CHILDREN'S GARDENS

A FIELD GUIDE FOR OR TEACHERS, PARENTS AND VOLUNTEERS

By Elizabeth Bremner and John Pusey
Illustrations by Caroline Arnold

Third Edition edited by Yvonne Savio

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION
COMMON GROUND GARDEN PROGRAM

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Third Edition, 1999. Editing and production coordinated by Yvonne Savio, Common Ground Garden Program Manager

Children's Gardens: A Field Guide for Teachers, Parents and Volunteers.

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DEDICATION

We dedicate this edition of **Children's Gardens** to the two people who created and have nurtured the Gardening Angels School Garden Program of the University of California Cooperative Extension Common Ground Garden Program in Los Angeles County since its inception in 1990—Rachel Mabie and Bonnie Freeman.

Rachel Mabie's vision for reconnecting school children with their environment led to her intiating the Gardening Angels School Garden Program. Her commitment is that all children—but especially inner city and urban youngsters—experience their world through the joys of gardening, starting with hands-on activities in the classroom and on-site garden. Rachel edited the second edition of **Children's Gardens** and now, as County Director of Cooperative Extension in Los Angeles County, oversees 4-H, nutrition and gardening programs serving all county residents.

Bonnie Freeman, a Gardening Angel volunteer since the inception of the program, has single-handedly recruited, trained and mentored hundreds of Gardening Angel volunteers who make a difference every day at schools throughout Los Angeles County. Thanks to Bonnie's efforts, children enjoy fruits and flowers where there was once nothing but blacktop.

Rachel's and Bonnie's cultivation of the Gardening Angels Program offers a bountiful harvest for our future—children who appreciate beauty, enjoy learning, and are thoughtful stewards of their environment.

ACKNOWLEDGEMENTS

Thanks to the staff of the Common Ground Garden Program for its work over the last two decades in developing programs that culminated in the production of this guide.

Thanks to Rachel Mabie, who edited the second edition in 1990.

Volunteers in the Master Gardener Program, sponsored by Common Ground and Cooperative Extension, helped update the third edition of **Children's Gardens**. Thanks to Cherry O'Meara, who expanded the bibliography of books, and Bea Gold, who produced the website listing. Special thanks to Marie Kashmer-Stiebing, who typed all the revisions.

Margaret Shackelford, of Rodale Press, graciously allowed us to reproduce charts on companion planting and plants for repelling insects.

Vegetable variety suggestions are provided from *Home Vegetable Gardening*, publication 21444, by Dennis Pittenger, Cooperative Extension Urban Horticulture Specialist, University of California, Riverside. The 61-page booklet is available from ANR Publications, University of California, 6701 San Pablo Avenue, Oakland, CA 94608-1239, (510) 642-2431, fax (510) 643-5470.

INTRODUCTION

In ancient China, it was said: work in harmony with nature to increase the natural yield, and you will find real satisfaction and begin to sense more clearly the meaning of life. That is, each of us should play some part in the care and nurturing of life on this planet. These days, few of us do. The urban lifestyle, despite its other rewards, has separated us from the natural world.

When we hear the story of the city kid who thinks milk comes from a carton, or that tomatoes only come in shrink-wrap, we see right away that something is wrong. But even if we provide the textbook version of how food is produced, it is still a poor substitute for contact with the earth.

There is a lot to be learned while caring for the green and growing things of this world. A garden may be the ideal place for you, as a teacher and nurturer, to expand your own awareness of life and life processes. Creating a garden is a very personal encounter with nature, one that is bound to change your ideas about the role of direct experience in education. There is no academic subject or life experience that does not have a complementary lesson in the garden.

The information in this manual is simply a guide to help you have a successful garden. Don't be afraid to try new things, to explore variations. You and the children working with you may discover something new, perhaps some new technique that will benefit us all.

Part One: The Process takes you step by step through the basic concepts that are important to successful gardening and the gardening techniques that can be adopted by young gardeners. It is arranged in a sequence that follows the natural progression of steps that you will take from the moment you decide to have a garden to the time you harvest. We recommend that before beginning your garden, you read it all the way through for a good overview of the total process.

Part Two: The Activities keys the concepts and techniques detailed in Part One. They are designed to be varied and expanded. You will find that these activities provide a variety of important educational experiences, ranging from exercises that encourage creativity to experiments which develop skills in objective scientific observation. These skills are listed in a chart at the end of the section.

Guide to Resources lists seed companies and sources of technical assistance, and describes where to obtain many free materials useful in developing the garden.

Selected Bibliography reviews publications that offer helpful background material for your children's garden.

If you need additional help, call the Common Ground Garden Program at (323) 838-4540, or your local Cooperative Extension Office.

PART ONE: THE PROCESS

PART ONE: THE PROCESS

INDIVIDUAL AND COMMUNAL GARDENS: TWO APPROACHES:

Most children find that gardening is great fun, and they generate a lot of energy and enthusiasm. You can help channel this natural energy by choosing the kind of garden that will provide the most productive educational experience for your group of children.

In this section, we consider two basic approaches: establishing individual or communal garden plots. The simple physical differences between each way of laying out a garden will not only affect the plant life, it will also influence the way the children relate to one another as they carry out the various tasks involved.

In a **communal garden**, children share the work of cultivating, planting and harvesting. A communal garden plot encourages group participation and cooperation, and ensures that every child receives something from the harvest. The size of a communal plot depends on the space available and the number of children who are gardening, but there should be room for everyone to work at the same time, without being crowded. This approach works especially well with younger children.

Many children's gardens consist of a number of **individual plots**. The plots don't have to be spacious, but they should be large enough for each child to plant a few of his or her favorite vegetables. Individual plots can be used to encourage friendly competition, to compare different varieties and to allow for the special needs of individual children. Plants that require a lot of

room, like corn or squash, can be planted in another area of the garden, leaving the space-savers like radishes, beets, chard and leafy lettuce for the individual plots.

Container gardens, which are appropriate for school sites that have a limited amount of open space, can be designed for individual or communal gardening.

Before you decide on one approach or the other, visit some children's gardens, and talk to the people involved.

CHOOSING A GARDEN SITE

Here are some of the physical features that you should consider when choosing your garden site.

Water is certainly a basic requirement. Since dragging long lengths of hose to the garden is time consuming, the garden should be as close as possible to a water faucet. A well-watered garden has a better chance of producing an abundant harvest.

A minimum of six hours of **direct sunlight** is necessary for growing most vegetables. Check your future garden site at different times of the day and in different seasons, if possible, to make sure it is not shaded by nearby trees or buildings.

Good drainage is important. Do not locate the garden in a low spot where water will collect.

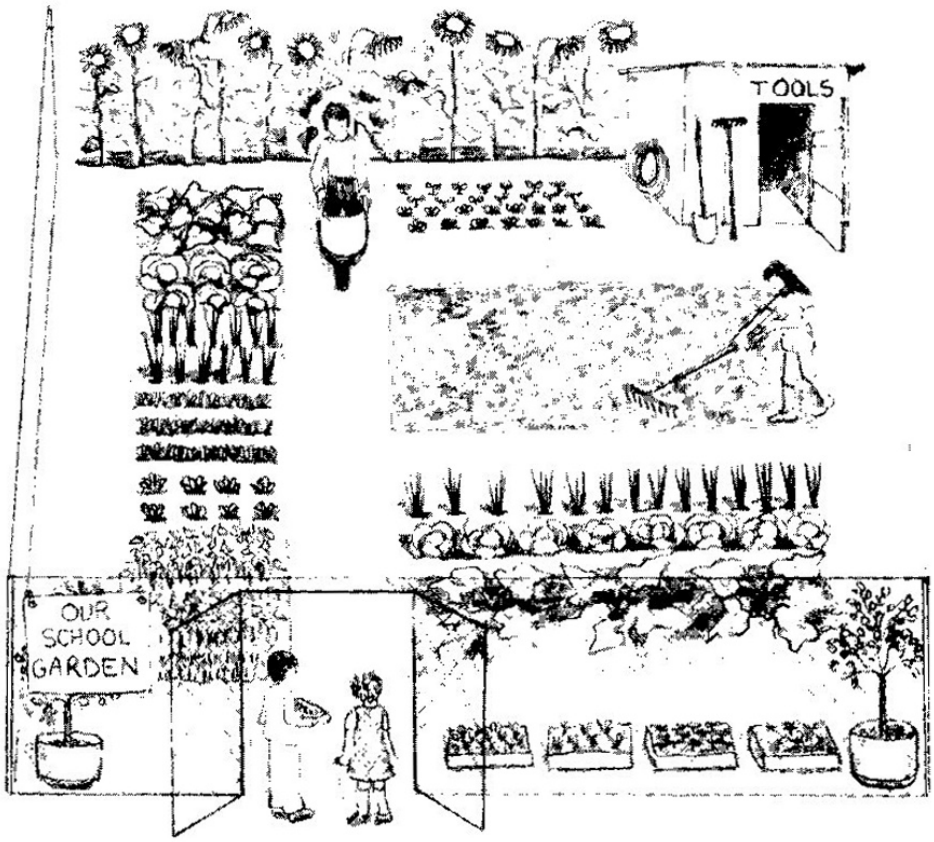
Avoid areas that have been sprayed with **herbicides.** Pick a spot that has a good growth of weeds! This is a good sign the soil has not been sterilized.

It is very important that the children have **access** to the garden. If the opportunity to observe and work in the garden is too restricted, interest will diminish.

Children will need plenty of room to use tools safely, to walk among the plants, and to just sit and talk. Gardens are wonderful environments for group discussions. Hay bales make great seats or benches, and the straw can later be used as mulch.

CHOOSING A GARDEN SITE

The garden should be in a relatively **secure** spot. Don't plant a garden in the middle of a popular short-cut or baseball lot. Fences can be helpful for keeping out unwanted dogs, bicycles, basketballs, and the occasional thief. A living fence can be created by planting safflowers or berry vines.



The garden should be considered a **permanent** school site. Try to get some guarantee that the garden is not the future site of a new bungalow or parking lot. Promoting the garden as a permanent school facility will help you gain overall support from school officials and the community.

SOIL

In urban environments, the original soil usually has been removed during leveling and scraping operations in preparation for building. Perhaps you will be lucky enough to find a site for your garden that is still intact from those earlier days when agriculture dominated the landscape. However, it is more likely that you and your group will be rebuilding the soil in your garden.

Soil acts as the mechanical support for plants. It also serves as a reservoir for nutrients, water, and beneficial microorganisms. In order to grow the healthiest plants possible, it is important to identify what type of soil you are working with so that you can add the necessary amendments and fertilizers.

Soil has four basic ingredients: decomposed rock, organic matter, air and water. Soil particles range in size from coarse particles the size of sand, and finer particles called silt, to very fine particles, as in clay. The proportion of these particles determines the texture of the soil, whether it is sand, silt, loam or clay. (See Part Two, p. 106, for relative percentages.)

Sandy soil is loose and well-aerated. It is coarse and grainy to the touch. Water drains through it quickly and as a result it dries out rapidly.

Silty soil feels smooth and slippery when wet, and floury when dry. It holds water well but does not drain well and is poorly aerated.

Clay soil feels sticky when wet, forms a solid mass when dry. Like silt, it holds water well but is poorly aerated.

Loam is the ideal mixture of sand, silt and clay. It remains crumbly, holds water well and is well-aerated.

Soil also contains many living microscopic and macroscopic plants and animals such as insects, earthworms, fungi, protozoa and bacteria. These living organisms contribute organic matter and nutrients to the soil.

Another property of soil is called the pH factor. Soil pH describes the amount of soil acidity or alkalinity. The acidity/alkalinity level is represented by a number ranging from 0 to 14. Acid soils are less than 7, and alkaline soils are more than 7. Soil at the neutral level of 6 to 6.5 has the most available nutrients. Test soil pH with kits available at garden supply stores, or send soil samples to a scientific service company. An organic method of lowering pH is to add pine needles or redwood compost. To raise pH, add limestone or wood ashes.

SOIL AMENDMENTS

Soil amendments are organic or inorganic materials used to improve the physical condition of the soil. By adding the proper amendments, you can improve the soil structure, which in turn will improve drainage, aeration, and the water and nutrient-holding capacity of the soil.

In clay soils, amendments are added to help break up the soil, resulting in increased air space, better drainage and improved root penetration.

In sandy soils, amendments increase the water-holding capacity and keep nutrients from being washed away.

Organic amendments have plant or animal origins. Compost, manures, leaf mold and peat moss are examples. (For information on sources of amendments, see the Guide to Resources, p.169.) Incorporate them into the soil before you plant. Use about four inches of an amendment over the entire area to be planted, and work it into the top ten inches of the soil. Allow it to sit for two to eight weeks before planting, unless the amendment has already been composted.

Inorganic amendments have a mineral origin. Sponge rock (vermiculite, perlite), as an example, is crushed porous rock, heated under pressure. It can help loosen soil or improve water and nutrient holding properties of soil. Gypsum (calcium sulfate) is used in alkaline soils to improve drainage. Read the package instructions before applying inorganic amendments.

SOIL AMENDMENTS

Remember that if you work the soil when it is too wet, you can harm the soil structure by compacting particles so closely together that air and water can't circulate. To test, form a ball of soil in your hand. If the ball crumbles, the soil is dry enough to be worked. If it sticks together, it is too wet.

ORGANIC AND INORGANIC FERTILIZERS

Plants depend on nutrients contained in the soil, air and water in order to grow, flower, and produce seeds and fruit. By studying the nutritional needs of vegetable plants, we have learned to increase the quantity and the quality of the food they produce.

Plants require 16 elements for normal growth. Some of these are needed in such small amounts they are called micronutrients. These are zinc, copper, boron, molybdenum, chlorine, manganese, and iron. There are nine macro nutrients. Carbon, hydrogen and oxygen are supplied by air and water, and calcium, magnesium and sulfur are usually abundant in the soil. But "the Big Three"--nitrogen, phosphorus and potassium—often have to be added in some form.

Nitrogen (N) aids in the production of large green leaves and the filling out of fruit. Nitrogen is the element most commonly deficient in soils. **Phosphorus** (P) is needed for root growth and fruit and seed production. **Potassium** (K) is needed for the formation of rigid stems and for root growth.

There are two general categories of fertilizer.

Organic fertilizers come from plant or animal sources. Most contain only moderate amounts of nutrients, and these nutrients are released over a period of time. Organic materials improve soil structure and feed microorganisms as they decay. Many are available at no cost. The chart on pages 19-20 lists several examples.

ORGANIC AND INORGANIC FERTILIZERS

Add organic fertilizers to the soil two weeks before planting. Work bulky materials and manures into the top eight inches. Other materials can be raked into the top inch or two. Seedlings and well-established plants can be fertilized by adding small bands of fertilizer, called side dressings, near the plants.

Inorganic fertilizers come from chemical or mineral sources. Many are very soluble in water, making nutrients rapidly available to plants. They do not improve soil structure. Packaged mixed fertilizers show relative percentages in the NPK sequence. A 10-10-10 fertilizer would be 10% nitrogen, 10% phosphorus, and 10% potassium.

Apply inorganic fertilizers just before planting, working them into the soil. Be sure to read the instructions on the package. Inorganic fertilizers are concentrated, so be careful not to use more than the recommended amount. The chart on p. 20 lists commonly available inorganic fertilizers.

FERTILIZER NUTRIENT CHART

Type of Organic Fertilizer	% N	% P	% K
Alfalfa hay	2.47	.50	2.06
Bean straw	1.20	.30	1.20
Blood meal	14.00	1.90	.73
Bone meal	2.16	19.00	.20
Chicken manure, fresh	1.90	1.31	.65
Chicken manure, dried	2.80	2.80	1.50
Cow manure, fresh	.46	.15	.31
Cow manure, dried	1.30	.90	.80
Fish meal	10.00	6.00	0.00
Grain straw	.40	.15	1.00
Hoof and horn meal	12.83	1.85	0.00

FERTILIZER NUTRIENT CHART

Type of Organic Fertilizer	% N	% P	% K
Horse manure	.48	.25	.38
Seaweed (kelp), dry	1.49	.62	5.00
Wood ashes	0.00	1.60	6.00

(These are average percentages for the materials listed. Since they are organic materials, the composition will vary.)

Type of Inorganic Fertilizer	% N	% P	% K
Ammonium nitrate	32.5-33.5	0.0	0.0
Ammonium phosphate	11.0	21.0	0.0
Ammonium sulfate	20.5	0.0	0.0
Potash rock	0.0	0.0	60.0-70.0
Rock phosphate	0.0	38.0-40.0	4.5
Super phosphate	0.0	16.0-20.0	0.0
Urea	42.0	0.0	0.0

COMPOST

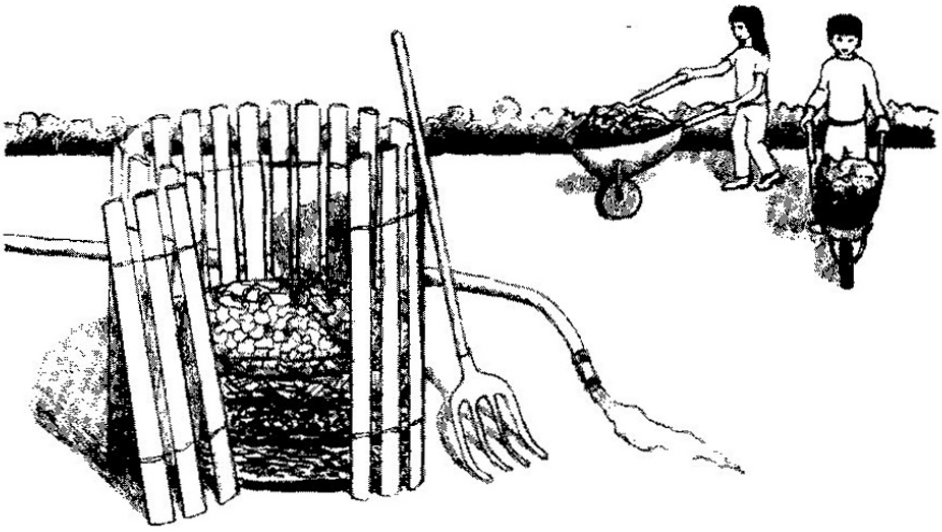
Making and using compost in the garden is an excellent way to demonstrate the cycles of growth and decay found in nature, and the "economy" of life. Garden plants take the food they need to grow from the soil and turn these nutrients into the fruits and vegetables we eat. When the growing season is finished, the plants die, decay and become part of the soil again.

But most vegetables are heavy feeders, and we grow much more on a small plot than nature would grow. When we harvest and remove dead plants, we interrupt the natural cycle. Something more has to be added to the soil.

Lawn cuttings, dead plants, leaves, sawdust, kitchen trimmings, table scraps (excluding oil, meat and dairy products) and animal manures can be turned into a natural fertilizer called compost, using the same process of decay found in nature. In order for these waste materials to decay quickly and completely, they must be shaped into a pile that is no smaller than three feet wide and three to four feet high. This helps keep the center of the pile warm enough for the decay process to take place. To keep the pile in the right shape, you can build a circular container out of wire fencing. Using a piece of fencing about ten feet long and four feet high, pull the two ends together to form a circle, and tie or hook the ends together.

Start the pile near the garden plot if possible, so that it is easy to get to and easy to water. Pile the plant materials inside the fencing in level layers. Try to alternate layers of green material like grass clippings with brown material like dried leaves. Then add a thin layer of soil or already broken-down compost. Each time you put on a new layer, water it lightly.

Don't soak the material, as this promotes anaerobic decay, which has an unpleasant smell. Overwatering will also wash away nutrients.



As the desired aerobic decay process develops, caused by bacteria which consume the waste products, the pile will get quite hot. Sticking a hand into a compost pile that has "heated-up" is an amazing experience for a child. The time it takes for the materials to be thoroughly composted depends on several things, including the kind of material put into the pile and the weather. Material that is still green and moist and not too thick will decay fairly quickly. Tree twigs, corn cobs and thick plant stems take a long time to decay, and should be chopped into small pieces before they are added to the pile.

Very cold weather can slow the decay process down. To keep the compost warm and moist, you can cover the pile with a sheet of plastic. The pile doesn't have to be turned, but it will decay faster if it is thoroughly mixed once a month. Generally

speaking, compost is ready when you can no longer recognize the original materials. Good compost is dark, fine, and crumbles easily in your hand.

Compost will provide nutrients to the garden soil for several months. It also improves the soil structure. It can be dug into the soil as with other fertilizers and amendments, or spread on the surface of the garden as a "mulch."

Some plant materials should not be included in the compost pile, such as hard-to-kill weeds like bermuda grass, wild morning glory or any weed that has already produced seeds. The seeds will end up in the garden. Also, avoid any diseased or insect-infested plants. Grass clippings from lawns that may have had weedkillers applied should not be added to the pile, since the chemicals used may end up killing the vegetables.

TOOLS

Before you and the children prepare the garden soil, you should consider the care and use of tools.

Children must learn to keep the tools out of pathways and other places where someone might trip or fall. Sharp edges should always be left pointing toward the ground. Do not allow children to lift or swing tools above their knees.

Always clean your tools before putting them away. To keep them from rusting, a bucket full of oiled sand is good--simply push the blade of the tool in and out of the sand a few times. An oily rag is handy, too. All tools with cutting edges need to be sharpened regularly. You can sharpen hoes and shovels with a metal file but don't make the edge too thin or it will chip. With proper care, tools will last through many growing seasons.

The number of tools needed will depend on the number of children that will be working in the garden at one time. The kind of tools will depend on how much soil preparation is required. Get the best quality tools your budget will allow. Cheap tools tend to break easily, and many end up costing more in time and trouble. Also, there are short-handled tools available for use by small children. Tools can be modified for use by children with physical handicaps.

Garden hoe — The flat blade is used for chopping, shallow digging, scraping, and for mounding the soil.

Metal bow rake — Good for leveling seed beds and for spreading soil amendments and fertilizer.

Garden shovel — Useful for digging and scooping.

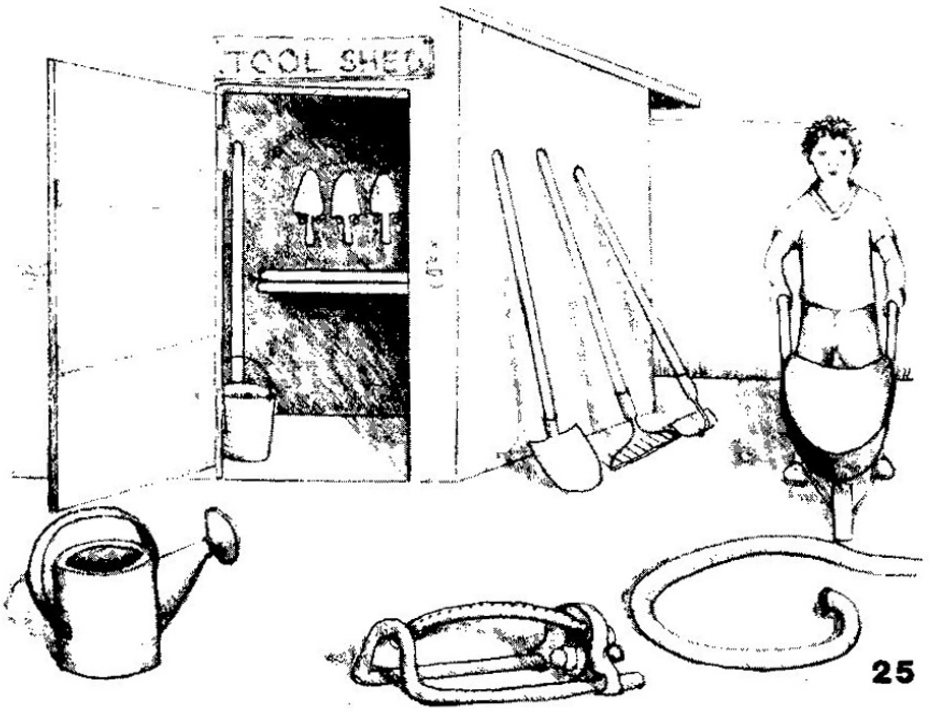
Garden fork — Best when incorporating manure, compost, and other amendments into the soil before planting.

Trowel — Used for transplanting and for light cultivating. Used more by children than any other tool.

Wheelbarrow — Good for transporting compost, manure, wood chips, top soil and debris.

Hose — Get a good rubber hose that will stay flexible for years and won't crack or split.

Sprinkler — An oscillating sprinkler can be set to water an exact square or rectangular pattern with a light mist; good for watering seedlings and raised beds.



BED CONSTRUCTION AND IRRIGATION

Gardeners have developed many techniques for creating a good environment for growing healthy, productive plants. These techniques utilize different methods of bed construction and irrigation. Each method has certain advantages.

Flat beds are constructed so that the entire surface of the bed is level with the surrounding garden area. After properly amending and fertilizing, rake the soil to a smooth, level surface. The bed can then be sectioned off from the rest of the garden by sinking a thin wooden railing around each edge of the bed. The beds can be any length, but should be narrow enough for children to reach the center from either side without straining. A three-foot wide bed works well.

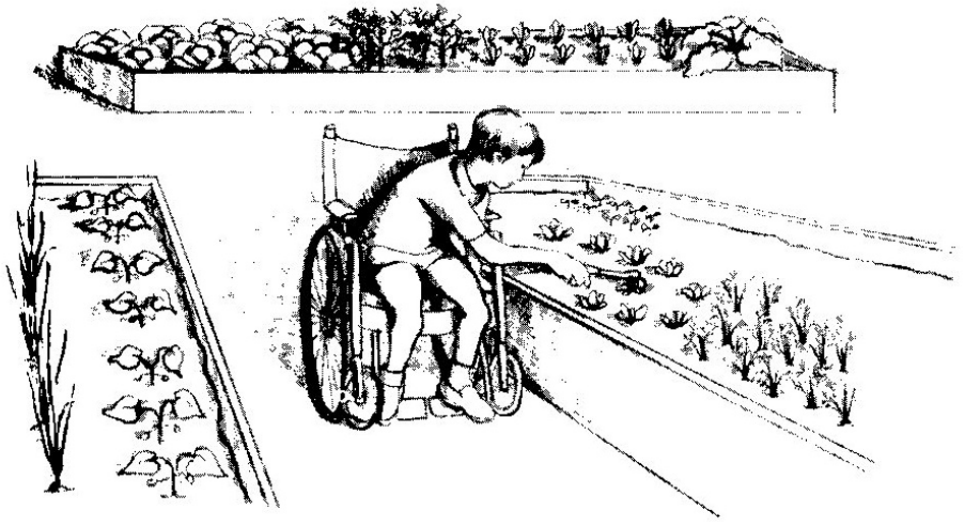
Raised beds should also be about three feet wide, and may be as long as twenty feet. The height depends on the amount of amendments added, and how much air space is present in the soil after it is prepared. Top soil may be brought in if the existing soil is poor.

The surface soil within the raised bed area is first cleared of weeds, grass and large rocks. Turn the soil over to break up the surface. Add a mix of sand, top soil, compost and well-rotted manure. If you frame the bed, use redwood or cedar. Other lumber can be used, but should be painted with a non-toxic paint as a preservative. (See Guide to Resources, pp.167-168.) Fill a framed bed up to an inch or two from the top. Organic matter decomposes rapidly, so there will be some settling.

BED CONSTRUCTION AND IRRIGATION

Both flat beds and raised beds lend themselves to intensive planting techniques, which make the most efficient use of space and create the best possible growing conditions. (See pp.48-50.)

Raised beds can also be built on paved surfaces. Some vegetables like tomatoes have deep root systems, so the soil may have to be as much as thirty-six inches deep. Eight inches is the minimum requirement for shallow-rooted plants like lettuce, but allowing for deeper root growth generally produces better results.



If a number of raised beds are constructed, the walkways in between can be covered with wood chips to prevent weed growth. Raised beds are easy to maintain, and a raised bed garden with wood chip or gravel walkways reflects the care and planning that have gone into your garden. If walkways are level and smooth, children confined to wheelchairs can garden quite well using raised beds twenty-eight inches high.

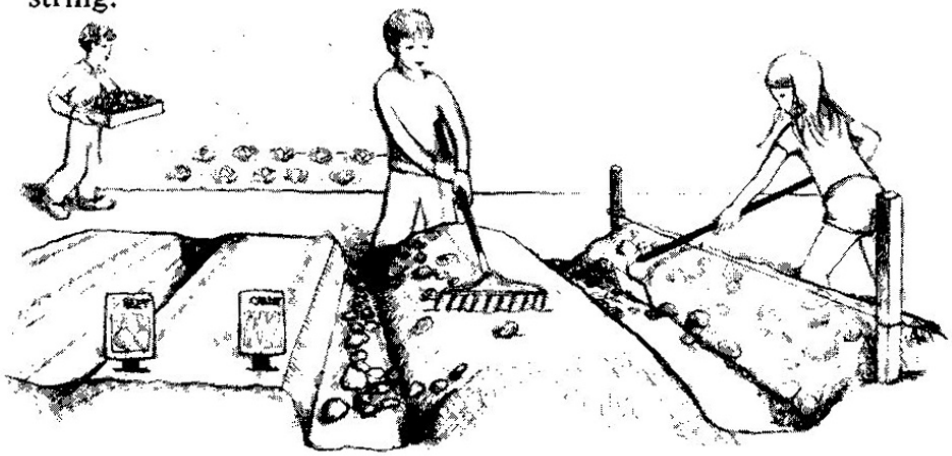
BED CONSTRUCTION AND IRRIGATION

The **double-row bed and furrow** method has been adapted from agricultural techniques used on large-scale farms, but is also similar to the style of gardening most familiar to backyard gardeners.

The garden is arranged in rows or beds eighteen to twenty inches wide. The rows are separated by furrows of about the same width, which are used for watering. Vegetables are planted in lines two inches from each edge of the bed.

You will need these materials to prepare the beds and furrows: a hoe, a metal bow-rake, two wooden stakes three feet high and string.

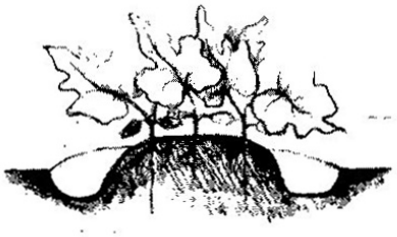
After you have improved the soil with amendments, be sure to level the entire planting area. This is essential for uniform irrigation. Start the first row about three feet from the edge of the garden plot. Put a stake into the ground at each end of the row and tie the string between them, twelve inches above the ground. Use a hoe to dig a furrow on either side of the string and scoop the dirt out of the furrow, forming a hill below the string.



After the hill is completed, move the stakes and string over three feet and position them to start the next row. Then level off the first mounded hill with the teeth of the rake. Make the top of the row — the seed bed — eighteen to twenty inches wide and four to eight inches high. Raking also causes any large rocks or clods to fall to the side, where you can pick them out. Then start the next row. Keep the spacing between rows even. Continue until all rows are completed.

Dam the ends of each furrow with soil. Use the hoe to even out the high and low spots so that furrows are level and fill evenly with water. You can use the furrows as paths between the beds when you plant, weed and harvest, since walking on the bed will compact the soil.

Hill and basin planting is used by many local gardeners for vining plants such as cucumber, melon and squash. This method saves space and lets you effectively water these crops, while allowing vines to spread.



Build a circular hill of soil four to eight inches high and about two feet in diameter by scooping soil from a basin around the hill. In effect, you create a circular furrow. (Add amendments and fertilizer as usual.) Place seeds in several spots three to four inches apart on the crest of the hill, and cover lightly with soil. Water by

overhead sprinkling until the seedlings are about six inches tall and their roots are established. Then thin, leaving only the healthiest three or four plants.

Trellises can be added to help save soil space for other plants, increases air circulation on foliage, and keeps fruits off soil surface, lessening advent of diseases.

Since water is a scarce resource, **irrigation methods** must take into account conservation techniques as well as the overall needs of the vegetables you plant.

Several factors determine the amount of water it will take to irrigate your garden properly, including the type of bed, soil, weather conditions and vegetables planted. Soil must be moist throughout the root zone. Although root zones vary for different types of vegetables, ranging from one to six feet or more, irrigation that wets the soil to a depth of ten inches to two feet deep should be sufficient.

Frequent shallow irrigations result in shallow root systems, which leave plants more susceptible to stress during hot weather. Also, relatively more water is lost through evaporation. If plants appear healthy and productive, they are probably receiving enough water. Be sure not to over water. Plants need air around their roots to live. Over watering floods the air spaces.

When irrigating a flat bed or raised bed, as much water as possible must be absorbed into the soil and not lost as runoff. Regular cultivation of the soil helps improve infiltration, as does the use of mulch, which prevents crusting and rapid evaporation. Watering with a hand-held hose and sprinkler nozzle is usually

not efficient. Oscillating sprinklers with adjustable rectangular patterns are helpful for providing a uniform, thorough watering. Soaker hoses are excellent for getting the water right to root zones. This is similar to drip irrigation, but much less expensive to install and maintain. Inexpensive soaker hoses can be purchased at garden supply centers. You can also make one using an old hose or PVC pipe by punching small holes (less than 1/32 of an inch in diameter) at three inch intervals. Place the hose, holes down, on top of soil. Water will ooze through the holes and soak into the ground. "leaky hose" soaker hoses are made from recycled rubber and ooze water along their whole length. Bury them slightly for least evaporation. But locate them again before digging!

Another way of watering a flat bed or raised bed is to build up a small lip of soil two to three inches high on each edge of the bed, creating a basin which can be filled with water. Or, you might want to try a series of small furrows in the bed. Remember that, in order for these methods to work effectively, the bed surface must be completely level.

To irrigate a double-row bed and furrow or hill and basin, run water in the furrows until each bed or hill absorbs enough water to be wet across the top. This assures good depth of irrigation. Note that furrow irrigation uses more water than overhead sprinkling to wet the soil to the same depth.

For plants that seem to need special attention because they are not receiving adequate water from normal irrigation, an attachment called a "watering wand" can be used. This attachment allows you to reach the base of a single plant. You can also use a "bubbler," a ball perforated with holes which can be screwed onto the end of a hose.

CONTAINER GARDENING

Many schools have a limited amount of open space. Container gardening is a good compromise solution for those gardening groups without a garden site. If you plan to garden using containers, there are special requirements you should be aware of.

Containers should hold at least three gallons of soil for large or deep-rooted plants such as tomatoes, squash and melons, and one and one-half gallons of soil for smaller plants like lettuce, onions and herbs. When filling the container with soil, leave a one to three inch basin below the lip for watering. Containers should have drainage holes in the bottom. Finally, containers should be made of a material that will not rot or deteriorate before the plants have matured.

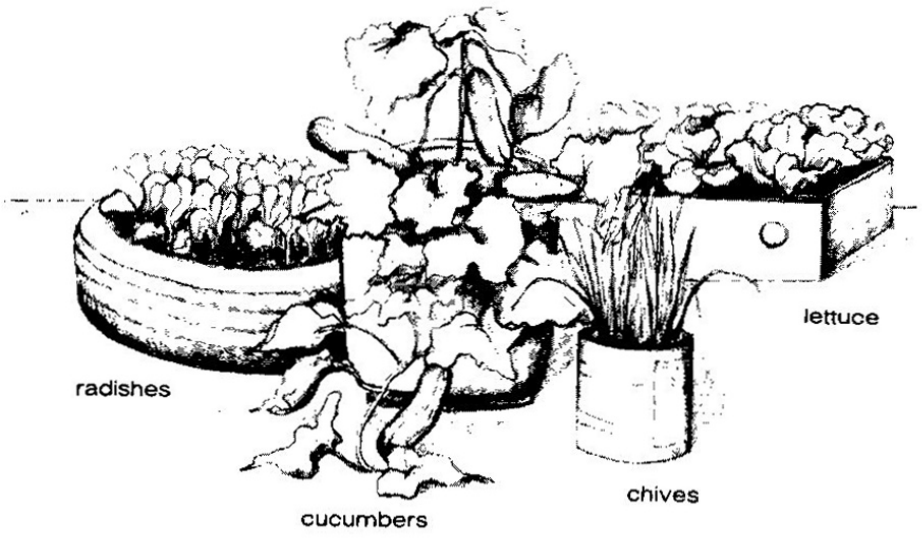
Most vegetables can be grown in containers, but for a few types this is impractical. Corn needs to be grown in large stands of several rows in a square to set fruit. Tomatoes and potatoes need large root areas, so will be more successfully grown in very large containers at least three feet wide and deep. Vining crops such as peas or pole beans will need trellises.

Use a light soil mix in containers. A good homemade mix is 50% commercial potting soil, 25% sand and 25% vermiculite. Add a small amount of commercial fertilizer, or a combination of organic fertilizers such as blood meal (for nitrogen), bone meal (for phosphorus), and kelp meal (for potassium) to the soil mix. Follow package directions.

Do not allow the soil to become completely dry. Infrequent deep watering is better than frequent shallow watering, since it prevents alkali build-up in the soil. During hot, dry weather, you may have to water containers almost daily. Once a month, flush containers thoroughly with water to remove excess salts.

Vegetables in containers should be fertilized regularly throughout the growing season. You can fertilize containers easily by using a water-soluble balanced fertilizer or "manure tea" (See p. 145). Be sure to water plants before adding the fertilizer mixture.

Small containers and some containers with wheels can be taken in at night. Larger containers can be used for rooftops and parking lot gardens. Spread wood chips or sawdust to cover the asphalt, and you can transform a hot dusty corner of the playground into a green oasis for your children.



WHAT TO PLANT, WHEN TO PLANT

In Southern California, it is possible to grow vegetables year-round. This means that you can start a children's garden anytime or the year—when school starts in September, in January following Christmas vacation, or in spring, for gardening all through summer.

For a fall garden, plant:

artichokes
beets
broccoli
brussels sprouts
cabbage
carrots
cauliflower
celery
chard
collards
garlic
kale
kohlrabi
lettuce
mustard
onions
peas
parsnips
radishes
spinach
turnips

For a winter garden, plant:

artichokes
asparagus
beets
broccoli
brussels sprouts
cabbage
carrots
cauliflower
chard
celery
chives
collards
garlic
kale
leeks
lettuce (leaf)
mustard
onions
parsley
peas
potatoes (white)
radishes
rhubarb
turnips
spinach

For a spring garden, plant:

beans
beets
cantaloupe
carrots
cauliflower
celery
chard
chayote
corn
cucumbers
eggplant
kohlrabi
leeks
lettuce (leaf)
melons
New Zealand spinach
okra
pepper
pumpkins
radishes
rutabaga
squash
tomatoes
turnips
watermelon

WHAT TO PLANT, WHEN TO PLANT

Many vegetables can be planted over a period of several months. This explains overlaps in the three seasonal categories. Some may not mature in time to be harvested before vacation periods. Check the number of days to maturity listed in the following chart.

Over the years, plant breeders have developed many **varieties** of each type of vegetable, in order to improve flavor, color, disease resistance or marketability.

Certain varieties of melons, cucumbers and squash have been developed which grow on bush-type vines rather than the more common trailing types, which need more space. There are also miniature or dwarf plants, such as Tom Thumb lettuce, midget corn and Pixie Hybrid tomatoes.

There are "early" and "late" varieties, as well, which can be selected to extend the growing season.

Selecting unusual varieties can stimulate the interest of first-time gardeners. Eggplants that really look like eggs, "spaghetti squash" with strands that look like pasta and sugar snap peas that can be eaten raw are good examples.

The following chart lists varieties recommended for the greater Los Angeles area. Since there are local variations in weather conditions, called microclimates, you should talk to gardeners in your community to be sure the variety you select will do well in your area.

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
Artichoke	Green Globe	120-150 (from roots)	Dec-Feb
Asparagus	500W Mary Washington UC72 UC157	Perennial	Jan-Feb
Beans (snap)	(bush yellow) Goldencrop Resistant Cherokee Wax	50-65	Apr-May
	(bush green) Contender Harvester Roman Tendercrop		
	(pole green) Kentucky Wonder Romano, Italia type Scarlet Runner, attractive scarlet flowers	50-65	Apr-May

(lima)	Fordhook 242 Bush Henderson's Bush, pole type King of the Garden, bush butterbean type Dixie Butterpea, butterbean type Baby Fordhook Bush, butterbean type	70-90	May-June
Beets	Ruby Queen Detroit Dark Red Little Ball (gourmet baby beet) Early Wonder Burpee's Golden Beet (for greens and roots)	55-100	Year-round
Broccoli	Green Comet Premium Crop Green Goliath Green Duke Green Valiant Emperor Packman	90-120	Sep-Feb
Brussels Sprouts	Jade Cross Long Island Improved Prince Marvel	150-160	Sep-Feb

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
Cabbage	(early—less than 100 days from time of planting to harvest) Stonehead Early Jersy Wakefield Darkri (small heads) Golden Acre Copenhagen Market	70-120	Aug-Sep/ Feb-Mar
	(late—more than 100 days from time of planting to harvest) Premium Flat Dutch Danish Roundhead		
	(red) Ruby Ball Hybrid Red Head		
	(savoy) Savoy Ace Savoy King		

Chinese Cabbage	**(michili)** **Jade Pagoda** **Michili** (nappa) China Pride (pak choi or mustard) Lei choi Joi Choi		
Cantaloupe	(orange flesh) Samson Ambrosia Saticoy Hybrid Topmark Bush Star Honeybush, ush plant Crenshaw Casaba (honeydew) Tam Dew Fruit Punch, distinctive flavor Limelight	90-120	Apr-May

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
Carrot	(baby or gourmet, 3-5", can be grown in ground or containers) Short 'n Sweet Little Finger Amstel Kundulus round Lady Finger Amsterdam Minicor	85-150	Aug-Apr
	(elevated vitamin A) A-Plus Hybrid 8", tapered Vitasweet 500 4-5", tapered Vitasweet 721 9-10", slender Vitasweet 750 5-8" blunt tip Vitasweet 771 C; 10", slender		
	(long tapered, 7-10", requires deep soil) Gold Pak 28 Imperator Danvers		

	(medium-long, 5-6", for shallower soils) Nantes Chantenay Danvers		
Cauliflower	Snow King Snowball "Y" Snow Crown	90-130	Sep-Feb
Celery	Giant Pascal Tall Utah 52-70 Golden Self-Blanching waxy-yellow petioles	160-200	Aug-Sep/ Feb-Mar
Chard	Fordhook Giant Lucullus Rhubarb Chard, red leaf stems Ruby, red leaf stems	50-60	Year-round
Collards	Vates Georgia	60	Aug-Mar

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
Corn	(standard sugary)	85-120	Apr-July
	Golden Cross Bantam		
	Jubilee		
	Butter and Sugar		
	Silver Queen		
	(sugary-enhanced)		
	How Sweet It Is		
	Breeder's Choice		
	Kandy Korn		
	Concord		
	(super sweet)		
	Early Xtra Sweet		
	Ivory 'n Gold bicolor		
	Bytterfruit		
	Sweetie		
	Illini Gold		
	Butterfruit Bi-color		
	Escalde		

Cucumber	**(pickling)**	52-60	Apr-Jun
	Liberty Hybrid		
	Saladin		
	Country Fair 83		
	Pickle Bush		
	Pot Luck		
	(slicing)		
	Dasher H		
	Sweet Success		
	Sweet Slice		
	Burpee Hybrid		
	Bush Champion		
	Parks Bush Whopper		
	Pot Luck		
	Salad Bush		
	Spacemaster		
	Slice Nice		
	Slice Master Hybrid		
Eggplant	(globe)	90-110	Apr-Jun
	Black Beauty		
	Epic		
	Early Bird		
	Dusky		
	Imperial		

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
	(oriental type) Ichiban Tycoon (white) Easter Egg		
Garlic sets	California Late California Early Elephant	110-140	Oct-Nov
Kale	Vates Dwarf Blue Curled Salad Savoy Ornamental	65	Sep-Feb
Kohlrabi	Grand Duke Early White Vienna Purple Vienna	50-60	Jan-Apr/ Aug-Oct
Leek	Large American Flag Electra Titan		

Lettuce	**(butterhead, Boston)** **Buttercrunch** Dark Green Boston Summer Bibb Tom Thumb (cos, romaine) Parris Island Valmaine (crisphead, iceberg; bolts too quickly in home gardens) Great Lakes Vanguard Calnear Empire (loose leaf) Salad Bowl Oak Leaf Green Ice Red Sails Ruby	**100-130**	**Sep-Nov**
Mustard	Tendergreen Southern Giant Curled Florida Broadleaf	50-70	Aug-Feb

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
Okra	Clemson Spineless Blondy	55-65	Apr-Jul
Onion	(early bulb) Grano (red or white) Granex (red or white) California Early Red	100-110	Oct-Nov
	(green bunching, scallions; best quality obtained by growing seeds or transplants) Evergreen White Southport White White Sweet Spanish White Lisbon Tokyo Long White		
	(late bulb) Fiesta (yellow sweet Spanish type) Yellow Sweet Spanish White Sweet Spanish Southport White Globe Stockton Yellow Globe		

Parsnips	All America	120	Aug-Oct
	Hollow Crown		
	Harris Model		
Peas	(China, snow, sugar)	60-80	Aug-Oct
	Dwarf Grey Sugar		
	Mammoth Melting Sugar		
	(green garden, dwarf)		
	Little Marvel		
	Progress No. 9		
	Laxton's Progress		
	Greater Progress		
	(green garden, require support)		
	Freezonian		
	Green Arrow		
	Maestro		
	(snap, thick edible pods)		
	Sugar Ann		
	Sweet Snap		
	Sugar Rae		
	Sugar Daddy		
	Sugar Snap		

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
Peppers	(hot)	120-150	Apr-May
	Tam Mild Jalapeno		
	Jalapeno M		
	Anaheim TMR 23		
	Anaheim		
	Cayenne Long Red Slim		
	Hungarian Yellow Wax		
	Serrano Chilli Pepper		
	(sweet bell)		
	Bell Boy		
	California Wonder		
	Keystone Resistant Giant		
	Jupiter		
	Golden Summer Hybrid		
	Golden Bell		
	Early Pimento		
	(sweet yellow, cubanelle)		
	Sweet Banana		
	Gypsy		
	Hy-Fry		
	Cuhanene		

Potato (white)	**White Rose** Kennebec Chieftain Norgold Russet Red Lasoda	90-140	Feb-Mar
Pumpkin	Spirit Autumn Gold Jack O'Lantern Big Max Rushkin	120	May-Jul
Radish	(red) Cherry Belle Champion Scarlet Knight (multicolored) Easter Egg Hybrid (white) April Cross Hybrid Icicle Snowbelle	22-30	Year-round

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
Spinach	Melody Hybrid America Malabar	50	Sep-Feb
Squash (summer)	(scallop, patty pan) Peter Pan Hybrid Sunburst Scallopini Early White Bush	50-70	Apr-Aug
	(yellow) Early Prolific Straightneck Sundance Early Golden Summer Crookneck Dixie		
	(zucchini) Aristocrat Greyzini Ambassador Gold Rush Burpee Foodhook		

Squash (winter)	(acorn) Table King Table Ace Jersey Golden Sweet Mama (butternut) Waltham Early Butternut Burpee Butterbush	100-120	Apr-Jun
Tomato	(cherry) Cherry Grande Sweet Cherry Sweet Red Red Cherry (container) Patio Toy Boy Better Bush Small Fry	110-150	Apr-May

RECOMMENDED VARIETIES

VEGETABLE	VARIETY	DAYS TO MATURITY	PLANTING TIME
	(standard size)		
	Ace Hybrid		
	Better Boy		
	Big Pick		
	Big Set		
	Bingo		
	Carmelo		
	Celebrity		
	Champion		
	Early Bush 76		
	Early Girl		
	Early Pick		
	Floramerica		
	Jackpot		
	Jet Star		
	Quick Pick		
	Royal Flush		
	7718VF		
	Supersteak		
	Valerie		
	Whopper		

Turnip	**Purple Top White Globe**	50-70	Aug-Mar
	Tokyo Cross Hybrid		
	Seven Top		
	All Top Hybrid		
Watermelon	(bush vine)	90-110	Apr-May
	Garden Baby		
	Bush Charleston Grey		
	Bush Jubilee		
	Bush Sugar Baby		
	(large vine)		
	Calsweet		
	Crimson Sweet		
	Sugar Baby		
	Sweet Baby		
	Charleston Grey		
	Prince Charles		
	(seedless)		
	Triple Sweet Hybrid		
	Tri Z-313 Hybrid		
	(yellow flesh)		
	Yellow Baby		
	Yellow Doll		

Turnip	**Purple Top White Globe** **Tokyo Cross Hybrid** **Seven Top** All Top Hybrid	50-70	Aug-Mar
Watermelon	(bush vine) Garden Baby Bush Charleston Grey Bush Jubilee Bush Sugar Baby (large vine) Calsweet Crimson Sweet Sugar Baby Sweet Baby Charleston Grey Prince Charles (seedless) Triple Sweet Hybrid Tri Z-313 Hybrid (yellow flesh) Yellow Baby Yellow Doll	90-110	Apr-May

HERBS

A children's garden is an excellent place to grow a variety of herbs as well as vegetables. These fragrant and colorful plants add beauty to the garden, and are sensory treats for children to taste, smell and touch.

The leaves, stems, flowers, seeds and roots of herbs have been used throughout history as flavorings, scents and medicines. Herbs have also played a part in religious rituals and in magic potions.

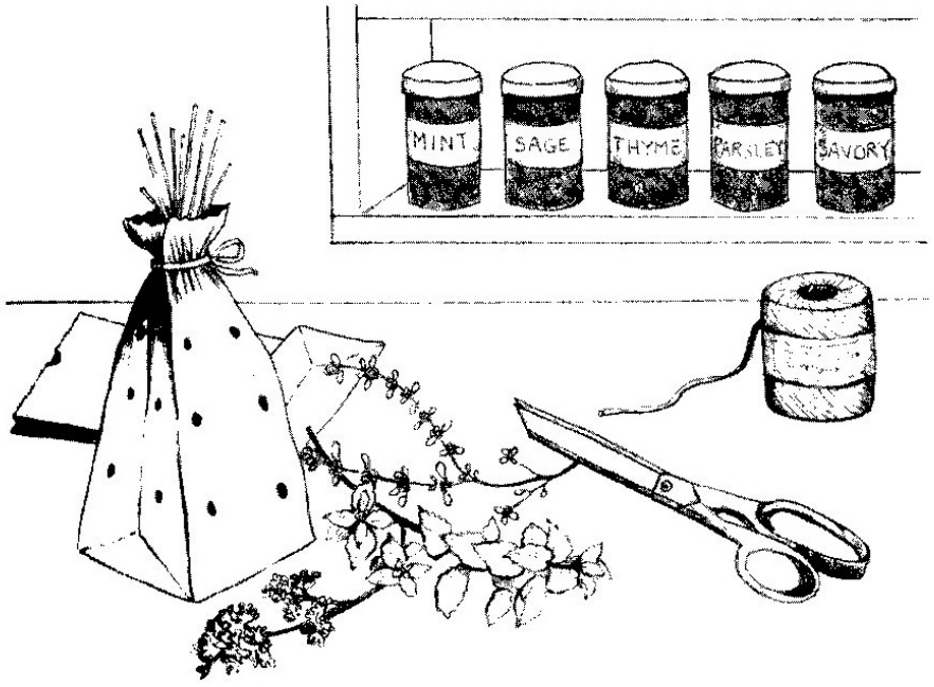
Easy to grow, edible herbs for a children's garden include oregano, parsley, rosemary, basil, cilantro, dill, chives and thyme.

Herbs perform many useful functions in the garden. (See the charts included in "Growing More on Less Space" and "Insect Control," for the names of herbs that are helpful as companion plants and for control of insects.)

Herbs can be used fresh, or they can be preserved by drying or freezing. The leaves of herbs contain the maximum amount of essential oils just before the plants come into bloom. The ideal time of day to harvest is early on a sunny morning after the dew has evaporated. Later, the sun's heat releases some of the oils. Annuals should be cut far enough above the ground that some leafy growth remains. Shrubby, tender perennials should be cut a few inches from the tip of each branch. With proper cutting, new growth sets in. Rinse harvested herbs well and remove any dead leaves.

Here is a method used for preserving long-stemmed quick-drying herbs. Arrange the cut ends in small bunches and fasten the stems together with a rubber band. To keep leaves from

getting dusty, and to catch leaves that fall, hang each bunch inside a paper bag punched with holes. Hang the bags in a well-ventilated, indoor place. The leaves should dry in about two weeks. Shake each bag and roll it between your hands to separate most of the leaves from the stems. Empty the contents, picking off any remaining leaves. After drying the leaves, place them in airtight, light-free containers that will keep them dry and flavorful, and store in a cool place. Flavorful herbs retain an intense hue. Leaf herbs lose most of their flavor within a year. Besides seasoning foods, other uses for herbs include herbal teas, seasoned vinegars, garnishings and sachets.



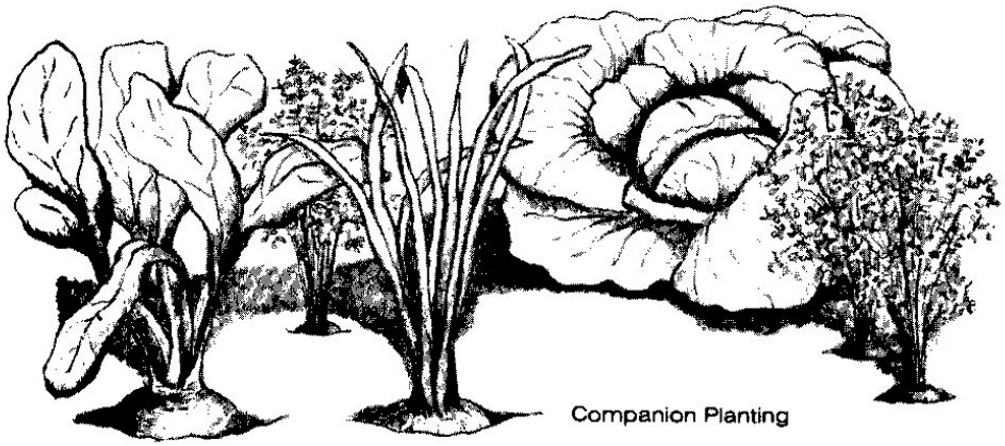
GROWING MORE ON LESS SPACE

When you plan your vegetable garden, consider some of these planting techniques that help increase the yield without increasing the size of the garden.

One of these techniques is called **interplanting.** With this method you plant slow-maturing plants with those that mature more quickly, or those that grow vertically with plants that spread or climb. For example, if you plant radishes between carrots, the radishes will be ready to harvest before the carrots need the extra space. Corn leaves a lot of ground space around each plant, so you can plant cucumbers or squash, which need room to spread their vines. You can also plant pole beans, and use the corn stalks as the poles.

Succession planting is a method that allows harvesting more vegetables over a longer period of time. You can start new seedlings for plants like lettuce every three to four weeks. As you harvest, plant a seedling that is ready for the garden in place of the vegetable that has just been picked. The same approach can be used with vegetables that are planted as seeds directly in the garden. Another method of succession planting utilizes varieties of the same vegetable that mature at different times. This ensures a more even supply. If you plan ahead, succession planting can keep every inch of the garden producing all year long.

Companion planting is a technique of combining specific types of vegetables, flowers and herbs in the garden plot. The theory is that companion planting imitates plant associations found in nature, encouraging better plant growth and helping control harmful insects. This theory has not been validated by University research, but many gardeners claim that the methods are successful. The companion planting charts at the end of this section were compiled by Rodale Press. Refer to them if you decide to experiment with companion planting in your children's garden.



Companion Planting

Vegetables should be **rotated** to a different part of the garden each year. It is not a good practice to grow the same vegetables on the same spot year after year, especially those vegetables that are heavy feeders or tend to cause a build-up of disease organisms in the soil. Legumes, such as beans or peas, are a good choice as an alternate crop because the nitrogen-

fixing nodules on their roots return nitrogen to the soil. For example, plant lima beans where you grew tomatoes last year. This technique can help maintain an abundant harvest year after year.

There are many approaches to vegetable gardening that incorporate these techniques into a complete system. One of the most popular is the biodynamic/French intensive method. (For more information, see the Selected Bibliography.)

COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Asparagus	Tomatoes, parsley, basil.
Basil	Tomatoes (improves growth and flavor); said to dislike rue; repels flies and mosquitoes.
Bean	Potatoes, carrots, cucumbers, cauliflower, cabbage, summer savory, most other vegetables and herbs; around house plants when set outside.
Bean (bush)	Sunflowers (beans like partial shade, sunflowers attract birds and bees), cucumbers (combination of heavy and light feeders), potatoes, corn, celery, summer savory.
Bee balm	Tomatoes (improves growth and flavor).
Beet	Onions, kohlrabi.
Borage	Tomatoes (attracts bees, deters tomato worm, improves growth and flavor), squash, strawberries.

COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Cabbage family (broccoli, brussels sprouts, cabbage, cauliflower, kale, kohlrabi)	Potatoes, celery, dill, chamomile, sage, thyme, mint, rosemary, lavender, beets, onions; aromatic plants deter cabbage worms.
Caraway	Loosens soil; plant here and there.
Carrot	Peas, lettuce, chives, onions, leeks, rosemary, sage, tomatoes.
Catnip	Plant in borders; protects against flea beetles.
Celery	Leeks, tomatoes, bush beans, cauliflower, cabbage.
Chamomile	Cabbage, onions.
Chervil	Radishes (improves growth and flavor).

COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Chive	Carrots; plant around base of fruit trees to discourage insects from climbing trunk.
Corn	Potatoes, peas, beans, cucumbers, pumpkin, squash.
Cucumber	Beans, corn, peas, radishes, sunflowers.
Dead nettle	Potatoes (deters potato bug).
Dill	Cabbage (improves growth and health), carrots.
Eggplant	Beans.
Fennel	Most plants are supposed to dislike it.
Flax	Carrots, potatoes.
Garlic	Roses and raspberries (deters Japanese beetle); with herbs to enhance their production of essential oils; plant liberally throughout garden to deter pests.

COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Henbit	General insect repellent.
Horseradish	Potatoes (deters potato beetle); around plum trees to discourage curculios.
Hyssop	Cabbage (deters cabbage moths), grapes; keep away from radishes.
Lamb's-quarters	Nutritious edible weeds; allow to grow in modest amounts in the corn.
Leek	Onions, celery, carrots.
Lemon balm	Here and there in garden.
Marigold	May help keep soil free of nematodes; discourages many insects; plant freely throughout garden.
Marjoram	Here and there in garden.

COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Mint	Cabbage family; tomatoes; deters cabbage moth.
Nasturtium	Tomatoes, radishes, cabbage, cucumbers; plant under fruit trees; deters aphids and pests of cucurbits.
Onion	Beets, strawberries, tomato, lettuce (protects against slugs), beans (protects against ants), summer savory.
Parsley	Tomato, asparagus.
Pea	Squash (when squash follows peas up trellis), plus grows well with almost any vegetable; adds nitrogen to the soil.
Petunia	Protects beans; beneficial throughout garden.

COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Pigweed	Brings nutrients to topsoil; beneficial growing with potatoes, onions and corn; keep well-thinned.
Potato	Horseradish, beans, corn, cabbage, marigold, limas, eggplant (as trap crop for potato beetle).
Pot marigold	Helps tomato, but plant throughout garden as deterrent to asparagus beetle, tomato worm and many other garden pests.
Pumpkin	Corn.
Radish	Peas, nasturtium, lettuce, cucumbers; a general aid in repelling insects.
Rosemary	Carrots, beans, cabbage, sage; deters cabbage moth, bean beetles and carrot fly.

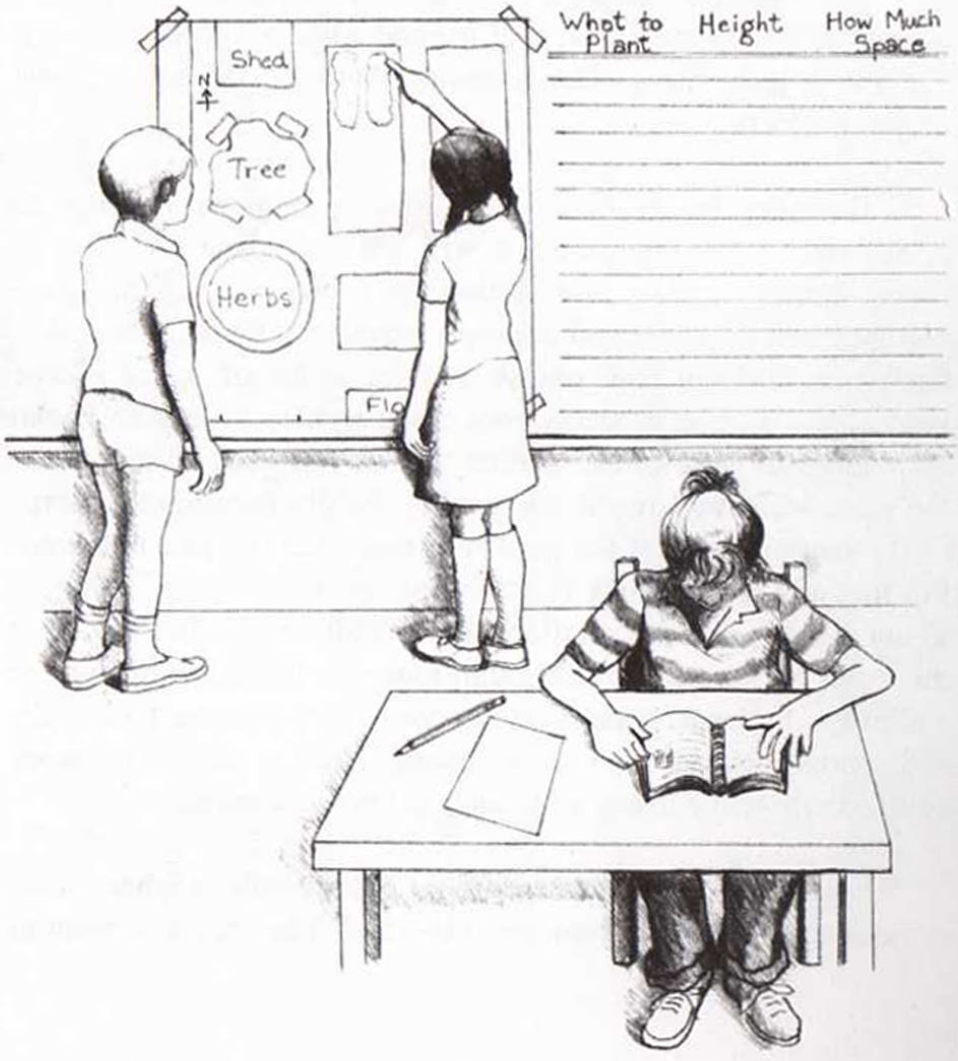
COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Sage	Rosemary, carrots, cabbage, peas, beans; deters some insects.
Southernwood	Cabbage; plant here and there in garden.
Sow thistle	This weed in modest numbers can help tomatoes, onions and corn.
Soybean	Grows with anything; helps everything.
Spinach	Strawberries.
Squash	Nasturtium, corn.
Strawberry	Bush beans, spinach, borage, lettuce (as a border).
Summer savory	Beans, onions; deters bean beetles.

COMPANION PLANTS

PLANT	COMPANION PLANTS AND EFFECTS
Tarragon	Good throughout garden.
Thyme	Here and there in garden; deters cabbage worm.
Tomato	Chives, onion, parsley, asparagus, marigold, nasturtium, carrot, limas.
Turnip	Peas.
Valerian	Good anywhere in garden.
Yarrow	Plant along borders, near paths, near aromatic herbs; enhances essential oil production of herbs.

leave a spot just for weeds. They can be as interesting to children as any other plant; many are edible--but exercise caution! And, make sure they don't go to seed--this is one kind of recycling you don't want!



SPACE REQUIREMENTS CHART

The "average diameter allowed" is intended as an approximate guide for intensive planting.

L = up to 24″; M = 24″-48″; H = 48″ and up.

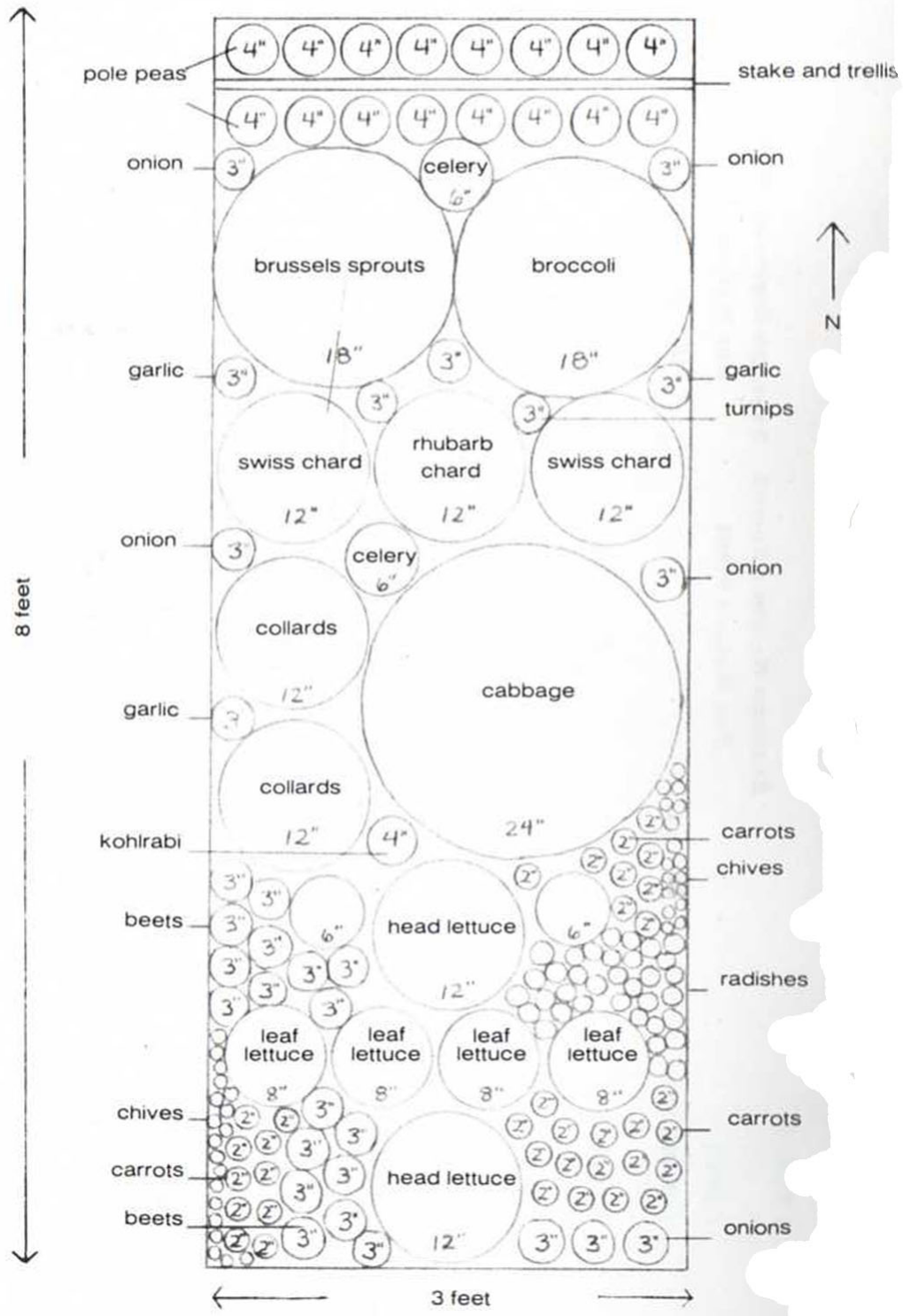
	Average Height Allowed For Mature Plant	Average Diameter Allowed For Mature Plant
Artichoke	M	48″
Asparagus	L	12″
Beans, snap		
(bush)	M	4″
(pole)	H	6″
Beans, lima		
(bush)	M	6″
(pole)	H	8″
Beets	L	3″

SPACE REQUIREMENTS CHART

	Average Height Allowed For Mature Plant	Average Diameter Allowed For Mature Plant
Broccoli	M	18″
Brussels sprouts	M	18″
Cabbage	L	24″
Cantaloupe	L	18″ (plus vines)
Carrot	L	2″
Cauliflower	L-M	18″
Celery	L-M	6″
Chard	M	12″
Collards	M	12″
Corn	H	12″

SPACE REQUIREMENTS CHART

	Average Height Allowed For Mature Plant	Average Diameter Allowed For Mature Plant
Cucumber	L	18″ (plus vines)
Eggplant	M	18″
Garlic	L	3″
Kale	L-M	18″
Kohlrabi	L	4″
Lettuce		
(head)	L	12″
(leaf)	L	8″
Mustard	L-M	6″.
New Zealand spinach	L-M	8″
Okra	M	18″



64 **Suggested Planting Scheme for Fall**

SPACE REQUIREMENTS CHART

	Average Height Allowed For Mature Plant	Average Diameter Allowed For Mature Plant
Onion		
(bulb)	L	3″
(green)	L	—
Parsnips	L	3″
Peas		
(bush)	M	3″
(pole)	H	4″
Peppers	M	18″
Potato	L	12″
Pumpkin	L	36″ (plus vines)
Radish	L	1″
Spinach	L	3″

SPACE REQUIREMENTS CHART

	Average Height Allowed For Mature Plant	Average Diameter Allowed For Mature Plant
Squash		
(summer)	L-M	18″-36″ (plus vines)
(winter)	L-M	36″ (plus vines)
Tomato	M-H	18″ (staked)
Turnip	L	3″
Watermelon	L	36″ (plus vines)

INDOOR SEEDING

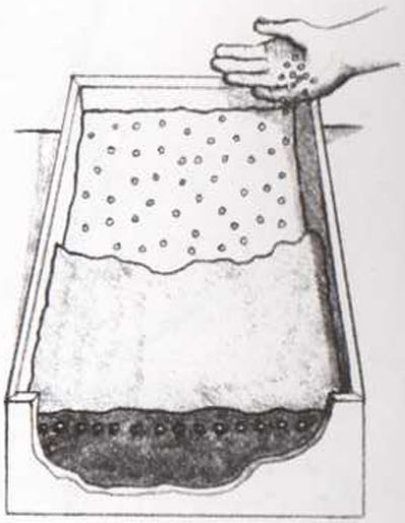
Many vegetables can be started indoors by planting seeds in containers or "flats." Children can make their own containers out of milk cartons or plastic gallon bottles by cutting them in half and adding holes for drainage.

Starting seeds indoors allows children to observe the germination process up close, and lets them get started on a garden while the soil is still being prepared. Starting seeds in containers is also an important part of succession planting.

You can start broccoli, cabbage, cauliflower, celery, eggplant, lettuce, onions, peppers and tomatoes indoors about three to five weeks before the regular planting time. You will need seed flats, sterilized potting soil, seeds, clear plastic bags, and plenty of sunlight. You may also want to use perlite with your potting mix.

INDOOR SEEDING

First, add potting soil to fill the flat or container about three-quarters full. Soak the soil and let it drain. Scatter the seeds across the surface of the potting soil. Make sure you get a fairly even coverage. Don't worry about keeping the seeds in rows. You can thin the plants out after they reach two inches in height. Cover the seeds with an eighth-inch to a half-inch of potting soil or perlite. The smaller the seed, the shallower the planting depth. A good gauge is four times the diameter of the seed.



After covering the seeds, water lightly to settle the soil. Put the flat in an open, clear plastic bag. This tiny greenhouse will speed up the germination process. Place the flat in a warm, sunny spot. Seedlings need a lot of light. Once the seeds have germinated, remove the plastic. After the seedlings reach a height of two to three inches, you can either thin the seedlings into evenly spaced rows, or transfer the seedlings to another container where they will have the space they need until transplanted into the garden. If you decide to transfer ("step-up") the seedlings, handle them as described in the following section on transplanting (pp. 69-71). Use a pencil to make holes three inches apart in the new container.

TRANSPLANTING

Seedlings should be strong and healthy to have a good chance of surviving "transplant shock." "Shock" happens to all plants that are moved from the indoor environment to the tougher conditions outside. This is partly because digging up a plant injures the roots to some degree. Choose strong seedlings that will survive while their root systems get back to normal.

There are other steps to take to improve your seedlings' chances for survival. One is to "harden off" the seedlings; getting them used to the conditions they will face in the garden. A week or two before you transplant, set the seedlings outside during the daytime. Do this for a short period at first (a couple of hours each day), then for longer periods. A day or two before transplanting, leave the seedlings out overnight. Hardening off helps plants thicken up their leaves and stems, which gives them a better chance of surviving shock.

On the day you transplant, take time to clean your tools. If they have been used around diseased plants, the tools might pass on the disease to your seedlings. Tools that have been stored for a while may have insect eggs on them, which will also put seedlings in danger. To avoid these problems, wash the tools in soap and water.

Here are the steps to follow when you are ready to transplant.

TRANSPLANTING

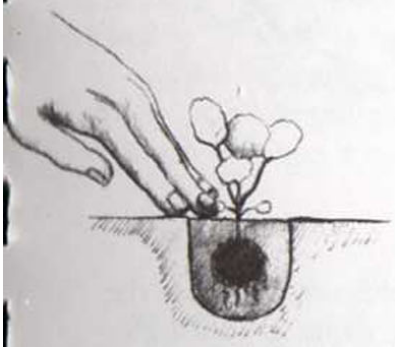
Transplanting is best done in the late afternoon on an overcast day, so plants can recuperate a bit before the next day's sunshine.

Remove the plant from its container very carefully. If the plant is in a flat with other seedlings, very gently tear it away from the other plants with your hands. Keep as much of the soil and roots together as possible.

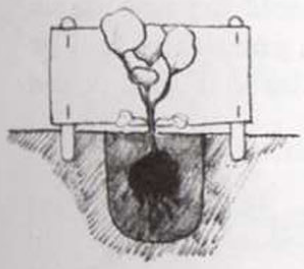
To remove plants from containers such as cans or milk cartons, gently tap the sides of the container to loosen the soil and roots from the sides, or cut the container open. Then turn the container over with one hand while supporting the plant with the other so that it does not fall. Gently remove it from the container. Do not pull on the stem because this may damage the plant.

TRANSPLANTING

Make a hole that is twice as large as the root ball of your transplant. Break up any dirt clods, and remove any stones that you find. Place the plant in the hole, then add water until the hole is half-full. Allow the water to be absorbed by the soil. Then fill in the rest of the hole with a mix of soil and compost, and gently press it down.



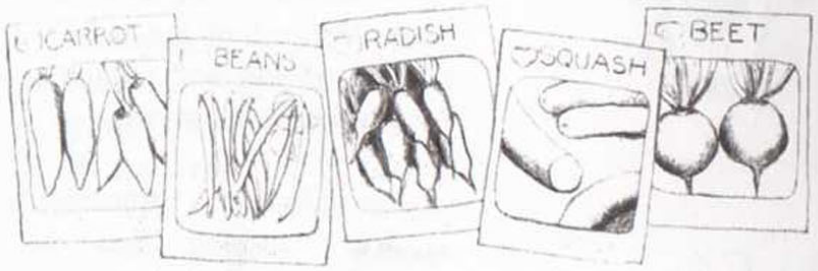
Give the transplants a deep watering, then do not water again until the soil has dried a bit. Often gardeners over water their transplants when they notice them drooping. The plants do not need more water at this time, and over watering will actually drown the seedlings. As long as they maintain their color, they will be all right. They'll perk up in a day or two.



When the weather is especially hot or windy, you can make screens for shading seedlings or for windbreaks by stapling cardboard on small wooden stakes.

DIRECT SEEDING

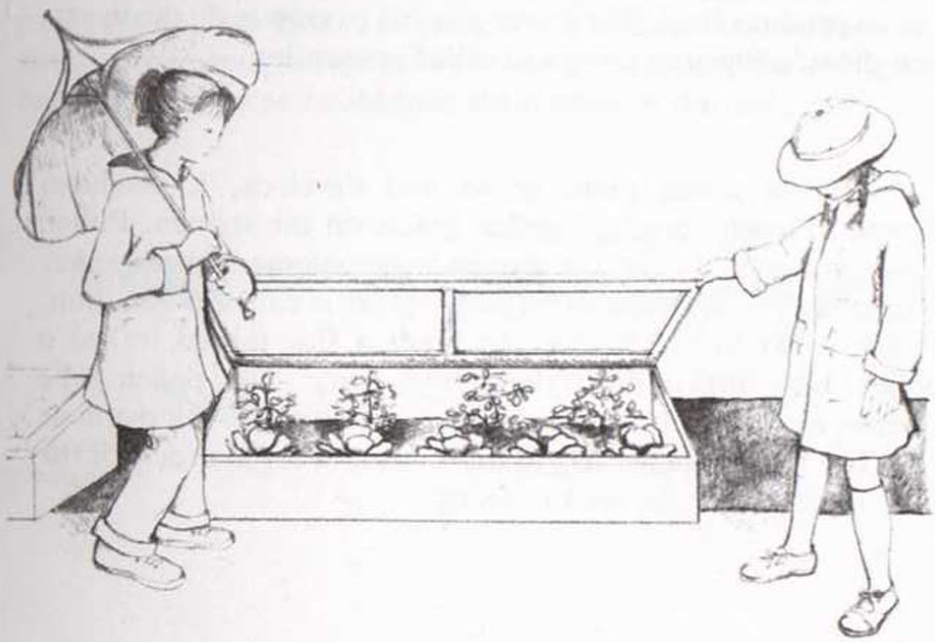
Vegetables that are not well-adapted to transplanting, or that are very hardy, are planted directly in the garden soil as seeds. These include the root crops, which are most susceptible to damage during transplanting (beets, carrots, radishes, turnips), and hardy plants like corn, beans, peas, cucumbers, squash and melons.



When direct seeding, the smaller the seed, the shallower the planting depth. Generally, a good planting depth is four times the average diameter of the seed. Cover the seeds with a layer of soil rich in organic matter such as compost. This keeps a hard crust from forming. Water gently but thoroughly by hand with a watering can or use an oscillating sprinkler until the new plants reach three or four inches in height. At this point there will be sufficient root growth to water using furrows, if that is the method of irrigation you decide to use.

You can also begin thinning when plants reach this height. At first, leave as many of the healthiest plants as possible. This is good insurance against possible insect damage. As the plants mature, continue thinning until there is enough space for each plant to reach its full growth.

One method which assures an early start on the growing season makes use of the **cold frame.** A cold frame is comparable to a miniature greenhouse. It is a portable, bottomless box, which can be made of glass, clear plastic, or plastic film. You can place a cold frame over a row of young plants during bad weather. If shade is desired, lath or shade cloth (available in different percentages of shade) can be added. Full sun and good drainage are important when using a cold frame. (For instructions on building a cold frame, see Part Two, pp. 147-150.)



PLANT STRUCTURE

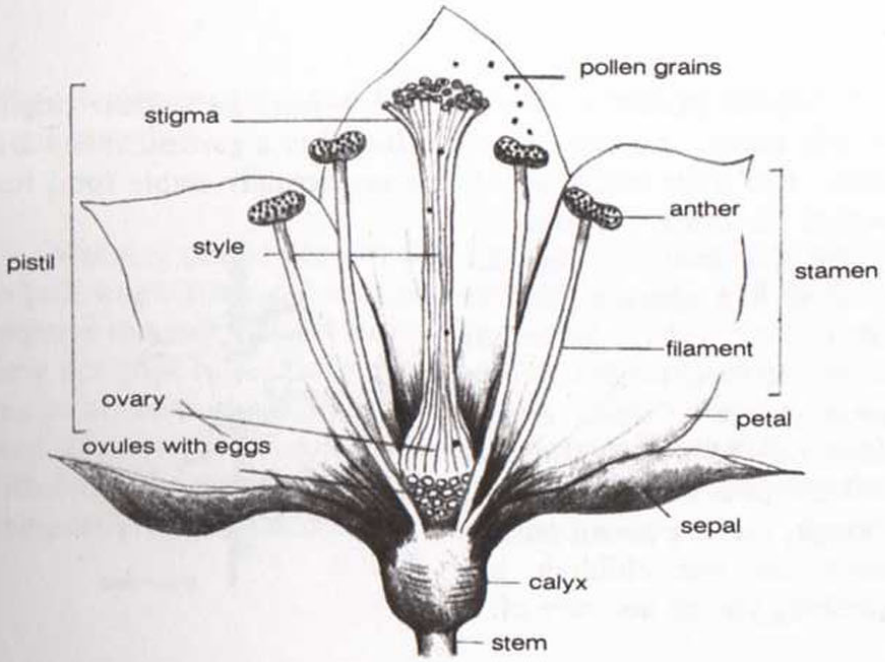
As plants that have been started either indoors or directly in the garden bed begin to germinate, the functions of various parts of the plant can be explained in relatively simple terms.

The **roots** draw in water and nutrients from the soil. Since the smallest roots are fine, hair-like structures, good soil texture is important.

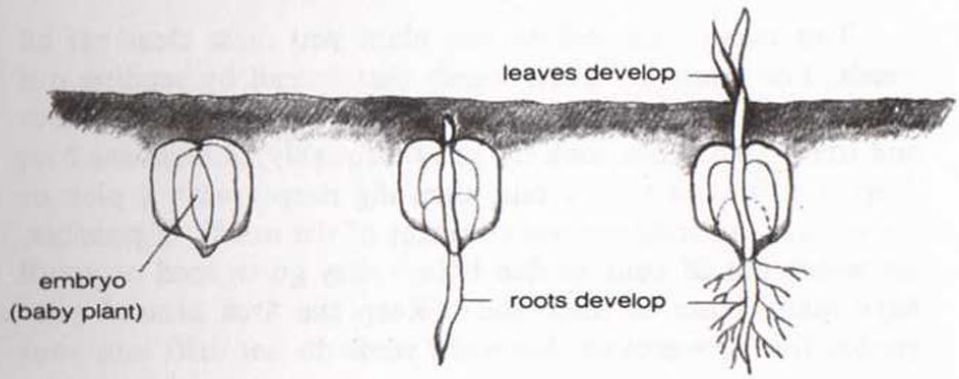
The **stem** carries water and nutrients from the roots to other parts of the plant, and provides the support structure for leaves, flowers and fruit.

The **leaves** contain chloroplasts which convert sunlight into energy through a process called photosynthesis. The plant uses this energy to manufacture the materials which it needs to grow and to produce fruit. The leaves give off oxygen and take in carbon dioxide through a process called respiration.

After a young plant grows and develops, it produces **flowers**. Flowers produce pollen grains on the stamen. Pollen grains are carried from the stamen to the stigma by bees, other insects, birds, the wind or by hand. This is called pollination. Pollen sticks to the stigma and sends a fine thread, called a pollen tube, down the style to the ovary. The pollen tube releases a sperm nucleus which unites with a single-cell ovum or egg. This action, called fertilization, must occur in order for the fruit to grow and the seed to form.



The **seed** contains the young plant (embryo), with roots and young leaves, plus enough food for the young plant to grow until it can produce its own food. The seed needs air, warmth and moisture to germinate. The plant starts to make its own food as soon as the young leaves have pushed through into the sunlight, and the roots have established themselves in the soil.



WEEDS

All the plants we now grow for food have their origin in wild plants. Among the weeds found in a garden, many are edible and quite nutritious. Some are actually staple food for people in other cultures. In China, for example, pigweed is used like spinach, and is served in many different dishes. In fact, weeds can be a good source of food if you know how to identify the safe, edible types. There are a few, though, that are poisonous, so never let the children eat anything you're not sure of.

pigweed

Weeds are usually carried into the garden by wind or water, or on animals, equipment and clothing. Once in the garden, weeds take space, sunlight, nutrients and moisture away from vegetables. The best control method is to keep them out of the garden in the first place.

This means that before you plant you must clear off all weeds. For grass and other weeds that spread by sending out underground runners, you will need to remove every bit of root and stem. To do this, soak the soil thoroughly, at least one foot deep. Let it start to dry out, then dig deeply with a pick or shovel and carefully remove all traces of the weeds. If possible, get weeds out of your garden before they go to seed or you'll have many more in their place. Keep the area around your garden free of weeds so that weed seeds do not drift into your

plot. Remember that mulching is a good way to reduce new weed growth.

Weeding can be done by hand pulling or hoeing. It is easier to pull weeds from soil that is moist and has been well worked because the soil will be looser. You can also turn weeds that have not gone to seed into the soil and let them rot. Most weeds can be added to the compost pile as long as they haven't gone to seed. Do not add Bermuda or similar grasses. These may not be killed in composting and could take root in the garden when the compost is added to the soil.

MULCH

Mulch is the term used to describe a layer of material such as straw, hay, leaves, compost or grass clippings which has been spread over the garden soil. This layer, which may be several inches thick, is used to reduce weed growth and to keep the soil moist. This means that less time has to be spent on maintaining the garden. Mulch is also helpful in keeping fruit such as tomatoes, melons and strawberries off the ground, so they are less likely to bruise, mold or rot.

Organic mulches can be turned back into the soil to improve fertility and soil structure as they decompose. A very thin layer of mulch, put over a new seedbed, will keep a crust from forming. This makes it easier for seedlings to push up through the soil. Mulch prevents soil from washing away during hard rains or when watering. Light-colored mulch also helps keep the soil cool in the summer; dark-colored mulch retains heat in the winter.

Mulches can be applied year-round. The garden should be thoroughly weeded before mulch is applied. Mulch can be spread over the entire garden or just between rows. When using a light fluffy material like straw, put it on four to eight inches thick, being sure not to cover the vegetables. When using a denser material, like compost, only a couple of inches should be applied.

TABLE OF MULCHES

KIND OF MULCH	CHARACTERISTICS
Bean Straw	Good, when available.
Black Plastic	Leave some soil exposed around plant for air and water; somewhat expensive.
Compost	Excellent mulch, and cheap, too!
Fir Bark	Coarse, long lasting.
Grass Clippings	Heat builds up, clippings need to be spread out and dried before use.
Leaf Mold	Excellent, but expensive in quantity.
Manure	Some nutrients; contains salt and some weed seeds.
Newspaper	Leave some soil exposed around plant for air and water.
Peat Moss	Must be kept moist constantly, very expensive.

TABLE OF MULCHES

KIND OF MULCH	CHARACTERISTICS
Pebbles	Coarse, long lasting.
Pine Needles	Good; can make soil slightly acidic.
Shredded Leaves	Better than whole leaves because they don't mat down; will enrich soil more quickly.
Spoiled Hay	Excellent mulch; may contain weed seeds.
Stable Bedding	Excellent mulch; may contain weed seeds.
Woodchips	Coarse material; some nitrogen loss.

CONTROLLING INSECTS

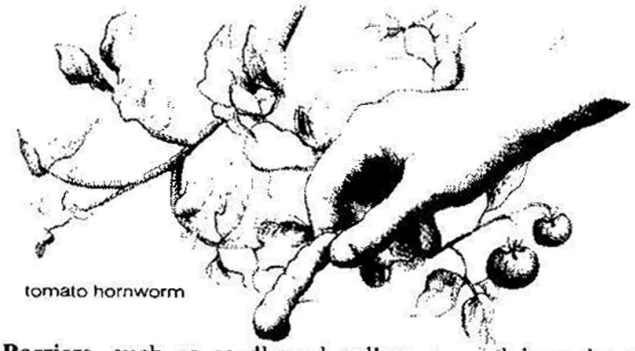
All insects play an important part in the ecology of the planet. Some, like bees, are essential for pollinating certain vegetables. Earthworms help aerate the soil and their "castings" improve soil structure. Ladybugs, lacewings and praying mantids are the natural predators of many harmful insects and should be protected. Unfortunately, some insects can have a devastating effect on a vegetable garden. When we try to limit the harmful effects of these insects, we should work in harmony with nature as much as possible. To help identify beneficial and harmful insects, you will need a chart or book on insect identification. (See the Selected Bibliography.)

Good gardening practices are the first step in controlling the effects of harmful insects. Healthy plants are less susceptible to insect damage than weak or stunted plants; and since they will bear more fruit, some loss can be tolerated. Choose the best varieties for your area, plant at the right time, and fertilize and water properly. Remove all weeds, since they are breeding grounds for insects. Diseased plants also attract insects. Pull them up and put them in the trash, not the compost pile.

If you find plants that are yellow, spindly or wilted, or have leaves or vegetables with holes, scars or spots, you may have an insect problem. Since chemical pesticides, including those derived from organic sources, are toxic, the following control methods are more appropriate for a children's garden.

Many insects and insect eggs can be **handpicked** from plants. Aphids can be washed off with a hard spray from the

garden hose. You can make **insect traps** by putting down wood planks in the garden. Insects will gather under the planks where they can be crushed. Fly paper or rolled newspapers also make good traps.



tomato hornworm

Barriers, such as cardboard collars pressed into the soil about 1 inch, protect seedlings from cutworms. Bands of ashes limit the movement of snails and slugs. Cheese cloth tents used during egg laying season can protect chard, spinach and squash from common pests. Physical control can be effective on a small scale if practiced regularly.

Backyard gardeners are experimenting with homemade sprays. (Listed in Part Two, p. 146, are some that you and your group of children may want to test.) The effectiveness of some of these sprays has not been verified by University research, so do not depend on these mixtures to solve all your pest problems.

Teach children about the natural predators of the garden who help control harmful insects. Children are fascinated by the praying mantid, which appears to be praying, then grabs its prey

with sharp, jagged forelegs. Mantids feed on aphids, caterpillars, leafhoppers, and sometimes each other. See p. 137 for an activity that involves the praying mantid.

Lady bugs spend their whole life, from the larval stage through the adult stage, feeding on aphids, and may eat as many as 30 aphids every day. Tiny garden wasps lay eggs on other insects. The eggs then hatch into larvae that feed on the host insect, weakening it to the point of death. Wolf spiders chase their prey and inject it with venom. Other spiders catch garden pests in their webs.

Lizards are also garden helpers, seeking out grasshoppers, crickets, grubs and caterpillars. Toads help patrol the garden as well. One toad eats up to 10,000 insects in three months. Children can help encourage toads to stay in the garden by providing a shelter from the sun, such as a flower pot half buried on its side.

Remember that any chemical controls used can also have an effect on these guardians of the garden.

Some plants may naturally keep away insects. Growing these plants near vegetables could make the job of controlling insects easier. See the following list of flowers, herbs and weeds suggested by Rodale Press for use in controlling insect pests.

Keep in mind that there is always room for a few unwanted insects in a children's garden. Be flexible; if one control method doesn't work, try another.

INSECTS THAT MAY BE REPELLED BY CERTAIN PLANTS

TYPE OF INSECT	REPELLANT PLANTS
Aphids	Mints, garlic, chives, coriander, anise, and nasturtium or petunia around fruit trees.
Cabbage maggot	Mints, tomato, rosemary, sage.
Cabbage moth	Mints, hyssop, rosemary, thyme, sage, celery, catnip, nasturtium.
Cucumber beetle	radish.
Flea beetles	Mints, tomato, interplanted with cole crops.
Leafhoppers	Petunia, geranium.
Mexican bean beetle	Marigold, potato, rosemary, summer savory, petunia.
Mites	Onion, garlic, chives.

INSECTS THAT MAY BE REPELLED BY CERTAIN PLANTS

TYPE OF INSECT	REPELLANT PLANTS
Nematodes	Marigold, salvia, dahlia, calendula.
Slugs (snails)	Prostrate rosemary.
Squash bug	Tansy, nasturtium.
Tomato hornworm	Borage, marigold.
Whiteflies	Nasturtium, marigold.
Wireworms	White mustard, buckwheat.

HARVESTING

Harvesting the produce from a well-planned garden is the reward for weeks and months of thoughtful care and attention. As you plan your garden, consider how much of each vegetable can be eaten at one time. When planting, put in only enough seed at each planting to satisfy that need, and time the plantings so as to have a continuous supply of fresh vegetables throughout the year for children to sample and enjoy.

Each vegetable hits its "prime" at a different time, so the point at which you harvest is critical. Fruiting vegetables, such as tomatoes, squash and beans should be picked throughout their season, or the plants will slow down their production. Broccoli should be harvested when it forms a tight head of florets. If the florets or immature flowers begin to open, the plant is past its prime. After leafy crops begin to go to seed, which you know has happened when they send up a tall stalk in the center of the plant, it is too late to harvest. Some crops are

best picked young and immature, such as beans, carrots and lettuce. Other crops such as tomatoes, dry beans and watermelons are best when completely mature.

The following chart describes when to harvest each vegetable for best flavor and nutritional value. Besides referring to the chart, sample your vegetables throughout their development and decide for yourself when they taste best. Experience will tell you when they have reached their peak.

HARVESTING VEGETABLES

VEGETABLES	TIME OF HARVEST
Artichoke	After enlarging of choke, before bud scales begin opening, cut, leaving 2 inches to 3 inches of stem on choke.
Asparagus	Not until third year after planting, when spears are 6 to 10 inches above ground, while head is still tight. Harvest only 6 to 8 weeks to allow for sufficient top growth.
Snap beans	Before pods are full size and while seeds are about ¼ developed, or 2 to 3 weeks after first bloom.
Lima beans	When the seeds are green and tender, just before they reach full size and plumpness.
Beets	When 1¼ to 2 inches in diameter.
Broccoli	Before dark green blossom clusters begin to open. Side heads will develop after central head is removed.

HARVESTING VEGETABLES

VEGETABLES	TIME OF HARVEST
Brussels sprouts	As sprouts mature from bottom of plant upward. Pick sprouts when green and hard, 1 inch to 2 inches in diameter, before outer leaves have slightly yellow color. Break away leaf just below sprout and snap off sprout. Harvest upward along stem to point where sprouts are too small. Allow these small sprouts to remain on the stem for more development.
Cabbage	When heads are solid and before they split. Splitting can be prevented by cutting or breaking off roots on one side with a spade after a rain.
Carrots	When 1 to 1½ inches in diameter.
Celery	Cut below ground at taproot before plant goes to seed when plant develops thick stalks.
Cauliflower	Before heads are ricey, discolored, or blemished. Tie outer leaves above the head when curds are 2 to 3 inches in diameter; heads will be ready in 4 to 12 days after tying.

HARVESTING VEGETABLES

VEGETABLES	TIME OF HARVEST
Sweet corn	When kernels are fully filled out, and their juice looks milky-white when punctured by a fingernail. Use before the kernels get doughy. Silks should dry and brown, and tips of ears filled tight.
Cucumbers	When fruits are tender and dark green before color becomes lighter. Harvest daily at season's peak. If large cucumbers are allowed to develop and ripen, production will be reduced. For pickles, harvest when fruits have reached the desired size. Pick with a short piece of stem on each fruit.
Eggplant	When fruits are half grown, before color becomes dull.
Garlic	When tops begin to die pull out and dry in sun for few days on top of ground. Should be 1 inch to 3 inches in diameter.
Greens	Lettuce, chard, spinach, mustard, etc. Harvest entire plant when fully developed **before** it bolts or just remove outer leaves as they get large enough to use.

HARVESTING VEGETABLES

VEGETABLES	TIME OF HARVEST
Kohlrabi	When balls are 2 to 3 inches in diameter.
Muskmelons	When stem easily slips from the fruit, leaving a clean scar. Some melon varieties do not "slip." Harvest these when you notice softening at the blossom end.
Okra	Pick pods every 2 to 3 days after they begin forming, when 2 to 4 inches long.
Onions	For fresh table use, when they are ¼ to 1 inch in diameter. For boiling, select when bulbs are about 1½ inches in diameter. For storage, when tops fall over, shrivel at the neck of the bulb, and turn brown. Allow to mature fully.
Parsnips	If your area gets cold enough, delay harvest until after a sharp frost. Roots may be safely left in ground over winter and used the following spring before growth starts.

HARVESTING VEGETABLES

VEGETABLES	TIME OF HARVEST
Peas	When pods are firm and well-filled, but before the seeds reach their fullest size.
Peppers	When fruits are solid and have reached full size. For red peppers, allow fruits to become uniformly red.
Potatoes	When tubers are large enough. Tubers continue to grow until vines die. Skin on unripe tubers is thin and easily rubs off. For storage, potatoes should be mature and vines dead.
Pumpkins and squash	Summer squash are harvested in early immature stage when skin is soft and before seeds ripen. Winter squash and pumpkin should be well matured on the vine. Skin should be hard and not easily punctured by the thumbnail. Cut fruit off vine with a portion of stem attached. Harvest before heavy frost.
Rhubarb	By second year you can cut large outer stalks—avoid all parts of green leaf; they contain poison!

HARVESTING VEGETABLES

VEGETABLES	TIME OF HARVEST
Rutabagas	After exposure to frost. Grows only in cooler areas of California. Rutabaga greens are also edible.
Tomatoes	When fruits are a uniform red, but before they become soft.
Turnips	When 2 to 3 inches in diameter. Larger roots are coarse-textured and bitter.
Watermelon	When the underside of the fruit turns yellow or when snapping the melon with a finger produces a dull, muffled sound instead of a metallic ring.

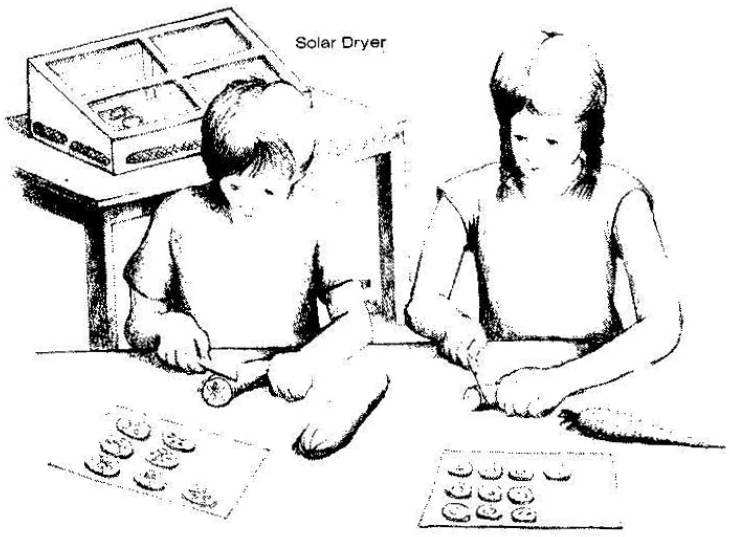
FOOD PRESERVATION

Whether or not you plan on having a surplus of vegetables, chances are you will have more fresh food than can be eaten at one time. There are several techniques for food preservation that provide an easy and economical way to store your extra produce. By preserving the high quality vegetables from your garden, you will be able to regulate the amount of sugar, salt and other additives that are typically used in commercial food processing. Children will be able to compare their preserved vegetables with commercial products.

There are three common methods of food preservation: canning, drying and freezing. These methods are discussed briefly below. It you intend to preserve your garden-fresh vegetables, you will need to consult other sources for additional technical information. (See the Selected Bibliography.) Publications on food preservation are available through your local Cooperative Extension office.

Canning is a technique for preserving foods that uses heat to destroy the bacteria, yeasts and molds which cause unprocessed foods to spoil. Subsequent contamination is prevented by storing the foods in jars with air-tight seals. Three methods of canning are hot water bath, open kettle and steam pressure. Pressure canning must be used for low-acid foods in order to prevent botulism.

Drying is an age-old technique, which is used to remove enough moisture from the produce to prevent decay. Sun, dehydrator and oven drying are the common methods.



Freezing produce slows the action of bacteria and enzymes which cause food to spoil. Since freezing does not kill the bacteria or change the enzymes, once this food is defrosted the normal process of decay begins again.

WHAT ABOUT SUMMER?

At year-round schools, summer won't present a problem since children can continue to care for the garden on a regular basis. At school sites that close for the summer, community volunteers can sometimes continue to water and weed. If your site will be closed for the summer, there are steps you can take to minimize the effects of a summer of neglect.

Here is one of the best methods for preventing weeds from taking over. Remove all weeds. Cover paths and walkways with wood chips. Eucalyptus has natural oils that prevent plant growth, so keep eucalyptus chips out of the garden soil. Cover the garden itself with a heavy layer of straw. This will also prevent weed growth and the straw can be turned back into the soil when gardening begins again.

You can also try sowing a cover crop of "green manure," such as alfalfa, barley or soybeans, if someone will be around to water. In early September, instead of harvesting, turn the green manure back into the soil. Green manures increase soil fertility, activate microorganisms, and increase disease and insect resistance.

Here are some tips for efficient green manuring:

1. Legumes such as alfalfa, clover, cowpea, fenugreek, hairy indigo, lupine, vetches and soybeans make good green manures because they increase soil nitrogen.
2. Rototill green manure plants into the soil while they are still succulent, before they enter their flowering phase. Then let the soil rest for several weeks before planting.

3. Leave green manures near the surface of sandy soils, but work deeply into clay soils.

A raised-bed garden lends itself to all these measures and has the added advantage of creating a relatively permanent structure that maintains your garden spot's identity throughout the year.

PART TWO: THE ACTIVITIES

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The activities described in this section will help children focus on the basic concepts involved in various gardening techniques.

The garden itself is the main "activity," but there are processes that can be more easily observed using some of the experiments designed for a classroom setting.

The activities have been arranged so that they can be used in sequence. Some have been designed to stimulate the child's awareness of the environment. The other activities lead to skill development in arithmetic, reading, science and art. The appropriate skill areas are listed in the skill evaluation chart.

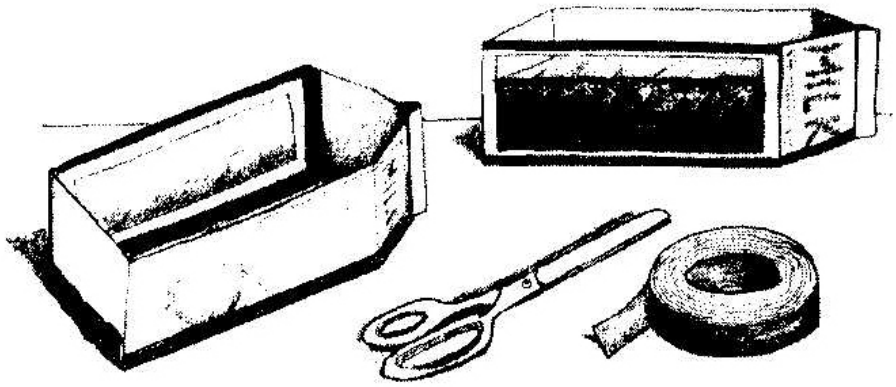
Several special projects, which require more time to complete than these activities, have been included at the end of this section. These can be incorporated at any time your garden group is ready to take on a new project.

Also included is a sampling of activities for young children.

MAKING ROOT VIEW BOXES

Root view boxes can be purchased, but it is less expensive and more fun to make them. Root view boxes are also required for the activity on mulching, page 136.

You will need several rectangular containers, such as ½-gallon milk cartons, and clear plastic or window glass. Cut a window in one side of the carton, leaving a ½-inch lip, and cut out the adjacent side. For a snug fit, the glass or plastic should be 3½ inches by 7½ inches. Seal the edges with duct tape. Also, cover the bottom of the carton on the outside with duct tape, for greater durability.



Roots will grow straight down. Plant seeds near the window, and tilt the root view box forward so that roots will grow against the glass and be more visible.

Using milk cartons will save time and expense and the children can try the same experiments at home. Re-use the plastic or glass with new cartons when necessary.

INDIVIDUAL AND COMMUNAL GARDENS

Gardening together, gardening alone

The purpose of this exercise is to demonstrate the differences between individual and communal gardening. Have the children imagine that they will be vegetables in a garden. Have them select from a group of name tags which vegetable they wish to play. Discuss with the group the various characteristics of each plant: how it grows, its size and shape, and what it may feel like, for example, to be a bean plant climbing or a cucumber vine crawling.

Allow one child a 4-foot by 4-foot space. Have him plant this area with no more than 5 types of vegetables, played by his classmates. As they act out their roles, discuss space limitations and the lack of variety and reduced yield in a small plot.

Then have a group of children plan a 4-foot by 10-foot plot and plant it with any of the "vegetables" they wish. Again, have the children act out the roles of the plants. Discuss the advantages of working together and being able to grow many different kinds of vegetables.

Materials Needed: Pictures of vegetable plants, paper for name tags.

CHOOSING A GARDEN SITE

Plants need sunlight, soil and water

To illustrate the needs of plants, have the children assume the roles of the various elements needed for plant growth. Have one child be the sun, and one child be water, and have several children be seeds. Discuss with the class what it feels like to be a plant to break through the ground with its leaves or to take up water with its roots. Have the children demonstrate the effect of too much, not enough and the right amount of sunlight and water on the growth of plants. Have the rest of the class explain what is happening to the plants under these conditions.

Visit a garden

Have the children take mental or written notes on what they see. Later, they can discuss what they observed.

Soil types

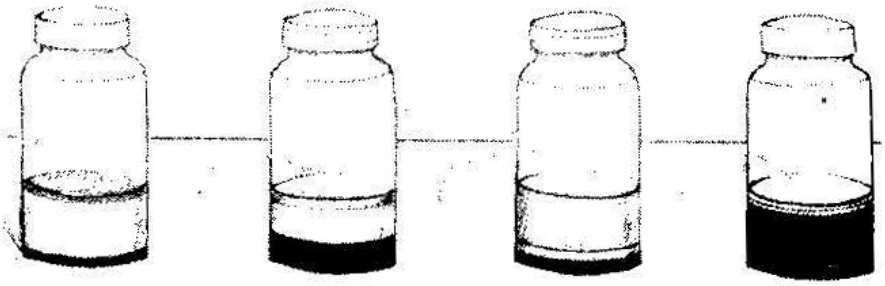
Check with a local nursery for sources of clay, silty and sandy soils. Have the children test each type of soil by rolling a slightly moistened sample between the palms of their hands. This is called "ribboning." Clay soil will hold together and be ropey. Silty soil will stick together and begin to crumble. Sandy soil will not "ribbon" at all. Have the children take a soil sample from their garden site. Use a shovel to remove the sample from the top 7 inches. Have the children compare the soil from their garden site with the three sample soil types.

Materials Needed: Samples of sandy, silty, and clay soils and sample of garden soil.

Soil texture

Have the children take a soil sample from their garden site. Use a shovel to remove sample from the top 7 inches. Fill a jar ⅔'s with water and add soil until the jar is almost full. Put the top on securely and shake vigorously. Let the soil settle. The heaviest particles, sand, will settle first; the silt and clay particles will take hours to settle; and the finest clay particles will remain in suspension indefinitely. Children can place a sheet of paper behind the jar and mark off the visible layers, and older children can then calculate the percentage of different sized particles.

SOIL



Silt	Loam (desirable)	Clay	Sand
5% clay	20% clay	60% clay	10% clay
85% silt	40% silt	20% silt	10% silt
10% sand	40% sand	20% sand	80% sand

Materials Needed: Clear glass jar with top, garden soil sample, paper.

Drainage

Make 3 funnels out of plastic ½-gallon jugs as illustrated. Cover the tip of each funnel with wire mesh or plastic mesh screen or a piece of nylon stocking. Then put each funnel on a jar. Add 1 cup of clay soil to one funnel, 1 cup of sand to the second funnel and 1 cup of soil from the garden to the third funnel. Add 1 cup of water to each soil sample. Record the time it takes for the water to drain into each jar, then measure and record the amount of water in the jar. Discuss the drainage

properties of these three samples of soil and how they might affect plant growth. Clay soil absorbs water, while water passes quickly through sand. Your garden soil will probably be somewhere in between.

Materials Needed: 3 pieces of fine-mesh screen or nylon stocking, 3 plastic jugs, 3 clear glass jars; a measuring cup; samples of clay soil, sand and soil from the top 7 inches of the garden.

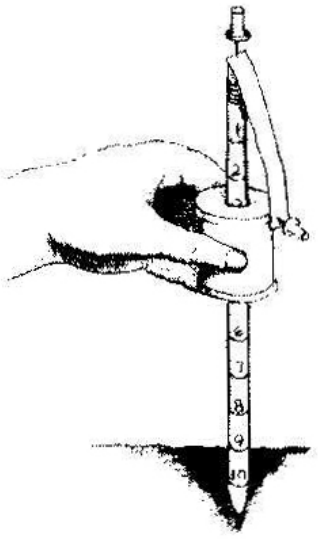
Compaction

Discuss with the children environmental and man-made factors that cause soil compaction. Then have them compact a

2-foot by 2-foot section of soil by jumping up and down on it, or by pounding the soil with their hands. Aerate another 2-foot by 2-foot area of soil with a cultivator. Plant the same type of seed in the 2 test plots. Observe the differences in germination and growth. Also have the children note the differences in water absorption.

Materials Needed: Seed, cultivator.

Test for soil compaction



After the children have discussed soil compaction and experimented with compacting and aerating soil in test plots, they can actually measure the amount of compaction by performing the spool test. Sharpen a ¼-inch diameter dowel or pencil. From the point measure and mark off 10 lines at ½-inch intervals and number them as illustrated. Attach one end of a wide rubber band to the top of the dowel, and the other end to the upper lip of the spool, using tacks. Pull down on the spool, forcing the pencil 1-inch deep into the soil. Record the number at the top edge of the spool; this represents the relative compaction of the soil. Have the children test soil in many different areas: playground, garden, lawns and under trees. Discuss the effect of compacted soil on root and plant growth.

Materials Needed: ¼-inch diameter dowel or pencil about 7 inches long, 2 tacks, spool, wide rubber band.

Soil pH

Have the children take a sample of the top 7 inches of their garden soil. Stir the soil in a clean container to get a uniform mix, and add distilled or purified water. Have each child tear off a 2-inch strip of pH paper, and dip it in the soil/water mixture. The pH paper dispenser should contain a color guide indicating the pH levels. After 1 minute, have the children compare their pH paper to the color guide and determine the relative acidity or alkalinity of their garden soil. Soil samples from other parts of the garden can be tested for variations.

The children can also taste the garden soil and compare the results of the pH paper test with their taste test.

Sour (lemon) - acidic
Bitter (soda) - alkaline
Sweet (sugar) - neutral

Materials Needed: Soil sample, pH paper (4-9 range), container, distilled or purified water. Optional: lemons, baking soda, sugar.

SOIL AMENDMENTS

Effect of amended soil on root growth

Have the children plant bean seeds in two containers, one filled with soil from the garden and one filled with a mixture of 50% garden soil and 50% amendment. (This percentage is exaggerated for the experiment.) Thoroughly moisten the soil, adding equal amounts of water (½ to 1 cup) to each container. Make sure not to compact the soil; when watering, cover the soil with a paper towel. Keep the containers in identical environments, where they receive the same amount of sunlight and water. After about two weeks, have the children carefully remove the plants from the containers and gently brush the soil from the roots. Have them observe and record the differences in root growth.

Materials Needed: 2 containers, bean seeds, garden soil, paper towels, coarse amendment such as leaf mold, compost, perlite, peat moss.

Effect of amended soil on drainage

Make 3 funnels as in the soil drainage experiment (p. 106). Put each funnel on a jar. Add 1 cup of garden soil to the first funnel, 1 cup of a mixture of 50% soil and 50% compost to the second funnel, and 1 cup of a mixture of 50% soil and 50% sand to the third funnel. These added materials will increase the pore space of the garden soil samples. (The percentages are exaggerated for the experiment.) Add 1 cup of water to each funnel.

Observe the time it takes for the water to drain into each jar, then measure and record the amount of water in the jars. Compare this data with the results of the soil drainage experiment. For further comparisons, amend different soil types.

Materials Needed: 3 pieces of fine-mesh screen or nylon stocking, 3 clear glass jars, 3 plastic ½-gallon jugs; a measuring cup; compost, sand and soil taken from the top 7 inches of the garden.

Finding free resources

To show children that amendments can be made from recycled materials, list various types of amendments, such as animal manure, leaf mold and compost on the blackboard and discuss where these amendments can be obtained. If some of these materials are easily available, have the children bring them to the garden. (Refer to the Guide to Resources, pp. 167-169.)

ORGANIC AND INORGANIC FERTILIZERS

Comparing the effects of different kinds of fertilizers

This experiment will compare the effects on plant growth of different amounts of organic and inorganic fertilizers.

Make 5 containers by cutting 5 half-gallon milk cartons in half, and punch drainage holes in the bottom of each. Fill one container with sterilized potting soil. Fill the second container with soil that has been mixed with the recommended amount of an inorganic fertilizer that is balanced 5-10-10. The recommended amount is usually about ½ tbs. for a 4- by 4-inch container full of potting mix. Fill a third container with soil mixed with 5 times the recommended amount of fertilizer. Repeat this procedure with the next 2 containers, using an organic fertilizer, such as a mixture of blood meal, bone meal and wood ashes. The recommended amount of this fertilizer is about 1 to 2 tbs. for the same amount of soil. The first container is the control for both types of fertilizer.

Have the children plant 3 bean seeds in each container. Put the containers in a sunny location and keep the soil moist. Have the children observe and record the growth rate of the plants. Also have them note any changes in color or size of the leaves, the number of new leaves and any other apparent differences between the 5 sets of plants.

ORGANIC AND INORGANIC FERTILIZERS

Be sure to discuss the different properties of the two kinds of fertilizer, including relative percentages of N, P and K (see Part One, pp. 17-18), the recommended effective amounts, cost and the way the fertilizers release their nutrients. (Chemical fertilizers are soluble in water and release the nutrients almost instantly; organic fertilizers release nutrients more slowly as a result of biological action.)

Materials Needed: 5 containers (such as ½-gallon milk cartons), bean seeds, sterilized potting soil, balanced inorganic fertilizer, blood meal, bone meal and wood ashes.

COMPOST

Recycling organic materials

Use wire fencing to construct a circular container 4 feet high and 4 feet in diameter, or build a bin using scrap lumber, leaving slits for air circulation essential for the decay process. Have the children bring materials suitable for composting to the garden site. (See the Guide to Resources, p. 169.) Pile the materials in even layers, watering each new layer lightly. To speed up the decay process, turn the pile semi-monthly. When the original materials are no longer recognizable, the compost is ready.

Materials Needed: Wire fencing 10 feet by 4 feet or lumber to build a bin 4 feet by 4 feet by 4 feet; fresh organic materials.

Tool care

Prepare a mixture of 5 parts sand to 1 part oil. Make sure the container is large enough for tools to be pushed into it.

Materials Needed: Oil (new or recycled), sand, container.

Using the right tool

Have a contest in which one child uses the proper tool for a job and another uses the wrong tool for the same job. For example, have a child use a shovel to fill a wheelbarrow with soil and have another try to fill the wheelbarrow using a hoe.

Materials Needed: Various garden tools.

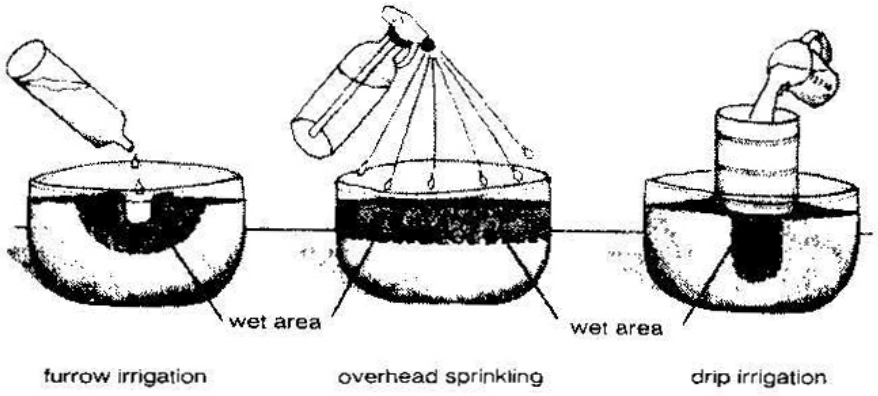
History of tools

Discuss tools and their uses. Arrange a museum field trip to compare primitive and modern hand tools.

BED CONSTRUCTION AND IRRIGATION

Watering techniques

By using glass bowls filled with fine textured soil, the children can observe three methods for watering a garden: furrow irrigation, overhead sprinkling and drip irrigation. Screen soil using 1/8-inch mesh or handpick stones and clods from the soil. Add soil to the bowls and pack down.



To demonstrate drip irrigation, level the soil in a bowl and place a coffee can with a small hole in the bottom directly on the surface of the soil, next to the edge of the bowl. Add 1 cup of water. Because this is a slow method of water application, begin the drip irrigation experiment the day before so the children will be able to compare the results of all three methods.

In another bowl, make a furrow in the soil as illustrated. Fill a squeeze bottle with 1 cup of water and carefully fill the furrow, being sure to leave the hill areas dry. Repeat this procedure until the entire cup of water has been applied.

In the third bowl, level the soil, then sprinkle evenly with a pump spray bottle; use the same amount of water. This will illustrate the effects of overhead sprinkling.

Have the children observe the wetting patterns and note the characteristic differences of each method.

Materials Needed: 3 glass bowls, squeeze bottle, pump spray bottle, coffee can with small nail hole in bottom, fine textured soil.

CONTAINER GARDENING

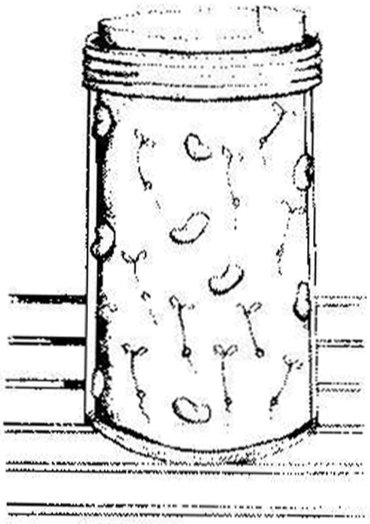
Preparing for container gardening

If your group will be container gardening, they can begin to collect various containers from home, friends and local merchants. Review with the children the size and space requirements that they should consider. Discuss the advantages of container gardening. Visit a local vegetable garden center or nursery to see vegetables growing in containers and flats.

Prepare containers for planting according to the instructions in Part One (pp. 32-33). Activities under most of the following sections will be appropriate. (See the Guide to Resources, p. 168, for possible sources of containers.)

WHAT TO PLANT, WHEN TO PLANT

Cool season and warm season vegetables



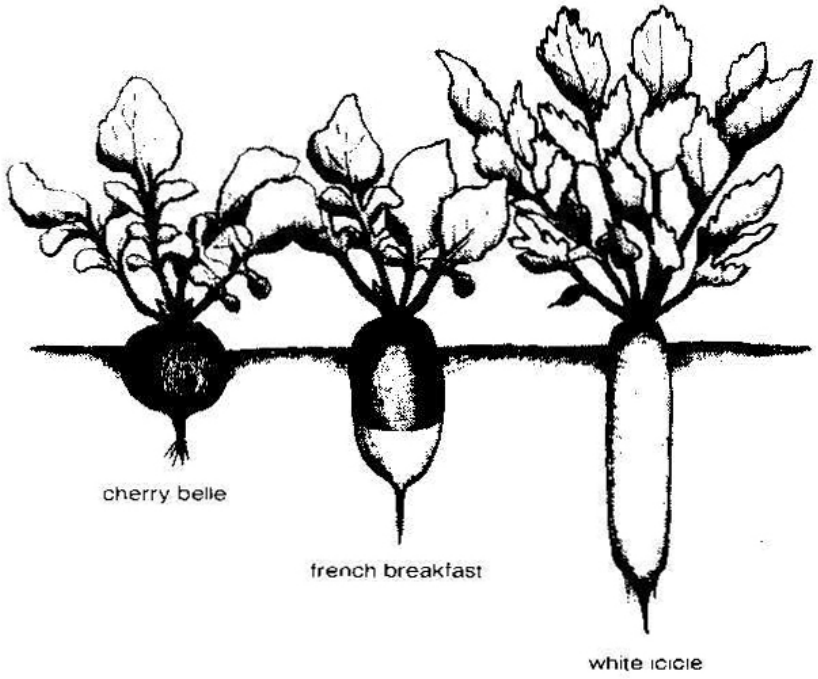
To demonstrate one difference between cool season and warm season vegetables, conduct an experiment using 2 kinds of seeds: bean and head lettuce. Mix the seeds. Line a clear glass jar with a damp paper towel, and place the seeds between the paper towel and the container. Keep the towel moist. Put the jar in a refrigerator. Remove when the lettuce seeds have germinated. Have the children discuss why the bean seeds do not germinate. Cool season vegetables, such as head lettuce, will also germinate in warm weather, but the plants will go to seed prematurely.

Materials Needed: A clear glass jar, paper towel, bean and head lettuce seeds.

Varieties

Have the children plant several different varieties of radishes in a container. Place the container in a sunny spot and keep the soil moist. The children should begin to harvest the

radishes after 21 days. Have them note the differences in days to maturity, physical appearance and taste. Conduct class surveys regarding preferences for appearance and taste. Have the children visit markets to find out which varieties are sold locally.



Materials Needed: Container, soil, radish seeds. (Try Cherry Belle, French Breakfast and White Icicle varieties. White Icicle radishes will not reach their full growth in a container less than 6 inches deep.)

HERBS

Discovering herbs

To introduce children to the variety of scents and flavors available from herbs, plan a field trip to the County Arboretum for a visit to the herb garden. If a guide is available, the children will learn fascinating facts, while experiencing the tastes and smells of an impressive array of cultivated herbs.

Herbs as garden helpers

Plan with the children which herbs to include as companion plants in the garden; or design a garden border of herbs with possible insect-repelling properties. (See Part One, pp. 83-85.) Explain to the children how these uses of herbs may help them harvest more food from their garden.

Materials Needed: Nursery seedlings or seed packets of herbs.

Using herbs for scents and flavors

Prepare an herbal sun tea. Have the children pick several leaves from a variety of flavorful mints; or, if the garden is new, bring fresh mint leaves from home or a neighbor's garden. Fill a clear glass jar with water, add a generous handful of mint leaves, cover the mouth of the jar with aluminum foil, and place in a sunny spot. Let the tea steep in the sun for 2 or 3 hours, then serve small portions to the children.

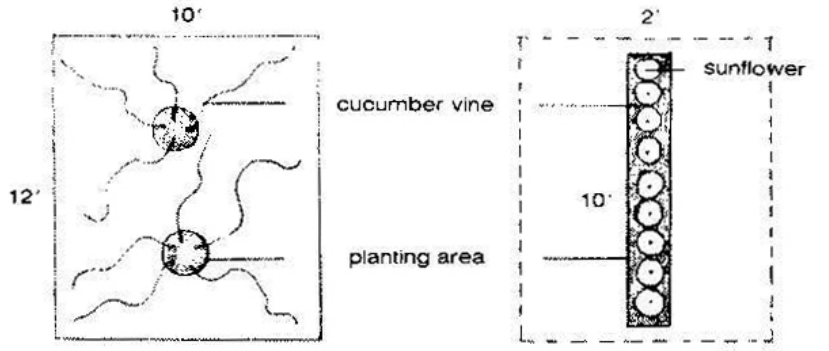
Materials Needed: Clear glass jar, cups, variety of fresh mint leaves, aluminum foil.

GROWING MORE ON LESS SPACE

Interplanting

Older Children

Discuss with the group the space-saving advantages of interplanting vegetables. (See Part One, p. 48.) For this activity, sunflowers and cucumbers can be used as examples. Cucumbers are often grown 4 or 5 to a hill, and the vines allowed to trail 6 feet in each direction. However, sunflowers can be used as a natural support structure for vining plants. Planted 12 inches apart in a bed 10 feet long and 2 feet wide, 9 sunflowers will support 9 cucumber vines.



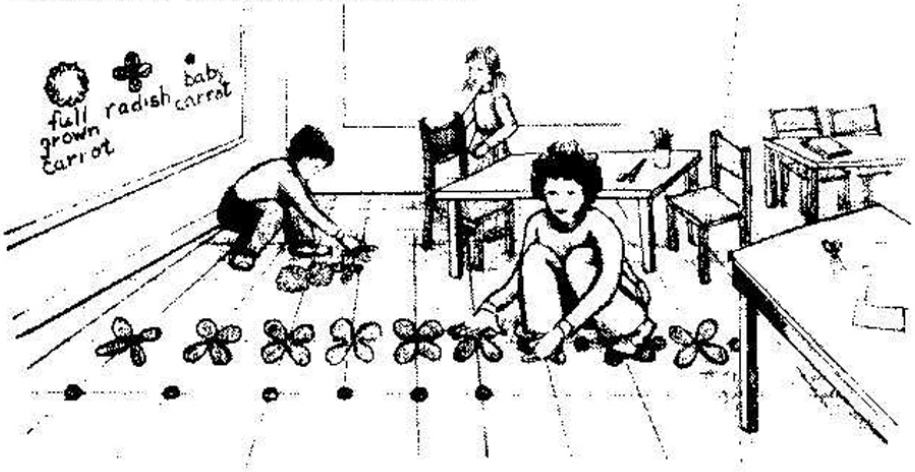
Distribute a handout which diagrams each planting scheme. Have the children, working in groups or individually, calculate the area of each plot; then have them calculate the number of square feet saved by interplanting. Discuss the advantages of this method.

Materials Needed: Handout of plot plan.

GROWING MORE ON LESS SPACE

Younger Children

To illustrate the advantages of interplanting, have younger children make large-scale cutouts of radishes, baby carrots and full grown carrots. Set the full grown carrots aside. They should place the rest of the cutouts on the classroom floor in two rows, with one row of radishes and one row of baby (immature) carrots. Leave the same amount of space between plants in each row. Now have the children combine the rows, placing the radishes in between the carrots.



Explain that carrots are slow growing plants (85-150 days to maturity), while radishes are fast growers (22-30 days to maturity). By the time the carrots need the space, the radishes will be ready to harvest. To show how this works, as each radish is picked, have the children cover the baby carrot next to it with a full-sized carrot cutout.

Materials Needed: Paper, crayons or poster paints and scissors.

PLANNING THE GARDEN

Setting goals, setting limits

Divide the class into small groups and have each group cooperatively plan a garden. Set specific limits as to the size of the garden and the number of different kinds of vegetables the garden can accommodate. Younger children can plan their garden by using seed packets and pictures from seed catalogues. Older children should consider space requirements, intercropping, succession planting and the varieties best suited to local conditions. Incorporate the children's plans into the final version and draw it up as a permanent record to return to as a guide.

Materials Needed: Seed catalogues, seed packets, chart paper, felt tip pens.

INDOOR SEEDING

Germination

Use lima bean seeds to observe the germination process. Have each child line a clear jar with a damp paper towel and place some seeds between the towel and the jar. Keep the towels moist. Within a few days, the seeds will swell and split. Roots will emerge. Have each child measure and record the growth of the roots and leaves, and keep a daily observation chart of the changes for a one week period.

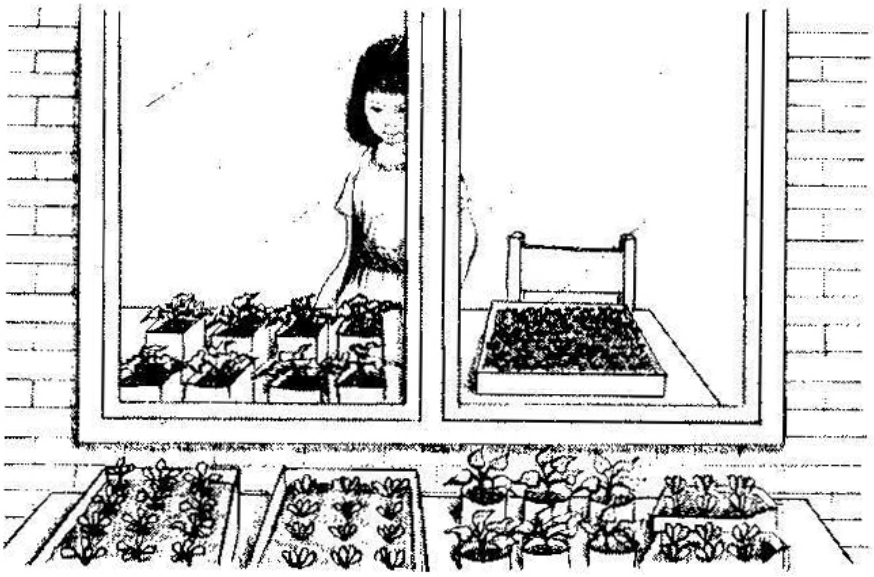
Materials Needed: Clear glass jars, paper towels, lima bean seeds.

Planting Indoors

Encourage the children to be as resourceful as possible in gathering materials for constructing seed flats. Suitable materials include: milk cartons, plastic bottles, cups and wooden boxes. Make sure there are holes in the bottom of each container for drainage. Prepare and plant the flats according to the instructions in Part One (p. 68). Keep moist and place in sunlight. As the seedlings mature, begin the hardening off process as described (p. 69).

Materials Needed: Containers, soil, seeds, plastic wrap or plastic bags.

INDOOR SEEDING



Environmental effects

Using the technique described in Part One (p. 68), start the same variety of lettuce seed indoors and outdoors, but do not cover the containers with plastic. Have the children observe the differences in the germination and casualty rate. Discuss the vulnerability of a seedling started outdoors as it is exposed to changing environmental conditions and various predators.

Materials Needed: Containers, soil, one variety of lettuce seed.

Thinning

It is necessary to thin seedlings to provide enough room for proper growth and development to occur. In one flat, plant seeds according to the instructions in Part One (p. 68), and as the seedlings grow, thin as needed. In another flat, plant the seeds but do not thin. As the plants mature, begin the hardening off process for both flats. (See p. 69.) When it is time to transplant, have the children observe the differences in the shape and size of the plants, and the differences they discover when trying to separate individual plants and their root systems.

Materials Needed: 2 seed flats, soil, seeds.

TRANSPLANTING

Hardening off

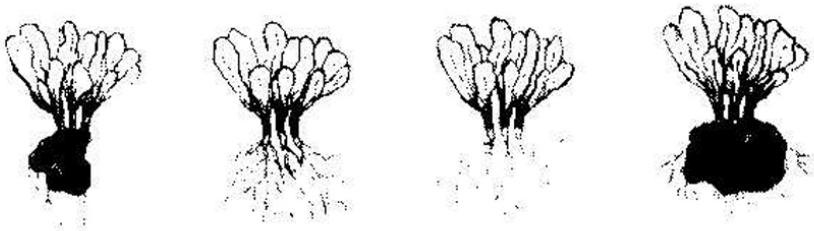
Discuss with the children the importance of hardening off seedlings before they are transplanted into the garden. Start 2 flats or 2 groups of seedlings with at least 4 to 6 plants in each group. A week or two before the seedlings are ready to be transplanted, harden off 1 group. (See Part One, p. 69.) Keep the other group indoors. On one side of a test plot, plant the seedlings that have been hardened off. On the other side, plant the seedlings that were left indoors. Compare the survival and growth rate and general appearance of the seedlings in the two areas.

Materials Needed: 2 flats or containers, soil, garden test plot and seeds. Spring: tomatoes, peppers. Fall: Brussels sprouts, broccoli.

Root damage

This exercise demonstrates the importance of being careful with the roots of seedlings as they are transplanted. Before transplanting remove part of the root ball from one group of seedlings. With another group, remove the soil but leave the roots intact. With a third group, expose the roots to the air for about an hour or until the roots begin to dry out. Transplant the seedlings. Transplant a fourth group, being careful not to disturb the root system. Water the transplants equally. Have the children compare the four groups, noting the differences in survival, recovery from transplant shock and growth rate.

Materials Needed: 4 groups of seedlings.



part of rootball removed | soil removed | roots exposed to the air | rootball intact

Watering

To demonstrate the effects of watering, plant three seedlings in the garden. Place a can, open at both ends, around a healthy seedling. Deliberately overwater by filling the can. Repeat this procedure twice daily. Completely withhold water from another seedling. The third seedling should be watered normally. Have the children observe, compare and record the changes in the seedlings. Have them draw conclusions about the amount of water needed by seedlings and the frequency of these waterings.

Materials Needed: 3 seedlings from 4 to 6 inches tall, an open-ended can.

DIRECT SEEDING

Natural scattering and controlled planting

Set aside a 4 square-foot test area. Simulate the natural distribution of seeds by randomly broadcasting a mixture of the types and varieties of seeds already planted in the garden. Lightly cover the seeds with soil and water normally. As the plants grow, have the children observe and compare the pattern of growth and the growth rate of the seedlings in the test area and the garden plots. Also have them note the difference in the general appearance of the two areas. Discuss the ways that seeds are propagated in nature.

Materials Needed: Garden test patch, seed.

Controlling the outdoor environment

For instructions on building a cold frame, see the Special Projects (pp. 147-150).

Identifying the parts of plants

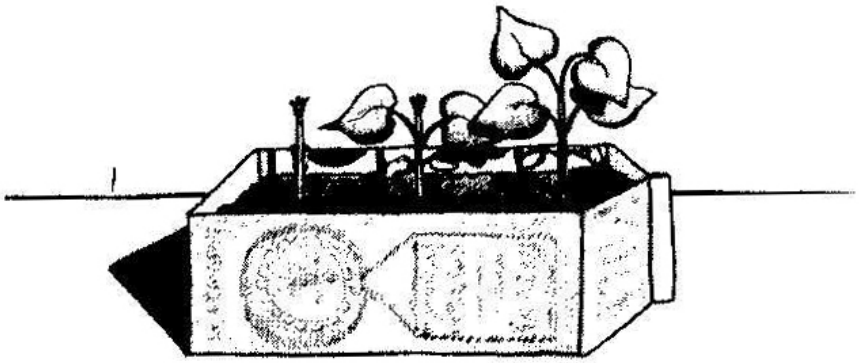
Place lima bean seeds in a moist paper towel for a few days until the seed coat has cracked. Have the children locate and identify the main parts of the plant. Have them examine the parts with a magnifying glass and draw what they see.

Materials Needed: Lima bean seeds, container, paper towels, magnifying glass.

The role of leaves

Plant several lima bean seeds in a container. Put the container in a warm location, and keep the soil moist. After the plants have developed their second set of leaves, thin to 3 plants, and remove 2 leaves from 1 plant, and all the leaves from another plant. Be sure to let one plant continue to grow naturally. Ask the class what they think will happen to each plant. Observe and record what actually happens and discuss the role of leaves in the growth of plants.

Materials Needed: Lima bean seeds, soil, container.



PLANT STRUCTURE

How plants absorb water

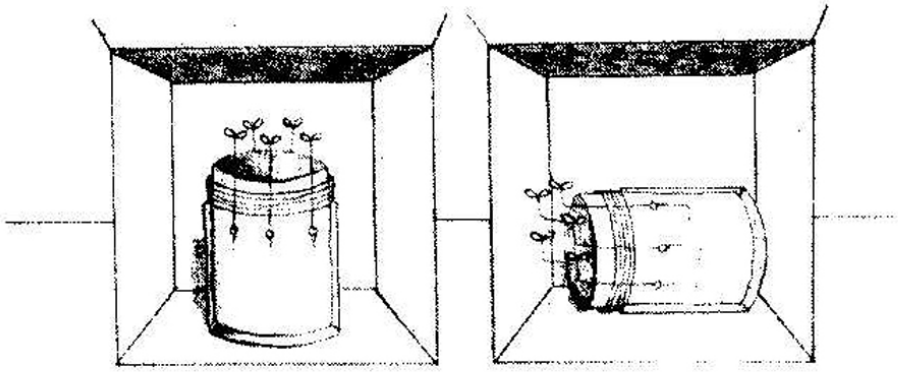
Fill a glass ¾'s full with water and add red food coloring. Cut the end off of a celery stalk and put the celery in the water. The leaves will begin to change color. Have the class discuss how they think the colored water got to the leaves. Cut the celery stalk in half to show the red coloring in the water conducting tubes, called xylem. Fill 2 glasses ¾'s full with water, adding red coloring to one and blue to the other. Cut a celery stalk lengthwise. Put one side of the stalk in the red water and the other side in the blue water. Also try experimenting with other plants such as daisies or carnations. Use different colored dyes. Have the children discuss the way food and water are carried to different parts of the plant.

Materials Needed: Celery stalks, glasses, food coloring.

Phototropism, the effect of light on plants

Cut a window about an inch square in one end of a box. Place a potted seedling, about an inch tall, in the box. Close the box and open it only to moisten the soil. Make sure the window faces a light source. After one week, have the children observe and discuss why the plant grows toward the light source.

Materials Needed: Cardboard box, seedling.



Geotropism, the effect of gravity on plants

Soak radish seeds overnight in water. Line a clear jar with a damp paper towel and place the seeds between the towel and the jar, 1 inch from the lip. Keep the towel moist. Stand the jar in the dark until the seeds have germinated and their stems extend an inch beyond the top of the jar. Then place the jar on its side as illustrated. Leave the jar in the dark. Check the seedlings in a day and discuss the change in the direction of growth of the stems and roots.

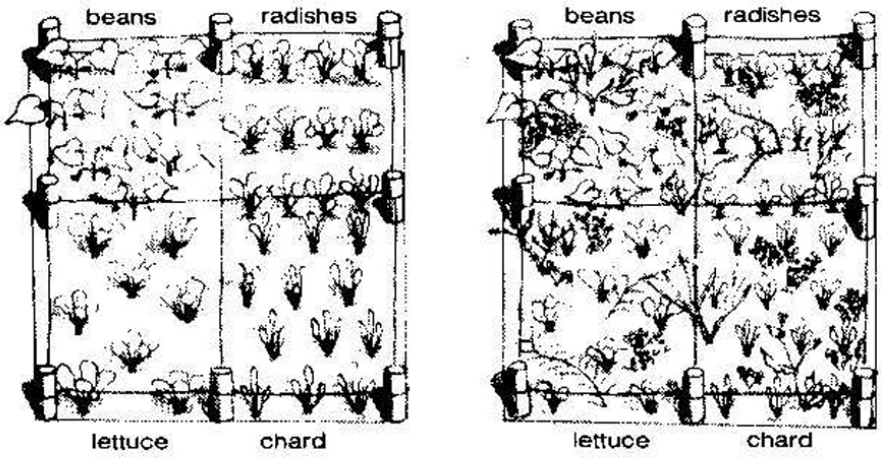
Materials Needed: Radish seeds, clear glass jars, paper towels.

WEEDS

Competition for water, space, sunlight and nutrients

The actual effects that competing for water, space, sunlight and nutrients has on seeds and young plants can be demonstrated by comparing 2 test plots.

Properly prepare the soil in 2 plots, 2 feet by 2 feet each. Shake weed seeds or hay over the first plot to encourage weed growth. Then divide each plot into 4 squares. Plant one type of seed in each square, matching test plots square for square (see illustration). Thin the seedlings to recommended spacing and water each plot equally. Weed the second plot by hand, pulling all weeds. Allow all the weeds in the first plot to grow.



Have the children observe, compare and record the rate of growth, the appearance of the seedlings and the overall appearance of the 2 plots. Have them evaluate the varieties and types of vegetables by their ability to compete with weeds as shown by their size and overall healthy appearance.

Materials Needed: Seeds of 4 types of vegetables or different varieties of the same type, 2 2-foot by 2-foot test plots, weed seeds from weedy lot.

Edible weeds

If you are familiar with edible weeds, assist the children in identifying them and prepare a weed salad. (See the Selected Bibliography for a guide to edible weeds.)

MULCH

Moisture control

To demonstrate the role of mulch in controlling soil moisture, cover the window side of 2 root view boxes with opaque paper and half fill boxes with potting soil. Water both boxes equally until the soil is uniformly moist, then place them in an area that receives full sun. Mulch the surface of one box using 2 inches of manure or compost or 3 inches of grass clippings, straw, leaf mold or shredded newspaper. Check each day. When the soil in the unmulched box appears dry, uncover the clear sides of each box and remove the mulch. Have the children compare the moisture content and surface texture of each sample. Discuss the benefits of using mulch in the garden.

Materials Needed: 2 root view boxes, potting soil, mulch.

mantid

Natural predators

To enable the children to observe the relationship between beneficial and harmful insects, put aphid-infested leaves and a mantid eggcase in a terrarium covered with a fine-mesh screen. As the eggs begin to hatch, observe the growth and predatory behavior of the mantids. Discuss the relationship between the insects and what would happen to the mantids if there were no aphids or if a chemical insecticide were used to destroy the aphids. As the mantids mature, release them into the garden. Have the children learn to identify other beneficial insects.

Materials Needed: Mantid eggcase (see the Guide to Resources.); aphid-infested leaves from common ornamental plants such as roses and flowering echeverias, and from vegetable plants such as broccoli, cabbage and eggplant; a terrarium or similar container, fine-mesh screen.

Testing control methods

In the previous activity, predatory insects were used to control harmful insects. Other organic pest control methods include handpicking, traps and barriers, and homemade sprays. Have the children experiment with these methods and others, which are described in Part One (pp. 81-85), and in Part Two (p. 146). Have them observe, compare and record the effectiveness of the various methods.

HARVESTING

Ripening

Most store-bought tomatoes are picked green and shelf-ripened. Have the children pick several tomatoes that are just beginning to change color and place them on a shelf to ripen. After these have ripened, have the children pick several tomatoes that have ripened on the vine. Compare the tomatoes for differences in flavor, texture and color.

Materials Needed: Green tomatoes, vine-ripened tomatoes.

Picking at the peak

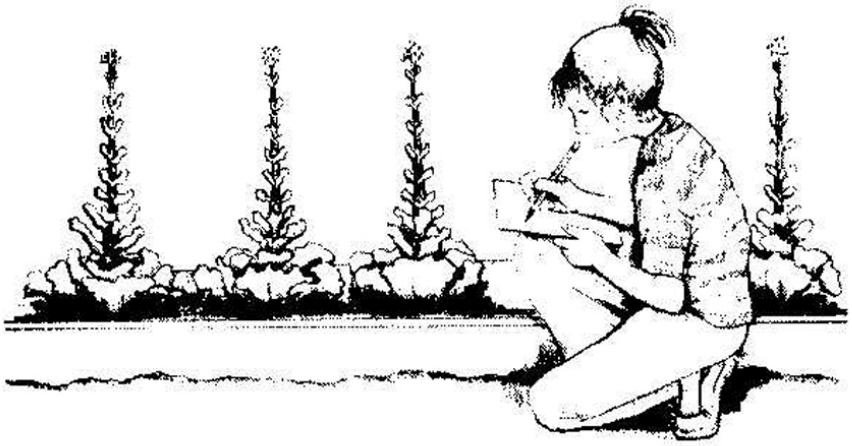
If you have planted peas in your garden, the children can compare them at different stages of development. Let some peas develop until they are past their prime, that is, when the pods begin to dry and the seeds make visible bumps in the pod. Pick a handful of overripe peas, a handful that are still immature and another handful that are at the peak of their development. Have the children compare the peas and pods for size, texture and color. Have them taste the peas and discuss the differences in texture and taste. If you want to be sure to have peas at different stages of development, succession plant three rows of peas 2 to 3 weeks apart.

Materials Needed: Immature, ripe and overripe peas in pods.

Seed production

Just as it is important for children to learn how vegetables are grown, they should also understand how plants produce seed. Let a leafy vegetable such as lettuce go to seed. Have the children observe flowering, seed production, and natural scattering of seeds. If you save seed, remember that hybrid varieties may produce different plants each year.

Materials Needed: Leaf crops allowed to go to seed.



Freshness and flavor

Have the children harvest vegetables from the garden and make a salad. Use herbs from the garden in the salad dressing. Have the children describe the qualities that make fresh vegetables taste "fresh."

FOOD PRESERVATION

Comparing different preservation techniques

The activities in this guide have taken the children step-by-step through the entire process of growing their own food. The final activity will introduce the children to the techniques of preserving food for later use. Harvest the garden vegetables as they mature. Freeze some of the vegetables and dry some of the others. (See the Selected Bibliography for a recommended reference book.) Purchase some canned vegetables and pick several fresh vegetables immediately before conducting this activity. Have the children compare the appearance, texture and taste of the fresh vegetables and the vegetables preserved by canning, drying and freezing.

Materials Needed: Fresh, frozen, dehydrated and commercially canned vegetables.

SPECIAL PROJECTS:

FLOWER DISSECTION

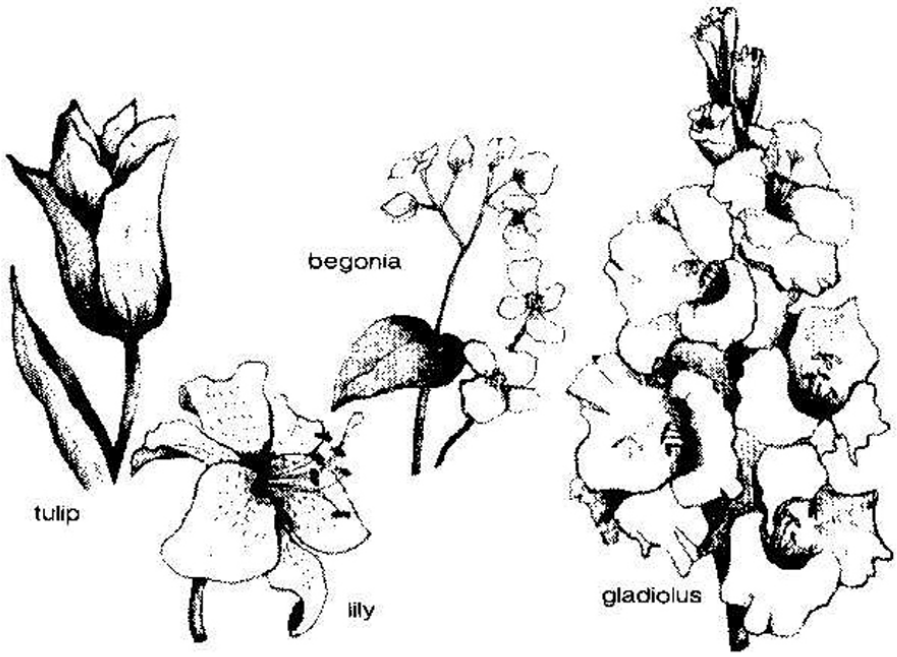
Flowers vary greatly, but they have certain basic structures in common. Listed below are flowers that are suitable for dissection and the time of year they are available. To dissect a flower, have the children pull or cut off the flower parts, moving from the outside to the inside of the flower.

The first floral organs, beginning at the base of the flower, are the **sepals**. Sepals are usually green and somewhat leaflike. Next are the **petals**. Some flowers, such as fuchsia, delphinium, or iris, have sepals colored like the petals, but a different size or shape. Flowers such as lilies and tulips have colored sepals which look like petals and are similar in size and form.

Stamens are the pollen-carrying filaments. **Pistil(s)** are in the center of the flower. The **ovary** is located below the pistil. See Part One (pp. 74-75), for an explanation of the reproductive functions of the stamen, pistil and ovule.

Have the children identify each part as it is removed or exposed, and press the parts between paper under the weight of several books or a stack of magazines. Use white glue to attach the parts to cardboard, and label.

FLOWER DISSECTION



Fall

Hibiscus: 5 sepals, 5 petals, several stamen, 1 compound pistil.

Winter

Begonia: ♂ & ♀ parts on same plant, but different flowers; ♂ flowers: 2 to 4 sepals, 4 petals, many stamen; ♀ flowers: 2 to 4 sepals, 2 petals, 1 pistil.

Spring

Tulip: 3 sepals, 3 petals, 6 stamen, 1 pistil.
Lilies: 3 sepals, 3 petals, 6 stamen, 1 pistil.

Summer

Day Lily: 3 sepals, 3 petals, 6 stamen, 1 pistil.
Gladiolus: 2 sepals, 6 petals, 3 stamen, 1 pistil.

Materials Needed: Available recommended flowers, scissors, paper and pens, glue.

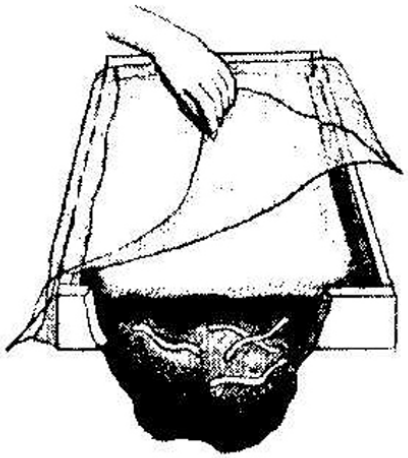
WORM CULTURES FOR GARDENS

Worms can play an important role in the total garden ecosystem. They improve the soil by aeration as they tunnel, and their castings (excrement) improve soil texture and fertility.

Raising worms will give children the opportunity to explore the relationship between plant life and other organisms. You will need some starter worms, either from a fishing tackle store or from someone who is already raising worms.

Worms require lots of food and moisture. One good way to grow them is to build a worm bed under a rabbit cage. Since the rabbit manure will provide the food for the worms, the bottom and lower sides of the cage should be made of galvanized wire mesh with openings ½ inch by 1 inch. The soil under the cage should be loose and rich in organic matter. Keep the worm bed moist by sprinkling regularly and turning it every few weeks with a spading fork. Don't use a shovel, since the blade will cut the worms.

If you want to raise worms without rabbits, build an open box out of redwood or cedar with sides 2 inches by 10 inches or use bricks or rocks. Keep the soil loose several inches below the sides of the bed. You may have to screen the bed to keep out birds and skunks. You can



worm box

also use old trash cans or large boxes lined with trash bags and filled with soil. These containers should be placed in the shade. You can even raise worms in a compost pile, if aerobic decay is taking place. Since these methods do not make use of rabbit manure, add garbage, compost and other organic matter regularly. Keep moist and stir every two weeks.

Every month, place some of the worm culture in the garden. If worms are added to poor soil, they will either die or migrate to a more favorable spot. If the garden is moderately high in organic matter and fertility, the worms will make it even more fertile. Be sure to leave enough worms in the worm bed to reproduce.

Here is a recommended soil mix for raising worms: 3 gallons of fine screened topsoil, 3 gallons of peat moss or fine compost, 3 gallons of horse or cow manure, 1 cup of corn meal and 1 to 2 cups of coffee grounds. Let this mixture compost for a few days before adding worms.

"MANURE TEA"

You can make your own liquid organic fertilizer by preparing a "manure tea." This "tea," made simply by soaking manure in water for a period of several days, will supply plants with a variety of essential water-soluble nutrients.

Add 1 quart of fresh or dried manure to a 1 gallon bucket and fill to the top with water. You will get a more potent tea if you use fresh manure, or if you allow the manure to soak for 10 to 14 days. Put a close-fitting wooden or cardboard cover on the top to keep away flies. Stir once or twice a day until it is the color of strongly brewed tea.

This solution can be strained and added directly to the garden soil, but since the tea may contain salts, it is better to dilute it with 2 to 3 gallons of water before fertilizing. You can use the solid matter that remains as a mulch, but note that most of the nutrients have been removed.

Any manure will work, including chicken, horse, pig, goat, sheep and cow manure. Some are stronger than others, in both nutrients and smell, so experiment before you brew large amounts.

HOMEMADE INSECT SPRAYS

Dozens of recipes for homemade insect sprays have been published. Some have been validated by traditional research methods. Three that you and your group of children may want to test are listed below. When making these sprays, note that water is the carrier, soap (not detergent) is the spreader/sticker, and the plant juice is the active ingredient. When using soap, Naptha is recommended. It will dissolve more easily if you add a teaspoon of alcohol to each quart of water.

Soap and water sprays have been found to be effective to some extent in controlling aphids, mealy bugs and white flies. Mix 1 teaspoon of pure soap, not detergent, with 1 gallon of water. Spray frequently when these pests appear.

Garlic sprays may be effective for controlling caterpillars and larvae. To make a garlic spray, soak 3 ounces of chopped garlic in 2 teaspoons of mineral oil for 24 hours. Dissolve ¼ cup of pure soap in a pint of water. Add the soapy water to the garlic and stir well. Strain the liquid through gauze and store in a non-metallic container. Dilute 1 part garlic solution to 20 parts water for first spraying, then further dilute to 1 part in 100 for subsequent sprayings.

Test hot pepper sprays for protection against ants, spiders, cabbage worms, caterpillars and tomato horn worms. They may be more effective when combined with onions and garlic. Chop 1 garlic clove, ½ onion, ½ mild green pepper and 2 to 3 jalapeño or long red cayenne peppers. Blend in 1 quart water, and let this soup sit for a day or two. Strain and use as a spray.

COLD FRAME

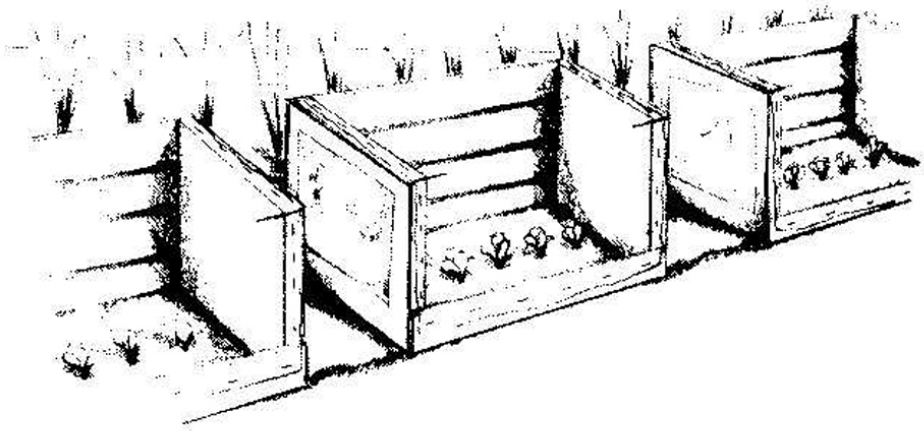
A cold frame functions like an incubator for new plants, creating a warm, protected space that can be controlled by the children to maintain the best growing conditions. A cold frame modifies the outdoor environment by sheltering young seedlings from wind, dry air, heavy rains and cold temperatures, as well as protecting seedlings from insects. A cold frame is also helpful when direct seeding tender plants, and for getting an early start on the growing season.

Basically, a cold frame is a portable bottomless box with a glass or plastic roof. Glass will trap more of the sun's heat, which is important in wintertime. A double layer of plastic will provide some insulation. The cold frame can be removed when nighttime temperatures are close to 60°F. During the summer, a cold frame can be covered with shade cloth to provide protection and moisture control without trapping too much heat.

You and the children can construct very simple cold frames using recycled wood and some inexpensive materials.

Have each child bring a small wooden vegetable crate to the garden site. (See Guide to Resources, pp. 167-168.) Crates should be about 1½ feet by 1½ feet by 2½ feet. Help the children remove the top slats, and 2 or more slats from one of the long sides. Leave one slat along the bottom front edge for strength. Use a staple gun to attach 2 layers of polyethylene to the top and front of the crate. If there are gaps between slats on the back side, cover with additional plastic.

COLD FRAME

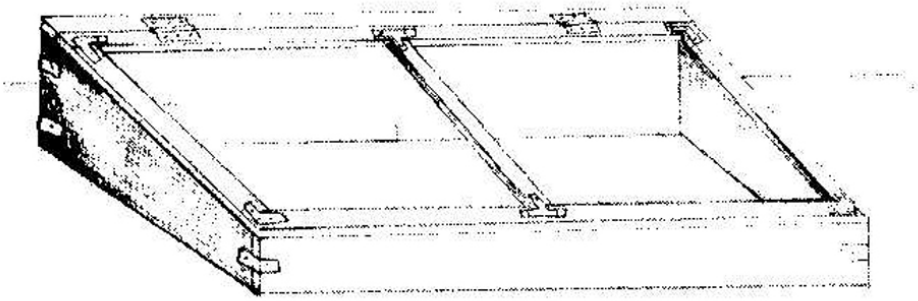


This simple cold frame is ready for the garden. Place it directly on top of the row or seed bed. During the day, raise the front with a stake or rock to prevent the buildup of heat and moisture.

A more permanent and more effective cold frame can be made from recycled lumber or, if your budget will allow it, from redwood or cedar, which will resist rotting. Other types of wood should be painted to resist weathering. Since you may want to use this cold frame as a miniature greenhouse, it can be constructed so that it holds several standard-size flats, which are 19 inches by 19 inches square. The illustration shows a cold frame 20 inches by 60 inches, big enough for 3 flats.

Build a wooden frame using 5 pieces of ¾-inch lumber. The front piece should be 5 inches high by 61½ inches long, and the back piece 12 inches high by 61½ inches long. The sides should be 5 inches and 12 inches on the ends, 20 inches long on

the base and 21 inches on the top. Each side must be cut from one piece of wood.



Butt the sides against the front and back pieces and join with nails and angle bracket as shown in the drawing. Attach a support piece 3 inches by 61½ inches across the back using wood screws. This forms the base of the cold frame.

If you are lucky enough to find a glazed wooden door or window to use as the top, modify the dimensions of the base to fit. A scale drawing will help you calculate the dimensions.

To build the lid, make a frame out of 1-inch by 2-inch (1 × 2) lumber. The outside dimensions should be 18½ inches by 61½ inches. The corners can be mitered and joined with glue and nails, or butted together with angle brackets (see drawing). For added strength, you can include a center support 15 inches long, also fastened with angle brackets.

Attach 2 hinges and handle, if desired, with wood screws. Cover the top of the frame with a sheet of 4- to 6-mil

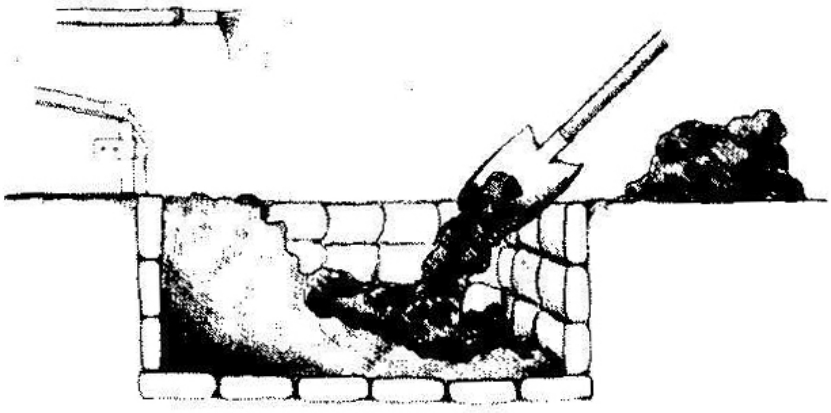
polyethylene plastic and fasten with a staple gun. Stretch the plastic so that it is fairly taut. Cover the back of the lid with another sheet of plastic. This creates an insulating air space. Note that the plastic will probably not last more than 2 years.

Attach the lid to the cold frame using wood screws to fasten the hinges to the 3-inch crosspiece. It will probably take 2 people to carry this cold frame to the garden. Use a 12-inch stake to prop open the lid on warm sunny days to allow for air circulation.

You can set up a cold frame on a paved area, and use it for growing seedlings, if open space in the garden is limited.

HOTBED

You can raise warm weather seedlings outside during cold weather, by creating a "hotbed" to provide added heat beneath the coldframe.



To prepare a hotbed, choose an area that gets full day sun. Dig a rectangular pit 2 feet deep, with the same outside dimensions as the coldframe. Pack uncomposted cow, steer, or horse manure in the pit up to the original ground level. Ideally, this pit should be lined with broken concrete or asphalt slabs. The concrete lining acts as an insulator to retain heat. As a final step, water down the manure to start the heating process.

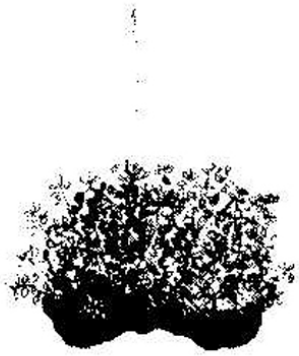
Place a coldframe over the hotbed. Heat from the manure will keep the inside air warm for several weeks. If potting soil is added to the inside of the coldframe, transplants may be raised by direct seeding. Otherwise, seedlings should be started in flats or pots. Open the coldframe only when necessary, as heat will be lost whenever the lid is lifted.

Carrot Planter

Cut off the top 2 inches of a carrot and hollow out the center. Poke 3 holes in the carrot top and attach string as illustrated. Have the children fill the hollowed center with moist soil and plant alfalfa or cress seeds.

Material Needed: Carrot, string, soil, alfalfa or cress seeds.

Sponge Sprouter

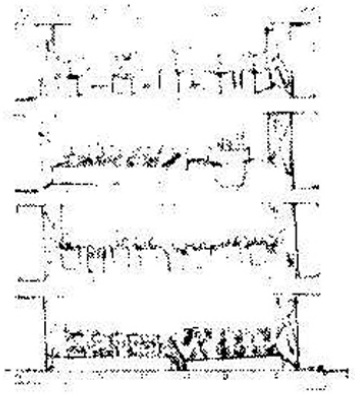


Squeeze most of the moisture out of a large wet sponge and attach a string to it as illustrated. Have the children sprinkle alfalfa or cress seeds on the sponge and hang it in a sunny window. Lightly spray with water each day.

Materials Needed: Large sponge, string, alfalfa or cress seeds.

GREENHOUSE

Greenhouses come in many shapes and sizes. They may be simple or very complex, but they all provide plants with a warm, humid and protected environment. The greenhouse shelters plants from dry heat, frost, wind, rain and insects. It creates an environment that is ideal for many vegetables, whether they are tiny seedlings or full grown plants.



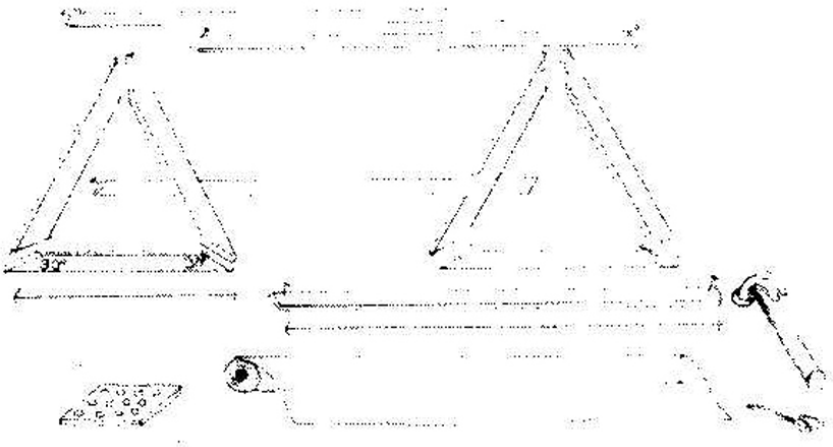
Using clear polyethylene plastic, greenhouses as simple as a block and board structure can be built in a few minutes. By placing 1-inch by 8-inch boards horizontally between decorative garden blocks, a sturdy, shelved frame can be set up without the use of nails, screws or glue.

Pre-cut plastic sheeting to cover the back and sides of the block and board frame. Fasten the plastic to the board edges using staples or tacks. The front can be covered with a separate sheet, attached to the top board with push pins for easy removal, and weighted at the bottom with a piece of lath. Use 4-or 6-mil polyethylene plastic.

The block and board greenhouse is ideal for raising seedlings in small pots or milk cartons, which might dry out quickly during hot weather.

GREENHOUSE

A small movable greenhouse can be made with 6 8-foot pieces of 1-inch by 2-inch lumber, plastic sheeting, galvanized nails, metal fasteners and staples. Saw 3 8-foot pieces of lumber in half, and use a miter box to cut end angles of 30°across the 2-inch width. Be sure the 30° cuts on each end face opposite ways, so the sides can be put together forming 2 equilateral triangles. Assemble each corner with metal fasteners.



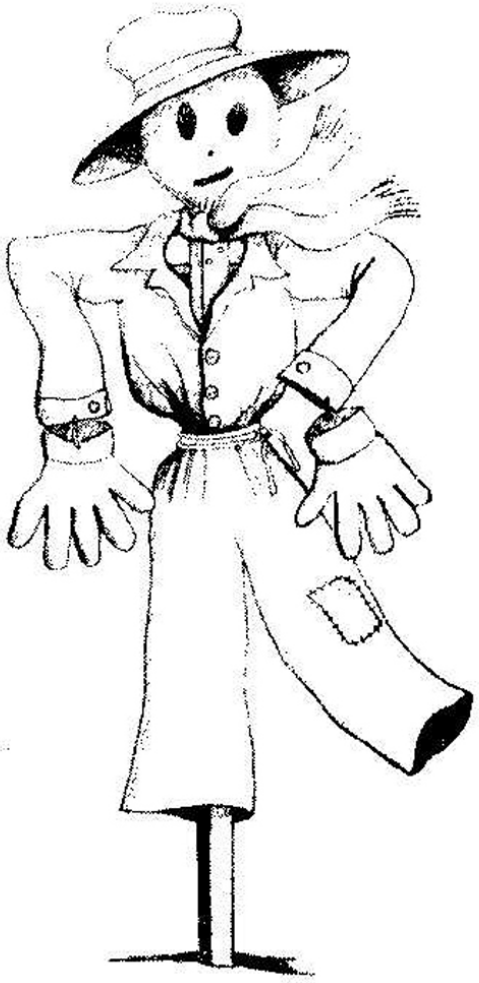
Now saw the remaining 8-foot lengths of 1-inch by 2-inch lumber in half. These boards will be used to frame the sides of the greenhouse. Hold the triangles upright and connect them by fastening 2 boards to each side, one at the lowest point and one at the highest point.

The peaked frame can be covered with plastic sheeting, fastened with wood staples or thumb tacks.

For access, cover the triangular ends with separate sheets of plastic, and use push pins instead of staples so that the plastic can be easily removed.

SCARECROWS

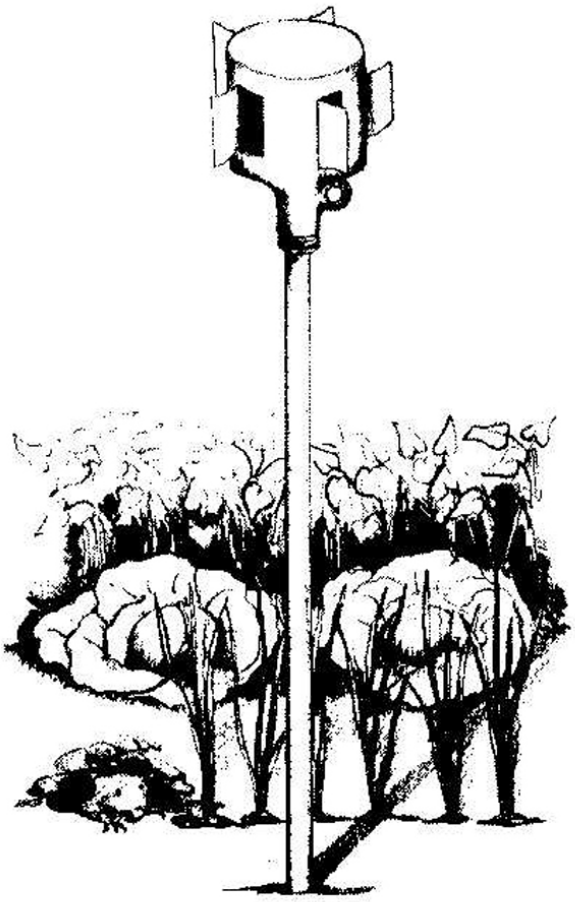
Making scarecrows is a garden ritual. They can be made of almost anything. For example, make a simple frame from sticks and twine or nails, dress with cast off clothes and paint a face on a stuffed stocking for the head. Or make a straw man as in the Wizard of Oz. If you are using straw for mulch, borrow some for your scarecrow. Tie bunches of straw together for arms, legs, body and head. Connect with wire, dress and hang the scarecrow on a pole. Making a papier-mâché scarecrow would be an excellent art project, with hand-painted papier-mâché head, hands and feet attached to a wood frame skeleton. Properly attired, you'll have a scary work of art.



GOPHER CHASER

Gopher chasers are another fun addition to the garden. Pound a 6-foot wooden pole or galvanized pipe 2 feet into the ground. Using a plastic gallon jug, cut 4 vanes out of the sides, pull them out and bend away from the jug.

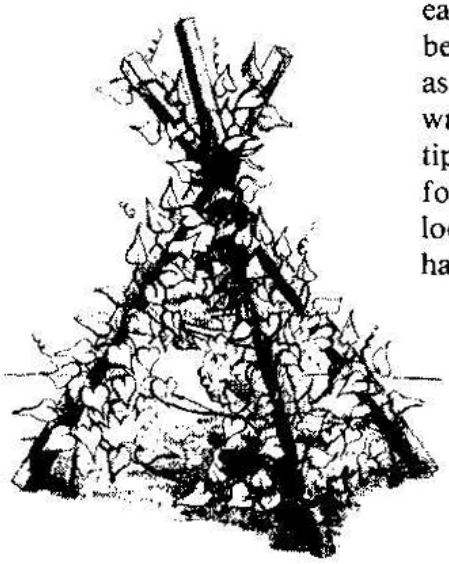
Turn the jug upside down and place on top of the pole. When the wind blows, the vanes will catch the wind and the jug will spin, making a clattering sound. The pole carries this sound underground, where it is said to chase gophers away.



BEAN TIPI

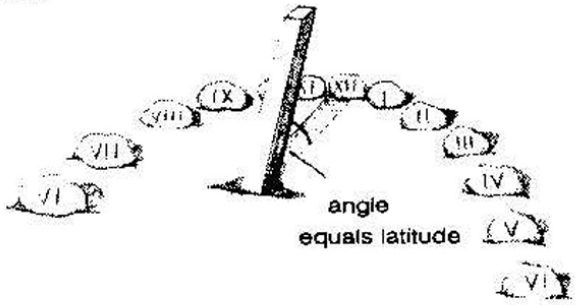
You can use several lengths of bamboo or other lightweight wood to build a bean tipi. Place 2 6-foot pieces side by side, and wrap loosely at one end with a few inches of twine. Spread the other end apart, creating an upside down "V." Place the top of a third pole in the notch formed by the other two and wrap all three with more twine, tying them together. This forms the basic tipi. More poles can be added if needed.

Tie one end of a ball of twine to the bottom of one leg of the tipi, and walk around the tipi, tying the twine to the poles as you go. As you go up the tipi, leave about 4 inches between each wrap. Plant peas or string beans around the base of the tipi; as they climb, the tendrils will wrap around the twine, and the tipi will soon be covered with foliage and pods. A bean tipi looks great and is easy to harvest, too.



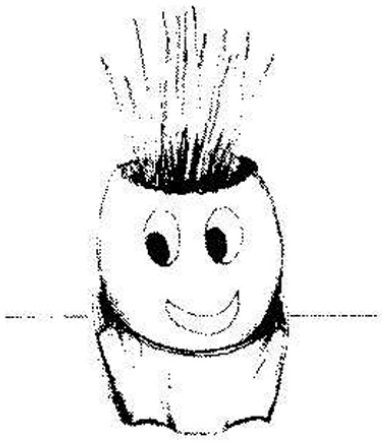
SUNDIAL

A simple sundial offers children the opportunity to observe the changes in the earth's relationship with the sun that help produce the seasons. Your sundial can be part of an herb lawn. Before planting, pound a wooden stake into the ground. Have the children mark the point where the shadow falls exactly at true noon with a stone. (Remember during daylight savings time true noon is 1 p.m.) The direction the shadow points to represents true north. Check the shadow line for a few days. Now that you have determined true north, remove the stake and pound it in at the same spot at an angle which equals the latitude of your area (34° if you live in Los Angeles). The stake should run north to south with the top of the stake pointing north toward the stone.



Over the next few days, come out to the garden at different times and mark the hours with additional stones. Roman numerals can be painted on the sides of the stones. The shadow will rotate counterclockwise, opposite to the direction the sun appears to be moving in. Now you can plant a low-growing herb such as chamomile. In six months, note where the shadow falls, and mark the hours with a new set of stones. The children will see how the angle of the sun has changed, and how the shadows are longer in the fall and winter and shorter in the spring and summer.

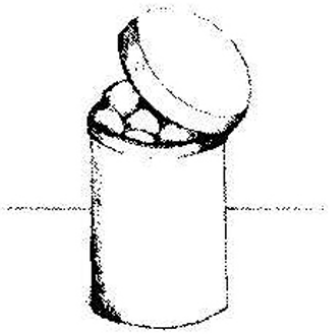
Egg Head



Break away ¼ of the pointed end of an egg shell, and empty the contents. Have the children draw a face on the shell using felt pens, then fill the shell with moist soil and plant chives or wheat seed. Make a stand from a cardboard egg carton. Place the egg head in the stand. Water lightly each day.

Materials Needed: Cardboard egg carton, eggs, felt pens, soil, chives or wheat seed.

Seed Top-Popper



Have the children fill a plastic bottle or plastic film canister with pea or bean seeds. Fill with water and put on the top. The seeds will swell, and by the following day the pressure created will pop the top off the container.

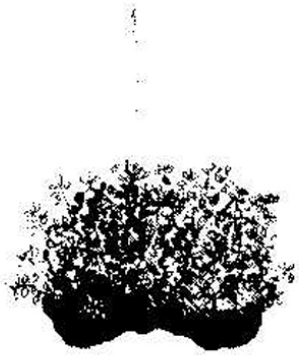
Materials Needed: Plastic bottle or film canister, pea or bean seeds.

Carrot Planter

Cut off the top 2 inches of a carrot and hollow out the center. Poke 3 holes in the carrot top and attach string as illustrated. Have the children fill the hollowed center with moist soil and plant alfalfa or cress seeds.

Material Needed: Carrot, string, soil, alfalfa or cress seeds.

Sponge Sprouter



Squeeze most of the moisture out of a large wet sponge and attach a string to it as illustrated. Have the children sprinkle alfalfa or cress seeds on the sponge and hang it in a sunny window. Lightly spray with water each day.

Materials Needed: Large sponge, string, alfalfa or cress seeds.

SKILL EVALUATION CHART

MATH: Making calculations, collecting numerical data, taking measurements.

LANGUAGE ARTS: Making written observations, developing verbal skills, participating in group discussions.

SCIENCE: Observing physical and biological processes, conducting experiments, documenting results, reaching conclusions.

SOCIAL AND BEHAVIORAL SCIENCES: Personal development through role playing, developing intuition, working cooperatively and making judgments; social development through an increased understanding of society's relationship to the environment.

	Math	Language Arts	Science	Social Sciences
INDIVIDUAL AND COMMUNAL GARDENS				
Gardening together, gardening alone		x		x
CHOOSING A GARDEN SITE				
Plants need sunlight, soil and water		x		x
Visit a garden		x		
SOIL				
Soil types			x	
Soil texture	x		x	
Drainage	x		x	
Compaction			x	
Test for soil compaction			x	
Soil pH			x	

SKILL EVALUATION CHART

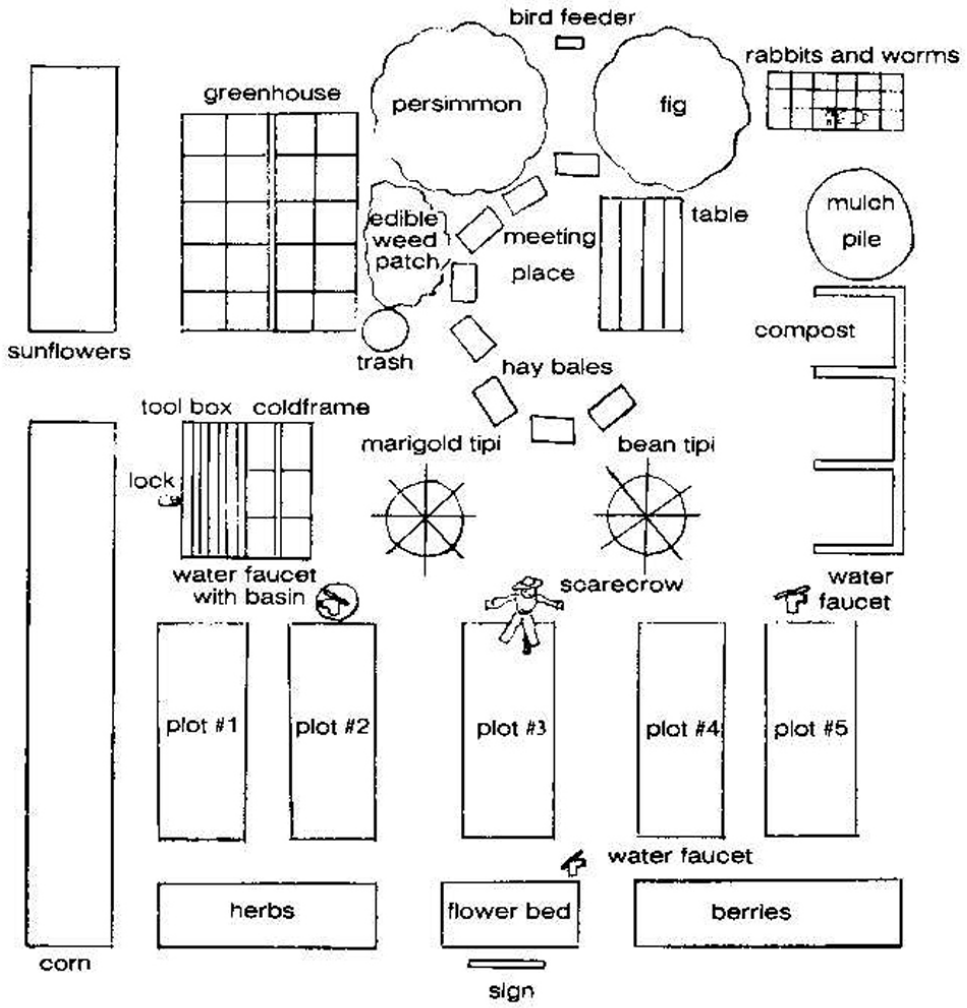
	Math	Language Arts	Science	Social Sciences
SOIL AMENDMENTS				
Effect of amended soil on root growth			x	
Effect of amended soil on drainage	x		x	
Finding free resources				x
ORGANIC AND INORGANIC FERTILIZERS				
Comparing the effects of different kinds of fertilizers	x		x	
COMPOST				
Recycling organic materials			x	
TOOLS				
Using the right tool				x
History of tools		x		x
BED CONSTRUCTION AND IRRIGATION				
Watering techniques			x	
CONTAINER GARDENING				
Preparing for container gardening	x			x
WHAT TO PLANT, WHEN TO PLANT				
Cool season and warm season vegetables			x	
Varieties			x	x
HERBS				
Discovering herbs			x	x
Herbs as garden helpers			x	
Using herbs for scents and flavors				x
GROWING MORE ON LESS SPACE				
Interplanting—Older Children	x			
Interplanting—Younger Children				x
PLANNING THE GARDEN				
Setting goals, setting limits	x			x

SKILL EVALUATION CHART

	Math	Language Arts	Science	Social Sciences	
INDOOR SEEDING					
Germination	x		x		
Planting indoors			x		
Environmental effects		x	x		
Thinning			x		
TRANSPLANTING					
Hardening off	x		x		
Root damage			x		
Watering			x		
DIRECT SEEDING					
Natural scattering and controlled planting	x		x		
PLANT STRUCTURE					
Identifying the parts of plants			x		
The role of leaves			x		
How plants absorb water			x		
Geotropism, the effect of gravity on plants			x		
Phototropism, the effect of light on plants			x		
WEEDS					
Competition for water, space and sunlight	x		x		
Edible weeds			x	x	
MULCH					
Moisture control			x		
CONTROLLING INSECTS					
Natural predators		x	x	x	
Testing control methods			x	x	

SKILL EVALUATION CHART

	Math	Language Arts	Science	Social Sciences	
HARVESTING					
Ripening				x	x
Picking at the peak			x	x	
Seed production				x	
Freshness and flavor			x		x
FOOD PRESERVATION					
Comparing different preservation techniques				x	



Plan for School Garden Site

GUIDE TO RESOURCES

Although there are some basic costs involved in establishing a children's garden, these can be minimized by tapping sources in your community. Many of the resources listed here are free. Be sure, when soliciting donations of materials, money or labor, that you outline what it will take to establish and maintain the garden program, and that you have an official letter supporting your project. It is also helpful to have a sketch of the proposed garden and a photograph of the site and the children. Remember to keep your donors posted on the progress of the garden.

Site Development

Lumber: can be used for stakes, raised beds, container gardens, compost bins, seed flats, greenhouses, coldframes, hotbeds, fences, tool boxes, storage sheds and trellises. Recycled "plastic lumber" can be used when there is concern about treated lumber.

Sources:

Local contractors and construction companies: scrap lumber may be available at construction sites; check with foreman.

Lumber yards: rejected boards can be obtained inexpensively or for free.

Glass companies: shipping crates and packaging materials.

Trucking companies: packing crates and pallets; an excellent source of free wood.

Highway departments: plywood, boards and stakes from highway signs.

Containers: can be used for planter boxes, seed flats, storage bins for fertilizer and amendments.

Tire companies: will usually donate used tires; used truck and tractor tires are good for growing deep-rooted vegetables. Leaching may be a concern.

Trucking companies: old tires and used shipping crates.

Tools: a hose, wheelbarrow, shovels, rakes, hoes and trowels are essential. There are short-handled tools which children can easily use. Tru-Temper manufactures small-sized tools.

Sources:

Hardware stores and garden centers: may discount or donate tools.

Rental companies: may donate rental fee. They also sell older tools.

Pawn shops and thrift stores: often have old tools for sale.

Garage sales: good source of bargains for single items.

Soil Amendments: most organic amendments can be obtained without cost. Leaf mold, green waste, and cow and horse manure can be worked into the soil or added to your compost pile. Lawn clippings, sawdust and straw can be used as mulch or composted. Transporting these materials is often the biggest hurdle.

Sources:

Stables: manure and stable bedding; some will deliver for free or for a minimal cost if large quantities are needed.

City Street Maintenance Department: green waste and wood chips which are good for mulch and for inhibiting weed growth when used on pathways. They probably will deliver a truckload at no cost.

Furniture manufacturers: sawdust and wood shavings.

Landscaping companies and gardening services: lawn clippings, green waste, and leaf mold. They might deliver; if not, find out where they dump these materials.

Seed

Although you can save seed from last year's vegetables, note that hybrid varieties are not true to seed and may produce different plants each year. Air-dry seeds you decide to save and store in airtight containers in a refrigerator.

Through a little extra work, school programs can often have seeds donated. Local garden centers may donate or discount seed packets. Wholesale seed companies may also make donations. A list follows of seed companies that may donate to worthy projects. Write them a letter describing your program and what the seeds will be used for, then make a follow-up phone call if necessary.

You will probably still want to purchase some seeds. Many retail seed companies have beautiful, often free, catalogs which can inspire children and help them plan their garden.

Wholesale seed companies and organizations willing to donate seeds:

America the Beautiful Fund
219 Shoreham Building
Washington, D.C. 20005
(202) 638-1649

A non-profit group which receives large seed donations from major seed companies, such as Park, and Thompson and Morgan. America the Beautiful supplies seeds to community and school garden projects nationwide. Sets of 50 mixed packets of seeds, including vegetables, flowers, and herbs, are

available for the cost of postage and handling. Larger quantities can also be obtained. Write them for an application.

Asgrow Seed
P. O. Box 1087
Tracy, CA 95376
(209) 835-1359

Seeds are available twice per year for donation. Bulk quantities only (one pound cans for tomato, carrot, etc., 50 lb. bags for corn, beans). All seed is treated with fungicide; children should be supervised.

California Seed Association
1521 I Street
Sacramento, CA 95814
(916) 441-2251

The CSA will solicit seeds on the behalf of California schools or youth programs from their 200 member seed companies. Write a request letter explaining your project 8-10 weeks in advance of planting. Seed provided are mainly in bulk quantities, usually treated with fungicides.

Neuman Seed Co.
P. O. Box 1530
El Centro, CA 92244
(760) 337-3100

Willing to donate seeds in bulk quantities of 1/2 pound or perhaps smaller. Untreated seed is available.

Petoseed Co.
1905 Lirio Avenue
Saticoy, CA 93004
(805) 647-1188

Seed available in bulk quantities only. Both treated and untreated seed.

Retail Mail Order Seed Companies:

Most have free catalogs and offer a wide selection of vegetable and flower seeds for sale. Some have plants, books and supplies. Specialties are indicated in parentheses.

Abundant Life Seed Foundation
P. O. Box 772
Port Townsend, WA 98368
(360) 385-5660
abundant@olypen.com
(Organically-grown seed, suited to cool summers)

Bountiful Gardens
18001 Shafer Ranch Rd.
Willits, CA 95490
(707) 459-6410
bountiful@zapcom.net
(Organic, heirloom, intensive planting)

Burpee and Burpee Heirloom
300 Park Avenue
Warminster, PA 18991-0001
(800) 888-1447
fax (800) 487-5530
www.burpee.com
(Best variety choices, good cultural information)

Cook's Garden
PO Box 535
Londonderry, VT 05148
(800) 457-9703
fax (800) 457-9705
(Many lettuces, greens, herbs)

Evergreen Y. H. Enterprises
333 City Blvd. West
Orange, CA 92868
(714) 938-3212
eeseeds@aol.com
(Oriental varieties)

Gardens Alive!
5100 Schenley Place
Lawrenceburg, IN 47025
(812) 537-8650
fax (812) 537-5108
gardener@gardens-alive.com
(Organic pest control)

Hermosa Valley Garden Seeds
P. O. Box 1409
Santa Maria, CA
(877) 834-7333
fax (805) 925-4140
(California-grown)

High Country Gardens
2902 Rufina Street
Santa Fe, NM 87505-2929
(800) 925-9387
fax (800) 925-0097
(Drought-tolerant plants)

J. L. Hudson, Seedsman
Star Route 2, Box 337
La Honda, CA 94020
(surface mail only)
(Ethnobotanical seeds from around the world)

Johnny's Selected Seeds
1 Foss Hill Road
RR 1 Box 2580
Albion, Maine 04910-9731
(207) 437-4301
fax (800) 437-4290
http://www.johnnyseeds.com
(Excellent cultural information)

Larner Seeds
Box 407
Bolinas, CA 94924
(415) 868-9407
(California-grown)

Le Jardin du Gourmet
P. O. Box 75
St. Johnsbury Ctr., VT 05863-0075
(800) 659-1446
fax (802) 748-9592
(Small, inexpensive sample packets)

A. M. Leonard, Inc.
241 Fox Dr.
P. O. Box 816
Piqua, Ohio 45356-0816
(800) 543-8955
fax (800) 433-0633
www.amleo.com
(Quality tools)

Lockhart Seeds
PO Box 1361
Stockton, CA 95201
(209) 466-4401
(California-grown)

Moon Mountain Wildflowers
Box 725
Carpinteria, CA 93014
(805) 684-2565
www.ss-seeds.com
(California-grown)

Native Seeds/Search
526 N. Fourth Ave.
Tucson, AZ 85705
(520) 622-5561
desert.net/seeds/home.htm
(Heirloom, American Indian varieties)

Nichols Garden Nursery
1190 N. Pacific Hwy. N.E.
Albany, OR 97321
(541) 928-9280
www.gardennursery.com
(Fun and theme collections, suited to cool summers)

One to Grow On, Inc.
P. O. Box 5372
Virginia Beach, VA 23471
(888) 383-2240
fax (888) 383-2239
(Ergonomic tools)

Ornamental Edibles
3622 Weedin Court
San Jose, CA 95132
(408) 946-7333
www.ornamentaledibles.com
("Pretty" edibles)

Park Seed
1 Parkton Ave.
Greenwood SC 29647-0001
(800) 845-3369
fax (864) 941-4206
info@parkseed.com

Peaceful Valley Farm Supply
P. O. Box 2209
Grass Valley, CA 95945
(888) 784-1722
fax (530) 272-4794
(Sustainable techniques, supplies)

Pinetree Garden Seeds
Box 300
New Gloucester, ME 04260
(207) 926-3400
fax (888) 52-SEEDS
superseeds@worldnet.att.net.superseeds.com

Plants of the Southwest
Agua Fria Rd.
Route 6, Box 11A
Santa Fe, NM 87501
(505) 438-8800
www.plantsofthesouthwest.com
(Drought-tolerant plants)

Seed Savers Exchange
3076 North Winn Road
Decorah, IA 52101
(319) 382-5990
fax (319) 382-5872
(Heirloom)

Seeds Blum
27 Idaho City Stage Rd.
Boise, ID 83716
fax (208) 338-5658
www.seedsblum.com
(Organic, heirloom, theme collections)

Seeds of Change
Box 15700
Santa Fe, NM 87506
(888) 762-7333
www.seedsofchange.com
(Heirloom, drought-tolerant)

Shepherd's Garden Seeds
30 Irene Street
Torrington, CT 06790
(860) 482-3638
fax (860) 482-0532
www.shepherdseeds.com
(Gourmet, baby varieties)

Territorial Seed Company
Box 157
Cottage Grove, OR 97424
(541) 942-9547
www.territorial-seed.com
(Organic, heirloom)

Theodore Payne Foundation
10459 Tuxford St.
Sun Valley, CA 91352
(818) 768-1802
theodorepayne@juno.com
(Southern California originated and grown wildflowers, drought-tolerant plants)

Thompson & Morgan
P. O. Box 1308
Jackson, NJ 08527-0308
(800) 274-7333
fax (888) 466-4769
(Many beautiful pictures, helpful cultural information)

Twinleaf
The Thomas Jefferson Center for Historic Plants
Monticello
Post Office Box 316
Charlottesville, Virginia 22902
(Many varieties grown by or at time of Jefferson)

Vermont Bean Seed Company
Computer Operations Center
Vaucluse, SC 29850-0150
(802) 273-3400
(803) 663-0217
fax (888) 500-7333
(Excellent cultural information)

Biological Controls and Garden Supplies:

Let's Get Growing
General Feed and Seed Co.
1900-B Commercial Way
Santa Cruz, CA 95065
(831) 464-1868

Free catalog lists many supplies for school garden projects, including child-size tools, watering equipment, soil test kits, hand lenses, green manure seeds and natural soil amendments.

Peaceful Valley Farm Supply
P. O. Box 2209
Grass Valley, CA 95945
(530) 272-4769

Catalog $2.00. Large catalog, organic pest controls, beneficial insects, growing and propagating supplies. Also has fruit trees and berry plants suitable for Southern California.

Technical and Educational Assistance:

The following organizations offer a variety of technical, educational and organizational resources, including publications, contact lists and project design assistance.

Bottle Biology Resources Network
B-37 Russell Laboratories
1630 Linden Dr.
Madison, WI 53706
(608) 262-1410

The Bottle Biology Program is a unique project from the University of Wisconsin, funded by the National Science Foundation, which teaches you how to make terrariums, aquariums, composters, and even complete eco-systems with 2L plastic soda bottles. A curriculum guide, workshops and a newsletter are available. Also ask about the related "Fast Plant Program".

California Department of Education
721 Capitol Mall
P. O. Box 944272
Sacramento, CA 94244-2720

To order an Environmental Education Compendia, call Publication Sales at (800) 995-4099.

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Common Ground Garden Program
University of California Cooperative Extension
2 Coral Circle
Monterey Park, CA 91755
(323) 838-4540

Common Ground is a federally-funded program which provides a wide range of services to gardeners in Los Angeles County. It sponsors youth gardening programs throughout Los Angeles. Publisher of **Childrens Gardens** and originator of the "Gardening Angels" School Garden Program. Master Gardener Program, Master Food Preserver Program, Master Composter Program. Horticultural advice on plant diseases and control. 24-hour gardening helpline, (323) 838-4541.

Cream of the Crop
California Foundation for Agriculture in the Classroom
1601 Exposition Blvd., FB-13
Sacramento, CA 95815
(800) 700-AITC

A free quarterly newsletter for teachers with ideas on how to integrate agriculture into the curriculum. An excellent resource.

Life Lab Science Program
1156 High St.
Santa Cruz, CA 95064
(831) 459-2001

Life Lab seeks to help schools integrate gardens into their science and nutrition curriculum. They offer "The Growing Classroom" curriculum guides (see Selected Bibliography), and are available to give teacher in-service training.

National Gardening Association
180 Flynn Ave.
Burlington, VT 05410
(802) 863-1308

Many helpful books on youth gardening (see Selected Bibliography). Bi-monthly magazine with useful gardening information and features on children's gardening programs nationwide. Sponsors the National Gardening Grant Program, which honors notable youth gardening projects. Winners receive grants of materials and supplies for their garden.

Small Grants for Teachers Program
Los Angeles Educational Partnership
315 W. 9th St., Suite 1110
Los Angeles, CA 90015
(213) 662-5237

Available for Los Angeles Unified School District teachers, grades K-12. $400 maximum per classroom, or $800 maximum for a team of teachers. Apply in October. Grants awarded in February.

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Tree People
12601 Mulholland Drive
Beverly Hills, CA 90210
(818) 753-4600

Field trips and classroom presentations are offered on a variety of environmental topics, including recycling, composting, and tree planting. Reservations should be made several months in advance.

Worms Eat My Garbage (How-to-Book)
and
Worms Eat Our Garbage (Curriculum Guide)
Flowerfield Enterprises/Flower Press
10332 Shaver Road
Kalamazoo, MI 49002
(616) 327-0108
fax (616) 327-7009

Vermicomposting in the classroom. Everything you need to know about setting up a worm culture with classroom activities for a better environment.

SELECTED BIBLIOGRAPHY

The bibliography is in four parts. Part 1 recommends books and a video for children. Part 2 includes books for adults on how to develop youth gardening programs. Part 3 lists useful gardening and related reference books. Part 4 is a descriptive listing of especially informative websites in all these categories as of January 1999.

Part 1. Gardening Books (and one video) for children

All About Seeds (Do it Yourself Science), Melvin Berger, 1992, Scholastic.

Young readers can read by themselves this simple book on plant science. Includes a few simple projects.

The Carrot Seed, Ruth Krauss, 1945; 24 pp., Harper & Row, Publishers, Inc.

The classic story of a little boy who plants a carrot seed and waits for it to grow. For ages 3 to 6.

Flower Garden, Eve Bunting 1994, Harcourt Brace.

A father & his young daughter plant a window box as a surprise birthday present for Mom. Lovely illustrations.

The Garden of Happiness, Erika Tamar, 1996, Harcourt Brace.

For older listeners, the story of how Marisol and her neighbors gather together to build a community garden out of a New York City vacant lot.

SELECTED BIBLIOGRAPHY

Get Ready, Get Set, GROW! Video produced by Brooklyn Botanical Gardens, Bullfrog Films, Inc., Oley, PA 19547, (215) 779-8226.

A 15-minute video, filmed at the children's garden at the Brooklyn Botanical Garden, "Get Ready, Get Set, Grow" shows the progress of a garden, from planting to harvest, through the eyes of children. Very much appreciated by children ages 6 through 11. Included with the video are two booklets for the child and the parent or teacher.

Growing Vegetable Soup, Lois Ehlert, 1987; 30 pp., Harcourt, Brace, Jovanovich, Publishers, New York, NY.

A child and father plant seeds, water them, and care for the plants as they grow. When they harvest their crop, they make vegetable soup. A very colorful book which should help young children, ages 3 through 6, visualize the gardening process. A recipe for vegetable soup is included.

How a Plant Grows, Bobbie Kalman, 1997; 32 pp., Crabtree.

Good overview of the plant life cycle. Well illustrated with close-up photographs & clear drawings.

How A Seed Grows (Let's Read and find Out Science), Helene Jordan, 1992, Harper Collins.

Also for novice readers about the growth of seeds into plants.

SELECTED BIBLIOGRAPHY

Jasper's Beanstalk, Nick Butterworth & Mick Inkpen, 1993, Simon & Schuster.

Jasper plants a bean and is discouraged when it doesn't grow in a week. Very simple story printed in a large type, with adorable illustrations.

June 29, 1999, David Wiesner, 1992, Houghton Mifflin.

Very large vegetables are falling to earth. Is it the result of Holly's ambitious science experiment? For a change of pace, a delightfully weird picture book.

Kids Gardening: A Kids' Guide to Messing Around in the Dirt, Kevin Raftery and Kim Gilbert Raftery, 1989; 87 pp., Klutz Press, 2170 Staunton Court, Palo Alto, CA 94306.

This fun and well-organized book is meant to be read and manhandled by children ages 5 to 10 years or so. It is printed on extra-heavy paper and profusely illustrated with amusing full-color drawings. Includes six packets of vegetable and flower seeds. Basic gardening information in a conversational, easy-to-understand style. Step-by-step instructions for growing eight different vegetables and things to do with what you have grown, like roasting pumpkin seeds from your own pumpkin. Other interesting projects like making guacamole, building a scarecrow, and raising earthworms in a box.

Linnea in Monet's Garden, Christina Bjork, 1987; 52 pp., Farras Straus & Giroux.

A young girl goes to France to visit Monet's garden & learns about his life & art. For upper primary and older.

SELECTED BIBLIOGRAPHY

Plant a Garden in Your Sneaker!, Diane L. Burns & Jill A. Burns, 1998; 60 pp., McGraw-Hill.

Simple instructions for imaginative planting projects, illustrated with cute drawings.

Pumpkin, Pumpkin, Jeanne Titherington, 1986, Morrow.

Very simple, beautifully illustrated, story of a boy who plants seeds, reaps the rewards (a Jack O'Lantern) & saves the seeds to plant again.

The Reason For a Flower, Ruth Heller, 1983, Putnam & Grosset.

Lovely illustrations and a poetic text explain some basic botantical information.

Sam Plants a Sunflower, Kate Petty, 1997, MacMillan.

Includes seeds. Lift the flap to see what's happening under the ground. A longer story about gardening. Also by the same author, **Rosie Plants a Radish**.

Sunflower House, Eve Bunting, 1996, Harcourt Brace.

A boy carefully plants sunflower seeds and is rewarded by a summer playhouse made of sunflowers. He saves the seeds to plant again. Rhyming text, lively illustrations.

The Victory Garden Kids' Book, Marjorie Waters, 1998; 148 pp., Houghton Mifflin Company, Boston, MA.

A group of children ages 3 to 16, of diverse ethnic backgrounds, participate in a summer garden. Discusses soil, tools, composting, insects, and individual crops in clear, non-condescending language. Excellent color photos.

10 Pasos Faciles para la Huerta de los Jovenes, Joyce McReynolds, 1980; Leaflet 21186, 19 pp., University of California, Division of Agricultural Sciences, 6701 San Pablo Avenue, Oakland, CA 94608-1239.

In Spanish. A very simple booklet (actually a coloring book) for children ages 6 to 9. Illustrated with many line drawings, showing the basic steps involved in gardening.

Part 2. Books for adults on developing youth garden projects

A Child's Garden, Walter Doty, *et al*, 1989; 53 pp., Public Affairs Department, Chevron Chemical Company, Ortho Division, 742 Bancroft Way, Berkeley, CA 94710.

Excellent low-cost booklet for teachers containing a potpourri of garden-related classroom projects and other miscellaneous gardening information.

Children's Kitchen Garden—A Book of Gardening, Cooking, and Learning, Georganne & Ethel Brennan, 1997; 146 pp., 10 Speed Press.

Inspired by French educational philosophy, explains how to foster in children a holistic appreciation of the world around them through growing and preparing their own food.

Container Gardening For Kids, Ellen Talmadge, 1996; 80 pp., Sterling.

More than 20 container gardening projects, illustrated with photographs.

SELECTED BIBLIOGRAPHY

Green Fun, Marianne Haug Gjersvik, 1997; 42 pp., Firefly.

How to make hollyhock dolls, rose bud birds, daisy chains, and other old-fashioned natural playthings, along with some plant folklore.

The Growing Classroom: Book 1:Becoming a Farmer; Book 2: Science; Book 3: Nutrition, Roberta Jaffe, *et al*, 1982; 419 pp., Project Life Lab, 809 Bay Avenue, Suite H, Capitola, CA 95010.

These books are for teacher use in developing a garden-based science and nutrition program. Book 1 is a guide for starting a school garden and consists of three sections: Breaking Ground, Cultivating Support for Your Growing Classroom, and Basic Gardening and Experimental Beds. Book 2 contains the Science Curriculum and consists of ten units: Problem Solving/Communication, Awareness/Discovery, Soil, Growing, Photosynthesis, Cycles and Change, Interdependence, Insects, Flowers and Pollination, Energy, and Recycling. Book 3 contains the Nutrition Curriculum and consists of six units: Food Choices, Basic Four, Nutrients, Digestion, Consumerism, and Recipes.

SELECTED BIBLIOGRAPHY

Grow Lab: A Complete Guide to Gardening in the Classroom, Eve Pranis and Jack Hale, 1988; 127 pp., National Gardening Association, 180 Flynn Avenue, Burlington, VT 05401.

This manual accompanies the National Gardening Association's Grow Lab, a fluorescent light gardening system enabling year-round indoor gardening in the classroom. The manual can also be purchased separately and is helpful in any indoor plant growing situation. Very well-organized and easy to read. Includes chapters on ways to integrate gardening into classroom curriculum and how to generate excitement and build support for the gardening program among parents, school administrators, and the community. A companion curriculum guide, **Grow Lab: Activities for Growing Minds**, is also available.

Kids Garden! The Anytime, Anyplace Guide To Sowing & Growing Fun, Avery Hart & Paul Mantel, 1996; 158 pp., Williamson.

Lots & lots of projects, illustrated with plain black & white drawings.

One Bean, Anne Rockwell, 1998, Walker.

Simple but thorough book on what happens to a bean when it is soaked, planted and watered. With activity and "more about beans" pages.

Plants, Claire Watts & Alexandra Parsons, 1993; 48 pp., Thompson Learning.

Part of the "Make it Work" series, this book gives all kinds of plant-related experiments & craft projects for upper elementary children.

SELECTED BIBLIOGRAPHY

Ready, Set, Grow: A Guide To Gardening With Children, Suzanne Frutig Bales, 1996; 130 pp., Macmillan.

This spiral-bound guide to gardening with kids is put out by Burpee.

Squirmy Wormy Composters by Bobbie Kalman & Janine Schaub, 1992; 32 pp., Crabtree.

Everything you could possibly want to tell a child about vermi-composting.

Vegetables & Herbs, Cecilia Fitzsimons, 1996; 32 pp., Silver Burdett Press.

Part of the "All About Food" series. History, how to grow them, how to cook them.

The Youth Gardening Book. A Complete Guide for Teachers, Parents and Youth Leaders, Lynn Ocone, 1989; 145 pp., National Gardening Association, Burlington VT.

This manual is for the adult who wants to start gardening with children, especially in big cities. It practical solutions to surmounting common problems such as lack of land, lack of money, lack of knowledge, and vandalism. A section describes numerous garden-related experiments and special activities.

Part 3. Reference books on gardening and related topics

Encyclopedia of Organic Gardening, J. I. Rodale, 1977; 145 pp., Rodale Press, Emmaus, PA 18098.

A comprehensive one-volume encyclopedia containing background material on every major aspect of vegetable gardening. It is a valuable reference on many topics, including insect control, companion planting, worm culture, composting, soils, ornamental and vegetable plants.

Guide to Wild Food, Christopher Nyerges, 1979; 239 pp., Survival News Service, P.O. Box 41834, Los Angeles, CA 90041.

An excellent, botanically accurate field guide to wild edible plants, many of which are common garden weeds in Southern California. Includes a summary of locations and uses for each plant, with practical illustrations.

How to Grow More Vegetables Than You Ever Thought Possible On Less Land Than You Can Imagine, John Jeavons, 1979; Ten Speed Press, P. O. Box 7123, Berkeley, CA 94707.

This book takes the reader step-by-step through the bio-dynamic/French intensive gardening method. Techniques are detailed in sections on bed preparation, composting, seed propagation, companion planting and insect life.

Putting Food By, Janet Green, et al, 1988;p 415 pp., The Stephen Greene Press, Lexington, MA.

A comprehensive reference book covering all aspects of food preservation, including canning, drying, freezing, pickling, and making jams and jellies.

SELECTED BIBLIOGRAPHY

Home Vegetable Gardening. 1992. University of California, Division of Natural Resources, Publication 21444. 64 pages. 6701 San Pablo Avenue, Oakland, CA 94608-1239.

Thorough overview of gardening practices and culture of individual vegetables, including recommended varieties.

Rodale's Color Handbook of Garden Insects, Anna Carr, 1979; 241 pp., Rodale Press, Emmaus, PA.

An invaluable reference describing 170 of the most common garden insects, both injurious and beneficial, plus a few other non-insects such as spider mite and snail. More than 300 excellent full-color photographs. For each insect, the following information is given: size, diagram, range within North America, description, similar insects (if any) and recommended natural controls (if a pest).

Vegetables: How to Select, Grow and Enjoy, Derek Fell, 1982; 192pp., HP Books, Tucson, AZ.

General information about vegetable gardening, plentifully illustrated with beautiful full-color photographs and useful charts. Detailed growing instructions for each vegetable, including many uncommon and foreign vegetables and many herbs. Chapters on container gardening and harvesting.

Part 4. Websites

52 Weeks in the Garden. Book by Robert Smaus, *Los Angeles Times* garden editor. California gardening throughout the year. http://www.latimes.com/garden/

The Ardent Gardener. Weekly gardening publication. http://trine.com/GardenNet/ArdentGardener/

W. Atlee Burpee & Co. Experts respond to questions. http://garden.burpee.com/

Duncraft. Bird feeders, etc., for wildlife in the garden. http://www.duncraft.com

The Garden Gate. Gardening advice. http:/www.prairienet.org/ag/garden/

Garden Net—California Gardens. Guide to gardens of the USA, California. http://trine.com/GardenNet/GardensOnline/ca.htm

Gardening Launch Pad! 1400 gardening links in 53 categories friendly to the home gardener. http://www.tpoint.net/neighbor/GLP.html

The Kinder Garden. For young gardeners-activities, interactive storybooks, gardening poems. http://aggie-horticulture.tamu.edu/kinder/index.html

SELECTED BIBLIOGRAPHY

Peter's Pond. Building water gardens.
http://reality.sgi.com/employees/peteo/

RotWeb. Website devoted to composting w/hot links.
http://net.indra.com/~topsoil/compost_Menu.html

Shepherds Garden Seeds. Order on line.
http://www.shepherdseeds.com

Sherry's Greenhouse. How to build a greenhouse, composting, worms.
http://www.teleport.com/~earth/

The Tomato Page. Recipes and nutrition tips.
http://www.tomato.org/

The Virtual Garden. Time Inc. on-line magazines—Southern living, plant encyclopedia.
http://pathfinder.com/

The Wildflower Seed Company of the Napa Valley. Specialized wildflower seed collection including one collection for California.
http://www.Wildflower-seed.com