs some moderate shade to continue growing during the hot summer months. Parsley seeds should be soaked overnight in warm water to help germination, which can take up to four weeks. It is easiest to purchase a small parsley plant from a garden center.

Parsley

- *Salvia officinalis* is one of more than 60 types of **sage** grown by gardeners. It is the most aromatic of the salvias, growing to a height of 30 inches. Definitely destined for transplant, salvia adds color and texture to an indoor herb garden. Full sun and regular water are all this garden favorite needs to thrive.
- **Rosemary** *(Rosmarinus officinalis)* is a woody plant and needs its own container. Rosemary—whether a climbing or shrub variety—is an excellent plant for landscaping because it grows almost anywhere there is sun and, once established, can survive long periods of dry weather. Full sun and moderate water will sustain rosemary until it can be moved outdoors in the spring.
- **Thyme** *(Thymus vulgaris)* is cousin to the mint plant and makes a wonderful addition to any herb garden. Thyme is a small, woody shrub, reaching a height of only 4 to 12 inches at maturity. Thyme is at home in a rock garden with a little shade, and it is happiest in its own container when indoors. Moderate water and full winter sun make thyme an easy-to-grow, fun-to-eat herb.

Rosemary

Thyme

Tools and Equipment

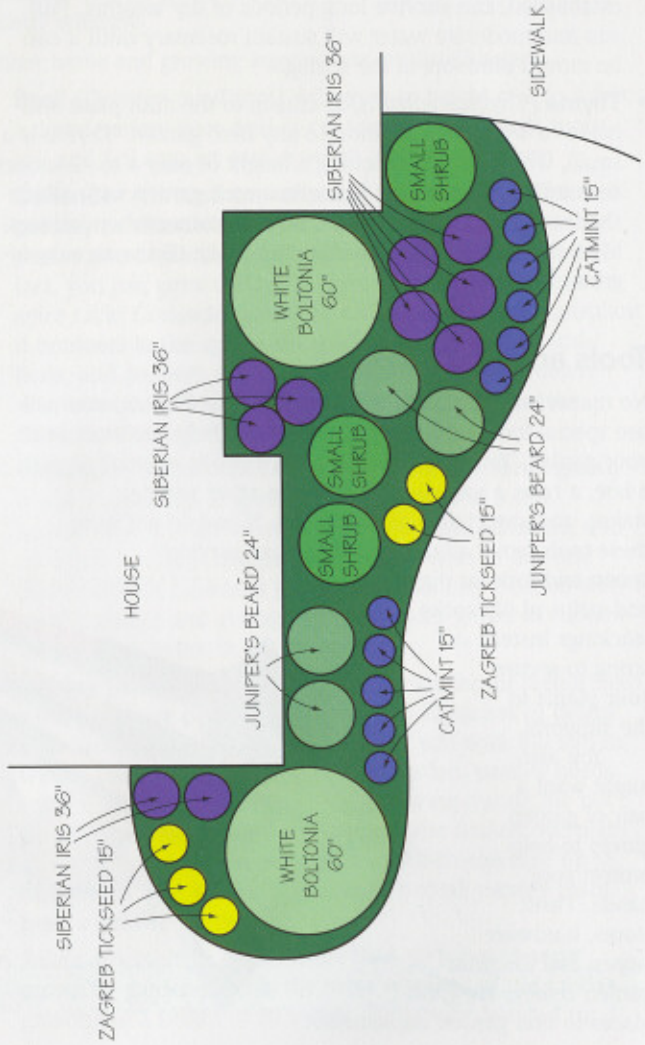
No matter what kind of garden you choose to grow, you will use special tools—called implements—to help you work with your garden. You probably will need a spade or small shovel, a hoe, a rake, a yardstick, bamboo or other wooden stakes, and stretchable garden string. If you do not have these tools, you can use an old kitchen serving spoon and fork for digging, and strips of old socks or stockings instead of string to secure your plants to the supports.

You also might want a pair of garden gloves to help protect your hands. Thrift stores, hardware stores, and discount garden centers are good places to find garden implements.

Planning Your Garden

After you have decided what you want to grow, identify which crops grow on plants and which grow on vines. Sometimes you can plant crops that need cooler temperatures beneath the vines or stalks of a taller crop that can tolerate full sun. Or you may decide to have an ornamental garden.

Before you plant your garden, decide what crops you want to grow. (Most tree crops take two to three years or more to produce fruit and will not be discussed in this pamphlet.)



Decide where to grow the garden. If the garden will grow in the ground, get a piece of paper and a pencil and map out where you will plant each crop. Visit the plot of land where your garden will be located and decide what you need to do to prepare the ground. You might need to till the soil and add compost or other materials, such as fertilizer, topsoil, or mulch, to make the ground ready for a garden.

If you are planning a container garden, first make a list of your crops. Then, decide how many plants you will grow and how many containers you will need. Suitable containers for patio gardens include pots made of clay, ceramic, wood, or plastic. Clean, recycled plastic containers for milk, soda, and juice also can be used.

Make sure the container has adequate drainage (cut a hole in the bottom and cover the bottom with gravel at least 1 inch deep). You can plant several plants in larger containers, so you might need only one or two containers. Finally, figure out how much soil is needed to fill the containers.

Decide how you will start your crops. You can buy seeds or young plants at a discount store, garden center, or farmers' market. Remember that if you are growing from seeds, your garden will take longer to produce crops. The growing time is printed on the back of seed packets so you can figure out how long it will take from planting to harvest.

A good rule to remember is to plant a seed as deep as the seed is wide. For example, a pumpkin seed is about ½ inch wide, so you would plant it ½ inch deep. Beans will be planted at a similar depth. Smaller seeds, such as pansy, marigold, and broccoli, need only a very thin layer of soil to germinate properly.

Planting Your Garden

Growing from seed is fun because you can watch the entire life cycle of a plant. It is best to sprout—germinate—seeds indoors in small pots or from seed-starting kits. In addition, starting seeds indoors gives you the chance to see your plants several times a day. However, you should be aware of the following disadvantages to growing directly from seed in the outdoors:

- The soil may be too hard for a young seed to sprout through.
- Rain might wash away the seeds.
- Cold weather might kill young sprouts.
- Animals, bugs, or birds might eat the seeds or young sprouts.

Growing From Seed

You can start your garden from seed by planting the seeds in peat pots, seed trays, or small pots, or in sheets of damp newspaper.

- If you are using soil, fill containers with soil to within 1/2 inch of the top. Place one or two seeds in each container (larger containers can handle more seeds). Lightly cover the seeds with more soil.
- If you are using peat capsules, place two seeds in the circle atop each capsule, then place the capsule in a waterproof tray.
- If you are using newspaper, layer six or eight single sheets of newspaper in the bottom of a 9-by-13-inch glass baking dish. Place the seeds about an inch apart on the top layer of newspaper. Cover the paper with two additional single sheets of paper.
- After the seeds have been planted, use a mist sprayer to dampen the soil. A garden hose, sink sprayer, or watering can provides too much water pressure and will wash away small seeds.
- Place the seeds in a warm, well-lighted location.
- Keep the soil moist. Most seeds will sprout within seven to 10 days.

Your garden has a better chance of surviving outdoors if you plant seedlings that already have roots. Starting seeds indoors gives your garden a head start when the weather outdoors is still cold—about four to eight weeks before your area's last frost date. (Table 1 shows the average last frost dates for a number of growing regions in the continental United States.)

Plants are ready to set out when they have at least four leaves and remain standing when you water them. When you are ready to plant, use the map of your garden to place your plants in the areas you planned.

Show What You Grow

Exhibiting what you grow is rewarding. You can show others how hard you worked and what you learned. You might find garden contests at county and state fairs, county extension services, farmers' markets, and local garden clubs. Read the garden section in your local newspaper to find out about garden shows. Most shows are open to the public; many allow hobbyist gardeners to enter their plants or crops in the show.

Every gardening show or contest has rules. You need to have a copy of the rules for each exhibit you prepare. These steps will help you prepare your produce for a show. After you have picked your produce:

1. Clean the produce using water and a soft brush.
2. Dry each item completely using a soft cloth or paper towel.
3. Wrap each item by itself in soft paper towels.
4. Place a 1-inch layer of packing material on the bottom of your packing box. (Plastic foam "peanuts," bubble wrap, and shredded paper work best.)
5. Place the produce on the first layer of packing material so that 1 to 2 inches of space buffers each item.
6. Fill in all the spaces with more packing material.
7. Place another inch or two of packing material on top of the produce.
8. Repeat the packing process until the box is full. (Leave enough space to add a layer of packing on top to help protect the last layer of produce.)

If you are showing a flowering plant or shrub:

1. Gently wash the leaves of the plant with water.
2. Dry each leaf carefully with a soft, lint-free cloth (clean cotton diapers or old T-shirts work well). Do not touch the flowers or buds except to remove harmful insects; the oils on your skin might cause the flower to turn brown or wilt.
3. Wrap the container in a leakproof layer of foil or decorative plastic so that it will not leak water and soil during the exhibition.

Nutrition

It is important to stay physically fit. You can do this by eating healthy foods, maintaining a healthy weight, and staying physically active. Homegrown vegetables provide a lot of nutritional value. The USDA food pyramid shown here provides suggested daily servings of the foods we need to eat to stay healthy.

Eat a variety of foods to get the nutrients you need and the right amount of calories to maintain a healthy weight. Remember to eat fats, oils, and sweets sparingly. Young children have different nutritional needs than older children and teenagers. They have a different food pyramid, too.

Following the food pyramid will help improve your eating habits. For more information on serving sizes and nutrition, contact your local extension service or visit the USDA Web site. There also are many books and other resources that focus on nutrition. The resources section at the end of this pamphlet is a good starting place.

An Apple a Day

What vitamins and minerals do fruits and vegetables provide? Here is a general guide.

Vitamin A
Tomatoes; bananas; broccoli; yellow melons and squashes, including pumpkins; yellow, green, and red peppers; citrus fruits; sweet potatoes; zucchini; green onions; mushrooms; and carrots

Vitamin C
Citrus fruits; dark green leafy vegetables such as spinach, collards, and kale; tomatoes; melons; peppers; cabbage; guava; strawberries; pineapples; potatoes; kiwi; and zucchini

Iron
Dark green leafy vegetables such as spinach, collards, and kale; dried fruits; and legumes (beans, peanuts)

Calcium
Broccoli, collards, kale, kidney beans, navy beans, garbanzo beans, spinach, sunflower seeds, and dried figs

Anatomy of MyPyramid

One size doesn't fit all

USDA's new MyPyramid symbolizes a personalized approach to healthy eating and physical activity. The symbol has been designed to be simple. It has been developed to remind consumers to make healthy food choices and to be active every day. The different parts of the symbol are described below.

Activity

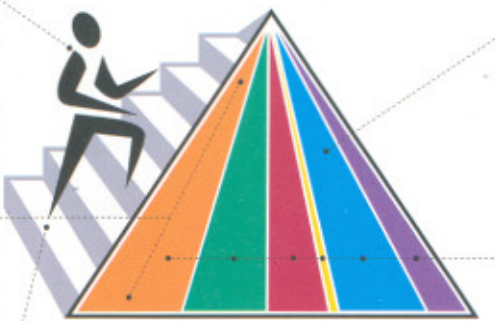
Activity is represented by the steps and the person climbing them, as a reminder of the importance of daily physical activity.

Moderation

Moderation is represented by the narrowing of each food group from bottom to top. The wider base stands for foods with little or no solid fats or added sugars. These should be selected more often. The narrower top area stands for foods containing more added sugars and solid fats. The more active you are, the more of these foods can fit into your diet.

Personalization

Personalization is shown by the person on the steps, the slogan, and the URL. Find the kinds and amounts of food to eat each day at MyPyramid.gov.



MyPyramid.gov

STEPS TO A HEALTHIER YOU

Proportionality

Proportionality is shown by the different widths of the food group bands. The widths suggest how much food a person should choose from each group. The widths are just a general guide, not exact proportions. Check the Web site for how much is right for you.

Variety

Variety is symbolized by the 6 color bands representing the 5 food groups of the Pyramid and oils. This illustrates that foods from all groups are needed each day for good health.

Gradual Improvement

Gradual improvement is encouraged by the slogan. It suggests that individuals can benefit from taking small steps to improve their diet and lifestyle each day.

USDA U.S. Department of Agriculture
Center for Nutrition Policy and Promotion
April 2005 CNPP-16

GRAINS | VEGETABLES | FRUITS | OILS | MILK | MEAT & BEANS

Storage

There are many reasons to store produce after it has been harvested. The most obvious reason is so that you can eat the food later in the year, after its growing season. The two most common ways to store produce are in bins and by preserving.

BINS

Bin storage is good for onions, pumpkins, squash, and sweet potatoes. Basements, a cool pantry, or a closed crawl space beneath a house or other building are all good places for a vegetable storage bin. If space is tight, you can place a small, flat bin beneath a bed, as long as the space is well-ventilated and away from heating ducts. In rural areas, you can buy wooden bins at hardware, garden, or feed stores. In suburban or urban areas, you can get discarded bins from a grocery store or produce stand, or simply use a sturdy laundry basket (ask first).

Preserving

Preserving means to prepare vegetables or fruit for storage by cooking or freezing. Cooked produce is usually stored in cans or jars. Canning produce is a lot of work and can be dangerous, but freezing produce can be done easily. If you would like to store your produce, contact your local extension service to get instructions. Always ask an adult to help you.

Growing Ornamental Plants and Grasses

Ornamental means decorative, like an ornament on a Christmas tree. Ornamental trees, plants, and grasses are plants we grow because we like the way they look.

Trees

We plant trees for two reasons: food and landscaping. Trees come in all shapes and sizes, but there are only three kinds of trees: coniferous, evergreen, and deciduous.

Coniferous

Coniferous trees produce cones containing seeds. Examples are pine, cedar, and fir trees.

Evergreen

Evergreen trees keep their green leaves year-round. Examples are magnolia, palm, and juniper trees.

Deciduous

Deciduous trees lose all of their leaves at one time each year, usually in the fall or early winter. Examples are dogwood, oak, and pecan trees.

Shrubs, Vines, and Ground Covers

Shrubs are smaller than trees, but larger and stronger than flowers or vegetables. Vines are plants that grow with leaves on a stem that is long and thin, like string. Some vines have soft green stems. Other vines have tough, wood stems. Vines can grow on the ground, up a tree or fence, or on a trellis. Ground covers grow low to the ground. Some grow like vines and others grow like grass. You do not mow ornamental ground covers. Some examples of ornamental ground covers include some varieties of sedum, lily turf, and Lenten rose.

For growing ornamentals, follow the germination techniques as described in the previous chapter, "Growing Fruits and Vegetables."

Flowers

We grow flowers because they add color and beauty to our landscapes and homes. Flowers have been used to celebrate special events for thousands of years. They also are used to produce perfumes, fabric dyes, and art. Like trees and shrubs, flowers come in hundreds of shapes and sizes. But, there are only two kinds of flowers: annual and perennial.

Big-leaf periwinkle

Annuals

Annual flowers grow for one season and then die. They often provide bright flowers that grow very quickly during warm weather. Thus, annuals grow and bloom during spring, summer, or fall and die after the first frost. New ones must be planted—either from seed or young plants—every year. Some examples are impatiens, periwinkles, marigolds, and pansies. Table 3 at the end of this chapter is a helpful tool for planting garden annuals.

Perennials

Perennial flowers and plants come back year after year without replanting. They are like deciduous trees because they lose their leaves or die back when the weather turns cool. When the weather warms up, perennials grow back again, sometimes larger and prettier than in the prior year. They often bloom later in the warm season than annuals, but their flowers are usually larger and more impressive. Some examples are daisies, daylilies, hostas, and black-eyed susans.

Table 3. Planting and culture of selected garden annuals

Plant	When to Plant Seed	Exposure	Germination Time (in days)	Plant Spacing (in inches)	Remarks
Ageratum	After last frost	Semishade or full sun	5	10 to 12	Pinch tops of plants to encourage branching; remove dead flowers.
Baby's breath	Early spring or in summer	Sun	10	10 to 12	Make successive sowings for prolonged blooming period; shade summer plantings.
Balsam	After last frost	Sun	10	12 to 14	
Calendula	Early spring or late fall	Shade or sun	10	8 to 10	
Calliopsis	After last frost	Shade or sun	8	10 to 14	
Candytuft	Early spring or late fall	Shade or sun	20	8 to 12	
China aster	After last frost	Shade or sun	8	10 to 12	For best plants start early, grow in cold frame; make successive sowings for prolonged bloom.
Cockscomb	After last frost	Shade or sun	10	10 to 12	
Coleus	Slow indoors anytime; outdoors after last frost	Sun or partial shade	10	10 to 12	
Cornflower	Early spring	Partial shade	5	12 to 14	
Cosmos	After last frost	Sun	5	10 to 12	
Dahlia	After last frost	Sun	5	12 to 14	For maximum bloom, sow several weeks before other annuals.
Forget-me-not	Spring or summer	Partial shade	10	10 to 12	
Four-o'clock	After last frost	Sun	5	12 to 14	Store roots; plant next year.
Gaillardia	Early spring through summer; shade in summer	Sun	20	10 to 12	
Globe amaranth	Early spring	Sun	15	10 to 12	
Impatiens	Indoors anytime; set out after last frost	Partial shade or deep shade	15	10 to 12	
Larkspur	Late fall in South; early spring in North	Sun	20	6 to 8	Difficult to transplant; grow in peat pots.
Lupine	Early spring or late fall	Sun	20	6 to 8	Soak seed before planting; guard against damping-off (disease)
Marigold	After last frost	Sun	5	10 to 14	High fertility delays bloom.

Plant	When to Plant Seed	Exposure	Germination Time (in days)	Plant Spacing (in inches)	Remarks
Morning glory	After last frost	Sun	5	24 to 36	Reseeds itself.
Nasturtium	After last frost	Sun	8	8 to 12	For best flowers; grow in soil of low fertility.
Pansy	Spring or summer; shade in summer	Sun or shade	10	6 to 8	Does best in cool season.
Petunia	Late fall in South	Sun	10	12 to 14	Start indoors early in spring; keep cool.
Phlox	Early spring	Sun	10	6 to 8	Make successive plantings for prolonged bloom.
Pink	Early spring through summer; shade in summer	Sun	5	8 to 12	Start indoors early in spring; keep cool; remove dead flowers.
Poppy	Early spring through summer; shade in summer	Sun	10	6 to 10	Difficult to transplant; start in peat pots; make successive plantings.
Portulaca	After last frost or in late fall	Sun	10	10 to 12	
Rudbeckia	Spring or summer; shade in summer	Sun or partial shade	20	10 to 14	Perennial grown as an annual; blooms first year.
Salpiglossis	Early spring	Sun	15	10 to 12	Needs supports; avoid cold, heavy soil.
Scabiosa	Spring or summer; shade in summer	Sun	10	12 to 14	Remove old flowers.
Scarlet sage	Spring or summer; shade in summer	Sun	15	8 to 12	
Snapdragon	Spring or late fall	Sun	15	6 to 10	Start cool; pinch tips to encourage branching.
Spider plant	Early spring; spring or fall	Sun	10	12 to 14	Reseeds freely; pinch to keep plant short; water and fertilize freely.
Strawflower	Early spring	Sun	5	10 to 12	
Summer cypress	Early spring	Sun	15	18 to 24	
Sunflower	After last frost	Sun	5	12 to 14	
Sweet alyssum	Early spring	Sun	5	10 to 12	Damps off easily; sow in hills, do not thin.
Sweet pea	Early spring or late summer through late fall	Sun	15	6 to 8	Select heat-resistant types.
Verbena	After last frost	Sun	20	18 to 24	Pinch tips often to encourage branching.
Vinca	After last frost	Sun	15	10 to 12	Avoid overwatering.
Zinnia	After last frost	Sun	5	8 to 12	Thin after plants begin to bloom; remove poor-flowering plants.

From *Growing Flowering Annuals*, by Henry M. Cathey. Published by the U.S. Department of Agriculture, 1970.

Nurturing Your Garden

Gardens sometimes have unwelcome visitors. You know the kind—the ones that eat or destroy plants and leave you with nothing to show for your hard work. You will need to learn how to identify and correct problems in your garden. But, the best way to fix problems in your garden is to prevent them in the first place. The old saying, "An ounce of prevention is worth a pound of cure," works for garden pests.

Preventive Measures

Creating a place that is unfriendly to garden pests—both insects and disease—will save you a lot of work later. The following are some ways to help prevent and discourage garden pests:

1. Use clean, well-drained soil.
2. Grow plants that are well-suited or native to your growing region.
3. Control weeds and grass in your garden.
4. Buy seeds and plants that are free of disease or insect damage.
5. Plant strong-smelling plants such as marigolds around your garden to discourage unwanted bugs, squirrels, and deer.
6. After the growing season, recycle old plants into the compost bin.
7. Destroy or properly dispose of diseased plants.
8. Do not use chemicals that will eliminate the "good" bugs in your garden.

"Supercharged" Fruits and Vegetables

What if farmers could grow fields of potatoes, corn, and strawberries that could protect themselves from frost, disease, and insect pests? What if the rice you eat at dinner could protect you against blindness and reduce the risk of cancer? "Supercharged" fruits and vegetables like these are the promise of a scientific field of study called *agricultural biotechnology.*

Scientists in this field use techniques such as *genetic engineering* to create, improve, or modify plants, animals, and microorganisms, according to the U.S. Department of Agriculture (USDA). Genetic engineering is the process of "cutting and pasting" genes within one species, or from one species to another. So, for example, a gene that protects a plant against early frosts can be inserted into strawberries; or, a gene that increases crop yield can be added to corn, so that a farmer produces a bigger crop than usual.

Some "supercharged" fruits and vegetables already exist and have been tested and approved by the USDA's Animal and Plant Health Inspection Service. A few examples include insect-resistant potatoes, corn, and cotton, and longer-lasting tomatoes. And experiments continue, so that one day wheat will grow in fields that are now unfavorable to the crop and bananas will contain edible vaccines.

Be On the Lookout

Even if you practice all the preventive measures, sometimes a pest will still find its way into your garden. You will need to know what to look for and how to fix pest problems in your garden.

Disease

Diseases in plants are a lot like diseases in people. Sometimes they are viral, like the chicken pox. Sometimes they are fungal, like athlete's foot. And sometimes they are bacterial, like a cavity in a tooth. Most stem, leaf, flower, and fruit diseases are caused by viruses, bacteria, and fungi. Most root or soil-borne diseases are caused by fungi.

Bacterial diseases are caused by single-celled organisms that feed on plants to survive. The host plant becomes diseased because the bacteria take nutrients from and cause damage to the plant's structure. You can control bacterial diseases with bacterial soaps made specifically for the garden. These soaps kill the harmful bacteria without harming beneficial insects.

Fungal diseases are caused by multicelled, threadlike organisms called fungi. Fungi grow and produce spores, or new cells, that spread with wind, insects, or water. Fungal infections damage the plant structure. Once weakened by fungal infection, a plant becomes vulnerable to other diseases. To prevent fungal disease from infecting your plants, pick off dead or dying leaves and use clean garden tools. Planting fungus-resistant plants and using antifungal sprays and soaps also help control disease.

Many types of plants have varieties that are resistant to fungus. Check the seed packet or the identification stake that comes with prestarted plants in the garden center. A fungus-resistant plant will be listed as "resistant to powdery mildew" or "resistant to gray mold."

Viral diseases spread among plants the same way they spread among humans. Plants infected with viral diseases grow deformed leaves, flowers, and produce, and might change color. Viral diseases are difficult to control. In most cases, the affected plant must be removed from the garden and destroyed.

Sometimes, plants become diseased because of environmental problems: pollution and too much or too little sun, nutrients, or water.

The most common environmentally based diseases are chlorosis and soil salinity. Chlorosis is caused by a lack of iron in the soil. Soil salinity results when overwatering and overfertilizing leave too much salt in the soil. Both problems can be corrected with readily available organic or synthetic soil additives.

What to Do With Infected Plants

If you have to remove a diseased plant from your garden, you should destroy it. This prevents the disease from spreading to other plants. You can dispose of infected plants by burning them, but that might require a local permit. An easier and safer method of disposal is to place the affected plant in a plastic garbage bag, seal it, and put the first bag into a second plastic bag. Seal the second bag and place it into the household waste bin for the waste company to remove.

IN ROOTS

Root diseases are the hardest kind of plant problems to detect and correct. The plant might wilt or die completely, without an obvious cause. When a plant becomes sick or dies from root disease, it is usually caused by water mold fungi that are too small to see with your eyes, or by immature insects, called grubs or larvae.

If you suspect root disease, soak the area with diluted dish soap. (Mix 1 tablespoon of dish soap with 1 gallon of water, adding the soap to the water to reduce foaming.) Grubs will surface within a few minutes. You can see grubs with your eyes. If you do not see any grubs, then a fungal infection is likely the cause. Gently dig an inch or two deep around the base of the affected plant. If there are no signs of grubs, remove the affected plant from your garden and destroy it.

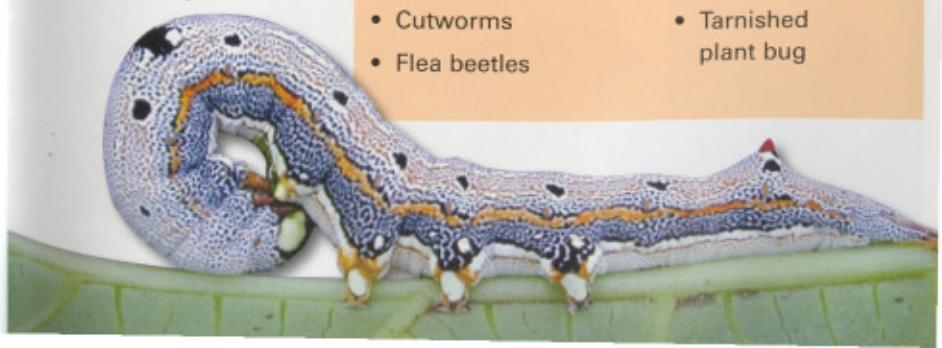
Pepper plant infested with southern root-knot nematode

Garden Pests

Here are some common pesky garden critters that need to be controlled.

- Aphids
- Cabbage maggots
- Caterpillars
- Colorado potato beetles
- Cutworms
- Flea beetles
- Japanese beetles
- Mealybugs
- Mexican bean beetles
- Scale insects
- Tarnished plant bug

Croton caterpillar



ON LEAVES

Problems on leaves are easier to see, because of the physical evidence: a chewed leaf, spider web, or bug droppings. Sometimes yellow leaves are the only symptom, but yellow leaves are usually caused by a root disease, not a leaf disease.

The safest way to control harmful insects in your garden is to pick them off (using gloves) and destroy them. You can use insecticidal soaps or sprays, but they often kill the good bugs as well. Yellow leaves might indicate what is called iron chlorosis. You can easily repair this problem by adding iron to the soil.

Your local garden center or extension service will be able to help you diagnose plant diseases. Follow these steps to obtain a sample of the problem:

Step 1—Using a resealable plastic bag, capture the sample fresh from your garden.

Step 2—Open the bag and gently place it around an infected leaf or group of leaves.

Step 3—Try to catch at least one insect, if possible.

Step 4—Seal the bag on both sides of the stem, then clip the stem.

Step 5—Push the stem into the bag.

Step 6—Seal the bag completely.

Step 7—Take the sample to your garden center or extension service as soon as possible so the sample remains fresh.

Step 8—Follow the instructions provided by the agricultural professional.

ON VEGETABLES OR FRUITS

Like leaf problems, disease or insect damage on produce is easy to see. The vegetable or fruit will have holes or soft spots on its skin. It is best to remove the damaged produce from the plant and dispose of it. Do not eat fruits or vegetables that have obvious insect damage.

Help Your Garden Grow

Many people think that *all* bugs are harmful, but this is not true. Some bugs are fun, and some bugs are very important members of our garden families. Good bugs pollinate our gardens and eat the bugs we do not want there. Unwanted bugs eat, damage, or destroy garden plants. Diseases also attack the plants. It is important to know how to control all types of pests in your garden.

Organic Controls

Organic controls are natural methods of garden management that do not harm the environment. Many inorganic controls contain toxic chemicals that kill beneficial insects, birds, and other wildlife. They also can leave harmful chemicals on the food we eat. By using organic garden practices, such as soil building, composting, plant care, and preventive pest control, you can create a garden that needs little "outside" help.

Organic Controls

The benefits of using organic controls include the following:

- **Cultural controls** reduce the number of pests by keeping the plants healthy and the garden clean.
- **Biological controls** reduce the number of pests by using living creatures, such as birds, beneficial bugs, and microbial sprays, to control insects and plant diseases.
- **Physical controls** keep pests away from your garden by using barriers or by removing them by hand.
- **Organic chemical controls** use chemicals that occur naturally in plants or minerals. These chemicals break down more quickly and have fewer toxic effects on the environment. They are used by organic gardeners only as a last resort.

Beneficial Bugs

One of the easiest ways to control pests in your garden is to let nature take its course. As you know, within the food chain small creatures fall prey to large creatures. The same principle can be applied to your garden. Let the good bugs eat the bad bugs and you won't have to spend time picking and squashing the bad bugs. The following list describes beneficial—good—bugs that you can invite into your garden to help control insect damage.

Japanese beetle grubs

Nematodes

- **Nematodes** are little wormlike parasites that feed on grubs and bad worms in the soil, such as Japanese beetle grubs, root weevils, wood-boring caterpillars, armyworms, and billbugs.
- **Green lacewings** produce the hungriest babies in the bug world. Their larvae have huge appetites for aphids, other small insects, insect eggs, and spider mites.
- **Parasitic wasps,** like the tiphia wasps, will not bother people or pets, but they do destroy garden pests. They reproduce by laying eggs in a host insect or insect egg, generally those of aphids, whiteflies, cabbage loopers, and hornworms. The larvae then eat the host, thereby removing the pest from your garden.
- **Syrphid fly** larvae eat aphids, mealybugs, and small insects like gnats. Adults are often called hover flies because they hover over nectar-producing flowers. They do not sting. Sometimes, they are large enough to be confused with a small hummingbird.
- **Red ladybugs,** or lady beetles, eat mealybugs, aphids, and young scale insects. Orange lady beetles, however, are destructive to many garden flowers.
- **Ground beetles,** sometimes called black beetles, eat dirt bugs—the kinds of insects and pests that make their homes in your flowerbeds, lawn, and patio containers. Ground beetles eat cutworms, root maggots, slugs, and snails.

The red ladybug makes a good garden resident.

Assassin bug

- **Assassin bugs** eat flies, mosquitoes, beetles, and large caterpillars. They have horns. They bite. They squeak. They hatch in June. They are not very "nice" bugs, but they eat the bad guys. They are aptly named.
- **Tachnid flies** love Queen Anne's lace, dill, and parsley. They also will munch on most any bad caterpillar, as well as gypsy moth larvae.
- **Rove beetles** are those little black or brown bugs that skittle away when you clear away mulch or pine straw to plant an annual or yank a weed. They look like little scorpions because they keep their abdomens pointed upward while they move. Rove beetles eat aphids, springtails, mites, slugs, snails, fly eggs, and maggots. They are also little compost machines, eating and breaking down decaying organic material.

Baltimore butterfly

Attract Butterflies to Your Garden

Besides being pretty and fun to watch, butterflies help pollinate your garden. You can attract butterflies by growing plants and flowers that contain a lot of nectar. Some nectarous plants are azalea, black-eyed susan, catnip, daisy, goldenrod, lilac, marigold, honeysuckle, zinnia, and, of course, butterfly bush.

If you grow plants on which butterfly larvae (caterpillars) feed, called larval plants, butterflies will take up residence in your garden. Some larval plants are aster, clover, dill, fennel, milkweed, nasturtium, parsley, snapdragon, sorrel, verbena, and violet. You will notice leaf damage where the larvae have fed, but the damage is temporary and usually minor.

Different butterflies feed on different plants during the larval stage. For example, monarch butterflies feed on milkweed, swallowtail butterflies feed on parsley, and American copper butterflies feed on sorrel. By planting a variety of larval plants, you can increase the variety of butterflies in your garden.

Lastly, do not forget one of the best garden friends of all, the toad. Toads eat just about all bugs, good or bad. In general, toads are welcome in gardens because most of them are harmless and there usually are more bad bugs than good bugs in any garden. You can encourage a toad to move into your garden by providing it a home.

Toad houses are garden accents that look like upside-down clay pots with little doors. Some even have windows and chimneys. You can make one by burying a broken clay pot halfway, so there is room enough for a toad to move into the house.

COMPANION PLANTING

Companions are friends. Friends help each other. Certain kinds of plants can help each other. Planting marigolds, garlic, or other herbs is a common way to control garden pests. Companion plants can protect crops by producing an odor that repels pests. Many kinds of companion plants, such as dill, are nurseries for larvae of beneficial insects. (Butterflies lay eggs in dill, then the larvae eat the eggs. Talk about a protein-rich breakfast!)

Some plants distract deer, squirrels, and other furry friends who use flowerbeds and gardens as a walk-through restaurant. Deer would rather eat soybeans and buckwheat than azaleas and roses. Marigolds contain pyrethrin, which is the chemical most commercial flea sprays use to ward off the pet-prone pests. Pyrethrin is one of the few chemicals permitted in organic gardens. Squirrels, mice, and other vermin dislike the chemical as much as they do fleas.

Come Play in My Garden

These plants will attract beneficial garden creatures.

- Angelica
- Bee balm
- Buckwheat
- Calendula
- Candytuft
- Chinese cabbage
- Cilantro
- Clover
- Daisy
- Dill
- Evening primrose
- Fennel
- Marigold
- Parsley
- Peony
- Yarrow
- Peppermint
- Queen Anne's lace
- Rudebeckia
- Spearmint
- Sunflower
- Sweet alyssum
- Thyme
- Valerian

Rank and Smelly Sulphur

Farmers have been using sulphur for hundreds—perhaps thousands—of years to repel garden problems. It decreases the pH of alkaline soils, which repels some pests, including fungi and mites. Snakes are particularly repelled by its odor. Sulphur might harm beneficial bugs, so use it as a last resort to kill fungal diseases, and under close adult supervision.

INSECTICIDAL SOAPS AND WASHES

Bugs sometimes leave behind droppings, which attract more bugs. One way of controlling unwelcome bugs in your garden is to use a natural insect soap. And don't forget: spiders build webs that catch dirt and insects, too.

Insecticidal soaps are specially made solutions of fatty acids that kill insects like aphids, mites, and whiteflies. The soap paralyzes the insect, which will then die of starvation. It must be applied every two to three days during an infestation. You can buy prepared insecticidal soaps, but many organic gardeners use a mixture of 1 to 3 tablespoons of gentle dish-washing soap (not detergent; read the label to be sure) per gallon of water in their garden sprayer.

Inorganic Controls

The most important thing to remember about inorganic, or synthetic, pest controls is that they are dangerous and toxic. The poisons they contain are harmful to your family, your pets, good bugs, wildlife, and the water supply. When used incorrectly, they can affect streams, rivers, ponds, and lakes. Always ask an adult to help you correctly and safely use pesticides, fungicides, and fertilizers. Start by reading the label on the container or package and closely following the manufacturer's instructions.

For example, caterpillars are not good for a vegetable garden, but the butterflies they become are helpful for a flower garden. If you kill the caterpillars, you are killing the butterflies. Before using an inorganic control, you might consider companion planting dill or milkweed to give the caterpillars something to munch on instead of your vegetables.

PESTICIDES

Pesticides, also called insecticides, are chemical mixtures that kill bugs. Properly used, they provide quick, effective ways to control insects and disease in your garden. Improperly used, they can make you very sick.

Each pesticide is required by federal law to contain a label that lists the diseases or insects for which it should be used, the plants on which it should be used, the ingredients it contains, and safety precautions. Many states further regulate the use of some pesticides. It is illegal to apply pesticide to a plant or pest not listed on the label.

When no other means of pest control has worked, you may choose to use a synthetic pesticide as a temporary means to control a serious infestation. A healthy natural environment is a balanced system. A diverse garden contains the plants and natural controls that should maintain this balance. When it does not, pests invade and damage begins. Here are some commonly used pesticides.

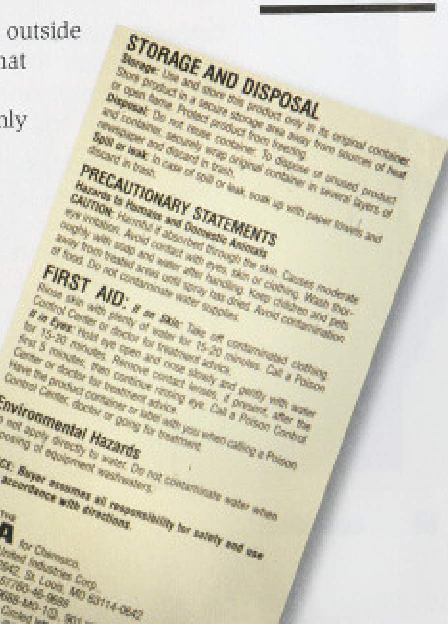
Azadirachtin. Used for insect control and some fungal diseases like black spot and powdery mildew.

Propoxur. Used in earwig baits and wasp spray, but unsafe for use on edible plants, fruits, and vegetables.

Bacillus thuringiensis (called Bt). Paralyzes and disintegrates the stomachs of the insects it destroys. It is poisonous to caterpillars, mosquitoes, and some beetles.

Contact dusts. Powders that cling to the outside of plants and typically suffocate insects that come into contact with it. Boric acid and diatomaceous earth are the most commonly used dusts. All are harmful if inhaled.

Diazinon. The only chemical control for soil pests in gardens. Unfortunately, this chemical also kills lightning bug larvae, bees, and birds. Use it sparingly, if at all.



Always carefully read the label on all pesticides, fertilizers, and other garden treatments. Follow the manufacturer's instructions, and use these chemicals only under close adult supervision.

Fungicides. These are dusted or sprayed onto foliage to kill or pre-vent fungal diseases. Some fungal diseases include powdery mildew, rust, black spot, leaf spots, and azalea petal blight. Ingredients of fungicides include cap-tan, triadimefon, triforine, calcium polysulfide, sulfur, and chlorothalonil.

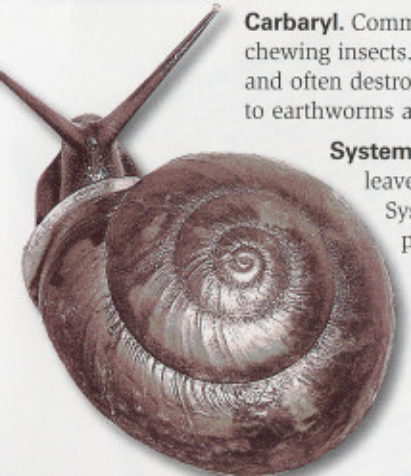
Malathion. A broad spectrum pesticide commonly used on vegetable and orna-mental plants. It is toxic to bees.

Oil sprays. These smother insects that come into contact with them. They are helpful for controlling aphids, scale insects, and mites. Use carefully on tender young leaves and flowers, as the oils can burn the tissues.

Pyrethrins. Natural insecticides derived from the Pyrethrum daisy. Marigolds also contain pyrethrins. In sunny areas, pyrethrins break down in a few hours. They are the main ingredient of most flea sprays, powders, and collars. They are also effective against flying insects.

Rotenone. An insecticide used to control chewing insects on vegetables. It is highly toxic to fish.

Carbaryl. Commonly used in vegetable gardens to thwart chewing insects. It is not effective against sucking insects, and often destroys their natural predators. It is highly toxic to earthworms and honeybees.



Systemic pesticides. Absorbed by plant roots or leaves and are effective on insects that eat either. Systemic pesticides are not safe for use on edible plants, fruits, and vegetables.

Pesticides and Fungicides: Think Safety

- Read the label and follow the manufacturer's instructions.
- Use pesticides and fungicides only under close adult supervision.
- Keep all pesticides and fungicides in original containers.
- Never combine pesticides or fungicides.
- Store pesticides and fungicides tightly closed, away from food, and out of the reach of children and pets.
- Wear protective gloves, clothing, an air mask, and safety glasses when preparing and applying chemicals.
- Wash your clothing, skin, containers, and sprayers thoroughly after you have finished.
- Stay out of treated areas until the spray is dry or the dust has settled. Keep pets and small children out of the area.

Hydrangea

Feeding Your Garden

Like you, your garden needs food to grow strong and healthy. Food for your garden is called fertilizer, which can be dry or liquid.

Dry fertilizers come in pellets, tablets, stakes, or powders that you spread by hand or using a mechanical spreader (handheld or pushed). They are usually time-released, meaning that they release a little bit of their nutrients with each watering or rain shower. It is important to spread dry fertilizer lightly and evenly, or you could harm the plants you are trying to feed. Dry fertilizers work best for large applications, such as trees, a yard, or large garden or farm.

Liquid fertilizers are mixed with water and are poured or sprayed onto foliage or around the plant's base. Liquid fertilizers provide the plant with quick and easy-to-absorb nutrients. Because they are diluted, there is little chance of harming tender foliage. Liquid fertilizers work well for container plants, water gardens, and small garden plots.

Just like pesticides and fungicides, inorganic and synthetic fertilizers are toxic and dangerous, and require special handling. You should observe the same safety precautions with synthetic fertilizers.

Dry and liquid fertilizers include the following:

- **Complete fertilizers** contain all of the primary nutrients: nitrogen (N), phosphorus (P), and potassium (K). These nutrients are described later in this section.
- **Special-purpose fertilizers** contain nutrients for a particular kind of plant. You might see fertilizers labeled "African violet food" or "camellia food," specially mixed with the nutrients these plants need most. Special-purpose fertilizers also can contain one or two of the primary nutrients. Simple fertilizers contain only one of the primary nutrients.
- **Organic fertilizers,** made from the decayed remains of living organisms, include blood meal, manures, composted yard waste, organic humus, and worm castings.

WHAT DO THE NUMBERS MEAN?

Fertilizers are complex mixtures of the different nutrients plants use. There are many kinds of fertilizers for many kinds of gardening. All fertilizers have at least one thing in common: the number system used to measure the nutrients in the product. The higher the number, the more nutrient in the fertilizer.

- The first number measures nitrogen (N). Nitrogen helps plants grow lots of healthy foliage. It is also the nutrient that all plants need to survive. A plant with a nitrogen deficiency might have stunted growth, yellow leaves, or an overall light green color when it should be dark green.
- The second number measures phosphorus (P). Phosphorus helps plants, especially lawns, develop strong root systems.
- The third number measures potassium (K). Potassium is the energy booster that helps annual and perennial plants produce a lot of flowers or vegetables. Along with nitrogen, potassium helps make grass and plants a deep green color.

For example, take a mixture of 20-20-20. This fertilizer contains 20 percent of each primary nutrient. It is called an all-purpose fertilizer because it provides equal amounts of all primary nutrients. The types of plants and soil you have will help you determine which fertilizer to use.

ORGANIC AND HOMEMADE FERTILIZERS

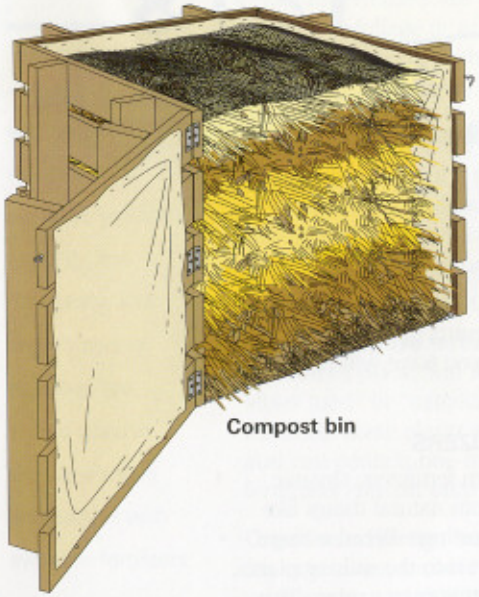
Many gardeners prefer to make their own fertilizers. Organic and homemade fertilizers are derived from natural things like decaying plants, food, and earthworm castings. Because these fertilizers do not add synthetic chemicals into the soils or plants, many gardeners believe this is a healthier way to garden. This section describes organic and homemade fertilizers, as well as how to construct compost and vermipost bins.

What Is Composting? Composting is the recycling of organic matter like grass clippings, leaves, and raw kitchen waste (no cooked foods!) such as vegetable peelings, apple cores, and meats, dairy products, or fruit. Compost bins are easy to make and use.

Find a suitable location in your yard to place the bin. Most gardeners keep compost bins in an area that receives full sun and is convenient to their garden. This ensures that the bin maintains a constantly warm temperature year-round. Once you have found a sunny location for your compost bin, collect the supplies listed below. Ask an adult to help you with this project because the compost bin materials are heavy and bulky for one person to hold.

To build your compost bin, gather the following supplies:

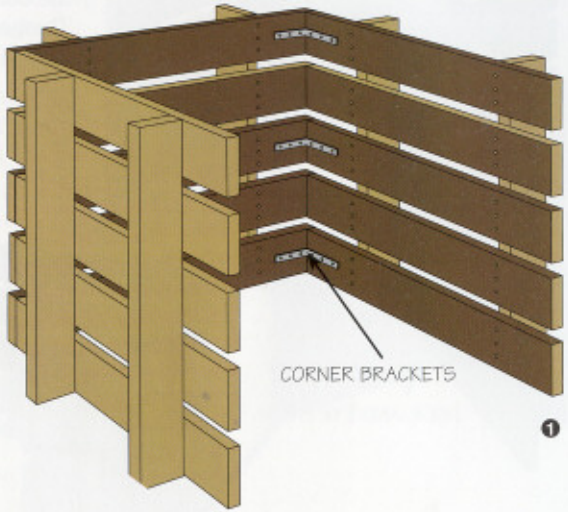
- Four wooden pallets
- 54 wood screws or wood nails
- One hook-and-eye latch (the kind used for screen doors)
- Six corner brackets (as shown in the illustration)
- Three hinges (as shown in the illustration)
- Heavy plastic sheeting (if you live in a dry climate)
- Weed matting
- Brown dry items, such as leaves, dried hay, and dried grass clippings
- Green wet items, such as fresh grass clippings and raw kitchen waste (no meat or dairy products)
- Water (preferably from a garden hose)



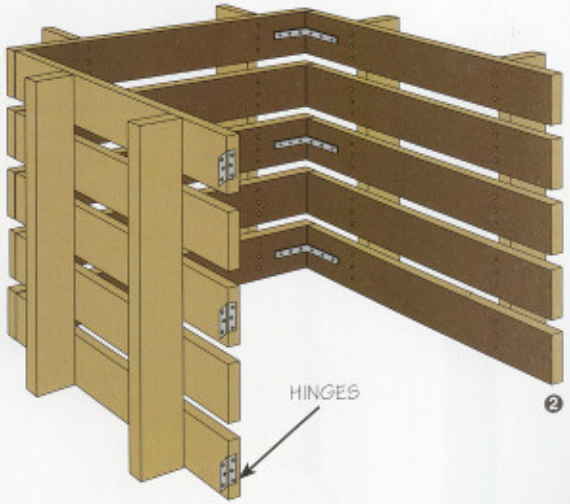
Compost bin

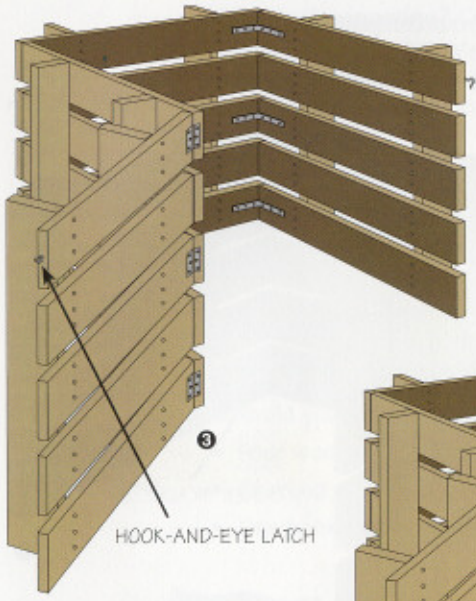
Complete these steps to build and fill your compost bin. You can bury kitchen scraps as you go, but make sure all kitchen scraps are buried deep in the pile to keep animals and insects from digging them up.

Step 1—Using the corner brackets as shown, screw or nail three of the pallets together at three points on each side.

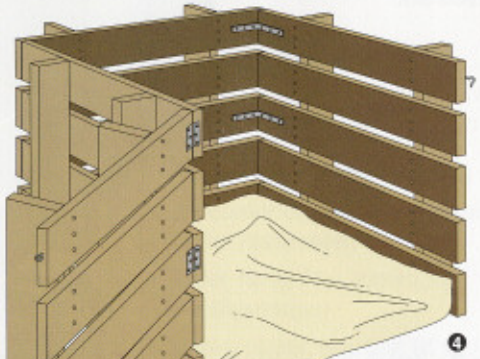


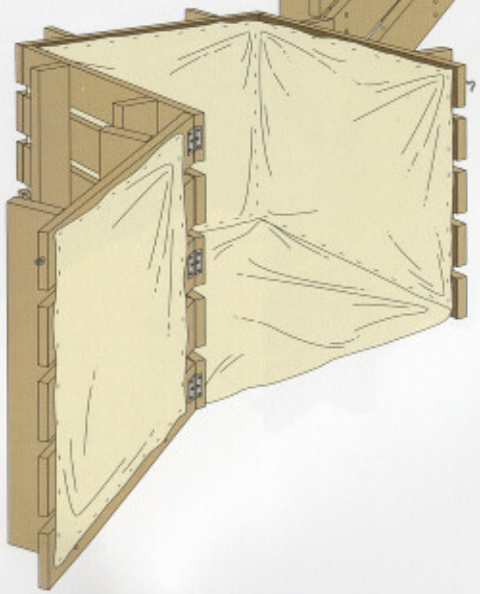
Step 2—Attach the hinges to the front edge of the bin so that the fourth pallet swings like a door.





Step 3—Attach the last pallet to the bolt hinges to make a door. Then attach the hook-and-eye latch that will secure the door in place.





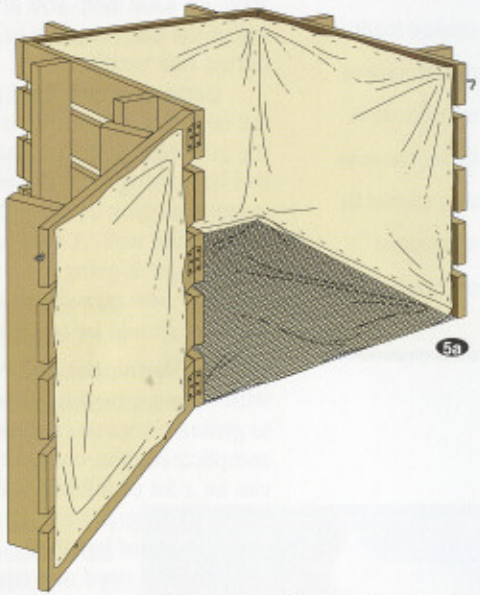
Step 4—In dry climates, line the bin with heavy plastic sheeting to maintain moisture levels and temperatures. Staple a sheet of plastic to the three sides of the bin. Use a separate plastic sheet for the front door.

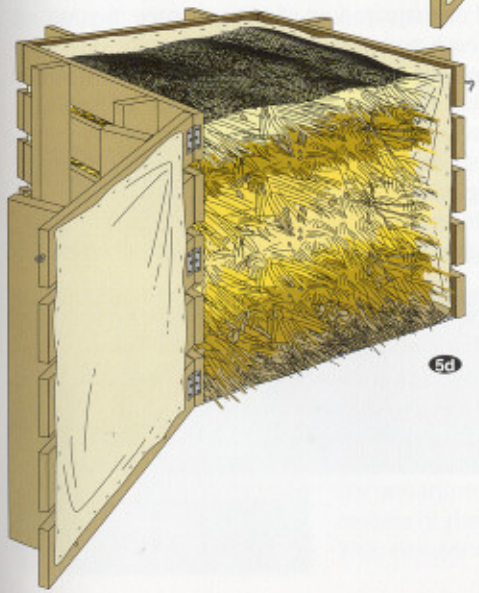
Step 5—Once your bin is stable and in its permanent location, add your compost ingredients in the following order:

a. Place a layer of weed matting on the bottom of the bin. This will help prevent weeds, keep out fire ants, and aid in drainage.

b. Add a 3-inch layer of hay, straw, or broken sticks and twigs over the weed matting to cover the entire bottom of the bin. This creates a drainage area.

c. Add a layer of brown waste, then a layer of green waste, and another layer of brown waste.





d. Continue layering in the following order until the bin is full or you have added all the waste: (1) sticks or hay, (2) brown layer, (3) green layer, and (4) brown layer.

Tip: Remember not to include cooked foods, raw or cooked meat, or dairy items, because they cannot be composted successfully.

When the bin is full, soak it with the garden hose. The entire pile should feel like a wet sponge when you touch it. Cover the inside of the bin with another layer of weed matting, then secure the cover of the bin by laying large rocks on it. Have an adult help you attach the cover to two corners of the top of the bin. Stapling or nailing the cover will help secure it during bad weather.

Using a shovel, hard rake, or pitchfork, till (turn over) the contents of your bin once a week. When you have turned the pile, hold your bare hand near the center of it. You should feel heat rising from the pile. In the winter, you might see steam emerging as you till. This heat means your pile is composting well. A cool pile will need more green waste or water to get it going.

Add new ingredients and water when you till. Your compost should be ready in three to six months.

What Is Vermiposting? A vermipost is a worm bin filled with—you guessed it—worms, and is maintained by gardeners to generate organic compost. Vermiposting is a bit more complicated than composting. But even with the extra work, it can be a lot of fun to watch worms recycle your kitchen waste. Worm castings are highly prized by organic gardeners as a potent, natural fertilizer.

You will need one square foot of surface space in your vermipost bin for each pound of waste. To determine how large your vermipost bin should be, measure the kitchen waste your family produces for one week. Collect all the kitchen scraps, such as raw vegetable and fruit peelings, coffee grounds, and egg shells, in gallon-sized airtight plastic bags (zipper freezer bags work best). Store the waste sealed in the bags in the refrigerator for one week. Use a standard bathroom scale to weigh your collection at the end of the week.

A total of 5 pounds of kitchen waste would equal 5 square feet of surface area in a vermipost bin. The bin would need to measure at least 12 inches wide and 5 feet long to accommodate enough worms to consume all that waste!

For purposes of timing and convenience to meet the merit badge requirements, you may reduce the size of your vermipost bin to compost half the weight of your family's weekly waste amount. If the weight is 5 pounds, build a small vermipost bin to compost 2.5 pounds of waste, or half your family's waste. You can increase the bin's size after you have learned how to vermipost.

Once you have determined the size of bin, gather the supplies listed below:

- Plastic or wood container, at least 8 inches high by 12 inches wide and 18 inches long
- Shredded newspaper
- Clean builder's or sandbox sand
- 1 to 2 pounds of red wiggler worms (purchase from organic gardening centers and Internet or mail order catalogs)
- 5 pounds of unbleached, unpainted aquarium gravel
- Tray to catch drainage

Follow these steps to build your vermipost bin.

Step 1—Punch holes in the sides of the container to allow air to circulate. Holes should be located along the sides and ends of the container about 2 inches above the bottom. Punch three small holes in the bottom of the container to catch any drainage.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Step 2—Layer 2 inches of the aquarium gravel in the bottom of the container. This ensures drainage.

Step 3—Tear black-and-white newsprint into 1- and 1½-inch strips. Do not use colored newsprint, advertisements, or magazine print. The dyes used in the inks are toxic to worms and will kill them.

Step 4—Moisten the strips with water and mix them with a few handfuls of sand.

Step 5—Fill the container three-quarters full with the mixture.

Step 6—Buy 1 to 2 pounds of red worms or red wigglers. Red worms are a kind of earthworm specifically adapted to eating rotting vegetable matter. Other kinds of worms will not perform this kind of composting. You can buy red worms at organic garden centers and through the Internet or mail order catalogs (with your parent's permission).

Step 7—Place the red worms, soil and all, in the container.

Step 8—Add approximately 2 inches of dry shredded newsprint and cover the container with a solid plastic or wood cover.

Step 9—Feed the worms once or twice a week by pulling up some of the mixture and burying waste in small holes at different locations in the bin. Do not feed the worms if they have not finished their last meal. Overfeeding causes the food waste to sit around too long, which creates a foul odor and attracts flies and gnats. If you overfeed the worms, stop adding food waste until the worms have composted what is already in there.

Step 10—Find a warm location where the temperature will remain between 55 and 85 degrees. Colder or hotter temperatures may kill the worms. The crawl space beneath a house or a shady corner of the yard are good locations for vermipost bins during the spring, summer, and fall. In the winter, vermipost bins should be moved indoors to the basement or other unused space.

Step 11—Place your bin on top of the blocks on the drain tray.

Step 12—Empty the drain tray into a bucket as needed. Save the juice in an old milk container or plastic soda bottle. You can mix this juice with water to make liquid fertilizer for your garden.

After about two months, you will see dark material that looks a lot like coffee grounds beginning to form at the bottom of the bin. These are the worm castings. Gently spoon the castings out into another container and add more bedding for your worms the next time you feed them. Use the castings to fertilize your garden.

What Do Worms Eat?

You can feed vermipost worms any of the following: nongreasy leftovers, fruit and vegetable peels and scraps, bread, coffee grounds, tea bags, and ground eggshells.

Do not feed worms dairy products, meat, or bone products because worms have difficulty eating these and the items will decay slowly, attracting flies and rodents and creating foul odors.