Gardening

National 4-H Curriculum
BU-07166

Leader/Helper's Guide

For Vegetable Garden Curriculum

Garden Group Activities

Purdue University Cooperative Extension Service

REVIEWED & RECOMMENDED
National 4-H Curriculum

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FOR VEGETABLE GARDEN CURRICULUM

BU-7166

Leader's Guide

Purdue University Cooperative Extension Service
West Lafayette, Indiana

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WHAT'S INSIDE?

Leader/Helper's Guide for Vegetable Garden Curriculum

Congratulations on your decision to serve as an adult or teen helper for the Vegetable Garden Project. Your role is critical in providing opportunities for youth to learn and grow in a caring and supportive environment. This guide has been designed to provide you with activities, ideas, and content to help you with this challenging and exciting role. In Unit 2: Planting a Garden, several ideas are provided in *Activity 2b: Anyone Can Garden!* for gardening with youth who have special needs (physically-impaired or learning disabled).

Age Graded

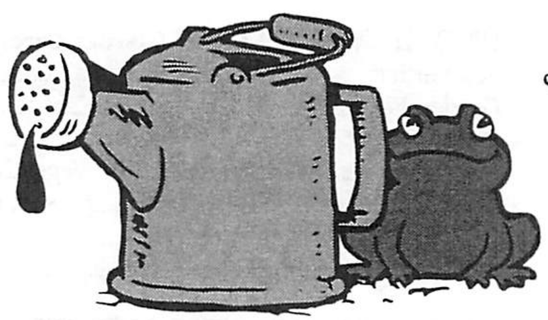
The guide is organized into four levels which correspond to the age-graded member levels as follows:

Level A: designed for 10 - 11 year olds
Level B: designed for 12 - 13 year olds
Level C: designed for 14 - 16 year olds
Level D: designed for 17 - 19 year olds

Major Categories or Units

The Leader/Helper's guide contains the same six major units, just like the Member's manuals:

- **Let's Plan! (Garden Planning)**
- **Dig In (Planting a Garden)**
- **While You Wait (Fun with Plants)**
- **Watch Out! (Garden Care)**
- **Now What? (Harvesting and Storage)**
- **Imagine That! (Careers)**



Each unit contains:
- additional background information not found in the Member's guide;
- easy-to-use reference tables; and
- group activities that can be done at club meetings, project workshops, or school or camp programs.

Other Features

- Solutions to questions posed in the *"My Discoveries"* and *"Dig Deeper"* sections of the Member's manuals can be found at the back of this manual.
- *"Definition of Terms"* and *"Resources"* can be found at the back of this manual.
- An *"Overview of Member Manual Activities"* can be found on page vii.

Developing Project and Life Skills

The Vegetable Garden curriculum is designed to help youth develop both project skills and life skills. Project skills are specific to the garden subject matter, such as learning how to plant seeds or make a compost pile. Life skills relate to the process a member undergoes when doing an activity and are useful long after the member completes the project, such as decision making.

PROJECT SKILLS

The content of the Vegetable Garden curriculum has a broader focus than previous curriculum. Rather than focusing primarily on skills related to vegetable gardening, the curriculum is designed to help youth develop project skills in six major areas:

- Planning
- Planting
- Fun with Plants
- Garden Care
- Harvesting & Storage
- Careers

LIFE SKILLS

The life skills involved in this project can be grouped into three major categories: Competency, Coping, and Contributory. The first two levels of the curriculum focus primarily on developing competency and coping life skills. Contributory life skills are introduced in Level C.

Life Skills Learned through 4-H

Competency	Coping	Contributory
Acquiring knowledge	Recognizing self worth	Applying leadership skills
Using scientific methods	Relating to others	Taking community action
Mastering technology	Making decisions	Volunteering
Making career decisions	Solving problems	Conserving the environment
Managing resources	Dealing with change	
Communicating		

Experiential Learning

"Learning by doing" is one of the main reasons 4-H has been so widely recognized and respected in the field of informal education. The Vegetable Garden curriculum follows a model known as the experiential learning process. Experiential learning is more than just doing activities. It involves discussing the activity, drawing conclusions from the activity, and applying them to the real world.

Activities in the Member's manuals are designed to help the 4-H'er work through the entire experiential learning process as they do the activity and record their answers. Group activities, found in the Leader/Helper guide, list each of the steps, along with what to do and sample questions to ask. This is useful as you help members do and process the activity.

HOW IT WORKS

Do

1. *Experience* – Begin with a concrete experience. This can be an individual or group activity that involves "doing something."

Reflect

2. *Share* – Next, get the group or individual to talk about what they experienced when they were doing the activity. Share reactions and observations. Talk freely.
   Sharing questions:
   - What did you do?
   - What happened?
   - How did you feel to ...?
   - What was most difficult? Easiest?

3. *Process* - Discuss how questions are created by the activity.
   Processing questions (Use information generated from sharing questions):
   - What problems or issues seemed to occur over and over?
   - What similar experience(s) have you had?

Apply

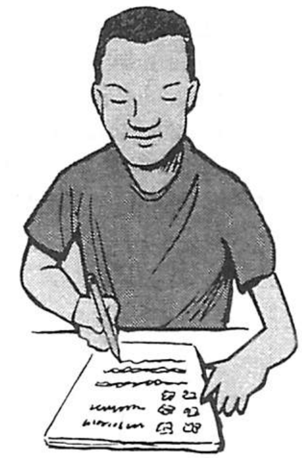
4. *Generalize* – Find general trends or common lessons in the experience. Identify the important points that apply to the "real world."
   Generalizing questions:
   - What did you learn about yourself through this activity?
   - What did you learn about making decisions (or other life skills)?
   - How do the major themes or ideas relate to real life and not just the activity?
   - How did you go about making your decision?

5. *Apply* – Talk about how the new information can be applied to everyday life or sometime in the future.
   Applying questions:
   - How can you apply what you learned (making decisions) to a new situation?
   - How will the issues raised by this activity be useful in the future?
   - How will you act differently in the future as a result of this activity?

Youth Learning Characteristics

Below you will find a list of characteristics that are common to children in four age-graded levels. Please remember, however, that children develop at their own pace, and all characteristics will not be observed in all children at the same age. But you should find this outline helpful as you work with youth of different ages. (Written by Judith Myers-Walls, Associate Professor, Child Development and Family Studies - Purdue University and adapted from *Ages and Stages of Child and Youth Development,* by Judith Myers-Walls and Jeanne Karns.)

10 – 11 Year Olds

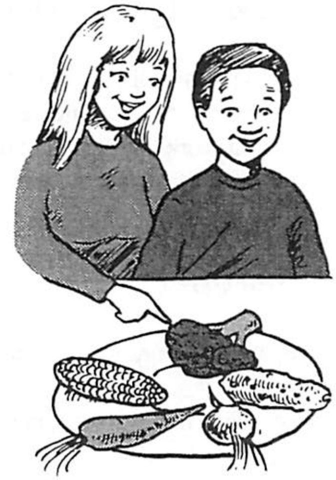


- Active, full of energy and anything but quiet. Activities should encourage physical involvement.
- Interests may change often, jumping from one thing to another. Activities divided into small pieces or steps work best.
- Fairly concrete thinkers; tend to be more attentive if they have an opportunity for hands-on learning (seeing and doing, rather than just listening).
- Just beginning to think logically and symbolically, and are beginning to understand abstract ideas. As they consider an idea, they think it is either right or wrong, fun or boring (very little middle ground).
- Look for adult approval and have a strong need to feel accepted and worthwhile. Adults should provide lots of encouragement and recognize even small successes.
- Individual evaluation is preferred over group competition. Instead of comparing success with others, youngsters prefer to know how much they have improved and what they should do better next time. They are easily embarrassed about doing either better or worse than their friend.
- Beginning to move out of the stage in which the satisfaction of completing a project often comes from pleasing the leader or parent rather than from the value of the activity itself.

12 – 13 Year Olds

- Growth spurts may begin at this age, with girls maturing faster than boys. These rapid changes may make some teens uncomfortable with their changing body images.
- As puberty approaches, there begins a roller coaster ride of hormones and emotions, presenting a major challenge to a young person's self concept.
- Faced with so many changes, they hardly know who they are. They begin to test values and identities, and seek adults who are accepting and willing to talk about values and morals.
- Desiring a sense of independence from parents, they are concerned about being liked by friends. Opinions of peers become more important than opinions of parents and other adults in the areas of dress, music, and activities.
- Moving from concrete to more abstract thinking. Ready-made solutions from adults are often rejected in favor of finding their own solutions. Small groups provide an opportunity to test ideas.
- Adults should continue to avoid comparing young people with each other, being careful not to embarrass them. They want to be part of something that is important and that provides an opportunity to develop responsibility.
- Justice and equality are important issues. Judging of projects is viewed in terms of what is fair. Ribbons are seen as reflections of the individual's self-worth instead of feedback on a specific project.

14 – 16 Year Olds



- Tend to be very concerned with themselves and their peer group. Relationship skills become a priority. Many begin dating, and acceptance by members of the opposite sex may become important.
- Since many are becoming aware of their own special abilities and talents, this is a good time for introducing them to leadership roles.
- As they begin to think about the future and make realistic plans, their vocational goals often influence the activities they select.
- Mastering abstract thinking, they imagine new ways of doing things that sometimes challenge adults.
- Set their goals based on feelings of personal need and priorities. Any goals set by others are likely to be rejected.
- Can initiate and complete tasks without supervision. Leader's role should be that of advisor/coach.

17 – 19 Year Olds

- Finishing up high school and moving on towards college, job, or marriage.
- Future plans are important as they begin making the transition to adult life. Their goals for the future influence which activities they continue.
- In most cases, they determine their own schedule and only general directions are needed when they are assigned familiar tasks.
- Close relationships develop as they become preoccupied with their need for intimacy.
- Make and carry out serious decisions, but still need adults for support and guidance.
- Adults no longer control activities, but should serve as resource people, helping to stimulate teens' thoughts.

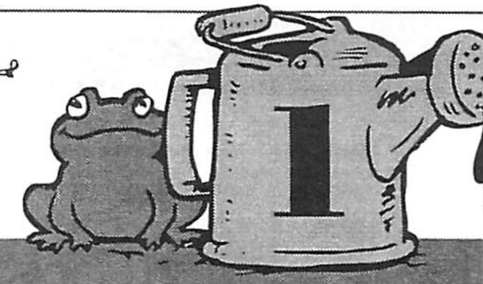
OVERVIEW of CONTENT in the
4-H VEGETABLE GARDEN CURRICULUM

	EXPLORING (6-9)	LEVEL A (10-11)	LEVEL B (12-13)	LEVEL C (14-16)	LEVEL D (17-19)	LEADER'S GUIDE
LET'S PLAN! (Garden Planning)	• Germination • Observing seeds	• When, where, and what to plant • Make a plan and layout design for a garden or container • Types of soil • Cool- and warm- season vegetables	• Changing plans to expand a garden or use a larger container or patio garden • Seed varieties • Similarities in family crops • Rotating crops • Seeds vs. cultivars ($) • Developing planting calendars	• Consider the value of broadcast planting • Consider the value of succession planting • Planning an herb garden • Plant companions • Extending the season • Soil structure/texture/ drainage • Improving soil	• Consider the value of intercropping and double cropping • More on veg. companions • Computer garden planning programs • Space-saving ideas (raised beds, vertical garden, patio garden, shelving, square foot, etc.) • Greenhouses	• Planning a garden • Soil basics • Making the most of garden space (broadcast, double cropping, succession, and intercropping planting methods)
DIG IN (Planting a Garden)	• Growing plants (carrot top, sweet potato vine, onion roots, ivy, avocado tree, peanut)	• Mark off a plot • Soil preparation • Soil mix for containers • Sowing seeds - spacing & depth • Rows vs. hills • Thinning	• Starting seeds indoors • Transplanting cultivars • Hardening off • Protecting transplants from wind, too much sun, and frost	• Broadcast planting • Succession planting • Herb companion planting • Hybrids vs. standard forms • Planting herbs • Soil nutrients/organic fertilizers • Soil management (conditioning /modifying pH)	• When and how to plant by intercropping and double cropping methods • Cultivar trials to increase production • Small garden strategies • Intensive gardening/square foot gardening	• Buying seeds, transplants • Soil preparation for garden plots and containers • Planting, thinning, and watering seeds • Transplanting cultivars for garden plots and containers • General planting hints
WHILE YOU WAIT (While You Wait)	• Water transport in plant stems (color dye celery veins; change the color of a white carnation)	• Seed germination/parts of a seed; testing for germination; plant needs • Plant parts: leaf, stem, and root form and function	• Plant properties - (phototropism, geotropism) • Plants from parts (bulbs, tubers, stems, leaf)	• Flower form and function • Self- and cross-pollination • Photosynthesis • Chlorophyll/ Chromatography • Soil pH/plant needs • pH indicators	• Pollution/acid rain/green-house effect • Biotechnology/genetic engineering/plant breeders • Diversity/seed banks • Hydroponics/food in space/NSCORT	• Summary of plant science: seeds, growing plant needs, plant cycle, roots, stems, food chain, diversity • Hydroponics
WATCH OUT (Garden Care)	• Plant needs (water and sunlight)	• Garden tools/Safety • Watering • Weeding • Mulching • Garden friends & foes • IPM	• More garden friends/pests • Preventative measures for pest control • Composting • Fertilizer (manure tea) • IPM	• Identifying insect damage • Identifying weeds • Other ways to water plants • Dealing with animal pests • Keeping records • IPM	• Identifying plant diseases • Nutrient deficiencies • Sources of nutrients • Organic vs. chemical fertilizers • Power garden tools • Pesticide safety • Pest management plan • IPM Controls	• Soil fertility • Garden equipment • Garden safety (equipment and supplies) • IPM • Managing weeds (mulching, cultivating, chemical) • Managing plant diseases: noninfectious and infectious agents (cultural and chemical control) • Managing insects (preventative practices, insecticides)
NOW WHAT? (Harvesting & Storage)	• Observe, peel, slice, and eat fruits and vegetables • Foods from plants • Other uses of plants	• When to harvest • Using the harvest (eat, store, preserve - drying pumpkin seeds) • Selling the harvest • Tool care • Cleaning up for winter	• Specialty harvest (largest, most interesting, etc.) • Storing crops • Selling the harvest • Preservation (freezing fresh and prepared foods) • Using excess harvest (what to do with too much)	• Harvesting herbs • Selling the harvest • Preservation (canning veg., pickling; dry/freeze herbs) • Storing/saving seeds • Keeping records • Growing vs. buying vegetables ($)	• Financial records; determining profits/losses • Selling the harvest/plan your own business/bank credit • Preservation (pressure canning, drying vegetables) • Winterizing power tools • After the frost plan	• Harvesting hints • How to store vegetables • Selling the harvest • Ways to preserve vegetables
IMAGINE THAT! (Careers)	N/A	• How plants are used (other than as food) • Greenhouse/garden center (workers and manager)	• Horticulture careers • Farmer (including truck, and roadside stands)	• Related Horticulture careers (soil scientist, entomologist, ecologist, etc.) • Education/teaching • Food industry careers related to vegetables	• Botanist (cultivar trials with resistant varieties) • Basic vs. applied research • Self analysis profile • Skills vs. traits • Using career resources • Exploring interests	• Summary of careers related to gardening

OVERVIEW OF ACTIVITIES
IN THE 4-H VEGETABLE GARDEN CURRICULUM

	EXPLORING (6-9)	LEVEL A (10-11)	LEVEL B (12-13)	LEVEL C (14-16)	LEVEL D (17-19)	LEADER'S GUIDE
LET'S PLAN! (Garden Planning)	• Germination • Observing seeds	**1a First You Plan** Life skill: Making decisions **1b The Second Year Garden** Life skill: Making decisions	**1a Plant-a-Transplant** Life skill: Communicating **1b Plan it Bigger** Life skill: Making decisions	**1a It's So Easy!** Life skill: Solving problems **1b Stretch it Out!** Life skill: Communicating **1c Don't Forget Herbs** Life skill: Making decisions	**1a It's In-Between!** Life skill: Conserving the environment **1b Two Crops in One!** Life skill: Volunteering **1c Make it Fun!** Life skill: Mastering technology	**1a It's Your Garden** Life skill: Making decisions **1b Not Just in Summer** Life Skill: Making decisions
DIG IN (Planting a garden)	• Growing plants from scraps (carrot tops, sweet potato vine, onion roots, ivy, avocado tree, peanut)	**2a Plant It!** Life skill: Acquiring knowledge **2b Make it Different!** Life skill: Acquiring knowledge	**2a On the Move!** Life skill: Dealing with change **2b Starting from Scratch** Life skill: Managing resources	**2a Scattering Seeds** Life skill: Solving problems **2b Keep-on Planting** Life skill: Dealing with change **2c Planting Thyme** Life skill: Acquiring knowledge	**2a All in the Row** Life skill: Dealing with change **2b Double Your Fun** Life skill: Communicating **2c There's No Room!** Life skill: Relating to others	**2a Soil Stuff** Life skill: Using scientific methods **2b Anyone Can Garden!** Life skill: Relating to others
WHILE YOU WAIT (While You Wait)	• Water transport in plant stems (color dye celery veins; change the color of a white carnation)	**3a Seeds Up Close** Life skill: Using scientific methods **3b What's It For?** Life skill: Using scientific methods	**3a A-Maze-ing Plants** Life skill: Using scientific methods **3b Not from Seeds Only** Life skill: Using scientific methods	**3a Acid Basics** Life skill: Using scientific methods **3b Getting Green** Life skill: Using scientific methods **3c Flower Power** Life skill: Acquiring knowledge	**3a The Air Up There** Life skill: Conserving the environment **3b Look Ma – No Soil!** Life skill: Using scientific methods **3c Designer Genes** Life skill: Acquiring knowledge	**3a Garden Talk Games** Life skill: Communicating **3b More Garden Talk Games** Life skill: Recognizing self-worth
WATCH OUT! (Garden Care)	• Plant needs (water and sunlight)	**4a Take Time for TLC** Life skill: Communicating **4b Gearing Up for Safety** Life skill: Relating to others	**4a Wiggly Farm Acres** Life skill: Relating to others **4b Let it Rot!** Life skill: Acquiring knowledge	**4a Be a Bug Buster** Life skill: Volunteering **4b When Animals are Pests** Life skill: Relating to others **4c What's with Weeds?** Life skill: Applying leadership skills	**4a Looking Closely** Life skill: Applying leadership skills **4b Talk about It!** Life skill: Volunteering **4c Taking Action** Life skill: Taking community action	**4a It's Tool Time** Life skill: Managing resources **4b Planting Ideas** Life skill: Conserving the environment
NOW WHAT? (Harvesting & Storage)	• Observe, peel, slice, and eat fruits and vegetables • Foods from other plants • Other uses of plants	**5a Is it Ready?** Life skill: Recognizing self-worth **5b Use it Up!** Life skill: Managing resources	**5a One of a Kind** Life skill: Recognizing self-worth **5b Too Much To Eat!** Life skill: Managing resources	**5a Lead the Way** Life skill: Applying leadership skills **5b Garden Cents$** Life skill: Managing resources **5c Let's Preserve!** Life skill: Making decisions	**5a Profit or Loss?** Life skill: Solving problems **5b Save the Best!** Life skill: Managing resources **5c Plants 'R Us** Life skill: Managing resources	**5a What Happened?** Life skill: Dealing with change **5b A Garden Journal** Life skill: Solving problems
IMAGINE THAT! (Careers)	N/A	**6a Check Out the Veggies!** Life skill: Communicating **6b At the Greenhouse** Life skill: Making career decisions	**6a What's in a Name?** Life skill: Making career decisions **6b On Your Own** Life skill: Making career decisions	**6a It's Related!** Life skill: Making career decisions **6b What about Teaching?** Life skill: Recognizing self-worth **6c Making Contacts** Life skill: Communicating	**6a All About You!** Life skill: Recognizing self-worth **6b Trials of Resistance** Life skill: Using scientific methods **6c Is it For Me?** Life skill: Making career decisions	**6a Hear the Speaker!** Life skill: Acquiring knowledge **6b On the Go!** Life skill: Making career decisions

Garden Planning



BACKGROUND INFORMATION

PREPARING FOR A VEGETABLE GARDEN

Planning is the first step toward growing a vegetable garden. Planning a garden on paper helps the gardener decide how much seed and the number of plants to buy. It also helps avoid problems and makes garden care easier during the growing season. In addition, for some vegetables, it is important to plan ahead because garden centers rarely carry seed for unusual vegetables; order these from a mail order company.

Steps to follow in planning a vegetable garden:

- Choose a site (place).
- Decide the size of garden which can be cared for easily.
- Make a list of vegetables to grow.
- Decide how much of each vegetable to grow.
- Plan on paper where each vegetable will be planted in the garden.
- Make any changes that are needed to fit everything in the garden space.
- Decide which *cultivars* (cultivated varieties) to plant.

The best place for a garden is on level, well-drained ground and in full sun; pumpkins and squash prefer planting in "hills." However, a good garden can still be grown on a less than perfect site. Most vegetables need at least 6 hours of direct sun daily. Avoid planting close to trees and shrubs because they compete with vegetables for light, water, and nutrients. It is especially important to locate a garden at least 50 feet away from walnut trees as their roots contain a toxin called juglone that kills tomato, potato, pepper, and eggplant plants.

The type of soil in a garden is very important. It should be well-drained, loose, and fertile. Heavy clay or sandy soils should have organic matter, such as well-rotted animal manure or compost, that is worked in to the soil. This helps increase the amount of air, water, and nutrients held by the soil.

When planning a vegetable garden, make a scale drawing of the garden plot, with one-half inch equal to one foot (½" = 1') such as the one illustrated below. Also, *Table 1: Vegetable Planting Guide* (in the back of this manual) will be helpful. It is best to start out small. Gardening chores, such as weeding, watering, and harvesting take time. A 50 x 20 foot garden requires at least 1 hour of care per week, not including planting and harvesting. Plan for a garden size that is manageable. The garden can always "grow" bigger next year, if desired.

To help decide which vegetables to grow in a garden, use *Table 2: These Vegetables Have Something in Common*. Group the vegetables selected according to their growth requirements, such as size and growing season.

- Vegetables will receive maximum sunlight if rows are oriented along the east to west axis of a garden.
- Tall vegetables, such as sweet corn, pole beans, peas, and tomatoes should be placed to the

GARDEN PLANNING SHEET

Vegetable List

Spinach
Lettuce
Radish
Beets
Onions
Carrots
Snap beans
Tomatoes
Corn
Broccoli
Cabbage

GARDEN PLAN (20 by 50 feet)

1 ft.	Spinach (Mar. 20, 1/2 oz.)	Lettuce (March 20, 1 pkt.)	Radishes[1]	Beets (Apr. 1, 1/2 oz.) [2]
2 ft.	Onions (Apr. 1, 1/2 lb. sets)	Carrots (Apr. 10, 1/4 oz.)		
3 ft.	Snap beans (May 10, 1/4 lb.)	Snap beans (May 25, 1/4 lb.)		
3 ft.	Snap beans (June 10, 1/4 lb.)	Tomatoes (May 15, 8 plants)		
3 ft.	Corn (May 10, 1/2 pkt.)	Corn (May 25, 1/2 pkt.)	Corn (June 10, 1/2 pkt.)	
3 ft.	Corn (May 10, 1/2 pkt.)	Corn (May 25, 1/2 pkt.)	Corn (June 10, 1/2 pkt.)	
2 ft.	Corn (May 10, 1/2 pkt.)	Corn (May 25, 1/2 pkt.)	Corn (June 10, 1/2 pkt.)	

[1] *(Mar. 20, 1 pkt.)*
[2] *Replant this row to late crops such as snap beans, carrots, broccoli, cabbage, radishes, spinach, lettuce.*

Scale 1/2 inch = 1 foot

north end of the garden to avoid shading shorter plants during the growing season.
- Cool season plants, such as broccoli, lettuce, and radishes should be grown as spring and fall crops.
- Warm season plants, such as tomatoes, pumpkins, and corn should be grown from late spring through early fall.
- Note that sweet corn should be planted together in three or more short rows rather than in long, single rows to allow better pollination.

Once the vegetables are grouped together, decide how much of each to grow. Look in *Table 1: Vegetable Planting Guide* for suggested spacing requirements and a planting date for each crop. Write this information next to each vegetable on a garden planning sheet. (See the Garden Planning Sheet illustration as an example.) The space between row widths should be at least 3 feet, if weed growth will be controlled by using a garden tiller. Otherwise, use the spacing recommended for each plant. Try to rotate crops so that the same plants are not placed in the same location year after year. This will help prevent disease and insect problems. (See Garden member manual *Level B: Activity 1a* for a sample crop rotation plan.)

Do not be surprised if it is necessary to grow less than what was planned or if the garden becomes bigger.
- If garden space is limited, look for compact cultivars (cultivated varieties) such as bush type squash and patio tomatoes.
- Gardens can also be grown in containers such as wooden barrels, planter boxes, bushel baskets, and tubs.
- There are also several gardening techniques to use to stretch the available space. Information about these techniques is discussed in this unit (see *Making the Most of Garden Space*)
- Stretch the harvest of most vegetables by planting in succession, instead of all at once. For example, sow carrots on April 10 and again every two weeks. This way there will be a continuous supply of carrots when needed.
- When cool season crops are ready for harvest, be prepared to plant a vegetable that can be grown during summer and/or as a fall vegetable. For example, after spring peas have been harvested, consider planting carrots or beans as a replacement. Cool season plants can be replanted in August and September for a fall harvest.

MAKING THE MOST OF GARDEN SPACE

Planting crops in single rows is maily for ease of care and harvest. However, this is not the only method of planting vegetables. Other planting methods include:
- broadcasting
- succession planting
- double-cropping, and
- intercropping.

These methods also represent four ways to maximize the use of garden space; they are discussed below. It is important for gardeners to experiment to determine which crop grows well under different planting methods.

Broadcast

For ease of planting, block out a wide row about 2 to 3 feet across and broadcast or scatter seeds within this area. Broadcast planting is used for crops that can be eaten when very young. For example: lettuce, spinach, radish, and onions will need to be thinned shortly after they germinate. Particular attention must be given to thinning plants properly when planted by this method. The thinnings of all these vegetables can be tossed into a salad.

Succession Planting

Planting in succession or succeeding intervals is a good way to stretch harvests so that a small quantity of vegetables is maturing throughout the growing season. Almost any crop can be planted in succession. Try vegetables that are grown for fresh use, such as radish, cabbage, carrot, bean, sweet corn, squash, and melon. Plant at intervals of about 7 to 14 days.

Advantages of succession crops:
- There is more organic matter for earthworms and soil life when a second and/or third crop is turned under after the harvest.
- Soil does not sit by idly in the sun. Since it is shaded by the new growth, it retains moisture and weeds are blocked out, too.
- Some pests and diseases can be avoided, if they prefer cool soils.
- It is easier to store some crops, such as carrots, beets, turnips, and rutabagas late in the season because they mature when it's already cool.
- There may be more time available to give extra attention and TLC to second and third crops that may not have been available in the spring.
- It is satisfying to get a new crop of beans or broccoli when other gardener's wish they had some to pick.

Double-Cropping

Doublecropping is growing two or more different crops in the same spot in one growing season. For example, if a spring crop of peas, lettuce, cauliflower, or broccoli is planted, it will mature and can be harvested by early summer. After the harvest, remove and discard the plants. Refertilize the soil with one to two pounds of 12-12-12 fertilizer (or similar analysis) per 100 square feet. Cultivate and then sow a warm season crop, such as summer squash, beans, Swiss chard, or carrots. Cultivars that mature quickly should be selected for the summer planting; there will not be quite as long a growing season as for vegetables that are planted in midspring.

Intercropping

Intercropping is the practice of planting two different vegetables within a row. Usually one vegetable matures quickly and is ready for harvest by the time the other crop in the row requires more room for growth.

Lettuce matures quickly and is a good vegetable to plant between onions, cabbage, broccoli, peppers, eggplant, and many other vegetables. Many leafy crops and/or root crops can be successfully intercropped. Leafy vegetables require space above ground while root crops need below-ground space.

Companion planting is related to the intercropping method; herbs and flowers, such as marigolds, are "mixed in" with vegetable plants in a garden. Such plant companions may be effective in repelling pests or attracting pests away from vegetables. How this works is not exactly known, and it has not been scientifically proven by research, but companion plantings may:

- produce odors that confuse or deter pests
- serve as trap crops that draw pest insects away from other plants,
- create a habitat for beneficial insects,
- provide food to sustain beneficial insects as they search for pests, and
- mask or hide a crop from pests.

TABLE 2: These vegetables have something in common

	Warm season	Cool season	Bush	Vine	Pole climbing	Cabbage family	Gourd family	Nightshade family	Root crop	Underground crop	Used for greens	3' Tall
Beans	X		X*		X							X
Beets		X							X			
Broccoli		X				X						
Brussels sprouts		X				X						
Cabbage		X				X						
Carrot									X			
Cauliflower		X				X						
Cucumber	X		X*	X*			X					
Eggplant	X							X				
Endive		X									X	
Kale		X				X					X	
Kohlrabi		X				X					X	
Lettuce		X									X	
Muskmelon	X		X*			X						
New Zealand spinach	X										X	
Okra	X											
Onions										X		
Parsnips		X							X			
Peas		X			X							X*
Pepper	X							X				
Potato		X						X		X		
Pumpkin	X						X					
Radish		X				X			X			
Rutabaga						X			X			
Spinach		X									X	
Squash, summer	X		X*	X*			X					
Squash, winter	X		X*	X*			X					
Swiss chard	X										X	
Sweet corn	X											X
Tomato	X							X				X
Turnips		X				X			X			
Watermelon	X		X*	X*			X					

*Certain varieties have this characteristic.

It's your Garden!

Project Skill: Taking responsibility for a garden
Life Skill: Making decisions

Materials:
- paper
- pencil
- index cards or small pieces of paper
- container for cards or paper

Time Required:
20 to 30 minutes

Preparation before Meeting:
- Write one discussion question on an index card; add other questions you want to discuss with the group, if appropriate; and
- Consider having two or three older youth available for role-playing with younger youth.

EXPERIENCE

1. Tell youth that this activity is about understanding and accepting the responsibilities of taking care of a garden.
2. Start a discussion by having youth choose one question card and asking others for a response.
3. If there is time, consider having pairs of youth role-play how brothers and sisters might argue about something related to the family garden. Ask each pair to discuss a different question for approximately 3 to 5 minutes. There could be an option of having others observe the role-plays. Remind observers that they may smile and laugh but not talk during the role-plays.
4. Review some rules for healthy disagreements:
   - Talk honestly about what is bothering you; do not attack the other person.
   - Start talking about what is bothering you before you get really angry about it.
   - If anyone is really angry, take time to cool down.
   - Try to be a good listener and listen extra hard to hear what the other person is saying. Stay on the topic or problem; do not let other topics that have nothing to do with the problem get discussed.
   - Realize that you do not always have to be right; if you are wrong, simply admit it and go on.

SHARE

- *How did you decide who would have the main responsibility for taking care of a garden?*
- *How did you feel when you talked about doing daily chores in the garden?*

PROCESS

- *What are the responsibilities for taking care of a garden? Who is responsible?*
- *What happens when a person does not follow through with his/her responsibilities?*

GENERALIZE

- *How will taking good care of the garden every day help you become more responsible?*
- *What kind of other decisions have you made that deal with taking responsibility? What happened?*

APPLY

- *The next time you make a decision, what will you do differently?*
- *How can you gather information to make a decision in the future?*

Discussion Questions

- Why do you want to have a garden?
- What do you think you will learn by growing a garden?
- What do you already know about gardens?
- Who do you know who has a garden?
- What makes a garden?
- What special needs do gardens have?
- Where should a garden be placed?
- How will you decide what to plant?
- Where can seeds be purchased?
- How will you decide which cultivars to purchase?
- Where can mulch and fertilizer be purchased?
- How often does a garden have to be tended?
- Who will do the weeding and watering? How?
- How can you keep rabbits out of the garden?
- What other animal pests can be a problem for the garden?
- Who could be called if help is needed (for example, identifying a plant disease, etc.)?
- What garden tool and supplies are needed?
- Where can garden supplies be purchased?
- Where will you store garden tools?
- Who cleans up garden tools?
- How much time will you and your family devote each day to taking care of a garden?
- What will you do with the vegetables you harvest?
- If you go on vacation, who will take care of the garden?
- If you forget to weed or water, who will take care of your garden?
- What should you do if frost is predicted and your plants are growing?
- What are some safety ideas you should think about when gardening?

Not Just in Summer

Project Skill: Making a year-long calendar plan
Life Skill: Making decisions

Materials:
- paper
- pencil
- regular one-year calendar
- copies of *Garden Management Practices* handout
- copies of *12-Month Garden Calendar* handout

Time Required:
30 minutes

Preparation before Meeting:
- Photocopy enough copies for everyone to have a copy of the *Garden Management Practices* handout and the *12-Month Garden Calendar* handout.

A person who is organized has a better chance of getting things done than the person who waits until the last minute. Having a garden may seem that it is just something to take care of in the growing season, but proper garden management throughout the year is important to the garden's soil fertility and the productivity of the garden.

EXPERIENCE

1. Tell youth that the activity is about developing a garden calendar. A garden calendar is a valuable tool to use in managing a garden, as well as to keep the gardener organized.
2. Have youth check the practices they already follow in the *Garden Management Practices* handout.
3. Discuss how to fill in the *12-Month Garden Calendar* for when and where youth will follow the garden practices they checked.

SHARE

- *What did you learn about planning a calendar?*
- *What did you like about making decisions and planning ahead? Dislike?*

PROCESS

- *Why is it important to plan ahead for your garden?*
- *What could happen if you didn't plan ahead?*

GENERALIZE

- *What would cause you to change your plan and/or start a new one?*
- *How would planning and organizing something else in your own year help you?*

APPLY

- *How will you use what you learned in this activity about making decisions?*
- *How will you use your garden calendar in the future?*

12 MONTH GARDEN CALENDAR Year____

JANUARY	FEBRUARY	MARCH
APRIL	**MAY**	**JUNE**
JULY	**AUGUST**	**SEPTEMBER**
OCTOBER	**NOVEMBER**	**DECEMBER**

GARDEN MANAGEMENT PRACTICES

Plan the Garden

____ 1. Know the first and last frost dates.
____ 2. Know the growing days prior to your exhibit or show when your harvest must be ready.
____ 3. Decide which vegetables you want to show at the exhibit or show.
____ 4. Count back on the calendar – when the exhibit or show starts – number of days for each vegetable cultivar. Allow one week more.
____ 5. Use *Table 1: Vegetable Planting Guide* at the back of your 4-H Vegetable Garden manual so you will know seed spacing needs.

Know the Garden's Soil Type

____ 1. Identify clay, muck, sandy loam, clay loam, etc.
____ 2. Take a soil sample and send it to a lab for analysis.
____ 3. Follow the recommendations from the lab analysis report, such as adding certain soil amendments to your garden's soil.

Soil Amendments Information

____ 1. Make a compost pile.
____ 2. Know the various types of mulch and where to purchase.
____ 3. Understand when to add compost, mulch, and fertilizers.

Seed Information

____ 1. Decide on purchasing seed packets or bulk seeds.
____ 2. Decide which seeds will be started indoors.
____ 3. Purchase transplants from a reputable source.
____ 4. Know the variety name, and record it in a garden journal or on a sheet of paper so it will not be lost.
____ 5. Purchase seeds or transplants from seed catalog, garden centers, feed stores, greenhouses, or at a farmer's market.
____ 6. Use *Table 1: Vegetable Planting Guide* at the back of your 4-H Vegetable Garden manual so you will know the quantity of seeds and transplants that need to be purchased.

Fertilizer Information

____ 1. Know that fertilizer packages may have three (3) numbers, such as 5-10-5, where:
- the first number stands for nitrogen, which is good for growth and green leaves;
- the second number stands for phosphorus, which is good for roots and fruit development; and
- the third number stands for potassium (or potash), which is good for overall plant functions.

____ 2. Know the difference between organic and inorganic (chemical) fertilizers.
____ 3. Decide if you need rapid grow formulas for transplants.
____ 4. Use whatever fits your needs.

When to Plant

____ 1. Know how to identify when the ground is workable.
____ 2. Be aware of when the ground warms up.
____ 3. Remove a garden cover that was placed on the garden after the growing season.
____ 4. Refer back to numbers 1 and 2 in Plan the Garden above.

Garden Safety

____ 1. Follow safety tips for equipment, tool, and supplies as discussed in the *Garden Care* section (Unit 4) of each Vegetable Garden manual.
____ 2. Use owner's instruction manuals for power-machinery.

Weather Conditions

____ 1. Understand how weather affects the garden.
____ 2. Know what to do for frost conditions, cold nights, rain, wind, and hot and dry weather.

Pest Program

____ 1. Use the information about insect pests, animal pests, and plant diseases as discussed in the *Garden Care* section (Unit 4) of each Vegetable Garden manual.
____ 2. Understand how to implement an Integrated Pest Management Program (IPM) in your garden. A healthy garden is the best defense.

Harvest Time for the Exhibit or Show

____ 1. Know what to show.
____ 2. Know how many of each vegetable should be on a plate.
____ 3. Have your record sheet signed by the leader.
____ 4. Refer to the *4-H Garden Exhibits* and *Preparing 4-H Vegetables for Exhibits,* both of which are supplemental to each manual.

End of Season Management

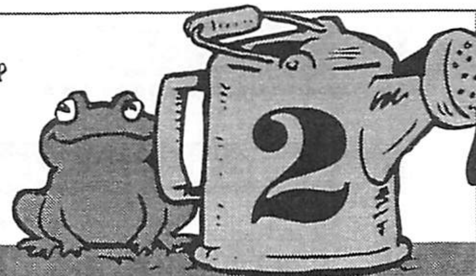
____ 1. Clean garden of leftover debris.
____ 2. Clean tools before storing them.
____ 3. Cover the garden.

12 MONTH GARDEN CALENDAR

Year______

JANUARY	FEBRUARY	MARCH
APRIL	**MAY**	**JUNE**
JULY	**AUGUST**	**SEPTEMBER**
OCTOBER	**NOVEMBER**	**DECEMBER**

Planting a Garden



BACKGROUND INFORMATION

SOIL BASICS

Soil is a complex system, composed of living and non-living materials. It helps provide plants with:
- support,
- nutrients,
- water, and
- air.

Non-living Components: Minerals
Soil takes a long time to develop. It can take up to 20,000 years to make 2.5 cm (one inch) of topsoil because rocks must be broken down into smaller and smaller particles. Living and non-living components interact, combine, and change over the years to form soil.

The particles of rock that are present in soil range in size from large, coarse sand particles to fine clay particles. It is the proportion of these different-sized particles that affects the amount of:
- air,
- water, and
- nutrients available in the soil.

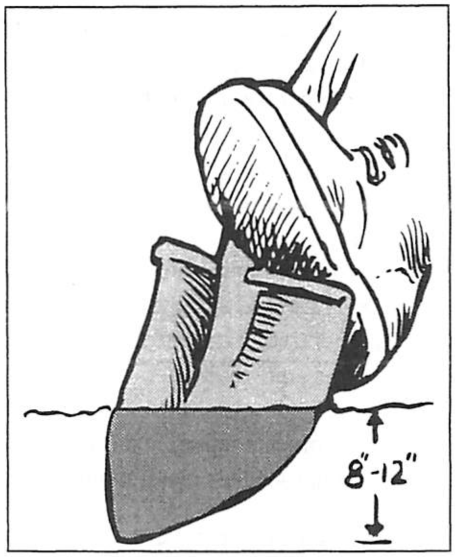
The proportion of these particles also determines how the soil "behaves."

Living Components: Organic Matter
In addition to the non-living mineral particle component of soil, there is another component that is just as important – organic matter. *Organic matter* includes the remains and waste products of living things. Plants and animals are being continuously decomposed by:
- bacteria,
- fungi, and
- other decomposers in the soil.

The once-living remains of plants and animals must be returned to the Earth to provide nutrients for new life. When completely decomposed, these materials form humus. *Humus* is dark, crumbly, and spongy-textured. It functions to:
- provide the majority of nutrients used by plants,
- help retain soil moisture, and
- provide good aeration, drainage, and a loose crumbly structure for plant roots to grow and thrive in.

Plant roots also help make soil by:
- exchanging nutrients,
- slowing down water loss, and
- aerating soil particles.

Many animals, including ants, earthworms, and mice also play important roles in the soil ecosystem by:
- adding nutrients from their waste, and
- loosening and mixing the soil.



The ideal soil for growing most plants contains a balance of different-sized particles (sand, clay, and silt) along with a high proportion of organic matter. This type of soil is called *loam*. Unfortunately, not all soils are similar to loam. Adding organic matter can help either soil with too much clay or sand.

ROCK PARTICLES	CHARACTERISTICS IN SOIL
Sand	• largest, coarsest soil particle • allows for large pore spaces between particles • water and nutrients drain through sand very quickly
Clay	• extremely fine particles • allows little pore space between particles, so they cling together • water and nutrients move through clay very slowly; drainage problem may occur
Silt	• particles are in-between the sizes of sand and clay particles • water and nutrients move through silt slowly

Soil with too much:	May have these problems:
Clay	• slow warming in the spring • poor drainage, resulting in lack of air for roots • slow seed germination because of heavy soil texture • poor growth because of poor root penetration
Sand	• poor growth because nutrients and water drain too quickly

It is recommended that a special potting mix be used for indoor gardens. Potting mixes serve some of the functions of soil. It is often recommended for indoor growing because it provides many of the advantages of soil without some of the drawbacks. The biggest advantage of potting mixes is that they are sterile; no live organisms or disease organisms are present.

Most commercial potting mixes consist of:

- peat moss – to hold onto moisture;
- perlite and/or vermiculite – to provide good drainage and a texture lighter than most soils; and
- some nutrients (fertilizer) – to supplement potting mix since garden soil usually contains more nutrients.

BUYING SEEDS

Vegetable seed can be purchased at local garden centers or through mail order catalogs.

- Garden centers usually sell a good choice of seeds and transplants.
- Mail order catalogs offer a larger selection of cultivars, but it is necessary to order early to allow enough time for delivery.
- Fresh seed should be ordered each year; old seed or seed saved from last year's garden may not be dependable.
- Recommended disease-resistant cultivars should be purchased whenever possible.

BUYING TRANSPLANTS

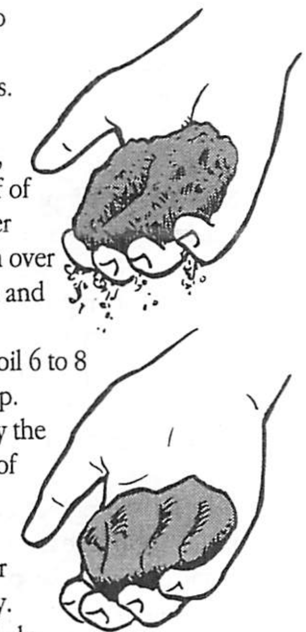
Many plants, such as carrots, beans, and sweet corn can be planted from seed directly into the garden. Other vegetables, such as tomato, broccoli, cabbage, cauliflower, eggplant, and pepper take too long to grow if planted directly from seed in the garden. Therefore, most gardeners buy transplants from their local garden center or grow their own.

- Buy only sturdy, healthy transplants of known cultivars.
- Stocky, short plants make better transplants than tall, leggy ones.
- Plants grown in plastic or clay pots should be removed from their containers prior to planting. Those in individual peat pots can be planted pot and all, because the peat will break down in the soil; it is helpful to poke a few holes in the bottom of the peat pot. Be sure that peat pots are covered completely by soil and are moist when planted.

SOIL PREPARATION

Preparing garden soil is important for an abundant, healthy crop.

- The soil should be worked up in the fall or early spring. Fall preparation is preferred if the garden site is not subject to severe erosion.
- Be sure the soil is dry enough to work before getting started. If a soil ball crumbles with your fingers, it's ready to work. If it clings, it is still too wet. If soil that is too wet is worked up, it will remain hard and cloddy for weeks. (See illustration.)
- A garden can be plowed, disked, rototilled, or spaded. To spade, shatter and slice each shovelful so the soil is crumbly. Finish by leveling and smoothing with a rake.
- Make final soil preparation, including fertilization, in the area you have planned for a certain crop just before that crop is planted. This spreads out the work and ensures that the soil is soft and easy to plant. This is especially true if soil is worked up in the fall. Wait until spring to apply fertilizers.



To fertilize, spread half of the fertilizer application over the garden and work the fertilized soil 6 to 8 inches deep. Then apply the other half of the fertilizer and disk or rake lightly. (*Hint:* To help measure fertilizer, remember that 2 cups of dry fertilizer equals 1 pound.) Heavy clay or sandy soils pose special problems. Improve soil by rototilling 4 inches of well-rotted manure, compost, peat moss, or other organic matter into the garden soil.

For Container Gardening

Good "soil," or *growing medium*, for container gardening should be quite different from typical garden soil. The "soil" in containers must provide excellent drainage and aeration. If typical garden soil is used in containers, it will not provide the best possible root growth conditions because it is too compact.

"Soil" for gardening in containers can be prepared by thoroughly mixing *equal volumes* of:
- garden soil,
- organic matter such as sphagnum peat moss, and
- a fast draining material such as vermiculite, perlite, or sand.

Also include fertilizer in the mix, such as:
- 1/2 cup of 10-10-10, or
- 5 to 15 cups composted manure per bushel of mix.

Many commercial potting mixes are available which have some of these components, but they usually lack soil. Thus, if desired, a gardener could make a growing medium mixture using:
- 1/3 soil, and
- 2/3 commercial potting mix.

PLANTING AND THINNING

Mark the row to be planted by stretching a heavy cord between stakes at either end of the row. Then, make a furrow for the seed using the hoe handle if planting fine seeds, and using the hoe blade for larger seeds. (See illustration.) Refer to *Table 1: Vegetable Planting Guide* for proper seed depth and spacing. Beware that one of the most common errors in gardening is planting too deeply.
- Small seeds should be barely covered.
- Larger seeds should be planted two times deeper than their largest diameter.
- Consult the planting plan for the correct distance between rows for each crop. Sow seed evenly and slightly thicker than the plants will finally stand. Then gently cover seeds with soil.

If the garden soil has a high level of clay, soil crusting may make it difficult for seedlings to emerge from the soil. To help keep the soil moist and prevent crusting, try applying vermiculite or finished compost directly over the seed. This will also help mark the planting row.

Rows are only one way to plant a garden. Crops may also be planted by:
- succession,
- intercropping, and
- double cropping methods.

See *Making the Most of Garden Space* in Unit 1 of this manual.

Once seeds begin to germinate, it is important for them to remain moist. If rains do not keep soil moist after seeding, water the seedbed or cover with weathered straw, plastic, or a board to retain moisture and aid germination.

For Container Gardening

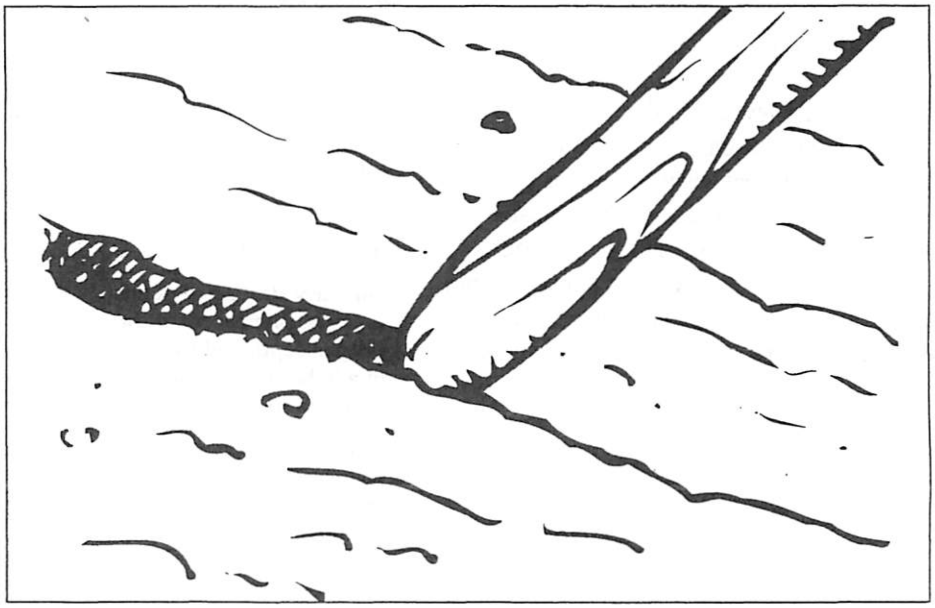
Planting in a container is somewhat similar to conventional garden planting.

- Depending on the size and shape of the container, seeds may be placed in rows or clusters.
- Avoid crowding too many plants together in a container, but spacing can be closer than in a typical garden situation.
- Soil will dry out faster in containers than in a garden, so check for drynesss frequently.

If *regular and frequent watering and fertilization* are provided, quite a large plant can grow with only a relatively small root system, compared to the same plant in a conventional garden.

Seeds need to be thinned after they germinate to achieve the proper spacing. Correct spacing allows plants to have maximum benefits of light, moisture and soil nutrition – all needed for plant growth. Refer to Table 1: *Vegetable Planting Guide* for the correct distance between plants.

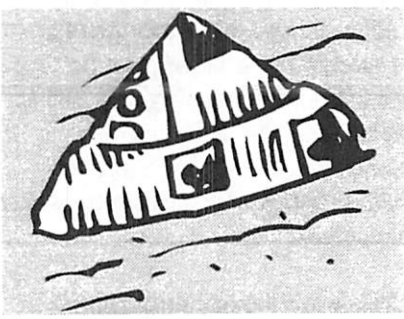
Thin plants when they are small and when the soil is moist. Prevent injury to other plants by grasping plants to be thinned at the soil line and pulling gently. Do not pull up the roots if other vegetables will be damaged; simply use scissors or a knife to cut off the plants to be thinned at the soil line.



TRANSPLANTING

Transplants should be planted in late afternoon or early evening, when the wind has decreased.

- Mark the rows as for planting seeds.
- Dig a hole for each plant. The hole should be about two times wider and deeper than the soil ball. (Refer to *Table 1: Vegetable Planting Guide* for the correct distances between plants.)
- Set each plant slightly deeper than it grew before.
- Transplants growing in peat pots must have the top of the pot covered; otherwise, the rim of the pot might act like a wick and dry out the root zone.



- Place soil around the roots and add 1 cup of soluble starter fertilizer solution. Make a starter solution by dissolving 1 tablespoonful of a high phosphorus, water soluble fertilizer in a gallon of water.
- Finish filling the hole and leave a small soil basin around each plant.

If the next few days call for sunshine, cover the new transplants with newspaper tents to prevent wilting. (See illustration.) When frost is predicted, cover tomatoes, peppers and eggplants with newspaper tents, cardboard boxes or blankets. Do not cover plants with metal containers, glass jars or plastic sheets; they conduct cold and can cause damage.

WATERING

Vegetable plants need to have water regularly throughout the season. Provide the water if it doesn't rain. The most common watering method is with a hose and sprinkler.

- Water thoroughly so roots develop deeply in the soil.
- Vegetables require 1 to 1 ½ inches of water per week, although plants on sandy soils should be watered more frequently.
- Water in the morning or early afternoon so plant foliage dries by evening; this helps prevent leaf diseases.
- Mark metal cans 1 to 1 ½ inches from the bottom of the can. Place these in the garden when running the sprinkler so it will show how much water was applied. Or, dig down in the soil to a depth of 6 inches to see if water has penetrated to that depth.

A more water-efficient way to water is with a drip, trickle, or soaker hose system.

Advantages of these "under-plant" systems, include that they:

- reduce water loss due to evaporation because they do not wet the entire soil surface and the plants,
- place the water right on the plant roots, and
- reduce disease problems by keeping the plant leaves dry.

For Container Gardening

Proper watering of container vegetables requires that the container have a drain hole in the bottom to allow excess water to move away. *Caution:* Vegetables in containers require more frequent watering than similar plants in a conventional garden.

- For small containers, be sure to water thoroughly, or until water begins to run out the bottom drain hole.
- Larger (especially deeper) containers may be well-watered before water drains out, but avoid light watering which only wets the surface of the growing mix. Be sure water penetrates the mix to an 8-12 inch depth with each watering.

HELPFUL PLANTING HINTS

Buy top quality seed of well-adapted species and cultivars.	• The use of well-adapted, disease-resistant cultivars is the simplest and most efficient method of controlling many diseases. • In general, gardeners are encouraged not to save their own seed. It is better to purchase seed from reputable seed dealers since seed produced on garden vegetables may not reproduce desirable characteristics.
Buy treated seed to help protect the seed if it sits in wet and/or cold soil prior to germination.	• The packet will state if the seed has been treated. • Use gloves when handling treated seeds.
For early starting of plants indoors, plant seeds at the proper depth and spacing, in a light, well drained, pasteurized soil mix.	• Be careful to avoid overcrowding and planting seeds too deeply. • Do not over water seedlings because this can result in seedling death from damping-off disease.
Buy disease-free, vigorously growing plants from a reputable establishment.	• Vigorous growth is indicated by the presence of newly formed buds, leaves or shoots. • Transplants should be free of yellowing, brown or black spots, and any leaf or stem injuries. • Roots should be white, not mushy, brown or black.

See *Unit 4: Garden Care* in this manual for information on how to protect the garden when frost/freeze warnings are announced.

Soil Stuff

Project Skill: Understanding soil
Life Skill: Using scientific methods

Materials:
- 2 measuring cups
- container with holes in the bottom for draining
- 2 to 3 cups of soil samples, including clay, sand, humus, potting soil, etc.
- organic matter, optional
- newspaper
- water
- paper
- pencil
- stopwatch or watch which indicates seconds

Time Required:
30 minutes

Preparation before Meeting:
- Gather different soil samples.
- Let youth know ahead of time that they can bring in a sample of their gardens' soil, if possible.

Soil is a complex living system; living and non-living materials make up soil. This activity will be investigating the particles of rock present in soil and how they affect soil texture. The particles in soil range in size from large, coarse sand to fine clay particles.

The proportion of the different types of particles (sand, clay, and silt) in soil affects the amount of air, water, and nutrients available in a soil. For example:
- Sand is the largest and coarsest soil particle. Since the pore space between sand particles are large, water and nutrients drain through very quickly. Soil with a high proportion of sand feels gritty; it crumbles easily.
- Clay particles on the other hand are extremely fine; they cling together. Since the pore spaces between clay particles are so tiny, water moves through very slowly; nutrients more slowly. Soil with a high proportion of clay feels heavy, and it is slippery when wet. It will stick together and make a tight ball.
- Silt particles are between the sizes of sand and clay particles; the same for silt properties.

EXPERIENCE

1. Tell youth that this activity is about exploring how different soils drain water and the importance of adding compost to soil. Explain that sometimes soil can be hard and compact. Since the ability to absorb water will be less, plants do not grow as well. Garden soil needs to be "fluffy." Adding organic matter is an easy way to change the soil's texture.

2. Ask youth to look at the soil samples and describe the general appearance, color, smell, and how they feel (texture).

clay particles (less than .002mm)

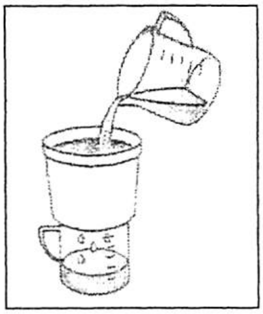
silt particles (.05mm to .002mm)

sand particles (2mm to .05mm)

3. Ask youth to predict which soil samples might drain fastest, and have them explain why they made each prediction. Then tell youth to write the predictions down on a sheet of paper.

4. Set up the experiment as per the illustration.

5. Have youth pour approximately 1 cup of water into each soil sample and see how much water drains out of the soil in 2 minutes. Record this amount. Then let water drain out completely.



6. Repeat with other soil samples.

SHARE

- *What did you expect would happen in this experiment?*
  You would expect that clay type soils drain the slowest; sand the fastest; silt, loam and humus in-between.
- *How did your soil sample from your garden compare with the other samples tested?*

PROCESS

- *Why do some soils drain better than others?*
  Each component of soil contributes to the properties of the soil sample. Large particles (such as sand) allow better drainage; clay binds soil together because the particles are so tiny. Adding organic matter to soil increases its water holding capacity.
- *Why would someone want to use potting soil instead of natural soil?*
  Container gardens require a soilless mix because natural soil is too heavy or compact for container gardening.

GENERALIZE

- *What other materials drain well? How are they like soil?*
  Other materials that drain well include coffee filters, kitchen colanders, fish nets, sieves, etc. All of these examples have pores or holes in them so water drains out.
- *What other experiments using the scientific method can you do to discover something about your garden?*
  Cultivar trails and different methods for managing insect pests are two examples.

APPLY

- *What will you do with your garden's soil to improve it?*
  Add organic matter, such as compost, manure, peat moss, and wood products such as sawdust and ground-up bark.
- *Describe an experiment that might help you learn something in another area in your life.*

Anyone Can Garden!

Project Skill: Planting gardens for special needs
Life Skill: Relating to others

Everyone can be a gardener, and everyone's garden will be different. A traditional garden is not the only kind of garden that is available to those who want to garden. A garden can be tomato plants in a barrel or green peppers in a large flower pot. The type of garden someone has depends on the gardener's needs, abilities, and desires.

Size, indoor/outdoor, or type of container are not the only differences a garden can have. How a gardener mixes vegetables, herbs, and flowers in a garden provides endless possibilities. In addition, specific types of a garden, such as a thematic garden, provide all sorts of learning opportunities. Some examples include:

- a Native American garden, with beans, squash, and corn planted together in hills;
- a regional or ethnic garden (oriental vegetables, collards, blackeye peas, tomatillos, etc.);
- a nutritional snack food garden (pumpkins for pumpkin bread; carrots for a low-fat carrot cake; carrots, radishes, celery, peppers, and cucumbers for raw veggies and dip; salads, watermelons, and stuffed tomatoes, etc.);
- an unusual garden (unusual cultivars, such as giant carrots, purple snap beans, and others that have odd shapes, sizes, colors, and aromas);
- an alphabet garden, with different vegetables, herbs, and flowers one for each letter of the alphabet; and
- a pizza garden planted in a circle with a "missing piece" and growing tomatoes, onions, pepper plants and herbs, such as basil, oregano, and thyme.

In some situations, it may be more practical to have a community or youth garden, especially if there is little or no suitable space to grow vegetables. Contact your local county extension office to find out if your county has a community garden program. Many community groups, parks, and cities operate community garden programs. These groups develop vacant lots and park land into fertile gardens. Usually the area is divided into small garden lots for neighboring families and/or individuals to garden. The soil is usually plowed or tilled and readied for planting; a small fee may be charged to cover operational expenses.

Some gardeners may be disabled. These gardeners have the same options, but in addition, the following hints for planning an outdoor garden are helpful:

- Location – is the garden accessible? easy to tend to? close to water?
- Size – is it appropriate size? the largest is not always the best;
- Shade/shelter – is there a need for shade and/or shelter for the gardener?
- Slope – level is best, but it is not essential; are stairs a problem?
- Containers – what type of containers will provide additional growing space, on the ground or table top containers?
- Support aids – are handrails, grips and other aids needed?
- Pathways – are these wide and big enough for easy movement?
- Water supply – is it close? Containers or raised beds tend to dry out quickly.

In this activity, any container garden could be planned and planted. Specifically, a "pillow pak" is used for growing plants in plastic bags; they resemble pillows when filled with soil. A container garden is adaptable for every youth. They need no soil, use very little space, and can be inexpensive. All that is needed is 6- to 8-hours of sun each day!

Materials:

for a pillow pak garden:

- garbage bags, freezer bags, or heavy polyethylene bags (one for each youth)
- transplants (see step #4)
- water
- premixed growing medium (a combination of sphagnum peat moss, vermiculite and fertilizer); a 4-quart bag provides enough mix for 15 half-pints
- if desired, youth can mix their own potting medium. To make a bushel of mix, combine:
  - ½ bushel vermiculite #2 size,
  - ½ bushel peat moss,
  - 5 tablespoons ground limestone, and
  - 2 tablespoons powdered superphosphate (0-20-0) fertilizer

  OR

  - 4 tablespoons rock phosphate, and
  - 10 tablespoons (4-2-4) fertilizer, preferably organic

Time Required:

30 to 45 minutes

Preparation before Meeting:

- Decide which type of container garden will be made (for example, a pillow pak, a flower pot container, etc.) and whether premixed growing medium will be used.

EXPERIENCE

1. Tell youth that in this activity they will be making a "pillow pak" garden to grow their plants. Explain that container gardening is an easy way for everyone to be able to have a garden.
2. If youth will be mixing their own potting medium, place the materials on a clean surface or in a large container. Mix thoroughly. Add water until the mixture is wet.
3. Fill the bag to be used to make the pillow pak until it is moderately firm. Then fold and staple the end.
4. Cut holes for the plants at approximate spots in the pillow pak. A 2-gallon plastic garbage bag can hold:
   - one dwarf tomato plant, or
   - four to six leaf lettuce plants, or
   - two pepper plants.
5. Explain the following garden pillow pak care instructions:
   - The pillow pak should be watered only when the medium appears to be dry; usually that is at one or two week intervals, but it depends on whether the plants are grown indoors or outdoors.
   - The fertilizer in the pillow pak will support plant growth for approximately 10 weeks. Additional feeding may be needed if plants will be grown for more than 10 weeks in the pillow pak. Use a solution of 2 teaspoons of water-soluble fertilizer per gallon of water.
   - Place the pillow pak on a windowsill, patio, or porch so it will receive 6 to 8 hours of sun each day. The pillow pak can be planted in the ground, but slit the bottom of the pillow pak with a knife, so the roots can get to the garden soil for moisture and nutrients.

SHARE

- *How did you feel about doing this activity?*
- *What did you learn about a container garden?*

PROCESS

- *Why is it important to understand that different people have different needs when it comes to gardening?*
- *How would you feel if you wanted to have a garden and couldn't? What could you do to correct that?*

GENERALIZE

- *Why do people need to do the same thing in different ways?*
- *What did you learn about relating to others?*

APPLY

- *How can you help someone you know have his or her own garden?*
- *How will you change the way you relate to others?*

GARDENING WITH YOUTH WITH SPECIAL NEEDS

Anyone can garden! A little ingenuity and imagination can make a garden accessible for all children.

For physical disabilities, consider these hints:

- If the youth can get around with a walker or crutches, prop him/her up using secure seating, such as a "corner sitter", right in the garden on the soil. The *corner sitter* can be made out of a sturdy cardboard box that is cut in half; it provides support for the youth's back and sides.

- If a youth's use of his/her hands (dexterity) is limited, choose vegetables with big seeds, such as peas, beans, and squash; or use vegetable or flower seedlings so planting is less frustrating.

- Raise a garden bed to new heights; eighteen inches is a good height for anyone sitting in a wheelchair.

- Try a half-barrel tub or ceramic crock pot as a container garden.

- Use windowboxes, especially for lettuce, radishes, herbs, and garden cress; they are the right height for easy care from a chair. Windowboxes can be set on two-foot high benches for even better access.

- Set a garden on a table for a tabletop garden; it's like a giant window box set on a table, or on a frame of lumber. Fill it with salad vegetables, herbs, or easy-to-grow annual flowers.

For visually-impaired disabilities, consider these hints:

- Tailor the garden to encourage the use of senses other than sight; focus on texture, scents, and sounds.

- Clearly define garden boundaries; use raised beds framed with lumber or brick and identify walk ways with a contrasting texture underfoot.

- Help youth with planting the garden, but encourage them to feel the differences between certain seeds, such as a corn seed versus a pea seed.

- Grow plants with interesting textures; the tiny leaves of woolly thyme hug the ground; the feathery foliage of carrots tickles the hand that strokes it.

- Plant herbs with distinctive aromas; encourage youth to crush the foliage of mint, tansy, catnip, and rosemary to release their distinctive aroma.

- Use a Braille writer to label plants in the garden.

- Consider adding a bird bath so the sounds of splashing on a warm summer day can be heard or the identification of whistles can be made.

For learning-impaired youth, consider these helpful hints:

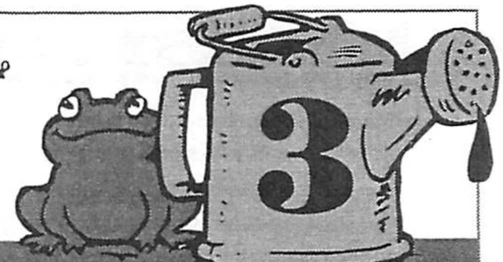
- Be aware of the youth's developmental age as well as the chronological age; a fourteen-year old may understand at the 10-year old level. Gear activities to the developmental level of the youth.

- Allow the youth to follow through the project relatively independently so he/she can see the entire process of planting, taking care of, harvesting, preparing for cooking or eating, watching it cook, and eating it.

- Have youth process through his/her experience by having him/her draw a picture each time something is done in the garden; for example, getting soil ready, planting seeds, a growing plant, weeding, etc. Later, the pictures can be reminders for what happened during the growing cycle; pictures can be sequenced or a sentence can be written to explain a picture.

- Encourage increasing independence by giving youth responsibility.

While you wait

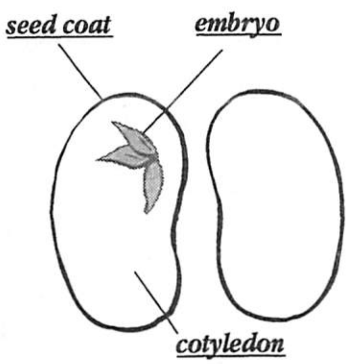


BACKGROUND INFORMATION

SUMMARY OF PLANT SCIENCE

ABOUT SEEDS
Basic components of seeds:

- an *embryo,* a tiny plant, complete with leaf, stem, or root parts; and
- a *seed coat* which protects the embryo.



Seeds have a temporary food supply to nourish the embryo until the seedling grows leaves so the plant can make its own food. This food supply can be:

- packed around the young plant, in which case it is called an *endosperm;* or
- stored in special leaves, called *cotyledons.*

Most seeds are either *monocots* (with one cotyledon) or *dicots* (with two cotyledons).

When conditions are right for seeds to begin growing, the seed germinates. To germinate, all seeds require:

- oxygen,
- water, and
- proper temperature.

Oxygen and water (for moisture) are initially taken in through the seed coat, through the tiny opening called the *hypocotyl;* later the root has this function. The embryo's cells begin to enlarge and the seed coat breaks open. The root emerges first, then the shoot follows. The shoot contains the stem and leaves.

Seeds have specific temperature requirements and/or preferences for germination. For example, tomatoes require warm temperatures of 70-75°F, but lettuce germinates better in cooler temperatures of 45-65°F.

Seeds may require proper light conditions to germinate. Some seeds require light; others are inhibited from germinating by light. A seed package provides the necessary information.

How seeds are treated during germination affects their chances of survival:

- if small seeds are planted too deeply, the young plants would use up their food supply before reaching light (which is needed for a plant to make its own food) and die.
- if seeds are planted in soil that is too dry, seeds may not receive the necessary moisture to germinate.
- if seeds are planted in soaking wet soil, seeds may not receive the necessary oxygen to germinate, or the excess moisture may cause the seeds to rot.

Some seeds have very hard seed coats. They germinate more quickly :

- after being soaked, or
- scarred (nicked) to allow water to enter the seed.

The following are some reasons why seeds may fail to germinate:

- soil temperature too low or too high,
- soil dried out,
- seeds planted too deeply,
- seeds washed away during watering,
- seeds too old and/or improperly stored,
- poor soil-to-seed contact,
- damping-off disease.

In the 4-H Vegetable Gardening member manual Level A, *Activity 3a: Seeds Up Close* youth explore seed germination and identify the parts of a seed.

BASIC PLANT NEEDS
All living things have basic needs, and plants are no different. To thrive and grow, plants need:

- light,
- water,
- mineral nutrients,
- air (carbon dioxide and oxygen), and
- adequate temperature range.

Mineral nutrients are derived from the breakdown of rocks and other materials in the earth. Plants take these minerals from the soil (dissolved in water) or through fertilizers applied by humans.

BASIC NEED	PURPOSE
Light	• required for photosynthesis so plants can make sugar (food) • to trigger certain changes, such as flowering (photoperiodism) in certain plants
Water	• to carry dissolved nutrients into the plant through the roots • required in photosynthesis • helps plant release energy from stored food when needed (in respiration) • helps support stems and leaves by water pressure in plant cells which are 65-95% water • transports nutrients and gases into, around, and out of the plant
Mineral Nutrients (major nutrients: nitrogen, potassium, and phosphorus)	• used for growth, repair, and proper functioning
Air	• required in photosynthesis (carbon dioxide is necessary to make food) • required in respiration (oxygen is necessary to release energy from a food)

Too much of a good thing can be as harmful as too little:

- too much light during germination will delay the process for certain seeds that prefer darkness;
- too much water can prevent necessary oxygen from reaching roots; and
- too much fertilizer can "burn" plants or cause plant cells to grow too quickly, resulting in weak, spindly plants or dead plants.

In the 4-H Vegetable Gardening member manual Level A, *Activity 3b: What's it For?* youth explore what happens when a plant leaf cannot get sunlight.

PLANT PARTS

Roots and stems help most green plants meet their basic need for nutrients and water. They form a special partnership.

ROOTS

Function

Roots play a very important role in enabling plants to meet their basic needs because roots:

- provide support,
- anchor the plant,
- absorb necessary water and nutrients,
- may store sugar and their carbohydrates which the plant can use (such as a potato plant with tubers

Roots also have a special partnership with soil because roots:

- assist the long process of soil formation by breaking off tiny pieces of rock as plant roots grow through cracks in rocks;
- aerate and loosen soil when a plant's roots are alive;
- provide tunnels for burrowing insects and animals;
- contribute to the rich humus component in soil when the plant's roots are dead and decomposing;
- help protect topsoil from erosion (the wearing away of soil by the action of ice, water, or wind);
- help absorb and recycle water when it rains.

The following nutritious food sources for humans and other animals are actually plant food storage roots:

- sweet potatoes,
- carrots,
- beets,
- turnips, and
- radishes.

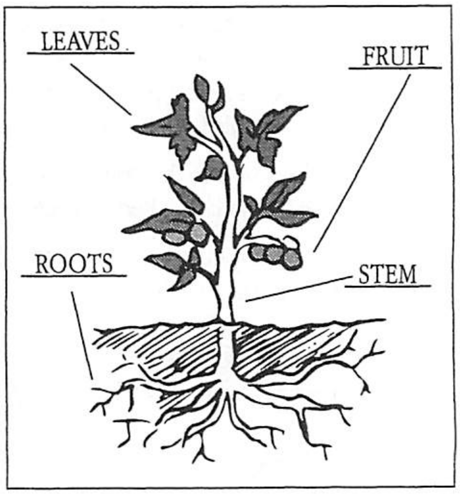
In addition, two-fifths of the world's sugar comes from the roots of sugar beets.

In the 4-H Vegetable Gardening member manual Level A, *Activity 3b: What's it For?* youth explore growing a carrot plant from the root instead of from seed.

Structure

There are two basic types of roots:

- Some plants have a primary *tap root* with a few smaller, hairy roots. Such long, strong roots reach deep into the soil and are able to pull up nutrients and water from far below the surface. Carrots, sweet potatoes, beets, radishes, and turnips are examples of tap roots which expand in size and are able to store sugars and starches.



- Other plants have a *fibrous root* system, which is a network of smaller roots and root hairs branching off the primary root. These networks can be extensive with more than a million branching roots covered with billions of root hairs. Beans and tomatoes are examples of vegetables with a fibrous root system.

In both types of roots, the tiny root hairs provide the surface areas for absorbing water and nutrients. They are the bridge between the root and the water and dissolved nutrients in the soil. That is why it is so important to be careful when transplanting young seedlings or transplants. A plant with damaged root hairs will have a difficult time to meet its water and nutrient needs. That is also why it is recommended that certain seeds be planted outdoors when the ground warms up instead of trying to start them indoors and transplanting when the weather is warmer. Beans and cucumber roots are more fragile then tomato plant roots.

Motion

Roots normally grow downward to meet the plants' nutrient and water needs. Roots are sensitive to gravity and the resulting movement to grow downward, regardless of their original position, is called *geotropism*. In the 4-H Vegetable Gardening member manual Level B, *Activity 3a: A-Maze-ing Plants,* youth explore how to influence the direction of root growth or geotropism.

STEMS

Stems play a vital role in enabling plants to meet their needs because they:

- provide an important link between plant leaves and roots, enabling all plant cells to be within reach of water and nutrients;
- transport water and minerals taken in by the roots to leaves to help produce food;
- transport food produced in the leaves to other parts of the plant;
- provide support to the plant, if above ground, allowing leaves to reach the light necessary to make food (photosynthesis); and
- serve as food storage sites.

Water and dissolved nutrients move upward in stems against the force of gravity. Water moving into the roots pushes water upward into the stem. When water evaporates *(transpiration)* through leaf openings *(stomata),* water is "pulled up" in stems. In the 4-H Vegetable Gardening member manual Level A, *Activity 3b: What's it For?* youth explore how the plant transport system works.

Structure

There are many shapes and sizes of stems, and they can be either soft or woody. However, they all serve the same type of transport functions. Not all stems grow above the soil. Underground stems *(stolons)* in potato plants also store food in tubers. In the 4-H Vegetable Gardening member manual Level B, *Activity 3b: Not From Seeds Only,* youth explore growing plants from plant parts, including potato tubers and garlic cloves.

Motion

Just like roots, stems respond to their environment to enable the plant to meet its basic needs. A plant responds to light by bending either toward or away from it *(phototropism)*. This movement is triggered by a concentration of auxins, which are plant hormones. When light hits a plant, the side of a stem away from the light accumulates *auxins*. This causes cell growth on that side to increase and the stem becomes longer; thus, the plant stem bends toward the light.

Auxins are concentrated in the tip of the stem. When this growing point is cut off (or pinched off) the auxins allow the lower branches of the plant to grow. That is why tomatoes are pinched at the growing points; it encourages bushier growth.

In the 4-H Vegetable Gardening member manual Level B, *Activity 3a: A-Maze-ing Plants* youth explore how to influence the direction of stem growth or phototropism.

LEAVES

Leaves have a critical function for plants. They convert the energy in sunlight, together with air and water, to make the energy that green plants need to live. Leaves make food.

Leaves come in many different shapes and sizes, but most have these components.

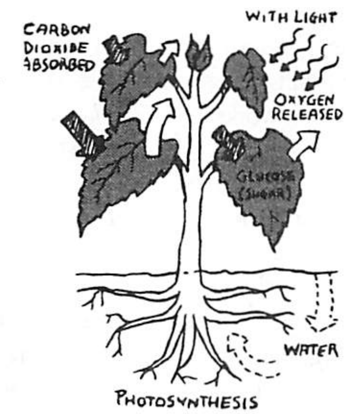
What is Photosynthesis?

Photosynthesis is the process by which plants make their own food. Using light energy, plants convert water and carbon dioxide into a simple sugar called *glucose.* This sugar is the source of food for most plants, and humans who consume these plants. This is not the only benefit of green plants. Life on our planet, without photosynthesis, would be nonexistent because there wouldn't be enough oxygen replaced in the environment to support life on earth. Approximately 10 to 100 billion tons of oxygen are produced by plants every year!

Photosynthesis is an ongoing process and it takes place in two phases. Each phase consists of many complicated steps that scientists are still trying to understand.

LEAF PART	FUNCTION
Stomata	• pores which open and close on the outer surface of most leaves • allow carbon dioxide and oxygen to enter and leave the plant during photosynthesis
Veins	• carry water, nutrients, gases, and other materials to and from all parts of a leaf in order for food to be produced and energy to be used. Once food is made by the leaves, it travels through the veins to the stem and other parts of the plant for use and/or storage. • provide support for the leaf to help position leaves to receive light.
Chloroplasts	• contain a green pigment, chlorophyll, which is necessary to trap light energy and allow photosynthesis to occur.

- The first phase of photosynthesis is sometimes called the *Light Cycle,* or light-dependent reactions, because *light is required*. Light rays are absorbed by the plant's leaves, and the chlorophyll traps this light energy. Water (taken up by the roots and transported to the leaves) is split into hydrogen and oxygen using the captured light energy. At the same time, carbon dioxide is taken in from the air through the stomata (leaf pores).



- The second phase of photosynthesis is called the *Dark Cycle,* or the dark reactions, because *light is not needed.* In this phase, the hydrogen that was split from the water combines with the carbon dioxide to form glucose. Then, the oxygen left over from the water is released into the atmosphere through the stomata. As oxygen is released, the stomata allow more carbon dioxide to enter so photosynthesis can continue.

Basically, the following reaction summarizes photosynthesis:

carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen

In the 4-H Vegetable Gardening member manual Level C, *Activity 3b: Getting Green* youth explore photosynthesis and take a closer look at chlorophyll.

What is Respiration?

Before a plant can use its stored food (in the form of glucose), the glucose must be broken down into a form that plants can use. During *respiration,* plant cells release the energy from glucose. Respiration is the same process used by humans and other animals. It is a series of complicated chemical reactions, just like photosynthesis.

First, plant leaves absorb oxygen from the air and combine it with glucose. Then, carbon dioxide and water are given off through the leaves. The plant can now use the energy released from the glucose. This glucose can also be changed and moved to other parts of the plant for use and storage through the following ways:

- Individual molecules of glucose are combined to form larger, more complex molecules called *carbohydrates,* such as:
  - *sucrose* (commonly called table =sugar). This is the form in which carbohydrates are transported around the plant. It can be found stored in the roots of sugar beets and the stems of sugar cane;
  - *cellulose,* which makes up the sturdy walls of plant cells;
  - *starch,* which is stored in plant leaves, stems (white potatoes) or roots (sweet potatoes) and can be broken down into simpler sugars for later use.
- Individual molecules can also be changed into fats and proteins that make up the materials in plant cells (in seeds, such as peanuts and soybeans).

FLOWERS

Although people enjoy flowers for their beauty and fragrance, the function of a flower is to produce seeds. All the attributes of a flower (color, size, shape, smell, etc.) are important in the effort to produce seeds.

The transfer of pollen from male to female flower parts is called pollination. Some pollinators include:

- bees,
- butterflies,
- moths,
- flies,
- beetles,
- birds,
- bats, and
- wind.

What Happens during Pollination?

When a grain of pollen lands on the stigma, a tiny tube grows from it and proceeds down the style into the ovary. Sperm cells travel through this tube to an ovule and fertilization occurs. Then, the fertilized ovule becomes a *seed,* and the ovary, a *fruit*. Without pollination and fertilization, fruit and seed production cannot occur in most plants.

There are basically two types of flowers: perfect and imperfect flowers.

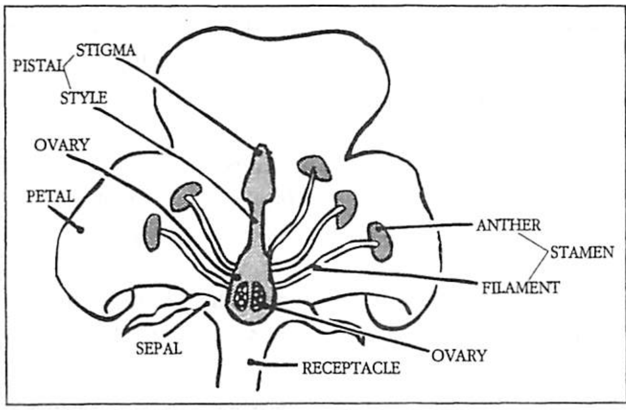
- *Perfect flowers* have both pistils and stamens. These parts are arranged in such a way to keep pollen from easily reaching the ovary of the same flower; this prevents self-pollination. Peas and beans are examples of vegetables with perfect flowers when they blossom.
- *Imperfect flowers* are either male or female, and pollen must find a way from the male to the female flower. Cucumbers and zucchini are examples of vegetables with imperfect flowers when they blossom.

Flower Part	Description and Function
pistil	generally in the center of the flower; it is the female organ
stigma	the platform at the top of the pistil; it is held up by the tubelike style
ovary	at the bottom of the style; it contains the ovules
ovules	inside the ovary; contain female egg cells
stamens	typically surround the pistils; the male organs
anther	on top of the stamen; held up by the filament
filament	stemlike; holds up the anther; produces pollen
pollen	contains male sperm cells
petals	often brightly colored to attract pollinators; often broad and flat to provide good "landing pods"
sepals	green leafy structures surrounding the petals which initially protected the developing bud
style	a tubelike structure that holds up the stigma and leads directly to the ovary

Flowers encourage pollination in many ways, including:

- aromatic nectar (sweet fluid),
- shapes designed to accommodate specific pollinators,
- designs or "tracks" to guide

pollinators to pollen and/or nectar,
- lightweight, petal-less flowers for wind pollination,
- structures that resemble other pollinators, so that there is an aggressive response.



In the 4-H Vegetable Gardening member manual Level C, *Activity 3c: Flower Power* youth explore flowers by dissecting a flower and cross-pollinating squash flowers.

FRUITS

Inside the ovary of a flower, as ovules develop into seeds, the ovary undergoes some changes. The ovary swells and becomes fleshy or it hardens to protect the developing seeds. This part of the plant containing the seeds is called the *fruit.* In addition to protecting the seeds, many fruits are designed to help seeds disperse.

Many foods that are commonly known as vegetables are technically fruits since they contain seeds. In the 4-H Vegetable Gardening member manual Level B, the *Did You Know?* section of *Activity 3a: A-Maze-ing Plants* provides an opportunity for youth to "guess" which vegetables are really fruits.

Fruits have many forms but there are two general types of fruits.
- *Fleshy fruits* include apples, oranges, plums, and berries. They generally have sweet, fleshy ovaries surrounding the seeds. Animals are enticed to eat these fruits, and the seeds are scattered away from the parent plant.
- *Dry fruits* have ovaries with thin, dry walls, not fleshy. Corn, wheat, oats, and barley are examples of dry fruits, but in each of these, each fruit is a single dry layer covering one seed. Thus, each grain on an ear of corn is a fruit. Other dry fruits, such as beans and peas, have a non-fleshy pod containing a number of seeds. When dry, the pods split open and the seeds drop out.

PLANTS from PARTS

In the *FLOWER* section, reproduction from seed was discussed. In another section, growing plants from roots, stems, and leaves, or reproduction from plant parts was discussed. Many plants are capable of *vegetative propagation* (or *asexual* reproduction) to produce a new, complete plant from part of another one. Unlike reproduction from seed, there is only one parent in vegetative propagation. And since every plant cell contains all the genetic information for that plant, the offspring are the same genetically as the parent plant; they are clones.

Some of the structures which plants use to reproduce vegetatively include:
- tubers (potato, but not a sweet potato because it is not a tuber),
- bulbs (garlic) and
- crowns (asparagus).

PLANT LIFE CYCLE

The plant life cycle begins with:
- seeds which sprout,
- mature into a plant,
- flower,
- bear fruit, which results in the production of
- seeds.

The key agents in the process of seed production are flowers.
Plant life can be categorized by the type of life cycle they undergo.
- *Annuals* are plants that flower and complete a full life cycle, from seed seeds, in one year. Examples include: beans, cucumbers, lettuce, peas, peppers, potatoes, tomatoes, many herbs and annual flowers.
- *Biennials* are plants that complete a full life cycle in two years. During the first year, the plant puts energy primarily into roots, and it flowers during the second year.
  Examples include: certain herbs, beets, carrots, onions, and parsley although normally these vegetables are planted every growing season.
- *Perennials* are plants that continue to flower, produce seeds, and grow for many years. They have adaptations, such as dormancy, and dropping leaves to help them survive year-round. Example include: asparagus and rhubarb.

DIVERSITY

Gardeners know that no two lettuce plants are exactly alike. There are variations between parents as well as different types of lettuce.

A diversity of organisms in our world is important for a healthy ecosystem.

- Plants supply food for *consumers* (humans and other animals) and help provide oxygen for the atmosphere to support life on Earth.
- Animals die, decompose, and provide materials to support plant life.
- Bacteria recycle nutrients that help maintain healthy plant life.

When there are many different kinds of organisms in an ecosystem, there is less competition for the same resources. For example, some plants have tap roots; others have fibrous root systems.

Humans have used natural genetic diversity to their advantage. In the beginning of farming, farmers saved their favorite seed to plant the following year. They purposely selected specific desirable traits which were beneficial, such as higher yielding varieties. This natural selection required centuries of work by farmers, or amateur plant breeders.

Today, however, scientists (researchers and plant breeders) in genetic technology can "design" crops to meet specific needs, such as taste, nutritional value, or harvesting and shipping requirements. For example, tomatoes have been bred for toughness so they can withstand mechanical packing and shipping. However, they have consequently also lost flavor and an appealing texture.

HYBRIDS AND CROSSBREEDING

Vegetables are available in *standard* and *hybrid* forms.

- Standard varieties may be called *open-pollinated* because they are mass produced through natural pollination (by bees and wind).
- Hybrid varieties need controlled pollination, usually done by hand between certain selected parent plants. Often different species of the same variety are pollinated. Although hybrid varieties produce seeds (except seedless varieties), these seeds, if saved and planted, would not produce the same hybrid plant. The original "cross" must be made.

A growing concern is that today, we rely heavily on "high performance" crops. This dependence makes these special crops open to diseases which can have devastating results. For example, when only one variety of a crop is planted and then hit by a disease, the entire crop may be destroyed. If people depended on that crop as a food staple, the loss would be disastrous. This is what happened when the failure of the potato crop led to the Irish Famine in the 1800's.

BIOTECHNOLOGY

Some Examples of Biotechnology Food Products on the Market

- FLAVR SAVR™ Tomato – a high-quality fresh market tomato that has been modified using antisense technology to ripen on the vine.
- FreshWorld Farms™ Tomato – a premium, fresh market tomato developed through somaclonal variation to have superior color, taste, and texture and a 10- to 14-day shelf life.
- FreshWorld Farms Endless Summer™ Tomato – a genetically engineered version of the FreshWorld Farms™ tomato, sharing its superior color, taste, and texture. It has a greatly extended shelf life of over 30 to 40 days after harvest.
- FreshWorld Farms™ Carrot Bites – crisp, juicy, baby whole carrots that are peeled and washed, ready-to-eat in one-pound bags.
- FreshWorld Farms™ Sweet Mini-Peppers – a sweet taste, deep red color, and nearly seedless. It was developed through anther culture, an advancedbreeding technique that captures and stabilizes preferred characteristics, such as taste, texture, and low seed count.
- FreshWorld Farms™ Cherry Tomatoes – specially bred for superior taste, color, and texture.

Biopesticides

Several biopesticides are in use today. Biopesticides are based on natural agents, such as microorganisms and fatty acid compounds. They are toxic only to targeted pests and do not harm animals, humans, fish, birds, and beneficial insects. In addition, because biopesticides act in unique ways, they can control pest populations that have developed tolerance to chemical pesticides. For example, Spod–X™ uses a naturally occurring insect virus to control the beet armyworm, which is becoming resistant to many chemical insecticides.

Herbicides

Using biotechnology, it is possible to make crop plants tolerant of specific herbicides. When the herbicide is sprayed, it will kill the weeds but have no effect on the crop plants. This allows the farmer to reduce the number of times herbicides have to be applied and reduces the cost of producing crops and damage to the environment.

Natural Resistance to Pests and Viruses

Today, genetic information can be transplanted into plants making a given bacteria, such as *Bacillus Thuringensis,* lethal only to a specific insect which feeds on that plant. The plant that once was a food source for the insect now kills it. This process, which has no effect whatsoever on humans or other species, reduces the use of chemical pesticide sprays to control infestations.

The following chart highlights the different ways humans have influenced plant genetics.

HUMAN IMPACT	DESCRIPTION	POSSIBLE PROS	POSSIBLE CONS
Plant Selection (Selective Breeding)	savings seeds with desirable traits to replant in the next season	• low labor and cost • seeds can be saved from year to year • plants are well-adapted to the environment • useful new offspring can emerge	• less uniformity • takes a very long time to occur
Hybridizing	occurs when humans manually cross-pollinate two different plants to achieve a mix of desirable traits	• offspring often have more uniform quality, earlier, more disease-resistance, and produce a higher yield	• other good traits may be lost • more labor cost • expensive • dependence on certain cultivars • diversity of older varieties is lost • hybridized seeds cannot be saved
Genetic Engineering	transferring specific genetic material from one organism to another	• increased human control • potential for increasing productivity	• expensive • other, unknown genetic changes and unknown impact on the environment

Preserving Genetic Diversity

Genetic diversity is so important because it enables plant breeders to create and maintain new varieties of crops. Today there is an awareness that we cannot rely heavily on specific crops. It is too easy to lose track of or discard other varieties of that crop. Other varieties may have beneficial agricultural or medical qualities; if lost, this valuable genetic information can never be recovered.

In order to preserve as much genetic variation of crop plants and their wild relatives as possible, two methods of conservation have been established:

- *in situ* conservation: preserves wild species within their natural habitat, often in biological reserves, and
- *ex situ* conservation: relies on acarefully controlled environment, such as that of a seed bank to ensure that the seeds of land races, genetic stock, and obsolete varieties will remain usable for decades. Thousands of species are preserved this way.

Protecting original habitats is the most important and successful way to preserve genetic resources that are being threatened. Some ways that everyone, not just gardeners, can help preserve genetic diversity include:

- Get involved with conservation groups that try to get areas set aside that represent major ecosystems to protect wild species in their natural habitats.
- Save and exchange seeds of old plant varieties to keep them from disappearing.
- Get involved with a local conservation group that move organisms to captivity, for example: the nature conservancy, botanical gardens, etc.

In the 4-H Vegetable Gardening member manual Level D, *Activity 3c: Designer Genes* youth explore biotechnology by designing a "super veggie" that would be ideal for both the food industry and consumers. More information on seed banks, genetic diversity, and the location of major crop centers in the world can be found in that activity.

INTERDEPENDENCE

All living things depend on one another. There are many types of relationships, at many levels, and at different degrees of complexity:

- many plants depend on animals for pollination of flowers and/or dispersal of seeds;
- animals, including humans, depend on plants for food, fuel, and shelter. Many relationships can be described in terms of a food chain.

Food chains are composed of:

- producers (such as plants),
- consumers (such as animals), and
- decomposers (such as bacteria and fungi).

In a food chain, green plants turn the sun's energy into food. This process activates the cycle of nutrients that make life possible on Earth. Green plants are the primary *producers* in food chains. All animals are both *consumers* and consumed, sometimes by other consumers, but all ultimately by the *decomposers*.

Thus, decomposers are the final links in food chains; they use dead plants and animals as food. This process releases locked-up nutrients to be used again by plants. Decomposers include:
bacteria, and fungi (molds, mildews, mushrooms, rusts, and smuts, etc.) Fungi feed on dead materials or act as parasites on living organisms because fungi lack chlorophyll and cannot carry out photosynthesis.

Earthworms help once-living materials decompose in a way that is easier to observe directly, especially in a garden. Earthworms live right in the soil; they eat and release nutrients from the soil and organic matter. They are able to recycle materials so that there is an immediate impact on plant life. But they, in turn, are eaten by animals, birds, and snakes. In the 4-H Vegetable Gardening member manual Level B, *Activity 4a: Wiggly Farm Acres* youth explore making a worm box and the importance of earthworms in a healthy garden.

Composting allows gardeners to control and promote a natural decomposition process. As bacteria breakdown large amounts of organic matter, heat is produced, and nutrients are released to form a rich, soil-like fertilizer for the garden. In the 4-H Vegetable Gardening member manual Level B, *Activity 4b: Let it Rot!* youth explore making a compost pile outdoors or in a container.

Even aphids, those insects that gardeners detest, play a part in interdependence. Aphids consume plant nutrients, but they are, in turn, consumed by other insects and animals, such as lady bugs.

Humans depend on plants not only for oxygen and food, but also for many forms of:

- energy,
- medicine,
- clothing,
- building materials, and
- many more uses.

In the 4-H Vegetable Gardening member manual Level A, *Activity 6a: Check Out the Veggies* youth explore how plants are used in different ways and look for food- and nonfood-products made from vegetables in a grocery store.

HUMAN IMPACT

We are all part of the web of life on Earth. It is becoming increasingly important that we recognize the impact of our choices and actions on living things. Some of these issues include:

- land use,
- environmental pollutants,
- waste disposal,
- burning fossil fuels, and
- acid rain.

As we use natural resources and dispose of wastes, humans create and release substances that are harmful to the environment. Since plants are low on the food chain, once damage has occurred, the impact can be magnified many times. This includes environmental pollutants (or toxins), such as:

- fertilizer spills or runoff into streams, and
- road salt.

Consider these effects:

- Many pollutants weaken plants; they become less resistant to diseases or insect attacks.
- Some air pollutants can damage the protective waxy layer on plant leaves; others may be more harmful by directly harming plant tissues.
- Systemic insecticides are taken up into plant tissues, and even thought the plant is not harmed, they can harm the animal eating that plant and the human eating that animal.

In the 4-H Vegetable Gardening member manual Level D, *Activity 3a: The Air Up There* youth explore the effects of pollution on plants. In addition, in Level D *Activity 4c: Taking Action* youth explore ways to address pesticide issues and how to become active and provide leadership in their community.

ACID RAIN

The effect of acid rain on plants is extremely complex and difficult to document because it is not easy to identify acid rain damage from other plant problems (nutrient deficiencies, pest problems, etc.). Damage to plants may result from other causes as well.

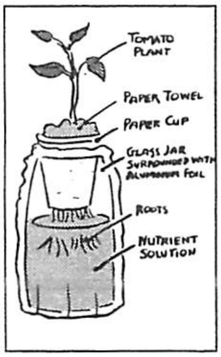
- Some scientists feel that the harmful effects of acid rain to soil, lakes, and rock are due to changes in pH rather than to the direct effects of a particular acid.
- On the other hand, several scientists report that some plants are "helped" if the acid rain contains dilute nitric acid since this adds nitrogen to the soil; nitrates are a source of nitrogen. Likewise with soils lacking sufficient sulfur for growth; sulfates from sulfuric acid are a source of sulfur.However, too much sulfur or nitrogen may be harmful to plants.
- Others assume the acid rain activates certain buffers in the soil which can temporarily neutralize the effects of too much acid rain.

HYDROPONICS

In the 4-H Vegetable Gardening member manual Level D, *Activity 3b: Look Ma – No Soil!* youth explore growing hydroponic plants. The following provides more background information on hydroponics.

Growing plants in nutrient solutions does not guarantee success. To do well, plants grown in hydroponic containers still need proper:

- light,
- temperature, and
- humidity.



Other Setups
Some simple hydroponic setups include:

- bucket and tray method,
- siphon-feed method,
- pump and timer method, and a
- recycling drip system.

Growing Mediums
Hydroponics is often defined as crop production without soil *(soiless gardening)*. This includes crop growth in *growing medium* (something that will support a plant), such as the following.

- Sand – quartz or builder's sand is best; do not use beach sand, it contains too much calcium for good plant growth.
- Gravel (such as aquarium pebbles) allows water and fertilizer to drain rapidly, so it's necessary to apply the nutrient solution several times a day.
- Perlite – small particles of expanded volcanic rock.
- Vermiculite – very lightweight and absorbs lots of water, and
- Other solid materials, such as cotton, paper towel, bark, etc.

Nutrient Solutions or Fertilizers?
You may be wondering if soluble houseplant fertilizers, such as Miracle-Gro™, can be used to make a hydroponic nutrient solution. They are more widely available and are cheaper than hydroponic nutrient fertilizer solutions or mixes. Remember that houseplant fertilizers are designed to be applied to potting soils and they will not work as well in replacing hydroponic nutrient solutions because they are missing some of the nutrients that plants need. Since these nutrients are already present in potting soil, houseplant fertilizers often contain just nitrogen, phosphorus, and potassium. These are the three mineral nutrients that are usually present in low concentrations in potting soils. A hydroponic nutrient solution contains all 14 of the minerals that plants require for optimum growth. There is another problem with houseplant fertilizers. Generally, houseplant fertilizers have most of the nitrogen as ammonium rather than nitrate. Hydroponic nutrient solutions have most or all of their nitrogen as nitrate. Too much ammonium in the nutrient solution is toxic to hydroponic plants. In soils, bacteria change ammonium into nitrate; this is not possible in hydroponic solutions.

Drainage
Drainage is important in hydroponics. Roots should be submerged in the hydroponic nutrient solution for regular but brief peroids. There's a delicate balance between water, air, and nutrients. In large hydroponic greenhouses, feeding and drainage are taken care of mechanically. The nutrient solution is continuously pumped in and out of growing beds. Also, containers used shouldn't be metal; the metal can interact with the nutrient solution and harm plants.

What about oxygen?
In hydroponics, vermiculite, gravel, sand, can be used to support the plant and hold moisture, but still allow air to get to roots. These materials must be sterile.

In hydroponics, the plant's roots are surrounded by 100% water. Unlike soil, there are no solids or air spaces in hydroponics. So how do hydroponic plants get oxygen? Most hydroponic plants must get oxygen from the nutrient solution. However, water holds only a small amount of dissolved oxygen, so it is quickly consumed by the roots. To give roots enough oxygen, air is constantly bubbled through the nutrient solution. This bubbling replenishes the oxygen supply and is called *aeration*.

Some set ups include an aquarium pump to provide air for the plant's roots and an air breaker to break the flow of air from the pump and to disperse the air gently in the water. Pumps and air breakers are available wherever aquarium supplies are sold.

Air pumps were not readily available in the 1930's. Early hydroponic growers provided oxygen to roots by keeping about half the roots above the nutrient solution. The hydroponic reservoir was just half full. The roots above the solution remained wet because of the moist air in the top half of the reservoir.

Well-watered soil in the field is approximately:

- 50% solids,
- 25% air, and
- 25% water, by volume.

Well-watered potting soil in a container is approximately:

- 15% solids,
- 15% air, and
- 70% water.

The air-filled pores are important because they act as air tunnels. Air above the soil can flow into the soil and to the roots through the air-filled pores. Air contains 21% oxygen, by volume. All plants require oxygen because they must respire.

- If soil is over watered, there are not enough pores filled with air. Roots suffer from lack of oxygen. In addition, microbes produce toxic chemicals which harm roots.

Garden Talk Games

Project Skill: Learning garden vocabulary
Life Skill: Communicating

Materials:
- for *Garden Search* option, copies of *Garden Search* handout
- other game options do not need materials

Time Required:
20 to 30 minutes, or as desired

Preparation before Meeting:
- Decide on a Garden Game option or a combination of game activities. *Activity 3b: More Garden Talk Games* can be used as another resource idea for games; choose vocabulary words according to the ability level of youth, but also providing a challenge.

Four Garden Talk Game options are included in this activity for use with youth in Level A and Level B in the Vegetable Garden project.

EXPERIENCE

1. Tell youth that this activity is about learning garden vocabulary in a fun, easy way.
2. Explain the instructions for the game option you selected.
3. Select two or more teams, if desired, and play the game.
4. Review what was learned at the end.

SHARE

- *What game did you play? Describe it.*
- *What did you like the most about this activity? Like the least?*

PROCESS

- *How do you communicate with others when you're playing a game?*
- *In what ways do people communicate without speaking?*

GENERALIZE

- *When is it important to communicate well?*
- *What other ways can you communicate something to be learned?*

APPLY

- *How will you use your communication skills to teach someone how to do something, such as how to play a game?*
- *You've probably heard someone say, "It's a communication problem." What does this mean?*

Garden Talk Game Option #1

Instructions for Garden Search:
- Give youth a copy of the *Garden Search* handout. Let youth work in small groups or individually.
- Tell youth to circle the garden vocabulary words they find. There are 23 words which can be horizontal, vertical, or diagonal, and some are written backwards (in reverse). Garden Search handout is on page 31.

Garden Talk Game Option #2

Instructions for Where Do They Grow?

- Discuss where vegetables grow - in vines, underground, and above ground; see categories below.
- Divide youth into two teams.
- Give each player the name of a vegetable. The player must identify where that vegetable grows. If the player misses the question, he/she goes to the opposing team.

On Vines
summer squash (zucchini)
winter squash
pumpkin
cucumber
watermelon
cantaloupes
gourds

Underground
carrots
potatoes
radishes
rutabagas
turnips
kohlrabi
onions
sweet potatoes
garlic
beets
parsnips

Above Ground
lettuce
cabbage
peas
beans
tomatoes
eggplant
green pepper
broccoli
cauliflower
asparagus
spinach and other greens

Garden Talk Game Option #3

Instructions for Name Three Veggies!

- Discuss that vegetables can be categorized by whether they are a root vegetable, cool- or warm-season vegetable, leafy, stem, or a fruit in disguise, etc. Give examples of some possible categories; see the chart below.
- Divide youth into two teams and have them stand on opposite sides of the room.
- Ask each player, in turn, to "Name three vegetables that are ......" using the categories below. If the answer is correct, the player stays on the same team; if incorrect, the player goes to the opposing team.

Root Crops
beets
carrots
celeriac
horseradish
Jerusalem artichoke
parsnip
radish
rutabaga
salsify
turnip

Vines and Sprawlers
beans (some)
cucumber
gourds
jicama
melon
peas (some)
pumpkin
southern pea (some)
sweet potato
tomatilla
tomato
watermelon

Fast-Maturing Crops
cress
herbs (most)
lettuce
mustard greens
onion (scallions)
Oriental greens
radish
spinach
sprouts
turnip

Stem or Shoot Vegetables
artichoke
rhubarb
celery
fennel
asparagus

Vegetables that are Fruits in Disguise
tomato
eggplant
sweet pepper
hot pepper

Squash Vegetables
zucchini
cucumber
cantaloupe
honey dew
pumpkin

Pod and Seed Vegetables
okra
sweet corn
peas
snow or snap peas
pole and bush beans
broad beans
lima beans

Bulb Vegetables
garlic
leek
green onions
shallots
onion

Cool-season vegetables
artichoke
asparagus
beets
broccoli
Brussels sprouts
cabbage
cauliflower
celery
collards
cress
endive
garlic
kale
kohlrabi
leeks
lettuce
mustard greens
onion
oriental greens
parsnip
peas
potato
radish
rhubarb
rutabaga
salsify
shallots
spinach
Swiss chard
turnip

Warm-season vegetables
pole beans
bush beans
chicory
collards
corn
cucumber
eggplant
herbs (most)
Jerusalem artichokes
jicama
melon
okra
peppers
pumpkin
southern peas
New Zealand spinach
squash
sweet potato
tomatillo
tomato
watermelon

More than One Edible Part
beets
chicory
kohlrabi
onion
pumpkin
rutabaga
turnip

Prolific Producers
beans
Brussels sprouts
cucumber
herbs
Jerusalem artichoke
mustard greens
Oriental greens
peas
radish
spinach & New Zealand spinach
sprouts
squash (some)
tomato

Leafy Vegetables
(or vegetables used for greens)
endive
cress and watercress
cos lettuce
red-leafed lettuce
green-leafed lettuce
spinach
mustard
chicory
celery leaves
loose leaf and head lettuce
Romaine lettuce
Bibb lettuce

Garden Talk Game Option #4

Instructions for What Parts Do We Eat?

- Explain to youth that this game relates vegetables to the parts eaten. Give examples of the categories used; see below.
- Divide youth into two teams.
- Have teams stand so they face each other.
- Team I names a plant that is used for food. Team II tells which part of the plant is eaten. If correct, Team II names a plant for Team I to identify.

Stem or Shoots
artichoke
rhubarb
celery
fennel
asparagus

Roots
carrots
turnips
beets
radish
sweet potato
rutabaga

Leaves
cabbage
spinach
lettuce
kale
collards

Seeds
peas
beans
corn

Flowers
broccoli
cauliflower
pumpkin

GARDEN SEARCH

T	U	B	E	R	A	V	I	T	L	U	C
R	H	Z	U	O	Q	M	C	I	P	M	O
A	O	I	S	O	I	L	S	B	L	D	M
N	E	Q	N	T	P	Y	R	N	A	L	P
S	E	E	D	S	B	E	T	W	N	F	O
P	S	M	U	T	T	Y	H	H	T	J	S
L	E	A	F	A	U	K	G	B	I	X	T
A	G	N	W	K	L	Q	I	Z	N	N	E
N	R	U	R	E	W	O	L	F	G	Y	D
T	O	R	Z	S	T	E	M	U	L	C	H
H	W	E	E	D	I	N	G	W	B	K	Z
B	O	K	R	E	G	A	N	I	A	R	D

Words Used:

transplant	planting	root	tuber	mulch	drainage	water	light
seeds	compost	leaf	flower	manure	soil	weeding	IPM
plan	thin	stem	grow	stakes	cultivar	hoe	

More Garden Talk Games

Project Skill: Learning garden vocabulary
Life Skill: Recognizing Self Worth

Materials:
- pencils
- copies of *Garden Bingo* handout
- flip chart and markers for *Garden Tic-tac-toe* (or chalkboard and chalk)
- words from the *Definition of Terms (Garden Talk)* section in this manual

Time Required:
20 to 30 minutes, or as desired

Preparation before Meeting:
- Decide on a *Garden Talk Game* option or a combination of game activities. Activity 3a can be used as another resource idea.
- If playing *Garden Bingo,* make a copy of the *Garden Bingo* handout for everyone. Select 24 vocabulary words and definitions from *Definition of Terms (Garden Talk)* section in this manual or from member's Level C or D manuals. Decide if you will make a list of the words to hand out or if you will read the words aloud to the group.
- If playing *Garden Tic-tac-toe,* select nine (9) vocabulary words and their definitions.

Games are an accepted way for teaching concepts and skills to any age group. They are not only fun, but issues and concepts can be made clearer and easier to understand in a game. Games can be used to motivate youth and/or to review and assess their understanding of the subject matter.

Games allow for:
- active learning,
- opportunities for youth involvement and participation,
- a chance for youth to work together, regardless of ability levels,
- individual preferences and differences, and
- an experience of success, especially for those who do not experience it often.

Both *Garden Talk Game* options in this activity can be repeated an unlimited number of times using different vocabulary words.

EXPERIENCE

1. Tell youth that this activity is about learning garden vocabulary words in a fun, easy way.
2. Explain the instructions for game.
3. Select 2 teams, if desired, and play the game.
4. Review what was learned at the end.

SHARE

- *How did you feel about doing this activity?*
- *What new words did you learn?*

PROCESS

- *How does playing a game help you learn more easily?*
- *What were other members in your group feeling as all of you were playing the game?*

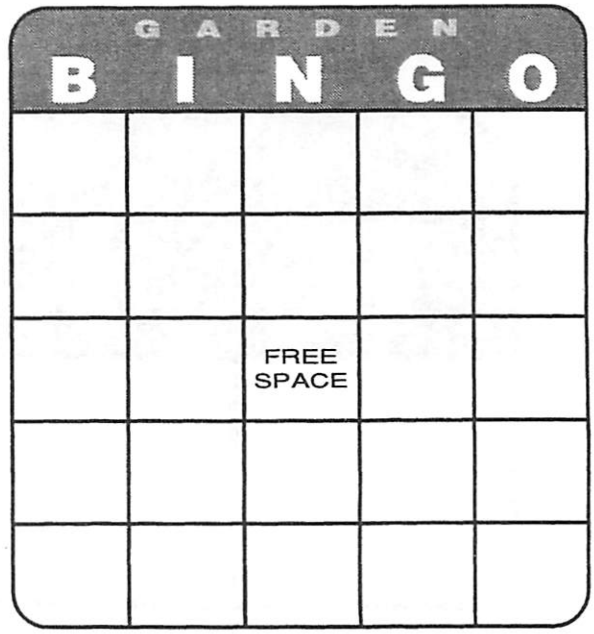
GENERALIZE

- *What other benefits, besides being fun to do and easy to learn, do games provide for the players?*
  Everyone can be involved and ability level is not important.
- *What are other things you do that make you feel good about yourself?*

APPLY

- *In the future, how will you try to learn new things?*
- *If you were to teach younger youth an activity, how would you go about making sure they experience success?*

Instructions for Garden Bingo:



- Give youth a copy of the *Garden Bingo* handout.
- Tell youth to write each vocabulary word you say in any of the blank spaces in the Bingo handout; youth are designing their own bingo card.
- Explain that they need to listen to the definition that you will be saying; one for each of the vocabulary words. If they recognize which vocabulary word the definition identifies, they should place an "X" through the box (but not covering the word up completely). The winner will be the first person to reach "bingo." (*Bingo* is four in a row horizontally, vertically, or diagonally, plus all four corner boxes.)
- Tell youth to raise their hand when they get "bingo." Then, say the vocabulary words for which you read the definitions. At this point, the winning bingo sheet can be checked. After a winner is declared, play can continue until the whole sheet is covered.
- If desired, play a new game with the same vocabulary list (or a different list) and a new *Garden Bingo* sheet.

Instructions for Garden Tic-tac-toe:

- Divide the group into two teams (or two youth can play, also).
- Draw lines on the flip chart paper or chalkboard to represent the familiar tic-tac-toe diagram. Write it large enough so everyone can see it easily.
- Using the 9 words you selected from the *Definition of Terms (Garden Talk)* section, write one word in each of the spaces.
- Explain that one player will select a word he/she knows and then say the definition. If the answer is correct, youth goes to the flip chart, erases the word and writes his/her team's symbol in the space, either "X" or "O." If the answer is incorrect, no change is made on the diagram; the other team takes a turn.
- Then explain that a player from the other team takes a turn. Play continues until one player or team has three symbols in a row horizontally, vertically, or diagonally – or until a stalemate has been reached and neither team can win.

hybrid	stamen	genetic engineering
IPM	photosynthesis	seed bank
phosphorus	biotechnology	pistil

GARDEN

B	I	N	G	O
		FREE SPACE		

Garden Care

BACKGROUND INFORMATION

SOIL FERTILITY

To avoid using too much or too little fertilizer, evaluate the garden site with a soil test. Contact the local Cooperative Extension office for a list of soil testing services. The soil test report will indicate what nutrients are present in the soil sample. It will also show the amount of acid present in the soil. Garden soil pH should be 6.0 to 7.0. Limestone should not be added to the garden to change soil pH unless the soil test result is below 6.0.

Most garden soils require 2 to 3 pounds of 12-12-12 fertilizer (or similar analysis) per 100 square feet (10' x 10'). The numbers on a fertilizer package indicate the percentage of nutrients in the fertilizer. A fertilizer analysis such as 12-12-12 means that 12% of the fertilizer is nitrogen, 12% is phosphorus, and 12% is potassium. These are the major nutrients required for plant growth because:

- nitrogen (N) is important in promoting leafy, green growth;
- phosphorus (P) encourages root and fruit development; and
- potassium (K) is important in carrying out many plant functions.

MATERIAL	% N	% P	% K
Alfalfa Hay	2.50	0.50	2.10
Blood Meal	13.00	1.50	0.80
Bone Meal	4.00	23.00	0.00
Cattle Manure (fresh)	0.55	0.15	0.45
Fish Meal	10.00	6.00	0.00
Hog Manure (fresh)	0.50	0.35	0.45
Horse Manure (fresh)	0.65	0.25	0.50
Poultry Manure (fresh)	1.00	0.85	0.45
Sheep Manure (fresh)	1.05	0.40	1.00
Wood Ash	0.00	2.00	6.00

There are several natural sources of nutrients such as animal manures, dried blood, and bone meal. The chart on this page shows the average fertilizer value of some commonly used materials.

Wood ashes have some value as a garden fertilizer, but their main effect is to raise soil pH. Wood ashes consist of 50% to 70% calcium or lime. If your soil has a pH of 6.5 or below, the use of 25 pounds of wood ash per 1,000 square feet on home gardens will meet potassium requirements without harming plant nutrition. Avoid using wood ashes if your soil pH is above 6.5.

GARDEN EQUIPMENT

A hoe, rake, trowel, shovel, watering can, garden hose, and a sprinkler are standard gardening equipment. Other useful equipment includes:

- short stakes and string to mark rows;
- long (7- to 8-foot) stakes for supporting tomatoes or pole beans;
- hot caps, cloches, and fabric row covers can aid in frost protection;
- a watering can for just after planting seed or transplants;
- a garden hose and sprinkler for thorough weekly waterings;
- a long-handled, wheeled cultivator or a garden hoe for weed control during the season; and
- a good duster or sprayer for pest control, if necessary.

Plowing or deep tilling are the preferred methods for preparing the garden for planting, but hand-turning the soil with a shovel is also acceptable.

- Garden tillers can be rented in most communities or borrowed from a neighbor.
- Trowels are useful for setting out transplants.

GARDEN SAFETY

Garden Equipment and Supplies

Equipment and supplies are a must for establishing and maintaining a garden. Dry, and if possible, heated storage should be provided to keep garden equipment in good working order. The storage space should be accessible, well ventilated, and well organized to keep the equipment and supplies from becoming safety hazards.

Stakes: Wire and bamboo stakes are frequently used in gardens and may be a hazard. As a precautionary measure, the top of the stakes can be painted white or covered with a small piece of white adhesive tape so they will be more visible. This may prevent an eye injury or some other injury. Stakes should be placed where they will not cause an individual to fall.

Hand tools: Accidents with hand garden tools such as rakes, hoes, spades, and shovels usually result from people tripping over tools laid on the ground or floor. All such tools should be kept in a standing, hanging, or leaning position, when in use and in storage. If this is not possible, the tools should lay with their points or sharp edges downward. Also, to prevent foot injury whenever using garden tools, shoes which cover toes and feet should be worn.

Power tools: Rototillers and other power garden tools are extremely dangerous if used without the greatest care and attention to safety. It is important to fully learn about a power tool before operating it. Never remove or override safety features that are built in to power tools. A gardener should never work alone when using power tools, because if an accident occurs, there is someone to apply first aid and/or go for help.

Garden Hoses: Hoses are used by most gardeners, but hoses can become dangerous if left lying about the lawn and garden area. However, coiled hoses should be stored nearby for fire protection.

Pesticides: Herbicides, insecticides, fungicides, bactericides, rodenticides, nematicides, miticides, and baits are all considered pesticides. They should be treated as dangerous materials. Other control measures should be tried in the garden before deciding to use a pesticide. Pesticides should be used only as a last resort.

- All pesticides should be stored in their original containers with a complete intact label.
- To avoid dangerous confusion, a pesticide should never be put in a container that was used for food.
- Pesticides should always be stored locked up.
- Pesticides should only be mixed in a well ventilated place.
- When a pesticide is purchased, it is wise to read the entire label. By law, there is a great deal of important information on a pesticide label. The label will tell how to properly handle, mix, and apply the pesticide. *It is important to read the first aid instructions before using the pesticide.* Then a gardener will be ready in the case of a serious accident. Also, the telephone number of a poison control center (Indiana - 1-800-(382-9097) should be handy.

Human poisoning by pesticides can happen when the pesticide enters the body through the skin, eyes, nose or mouth. When using pesticides, it is important to reduce the exposure of these parts of the body by wearing proper clothing.

- At a minimum, a long-sleeve shirt, long pants, shoes that completely cover feet, gloves, and goggles or safety glasses should be worn.
- A hat makes sense if the gardener is spraying overhead.
- If a gardener has breathing problems, he/she should wear a mask over the mouth.
- Protective clothing should be washed separately from the rest of the laundry to avoid pesticide material from being spread to other clothing.
- If a pesticide should splash on to a person's skin or eyes, it should be washed off immediately with clear water.

Other garden chemicals: Chemicals such as paint, gasoline, and fertilizer are commonly used around the home and garden. They should be locked up in storage, and they should be kept in proper containers.

PREPARING FOR FROST/FREEZE WARNINGS

When there is a threat of an early fall frost or a late spring frost, many gardeners become concerned about their vegetable crops. Some helpful information and suggestions follow to aid gardeners as they prepare for frost/freeze warnings.

Vegetable plants vary in their susceptibility to cold temperatures.

- Tender crops, such as tomatoes, peppers, melons, and okra, cannot withstand frost unless protected by some insulation.
- Cool season crops, such as cabbage, broccoli, Brussels sprouts, and kohlrabi, will tolerate frost or even a light freeze.
- Other crops, such as beets, carrots, lettuce, and potatoes will stand a light frost.

Suggestions for Protecting the Garden:

- Mulching is a good way to protect very small gardens. Use several layers of newspaper, straw, or chopped cornstalks. With a large garden, it may be more practical to protect only a few plants of each crop. Blankets, tarps, floating row covers, or other large materials can be placed over rows of vegetables to supply insulation.
- Cloches, paper tents, hot caps, and plastic walls of water are the more expensive approaches to frost protection, but are very effective. In cases of light frost, sometimes only the upper and outer foliage are damaged, and the plants can still continue production.
- If plant covering is not feasible, pick as much produce as possible if frost is predicted. Some crops can be further ripened indoors if they are not fully mature. Most green tomatoes can be ripened to full red indoors. Light is not necessary to ripen tomatoes. In fact, direct sun may promote decay of the fruit due to excessive heating. Ripening is mostly affected by temperature; the warmer the temperature, the faster the ripening. To store tomatoes for later use, wrap the fruit individually in newspaper and store at 55°F. The fruits will gradually ripen in several weeks.

Cold Temperature Tolerance of Vegetables

Tender *(damaged by light frost)*

- Beans
- Cucumber
- Eggplant
- Muskmelons (cantaloupes)
- New Zealand Spinach
- Okra
- Pepper
- Pumpkin
- Squash
- Sweet Corn
- Sweet Potato
- Tomato
- Watermelon

Semi-Hardy *(tolerate light frost)*

- Beets
- Carrots
- Cauliflower
- Celery
- Chard
- Chinese Cabbage
- Endive
- Lettuce
- Parsnip
- Potato
- Salsify

Hardy *(tolerate hard frost)*

- Broccoli
- Brussels Sprouts
- Cabbage
- Collards
- Kale
- Kohlrabi
- Mustard Greens
- Onion
- Parsley
- Peas
- Radish
- Spinach
- Turnip

INTEGRATED PEST MANAGEMENT IN THE VEGETABLE GARDEN

MANAGING WEEDS

Simply said, a weed is a plant growing where it is not wanted. Weed control in the garden is a must, for if weeds are allowed to grow, they rob other plants of water, nutrients, and sunlight. They also harbor insects and disease. The best time to get rid of weeds is when they are small.

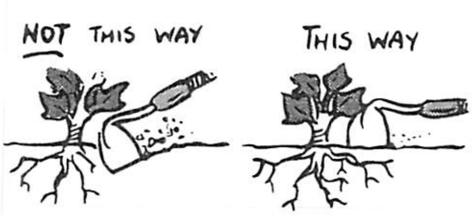
The two recommended methods of weed control in the home garden are:

- cultivation/mechanical removal (hoeing, pulling, etc.); and
- mulching (covering soil to prevent weeds from sprouting).

Here are several hints to help prevent certain weed problems and to reduce the time and effort a gardener must spend in the garden:

CULTIVATING

- When deciding on a garden space, all the weeds in that space should be removed (by plowing, tilling or hoeing) before planting the garden.
- Since other weeds will come up in the garden after hoeing once, a gardener must hoe the garden several times during the summer to control weeds.
- Weed with a sharp hoe, using a shaving stroke (not a chop) and do not go any deeper than 1 inch into the ground. Deep hoeing may bring last year's weed seeds to the surface where they can sprout. Deep hoeing may also hurt garden plant roots.



- Keep hoes sharp and in good condition to help reduce injury to garden plants.
- Hoe carefully around your plants and hand pull all weeds close to the plants.
- For large garden plots: a wheel hoe with knives (push-plow), or power equipment such as a tiller or garden tractor may be used. Avoid deep cultivation. Shallow cultivation controls weeds without harming plant roots.
- A combination of several thicknesses of newspaper covered by organic materials can be used as a summer type of mulch.
- Mulch in late May or early June, after the weeds are cleaned up. Place the mulch material around the plants and between the rows (up to 4 inches deep if using a coarse material like straw, but no more than 2 inches deep if using a fine material like grass clippings).

MATERIALS	PROS	CONS
Straw/Hay	Cheap; generally available; adds organic matter	May contain weed seed, insects, and/or disease
Leaves	Readily available; free; rich source of nitrogen	Can mat down or be too acidic for some plants
Grass clippings	Easy to get and apply; good source of nitrogen	Can burn plants, may contain weed seeds
Pine needles	Attractive; easy to apply	Can be difficult to collect large quantities; may be too acidic
Wood shavings	Weed and disease free; easy to apply; available	Can be acidic; tends to tie up nitrogen in soil
Manure	Excellent source of fertility and organic matter	Must be well-rotted to avoid burning plants; expensive; usually contains weeds
Newspaper	Easy to obtain and apply; earthworms thrive in it	Decomposes quickly; must be weighed down
Plastic	Provides total weed control, if dark plastic is used; warms soil for an early start; recyclable, can be used more than one season	Expensive; may be unattractive; does not improve soil texture; must be weighed down and cleaned up and removed in the fall

MULCHING

- Mulching helps prevent weeds, holds moisture in the soil, and can make the soil cooler or warmer, depending on the type of mulch used.
- Mulching is especially useful for vegetables that have a long growing season, such as tomatoes.
- Weathered straw, shredded bark, peat moss, crushed corncobs, sawdust, shredded paper, and compost are all good mulching materials. These materials tend to cool the soil. They can be worked into the soil at the end of the growing season to improve soil.
- Black plastic makes an excellent mulch that also warms the soil by several degrees. Black plastic is best used on warm season plants such as tomatoes, peppers, melons, pumpkins, cucumbers. Lay the plastic on top of the soil and securethe edges by covering with soil. Then cut holes in the plastic to place the plants. The plastic must be removed at the end of the growing season. Reuse or recycle, if possible.

COMPOSTING

Use the following *Troubleshooting Compost* guide below to help solve common composting problems.

SYMPTOM	WHAT HAPPENED?	TRY THIS
Bad Odor	not enough air	turn the pile
Center of pile is dry	not enough water	moisten the pile when turning it
Pile is damp and warm only in middle	pile is too small	build a larger pile; mix new materials with the old
Pile is damp and sweet-smelling but remains cool	lack of nitrogen	add a nitrogen source, such as fresh grass clippings, manure, or blood meal

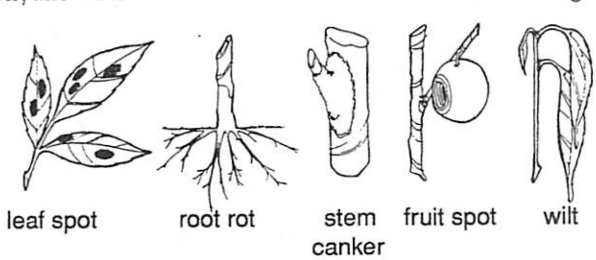
CHEMICAL CONTROL

Generally, chemical weed control is not recommended for 4-H gardeners. Only a few herbicides are labeled for use in the home vegetable garden. None of these chemicals can be used on all vegetable crops, nor do they control all of the many different weeds. If a gardener chooses to use a herbicide, it is important to read and follow all of the label recommendations before applying the herbicide.

MANAGING PLANT DISEASES

Anyone who has grown a vegetable garden has been faced with some loss from insects, diseases or weeds. Seeds planted in the garden may never break through the soil surface or may die soon after emerging. Tomato vines may produce fruit with a rotten end caused by blossom end rot. Knowing how to recognize and control some of the common problems can greatly increase a garden's yield, as well as the gardener's satisfaction.

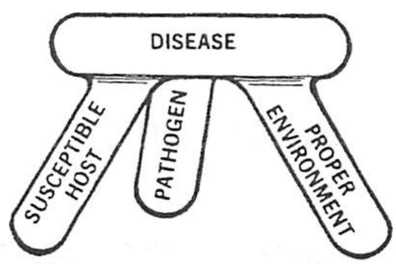
When a person is sick (diseased), symptoms such as a temperature, sneezing, coughing, and sweating tell the person what kind of disease he/she might have. Likewise, a plant is diseased any time it does not function normally. The visual abnormal condition produced in the plant is called a disease *symptom*. A sick plant may show symptoms, such as leaf spots, root rots, stem cankers, fruit spots, and wilts.



- Sometimes the damage will be caused by *noninfectious* agents (cannot be passed from plant to plant), such as wind, too much fertilizer, too little water, or mechanical injury from animals, garden tools, or blowing sand.
- Other times the damage may be *infectious* disease-causing agents (can be passed from plant to plant), such as a bacterium or a fungus.

How Do Plant Diseases Develop?
Three things must be present in order for an infectious disease to develop:
- susceptible host (garden plant that can get sick);
- pathogen (the living organism that causes the disease); and
- proper environment.

Imagine these three things as parts of a 3-legged stool. If any one of the legs on



the stool is removed, the stool will fall over and there will be no seat. Similarly, if any of the necessary requirements for disease to occur are removed, then there will be no infectious disease. That is how a disease begins, but what exactly can cause a disease? Plant diseases can be caused by infectious or noninfectious agents.

INFECTIOUS AGENTS
Infectious agents may be passed or transmitted from a diseased plant to a healthy plant, and under favorable conditions (usually wet) can cause disease in the healthy plant. Infectious agents include fungi, bacteria, viruses, and nematodes. A specific living organism that causes a plant disease will not cause a human disease; nor will organisms that cause diseases in man, called "germs," cause diseases in plants. One word which could be used to refer to fungi, bacteria, viruses, and nematodes all at one time is *microorganisms* – "micro" meaning small and "organism" meaning plant or animal.

Just because a microorganism is associated with a plant does not mean the plant is diseased. The world has billions of microorganisms in it, and only a very, very few of them cause disease. Microorganisms are important to us in the balance of nature.
- On one side of the scale are all the plants – growing and dying – building up a big pile of dead trees, leaves and weeds.
- On the other side of the scale are the microorganisms breaking down the pile to its simple chemical parts and returning them to the soil. These microorganisms are called *saprophytes* since they are feeding on the dead organic matter. Occasionally, one of these microorganisms may become too great in number or too aggressive, and it may make a plant diseased. Microorganisms that feed on live plants are called *parasites*.

Provided that conditions are right, infectious microorganisms can enter a living plant and cause it to become sick (diseased). These parasites are then called *causal agents* of infectious disease. When a plant provides a place for one of these causal agents to live, it is also known as a host. If the plant becomes sick, it is known as a *susceptible host*. If it stays healthy, it is *resistant*. When infectious microorganisms are involved, three components (parts) are necessary for disease to develop:
- susceptible host,
- causal agent (pathogen),
- proper environment (favors growth of disease).

These can be pictured as a 3-legged stool, as described before. Remember, all three parts are needed to have an infectious plant disease.

Some of the microorganisms that can cause plant diseases include the following:

- **Fungi** (singular, fungus) are "thread-like" plants that do not have green-colored matter called *chlorophyll.* Other plants have green leaves and use energy from the sun, carbon dioxide from the air, and nutrients from the soil to make their own food. Fungi cannot make their own food and, therefore, must feed on other plants and organic matter. Fungi are sometimes called *molds.* Many people have seen mold growing on bread, jam or on an old leather shoe left in the cellar. A mushroom is also a fungus.*Fungi can cause leaf spots, root rots, seedling disease, leaf curl, wilts, fruit rots, and stem cankers.*

- **Bacteria** (singular, bacterium) are the simplest living organisms known to man. They are much smaller than fungi. Some are so small that 10,000 of them laid end to end would not measure more than one inch. They are one-celled but increase in numbers rapidly. In some of the faster multiplying types, a single bacterium could produce over a billion offspring in 12 hours.
  Disease symptoms caused by bacteria are leaf spots, blights, wilts, galls, stem cankers, and soft rots of vegetables and fruits.

- **Viruses** are very small and can only be seen with a very powerful microscope known as an electron microscope. Viruses are regarded as neither plants nor animals. They are made up of genetic material (DNA or RNA) and are spread by insects and some fungi. Viruses can only live inside a living cell of a plant or animal.
  Disease symptoms caused in a plant by a virus are chlorosis (yellowing), leaf mosaic (green and yellow pattern), stunting, leaf spots, and wilting.

- **Nematodes** that attack plants are round, slender, non-segmented, thread-like worms about 1/70 of an inch long. They can barely be seen with the unaided eye. They have a spearmechanism that is inserted into a plant to withdraw the plant's juices. Some nematodes feed on the outside of roots, others on the inside, and some feed on buds, leaves, and stems of plants. Plants attacked by nematodes do not grow well, are yellow, are stunted, and wilt quickly after dry periods. Some nematodes cause galls on roots and others cause a small and rotted root system.

Control of Infectious Diseases

The most important part of control is to first know exactly what is causing the problem. Once the problem is correctly diagnosed, it is then possible to choose control of the problem.

There are two main types of control measures for infectious diseases:

- cultural control, and
- chemical control.

Cultural Control

Cultural control measures for diseases in the home garden include the use of the following.

CULTURAL CONTROL	HOW IT WORKS
Resistant plants	Plants that do not become "sick" when exposed to infectious disease agents. Resistance to specific deseases is listed in vegetable seed catalogues, on seed packets and sometimes on stakes when vegetable transplants are purchased.
Sanitation	Cleaning up dead plants removes disease organisms and makes for a healthier garden. Diseases and insect pests may get an early start in a garden if plants are left in the garden all winter. Many fungi, bacteria, and insects cannot live outside a plant, which is their house for the winter. By removing old plants and weeds, insects and diseases are also removed. Good gardeners clean up their gardens in the fall.
Weed Control	Since insects live and reproduce in weeds, removal of weeds will reduce the number of insects, such as aphids, which might spread diseases.
Crop Rotation	Moving plants to different areas of the garden each year helps to avoid a build-up of disease organisms.
Time of Planting	Planting at the proper date avoids wet, cool soils, and possible seed and root rot, as well as soil compaction.
Proper watering and fertility	Maintaining good plant vigor makes plants less susceptible to disease.
Cleen seed	Plant disease free seed for a healthy start.

Chemical Control

Chemical control measures in the home garden include the use of fungicides as:

- seed treatments to protect the seed from rotting as it sits in cool, wet soils awaiting good germination conditions; and
- as preventative "coatings" on healthy leaves to control the spread of disease.

Fungicides are used mainly to protect healthy plant tissue from infectious disease problems. To properly control an infectious disease, these chemicals must be used *before* or shortly after the disease appears.

Fungicides used in a vegetable garden will not kill the infectious disease-causing agents, unlike the insecticides which do kill insects. Fungicides are put on the plant to protect the healthy leaves from becoming infected. Fungicides are easily washed off by sprinklers and rain. Therefore, when there is a disease problem and fungicides are chosen for control these chemicals usually need to be applied every 7-14 days throughout the growing season to maintain proper coverage of the leaf tissue for protection from disease development. Since this is time consuming and expensive, the use of cultural control measures should always be considered first.

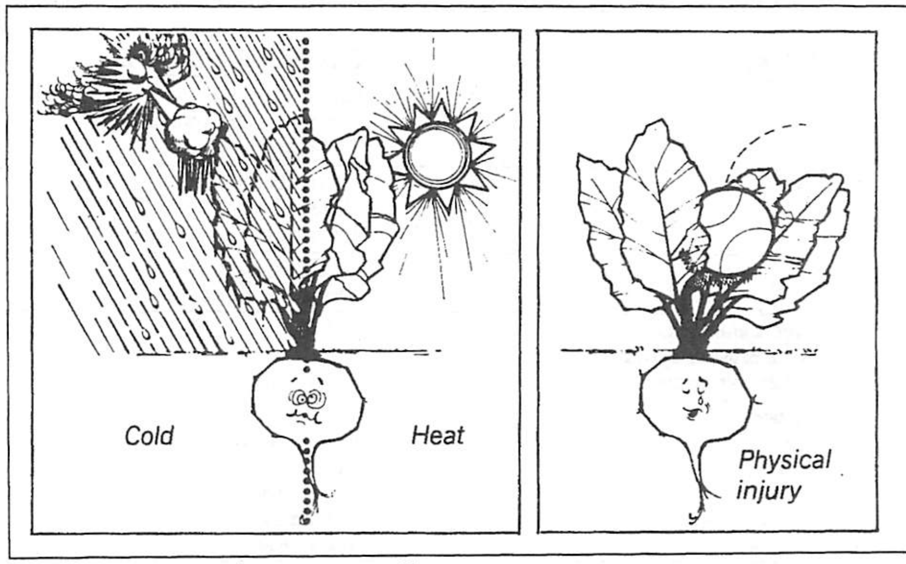
NONINFECTIOUS AGENTS

Noninfectious agents cannot be passed or transmitted from one plant to another.

Noninfectious agents may be:

- mechanical - rototillers, cultivation equipment (hoes, rakes), sand, insects
- chemical - fertilizers, herbicides, other pesticides
- environmental - water, wind, temperature, hail, sunlight

Thus, many noninfectious agents, such as water, temperature and fertilizer, are necessary for normal plant growth, but produce a noninfectious disease when



they are present in too large or too small quantities. (see illustration above)

For example:

- too much water will drown roots;
- too little water will dry out the plants;
- too much sun will burn the plants;
- too low temperatures will cause poor growth or plant injury;
- too much fertilizer or improper placement will burn the roots;
- too much pesticide may cause abnormal growth;
- soil compaction restricts root growth; and so on.

How About Air Pollution?

Air pollution is a noninfectious disease which can cause plants to die. *Smog* is air polluted with mixtures of moisture, smoke, and gases. Exhaust from cars reacts with moisture and sunlight in the atmosphere to form plant poisons, such as oxides of nitrogen and ozone. These are harmful to plants and are known as noninfectious disease agents. Air pollution causes many plants and trees to age early. It may also cause leaf burning and discoloration.

Table 3. Diseases Commonly Found on Home Garden Vegetables and Recommended Control Measures

VEGETABLE	PRINCIPAL DISEASE	CONTROL MEASURES
Asparagus	Rust	1,5,8
	Fusarium wilt & crown rot	1,6,9
	Virus diseases	1,10
Beans	Bacterial blights	1,3,4,5,7,9
	White mold	3,4,5,6,7
	Anthracnose	1,2,3,4,7,9
Beet	Cercospora leaf spot	1,2,3,4,7
	Alternaria leaf spot	1,2,4,7
Cabbage, Cauliflower, Broccoli, Brussels sprouts, and other cole crops	Club root	5,6,8,9
	Black rot	1,3,6,9
	Fusarium yellows	1,6,9
Cucumber	Scab	1,3,4,7,8,9
	Virus diseases (mosaic)	1,9,10
	Powdery mildew	1,3,4,7,8
	Bacterial wilt	1,2,5,7,10
	Anthracnose	1,2,3,4,7,8
	Angular leaf spot	1,2,3,4,7,9
Eggplant	Verticillium wilt	6,9
	Fungal leaf spots	2,3,4,7,8
Muskmelon	Bacterial wilt	1,2,5,7,10
	Fusarium wilt	1,6,9
	Powdery mildew	1,3,4,7,8
	Other fungal leaf spots	1,2,3,4,7,8
Onion	Blast, Purple blotch and	2,3,4,7,8
	Leaf blights	3,4,5,7
	Neck rots	3,4,5,7
	Fusarium basal rot	1,3,4,5,7
	Bulb rot	3,4,5,7
	Bacterial soft rot	2,3,4,5,7
Pea	Fusarium wilt	1,6,9
	Root rot	6,11
	Virus diseases	1,10
Pepper	Virus diseases (mosaic)	1,9,10
	Sunscald	3,14
	Anthracnose	2,3,4,7,8
	Bacterial leaf spot	1,2,3,4,7,9
Potato	Scab	1,6,9,11
	Virus diseases	1,9,10
	Early and late blight	2,3,4,6,7,8,9
	Black leg	2,5,6,7,9
Pumpkin	Powdery mildew	3,4,7,8
Squash	Fusarium wilt	1,6,9
	Powdery mildew	1,3,4,7,8
	Scab	3,4,7,8,9
	Virus diseases	1,4,9,10
Sweet Corn	Stewart's bacterial wilt	1
	Rust	1,3,4,8
	Smut	1,2
	Virus diseases	1
	Other fungal leaf spots	1,2,3,4,7,8
Tomato	Blossom end rot	13
	Cracking	13
	Catface	0
	Sunscald	14
	Fusarium/Verticillium wilt	1,6,9
	Fungal leaf spots	1,2,3,4,6,7,8
	Bacterial leaf spots	2,3,4,6,7,9
	Root knot nematode	1,6
	Virus diseases	1,9,10
	Walnut wilt	12

Key to Control Measures:

0. This problem may occur when cool, cloudy weather at blooming time causes the blossom to stick to the young developing fruit, resulting in a malformation of the fruit. 2,4-D can also cause this type of distortion.

1. Plant disease resistant or tolerant varieties.

2. Plant sanitation – Cleaning up dead plants and diseased plant parts removes disease organisms and makes for a healthier garden When plants are not wet, carefully remove and destroy or discard affected plant parts or portions thereof. Remove and destroy or discard rotten or damaged fruit throughout the growing season.

3. Water early – Avoid wetting foliage, if possible. Water early in the day so that the above ground plant parts will dry as quickly as possible.

4. Improve air circulation – Avoid crowding plants, space plants apart to allow air circulation. Eliminate weeds around the plants and garden area to improve air circulation.

5. Rogue plants – Remove and discard or destroy entire infected plant immediately and surrounding soil or soil clinging to roots.

6. Crop rotation – Sow seed or set transplants in a different location of the garden than where they grew the previous year. Infested soil in a containerized garden should be removed and replaced with fresh soil.

7. Autumn clean-up – In the autumn, rake and dispose of all fallen or diseased leaves and fruit.

8. Apply a fungicide as recommended on the label.

9. Use disease-free plants or seed.

10. Control insects that spread the disease.

11. Improve soil drainage and maintain a balanced fertility; mulch where appropriate.

12. Avoid planting tomatoes or other solanaceous crops within 50 to 100 feet of black walnut trees to avoid juglone toxicity from the roots.

13. Avoid soil moisture extremes during hot, dry spells by mulching and irrigating.

14. Caging offers the best protection due to an increase in foliage cover of the fruit.

TAKING CARE OF TOMATO PLANTS:

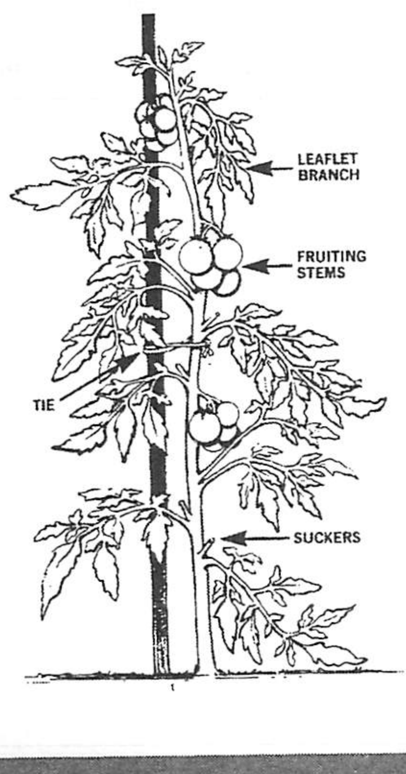
Methods of Support

Advantages	*Disadvantages*
NO SUPPORT (Letting Plants Run)	
• Very little time spent caring for crop; ittle or no pruning; no staking and training; no support to build or buy. • Total yield may be higher than staked or caged plants.	• Requires more room in the garden; sprawling plants bush out quite a bit. • In wet weather, gardeners will have rot, slugs, or bug problems with tomatoes on the ground. • Sometimes hard to find tomatoes that are close to the ground or hidden by thick growth.
STAKING	
• Staking saves space; can grow more tomato plants in a row, if staked as close as 28 inches. • Keeps vines and tomatoes off the ground; slugs; harvest is cleaner, and there is less rotting • Earlier harvest. The pruning that staked tomatoes need forces more of the plant's energy into ripening the fruit. Tomatoes tend to be larger when a plant is staked; more energy goes into fewer tomatoes. • Easier to pick tomatoes and to work around staked plants.	• Takes time and effort to set stakes, train the plants up the stakes, and prune them. • Plants usually need plenty of mulching. • Staked plants need more water than unstaked ones • Tomatoes are more prone to cracking, blossom end rot, and other problems when they are standing up; they are much more exposed. • Decreases yield (in terms of number of fruit).
CAGES	
• If cages are set up as seedlings are transplanted to the garden, no additional work is necessary. • No pruning is involved; leaves shade the tomatoes and protect them from sun scald and allow them to ripen evenly. • Easier to pick tomatoes and to work around caged plants. • Keeps vines and tomatoes off the ground; no slugs; harvest is cleaner and there is less rotting	• Store-bought cages can be expensive; make your own from galvanized wire mesh. • A lot of work is required in setting up the cages and securing them to small stakes. • Takes time at the end of the season to disassemble cages and store parts.
TRELLISING	
• Holds tomatoes off the ground for cleaner, easier-to-pick harvest. • Usually does not require as much pruning as staked tomatoes; two or three main stems can grow with trellising.	• Trellising can be hard work, especially for a large planting; poles, wires, and braces are usually • Requires weekly maintenance to keep plants running up the trellis; tied to trellis wire. • Takes time at the end of the season to disassemble the trellis and store parts.

More on Staking Tomatoes

Put a stake, approximately 8 feet tall and 1 to 2 inches wide, about 4 inches from each tomato plant. Use large sticks or branches if stakes are not available. Drive the stake about 1 to 2 feet into the ground. Tie strips of soft cloth (1 inch wide) around the stake. Tie the strips again in a loose loop around the stem of the tomato plant under the first group of blossoms. To train the tomato plant, twist the main stem around the stake once a week.

Tomatoes grown on a stake need to be pruned regularly to remove non-fruiting *suckers*. Suckers grow between the main stem and the leaf. (See the illustration.) Remove suckers when they are small by snapping to one side and pulling off in the opposite direction; do it every week. Be careful not to confuse suckers with fruiting stems. Also, be careful not to injure any flowers that are on the main stem. Be sure to remove all suckers even if they have flowers. If left unpruned, each sucker will grow into a whole new vine.



MANAGING INSECT PESTS

Insects feeding on vegetables grown in the home garden are a fact of life for most gardeners. A gardener's two choices are to tolerate the damage or attempt to prevent it. Frequently, tolerating the damage is a reasonable approach. For example, when tomatoes begin to ripen, most gardeners have more tomatoes than they can possibly use. Therefore, caterpillars chewing on a few of the fruits are no real concern. Corn earworms usually confine their damage to the tips of sweet corn ears. A viable strategy is to cut off the damaged tips before cooking the corn. In addition, some crops are much less likely to be attacked by insects than others. Table 4 categorizes those crops that are never or rarely, sometimes, and usually or always attacked by insects. Planting crops that are less likely to suffer injury from insect feeding will reduce the problems a gardener can expect from insect pests.

Preventative Practices

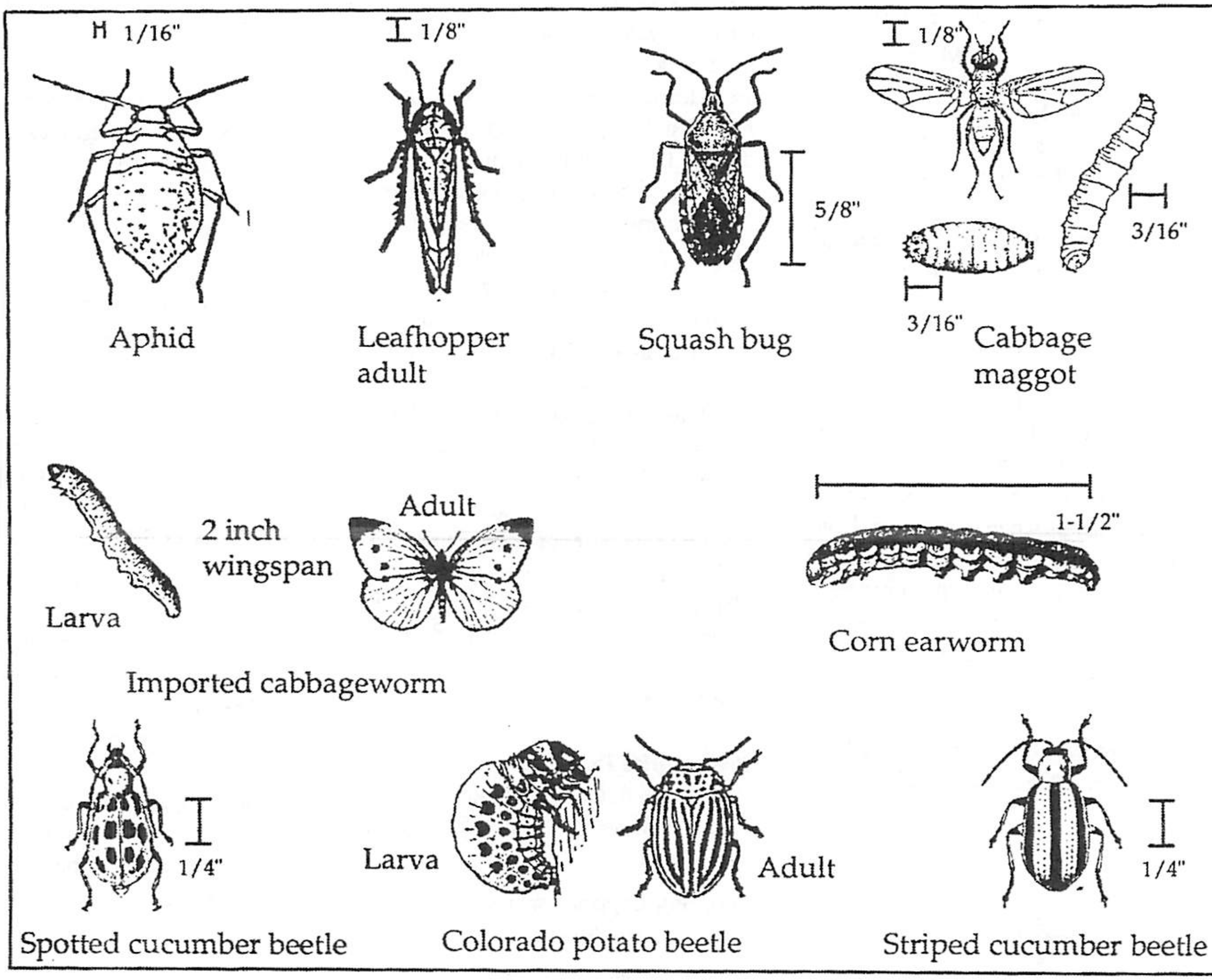
There are a number of practices that the home gardener can use to reduce insect problems.

- Dispose of plant residues from the previous year's garden.
- Plant varieties that are recommended for use in the gardener's area and plant them at the proper time for best growth. (Planting too early when the soil is cool may make the plants more susceptible to some soil insects.)
- Use proper plant spacings, fertilizers, water, and cultural practices to insure vigorous plant growth. Plants that are growing vigorously often can tolerate more insect damage than poorly growing plants.
- Inspect transplants before purchase to make sure they are not infested with insects.
- Keep the garden as weed-free as possible. This will help the plants to continue to grow vigorously, and weeds often harbor insects that also will attack the crops.
- Inspect plants regularly for the presence of insects or insect damage. Early detection can often esult in more effective control and reduce the amount of damage suffered. Particularly in small gardens, early-detected caterpillars, loopers,hornworms, and large beetles can often merely be hand-picked from plants and destroyed before they cause problems.

Frequency of insect injury to various vegetables grown in the home garden

Never or rarely	Sometimes	Usually or always
Carrots	Asparagus	Broccoli
Green Onion	Beans	Cabbage
Lettuce	Peppers	Cantaloupes
Peas	Spinach	Cauliflower
Radishes	Tomatoes	Cucumbers
		Eggplant
		Potatoes
		Squash
		Sweet Corn

Some common garden pests are illustrated. (Bars represent actual size)



BENEFICIAL ARTHROPODS

Arthropods are animals with jointed legs, including insects, spiders, and mites.

- Only a very small perc entage of the arthropods that occur in Indiana are pests, and only a few of these are pests of vegetables.
- Most are so innocuous that they are never noticed.
- Many play important roles in providing food for larger animals, helping to break down decaying plants and animals, etc.
- Other arthropods provide direct benefit for gardeners.
- A number of insects and other arthropods are predators; that is, they eat other insects, including pest insects. These include spiders, adult and immature lady beetles, adult and immature lacewings, preying mantids, and ground beetles.
- Others act as parasites on pest insects. These include a number of species of wasps and flies, which lay eggs in or on the host insect.

It is important to preserve as many of these predators and parasites as possible. Often they will control the pest species well enough that additional control is not necessary. A good method for conserving beneficial insects is to spray insecticides only when necessary and to choose insecticides that are least toxic to the beneficial insects whenever possible.

One of the most notable beneficial insects is the honey bee. Besides providing honey, they serve as pollinators for many vegetable and fruit crops. Without these pollinators, many crops would never produce fruit. Never apply insecticides that are toxic to bees when plants are in bloom.

INSECTICIDES

An insecticide is any product which you apply which kills insects. There are several different types of insecticides available for use by the home gardener.

Botanical insecticides

Botanical insecticides are extracted from plants:

- *Rotenone:* derived from the roots of tropical plants; needs to be eaten by the insect to act as a stomach poison. Normally used against chewing insects.
- *Pyrethrum:* derived from the flowers of certain chrysanthemum plants. Pyrethrum causes rapid paralysis and apparent death, but insects may subsequently recover. It is most effective against soft-bodied insects such as scales and aphids. Mixtures with piperonyl butoxide provide improved control.

Microbial Insecticides

The microbial insecticides available to the home gardener contain spores of the bacterium *Bacillus thuringiensis* (BT), which contains a toxin that causes gut paralysis in the insect after being consumed. Most of the BT strains sold are effective against most caterpillars. These are sold under many different trade names. There are several new strains of BT's that are effective against beetles, specifically the Colorado potato beetle. A major advantage of using microbial insecticides is that they do not affect bees, beneficial insects, humans, or other vertebrates.

Manufactured Insecticides

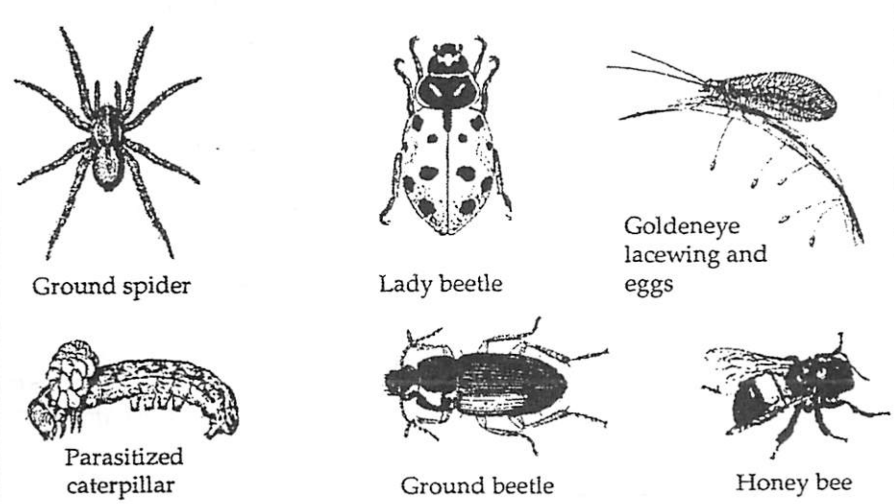
There are several different manufactured insecticides available for use by the home gardener. These insecticides vary in:

- which insects they will control,
- how long they are active, and
- the length of time between application and harvest.

Inorganic Insecticides (oils and soaps)

- Highly refined oils can be used at low concentrations to control insects. Oils work only on contact and have no residual activity. Oils can damage growing plants, so it is a good idea to test an oil spray on a few plants if the gardener has not used oils before. Wait a couple of days to see if the oil damaged those plants before spraying the remainder.
- Commercially available insecticidal soaps, which are made from naturally occurring fatty acids, will help control aphids, mites, leafhoppers, scales, and whiteflies. Like oils, soaps only control those insects on which the spray lands. Pure unscented household soaps can lso be used, but should be tested on a small scale first to make sure it does not burn the leaves.

Some common beneficial arthropods are illustrated.



GENERAL USE AND SAFETY OF INSECTICIDES

- Ready-to-use "general purpose" garden sprays and dusts usually contain several ingredients to control the principal insects and diseases of vegetables or ornamentals. The insecticides most commonly included armethoxychlor, rotenone, carbaryl, pyrethrins, or malathion. Sometimes a fungicide is often added, such as captan, for disease control. If applied according to directions, general purpose mixtures usually will give adequate protection from most insect pests.
- Although most of the insecticides available for use in the home garden are relatively safe to use, remember that all insecticides are potential ***poisons,*** and should be used with the utmost care. A common misconception is that botanical insecticides are safer to use than manufactured insecticides.
  - Treat all insecticides with extreme care.
  - Carefully read and follow all precautions on the insecticide label.
  - Check the label to determine how many days to wait after using an insecticide before harvesting and eating the produce.
- Sometimes using an insecticide will increase insect problems. For example, overuse of carbaryl on some crops can increase problems with aphids, mites, and whiteflies because it kills the natural enemies that eat those pests, but does not kill the pests themselves.
- Properly done, either spraying or dusting should give adequate control of insects.
  - If dusting, plants need only the lightest coating of dust, but that coating must be on both the upper and lower leaf surfaces. Because of this, shaker-can dusters usually do not do an adequate job. Squeeze or plunger dusters probably are better, as are aerosol dusters if kept agitated while dusting. Dusts will usually be more expensive per ounce of active ingredient than spray formulations.
  - When spraying, again both the upper and lower surfaces must be treated. Sprayer pressure must be sufficient to roll leaves over for coverage. Hose-x end, trombone, and compressed air (pump) sprayers are all adequate, with compromises to be made between convenience, cost, and effectiveness. Aerosol cans of insecticide are not recommended except to treat individual plants or very small gardens. Unless otherwise noted on the material label, a gallon of spray will cover approximately 500 square feet or 200 feet of row.

Table 4

Insects Commonly Found on Vegetables and Recommended Insecticides* for Control.

INSECTS	VEGETABLES ATTACKED	RECOMMENDED INSECTICIDES
Aphids	Many vegetables	3, 4, 7
Asparagus beetle	Asparagus	2, 4, 5, 6
Bean leaf beetle	Bean	2, 3, 4, 5
Blister beetle	Many vegetables	2, 5
Cabbage looper	Cabbage, cauliflower, broccoli	1,6
Colorado potato beetle	Potato, tomato, eggplant, pepper	2, 3, 5
Corn earworm	Corn, tomato, bean	2, 3
Cucumber beetles	Cucumber, bean, melon, squash, pumpkin	2, 3, 5, 6
Cutworms	Many vegetables	2 bait
European corn borer	Corn, pepper, bean	2, 3, 6
Flea beetles	Many vegetables	2, 3, 4, 5
Grasshoppers	Many vegetables	2, 3
Imported cabbageworm	Cabbage, cauliflower, broccoli	1, 2, 3, 6
Leafhoppers	Bean, potato	2, 3, 5, 7
Mexican bean beetle	Bean	2, 3, 5, 6
Root maggots	Onion, cabbage, cauliflower, broccoli	3 in seed furrow or over row
Spider mites	Many vegetables	3, 4, 7
Squash bug	Cucumber, melon, squash, pumpkin	2
Squash vine borer	Cucumber, melon, squash, pumpkin	2, 4, 5
Tomato hornworm	Tomato, potato, eggplant, pepper	2, 6
Whitefly	Many vegetables	3, 4, 7
Wireworms	Corn, potato, sweet potato	3 as soil treatment

Key to Recommended Insecticides:

1. *Bacillus thuringiensis*
2. Carbaryl
3. Diazinon
4. Malathion
5. Methoxychlor
6. Rotenone
7. Soaps or oils

*Recommendation current as of January, 1996. Read labels carefully for up-to-date information.

It's Tool Time

Project Skill: Making garden tools from recycled material
Life Skill: Managing resources

Materials:
- things around the home that can be used in the garden (old forks, spoons, kitchen scoops, turkey baster, eye dropper, shoe box, empty coffee can, etc.)
- scissors
- hole puncher
- popsicle sticks
- 3 or 4 empty plastic gallon milk or juice containers
- markers, stickers, optional

Time Required:
30 to 40 minutes

Preparation before Meeting:
- give some thought to which tool(s) would be possible to make with your group
- prepare some sample garden tools that you've made out of recycled material

This activity is about making do with what is available, whether or not youth have the option of purchasing garden tools. Obviously, some tools to work up the soil are necessary; perhaps those can be borrowed. Here are some ideas for using items in the garden that you can find around the home:
- old flatware (forks, spoons, and kitchen scoops) can be used when planting seedlings;
- a turkey baster can be used to water germinating seeds and seedlings or even to water hanging baskets;
- scissors are useful to take cuttings or clip away seedlings when thinning a row;
- an empty coffee can makes a watering can;
- an eye dropper can be used to give water to seeds that will be germinated indoors; and
- a shoe box can safely store tools.

EXPERIENCE

1. Tell youth that this activity is about making tools from recycled material (empty plastic gallon milk or juice containers), including a tool tote, a watering can, a scoop, plant labels, a plant "hat" called a cloche, and more.
2. Demonstrate how ordinary items around the home can be used as tools in the garden.
3. Lead youth through the directions to make one or more of the garden tools. *(Note: With younger youth, special care is needed when using scissors to cut plastic gallon containers.)*

***Tool Tote** (or a compost bucket)*

- Use scissors to cut away the top front section of a plastic gallon jug.

- Decorate it using permanent markers, decals cut from adhesive backed paper, or stickers.
- Fill with gloves, a trowel, old forks and spoons, scissors, plant labels, or popsicle sticks, string for plants that need support, a magnifying glass, etc. The handle makes it easy for a gardener to carry tools to the garden!

Watering Can

- Cut away the top part of a plastic gallon jug with scissors.
- Punch holes in the front using a hole punch or large nail.
- Fill with water and try pouring out some water to test it. If necessary, add more holes.

Irrigation Jug

- Punch holes in the bottom of a plastic gallon jug using a nail.
- Set the jug on the ground near plants to be watered. Water will slowly seep into the ground.

Scoop

Variation #1

- Cut around the handle of a plastic gallon jug, adjusting for the size of scoop needed. (Note: a 1-liter plastic bottle can also be used) Several sizes will fit most any need: a large scoop at the compost pile, another where you container garden, and a smaller one for digging little trenches when planting seeds, etc.

Variation #2

- Cut off the bottom of a plastic gallon jug at an angle to make another kind of scooper.

Plant Labels

- Cut a strip from the sides of a plastic gallon jug, or use popsicle sticks.
- Print the plant name with a permanent marker.

Plant Hat (Cloche)

- Cut away the bottom of a plastic gallon jug, and cut slits up the sides to make a simple cover for tiny seedlings that have just begun growing in the garden outdoors.
- Spread the slits apart and push the ends into the soil around the plant.
- Once the seedlings grow larger and stronger, put the hats away for next year's seedlings.

Mini-Greenhouse (or frost protector)

- Cut the bottom off of a plastic gallon jug to make a mini-greenhouse.
- Remove the cap during the day.
- Use the mini-greenhouse to cover plants when frost is possible at night.

Plant Collar

- Cut a plastic gallon jug as shown to make a collar for seedlings to keep cutworms away.
- Place the collar around the seedling and push it in the ground a little so it will not move around.

SHARE

- *How did you save money (or manage your resources) in this activity?*
- *How did you decide which garden tool(s) to make?*

PROCESS

- *How did making your own garden tool(s) help you learn about managing resources?*
- *Why is it important to learn how to manage your resources?*

GENERALIZE

- *Besides learning about managing resources, what else did this activity demonstrate?*
  The activity also emphasized conserving the environment.
- *In what other ways do you manage your resources? (Hint: Think about spending allowances and time resources that you have.)*

APPLY

- *In what other areas of your life will you be managing your resources as you grow older?*
- *How can you use things you find around your home (other recycled material, for example) to make other useful items?*

Planting Ideas

Project Skill: Understanding both sides of an issue
Life Skill: Conserving the environment

Materials:
- paper pad and pencil for reporter
- props for fun and effect
- video cameras or camera, optional
- mock microphone

Time Required:
30 to 45 minutes

Preparation before Meeting:
- Think about several garden-related issues that are a concern in your local area. Read through the activity and consider that group size may affect the type of activity you want to lead. Two of the three choices suggested in the activity (making a public service announcement or writing a newspaper article about your group's actions regarding the issue) involve fewer people and are less complicated than a news conference.

People all around the world are becoming more interested in and concerned with protecting the environment. Natural resources must be used wisely because some are not renewable. This activity is about doing one of the following choices to help youth understand both sides of a garden-related issue that has an environmental impact:
- role-playing a news conference or interview, or
- "producing" a public service announcement for TV or radio, or
- writing a news article for the local newspaper about what your group is doing about the issue.

Examples of some environmental issues related to gardening include:
- a pesticide spill, or
- the no-till planting method, or
- what to do with grass clippings, if the local landfill no longer accepts the clippings, etc.

If youth opt to role play a news conference, any one of the following roles can be used, depending on the garden-related environmental issue the group chooses to explore:
- news reporter,
- camera/video person,
- parent,
- youth,
- person with strong environmental views and beliefs,
- volunteer who works with youth groups interested in gardening, and an
- industry spokesperson representing a company involved with the issue.

EXPERIENCE

1. Tell youth that this activity is about expressing their feelings in an interview process or a news reporting situation. Gardening-related issues have been increasingly in the news, and it is the right time to think about them in one of several ways: role-playing a news conference or interview regarding an environmental concern in the local area, making a public service announcement about a garden-related practice (such as composting), or writing a news article or editorial about the groups activities and submitting it to the local newspaper.
2. Brainstorm with youth on exactly what the group wants to do. Local issues may influence the choice, too. For example, a recent county council decision not to accept grass clippings

at the county landfill may result in a heated discussion on the issue, but it is also an opportunity to make a public service announcement on what homeowners can do with grass clippings (start a compost pile, use as mulch, etc.).

3. Ask youth to pretend they are not familiar with a certain garden-related issue that the group wants to explore. As individuals or groups of 2 or 3, think of questions that might be asked about how the garden-related issue affects the environment, including soil, waterways, rivers, air, etc. Think of potential answers, also.

4. Divide into the appropriate role if the group is role-playing a news conference or interview, including:
   - one 4-H garden project member,
   - a parent or guardian of the member,
   - a farmer who sells produce in the local area,
   - a vocal opponent of the garden-related issue,
   - a local news reporter,
   - camera/video person, and
   - others.

5. If the group is large, this activity can accommodate several smaller groups. In that case, interviews can be conducted at the same time and then summaries of what happened can be presented to the whole group. That way everyone will hear what each group discussed.

SHARE

- *What happened in this activity?*
- *How did you feel about the role you played?*

PROCESS

- *How did this activity help you understand "the other side" of the garden-related issue?*
- *Why is it important to listen to both sides of an issue?*

GENERALIZE

- *Give an example of an experience like this which you have had. Think about school-related issues and other 4-H projects, such as those with animal and animal welfare/animal rights issues.*
- *What other environmental conservation impact issues have you heard or read about?*

APPLY

- *What would you do differently the next time you must deal with an environmental conservation issue?*
- *How can you use the skills you learned in this activity to tell your point of view the next time you are questioned by a person with ideas very different from your own?*

Harvesting & Storage

BACKGROUND INFORMATION

HINTS FOR HARVESTING, STORING, AND COOKING VEGETABLES AND HERBS

Here are some ideas and helpful hints for to harvest and use of garden vegetables once they are grown. Prior to harvesting vegetables, be sure to review the "days to harvest" restrictions on all pesticides used.

- Eat vegetables raw or cook them.
- Eat vegetables right away, freeze, or can them for use later.
- Give vegetables away or sell to neighbors and friends.
- Store certain vegetables in pits and special structures.

Ask your County Extension office for a bulletin on storing fruits and vegetables at home.

When any vegetable is prepared to eat, it should be cleaned carefully. Also, remember that vegetables taste best if they are eaten at the right stage of their development. The following tips will help a gardener decide when to harvest.

Basil
Pinch stem tips as plants grow to keep plant bushy. Harvest leaves just as the first few flowers appear. Use fresh or dry for later use in Italian dishes.

Beans, Snap or Green
Harvest green beans as pods fill for the best taste but before the seeds bulge. Green beans can also be picked later and shelled out. Beans like this are called "shellies." To cook: boil green beans whole, split, sliced, or chopped, for 10 to 25 minutes. A small amount of onion or bacon adds to their taste.

Beets
Begin harvest when beet is 1 inch in diameter. Beet tops make excellent tender greens at this time. Beets are considered full size when 2-3 inches in diameter.

Broccoli
Harvest the terminal head while florets are still tight and of bluish-green color. Smaller sized heads will develop from side shoots after the main head is removed. Eat broccoli raw in salads, stir-fried, or steamed until tender but firm.

Cabbage
Cut, twist or pull cabbage when it is mature. Maturation time depends on the cultivar of cabbage planted. Some cabbage is fully developed in 80 days; others need up to 105 days. Eat cabbage raw, shredded or in a combination salad. To cook: boil, pan fry, pickle, or make sweet and sour cabbage.

Carrots
Pull carrots from the time they are the size of your thumb. If the green tops break off, you may have to dig them out. Wash and peel carrots before you eat them. To cook: shred, slice, shave, shoestring, or leave whole. Boil or steam carrots. To eat raw, cut into strips, make curls or leave whole.

Cauliflower
To keep heads white, tie outer leaves above the head when curds are about 1-2 inches in diameter. Heads will be ready for harvest in about 2 weeks after tying. Eat cauliflower raw in salads, or steamed until tender.

Corn, Sweet
Harvest sweet corn when kernels are plump and tender. Silks will be dry and the kernels filled. Check a few ears for maturity. Open top of ear, press a few kernels with your thumbnail. If milky juice is present, it is ready for harvest. If the kernel is doughy, the flavor will be starchy. If watery juice is present, the corn is not yet ready to pick.

Cucumbers
Although size depends on the cultivar, most slicing cucumbers will be ready to harvest when 1 ½ to 2 ½ inches in diameter and 5-8 inches long. Pickling cucumbers will be more blocky and 2-3 inches long.

Eggplant
Harvest when fruits are firm and color is solid and bright. Eggplants do not store well; store in the warmest part of the refrigerator up to 1 week.

Kohlrabi
Harvest when the swollen stems are 2-3 inches in diameter. Stems become woody if allowed to grow larger.

Leaf Lettuce
Harvest leaf lettuce from the time it is about 3 inches long until it sends up a seed stalk. Cut off the leaves. Do not disturb the root, as new leaves will grow. Wash the lettuce leaves to remove soil and other residue. Use lettuce raw as a salad vegetable. To cook: shred, wilt or braise lettuce until it is tender. Bacon, onion, and other seasonings add to the taste of wilted lettuce.

Mint
Harvest leaves any time during growing season. Use fresh in iced tea and salads, or dry for later use.

Muskmelon (Cantaloupe)
Harvest when the stem slips easily from the fruit. The color beneath the outer netting of the melon should be slightly orange in color with little green.

Okra
Harvest pods when they are 2-3 inches long. Larger pods will be tough and seedy. Harvest pods daily to keep plants in production. Use pods in stew or soup.

Onions
Pick onions green or let the bulbs mature. They are mature when the tops fall over. After pulling mature onions, let them dry outside for several days in the shade. Eat onions raw in salads or on sandwiches. Use onions to flavor stews and other foods. To cook: boil whole for 15 to 40 minutes, bake, fry, french fry or braise.

Oregano
Pinch stem tips as plants grow to keep plant bushy. Harvest leaves just as the first few flowers appear. Use fresh or dry for later use in Italian dishes.

Parsley
Harvest leaves any time during growing season. Use fresh in salads or dry for later use.

Parsnips
Harvest in late fall after several moderate freezes. Cold weather enhances the sweet flavor. Steam or boil similar to carrots.

Peas
Harvest shelling peas when the pods are rounded and firm. Do not let the pods turn yellow or the peas will be tough. To cook: steam or boil peas 10 to 20 minutes. Cook peas with mushrooms, young potatoes, melted butter, or in a cream sauce. Oriental or snow peas should be harvested before the seeds begin to bulge. Snap peas are harvested as seeds fill the pod. The pod is edible on both oriental and snap peas. Prepare these peas by stir-frying or steaming.

Peppers
Harvest peppers when they are firm and before they become soft or before brown spots begin to appear. To eat raw, wash and cut out the stem. Remove seed before cutting into strips or rings, dicing or leaving whole. To cook: hollow the pepper out and stuff with mixtures of shrimp, beef or chicken, and bake.

Potatoes
Harvest when the tops have yellowed. Cure for about 1 week in a shaded, well-aerated place before storing. Avoid exposing the potatoes to light to prevent greening. Bake, boil, fry, broil, or stew.

Pumpkin
Harvest when the skin is hard and the colors darken before the first fall frost. Leave 1-2 inches of stem attached to the pumpkin. Use for baking or carving.

Radishes
Harvest radishes from the time they reach the size of cherries, depending on the cultivar. Eat raw or slice for salads. If left in the soil, radishes take on a fibrous quality; these are good to eat sliced and steamed or stir fried since the texture is like water chestnuts.

Sage
Harvest leaves any time during growing season. Use fresh or dry for later use.

Spinach
Harvest spinach from the time the leaves are 4 inches tall until the plants send up seed stalks. If you cut off spinach an inch or so above the ground, the plants will grow out again. Eat spinach raw in salads, or steam until wilted.

Squash, Summer (zucchini and others)
Harvest when fruit is small (6-8 inches long or 3-4 inches in diameter for scallop-types). Fruits should be tender with skin that is easily scratched. Use raw in salads, steam, or stir-fry.

Squash, Winter
Harvest when the skin is hard and the colors darken before the first fall frost. Bake until tender.

Tomatoes
Don't pick tomatoes too early! Pick them when they are almost fully colored red. Eat tomatoes raw, sliced, plain, with lettuce, in a salad, or on sandwiches. To cook: stew, fry, or bake.

Turnips
Harvest turnips from the time they are the size of golf balls until they become very large, woody and difficult to cut. Raw turnip sticks are delicious with a dunking sauce. Eat the tops as cooked greens. Eat turnip roots raw, or cook them by stewing, frying or baking.

Watermelon
Harvest when the underside of the fruit turns from whitish to yellowish. The tendril at the juncture of the fruit stem and the vine usually turns brown when the fruit is ready to harvest. Some gardeners use the "thump" method. A ripe melon should sound like a dull thud when thumped with your thumb. A melon that is not yet ready should make a ringing sound.

USING AND PRESERVING GARDEN VEGETABLES

VEGETABLE	SALADS	COOKING	CANNING	FREEZING	DEHYDRATING	STORING*
Beans	x	x	x	x	x	x
Beets	x	x	x	x	–	x
Broccoli	x	x	–	x	–	–
Brus. Sprouts	–	x	–	x	–	–
Cabbage	x	x	can be pickled	x	–	x
Carrots	x	x	x	x	x	x
Cauliflower	x	x	x	x	–	–
Chard	x	x	x	x	–	–
Corn	–	x	x	x	–	–
Cucumbers	x	–	can be pickled	freezer pickles	–	–
Eggplant	–	x	–	x	–	–
Kohlrabi	–	x	–	–	–	x
Leeks	–	x	–	–	x	x
Lettuce	x	–	–	–	–	–
Okra	–	x	–	x	–	–
Onions - green	x	x	–	x	x	–
- regular	x	x	–	x	x	x
Muskmelon	x	–	–	x	–	–
Parsley	x	x	–	x	x	–
Parsnips	–	x	–	–	–	x
Peas	edible pods	x	x	x	x	–
Peppers	x	x	x	x	x	–
Potatoes	–	x	x	–	x	x
Pumpkin	–	x	–	x	–	x
Radish	x	braised	–	–	–	–
Spinach	x	x	x	x	–	–
Tomatoes	x	x	x	x	x	–
Turnips	x	x	–	–	–	x
Zucchini	x	x	x	x	x	–
Watermelon	x	–	can be pickled	x	–	x

*NOTE: Food storing, such as in food cellars, where no other treatment is necessary after drying.

Summary of Activities Related to Harvesting/ Marketing in the Garden Project Member Manuals

It is not the scope of this Leader/Helper's Guide to provide additional background information on selling the garden's harvest than what is already in the four member manuals. A summary of the activities in *Unit 5: Now What?* of each project manual follows.

In the *Garden Level A: See Them Sprout* manual:
- learning when to harvest vegetables; and
- what to do with too much produce.

In the *Garden Level B: Let's Get Growing!* manual:
- judging vegetables; and
- managing resources by freezing extra produce; storing vegetables.

In this same manual, *Level B, Activity 6a: On Your Own* explores growing vegetables for cash and discusses truck farming and places to sell the harvest (on-farm and off-farm outlets).

In the *Garden Level C: Take Your Pick* manual:
- learning how to keep records, such as one for harvest production;
- planning an event, such as a field day or judging contest, for younger youth; and
- learning about canning and pickling vegetables and drying herbs.

In the *Garden Level D: Growing Profits* manual:
- making a financial record of gardening expenses and comparing it to harvest production;
- learning about preserving the harvest by pressure canning and drying vegetables; and
- making plans (budget plan and a business plan) to start a vegetable or plant-related business.

What Happened?

Project Skill: Accepting Loss
Life Skill: Dealing with change

Materials:
- paper
- pencils
- flip chart or blackboard or large sheet of paper
- markers or chalk

Time Required:
45 minutes to 1 hour

Preparation before Meeting:

- Discussion is a big part of this activity, so group size should be 3-15, including adult volunteers. You may wish to make special arrangements for another group to meet with yours.

Growing vegetables provides the opportunity to appreciate success and failure. Losing a garden or part of the harvest may be the first experience of loss that youth might have. It might be due to a variety of causes, including:
- accident (forgetting to plan who will water the garden during vacation);
- weather conditions (extreme cold, heat or drought); and/or
- mismanagement (allowing weeds to take over the garden).

Emotions are part of growing any kind of garden, even though youth may or may not be growing vegetables to provide food for his or her family. Success brings excitement. Failure, for whatever reason, brings a feeling of loss. This feeling is different for everyone, depending on how the person feels about the garden.

This activity will help youth understand that feelings of loss are natural. It is important to understand and learn to deal with the feelings that are part of every change in life, whether it is moving to a new town or losing an entire garden to drought or high heat. By understanding these feelings, youth are better able to cope positively with changes in life.

EXPERIENCE

1. Have youth, family members, and helpers brainstorm at least 10 losses or changes they have experienced. The experiences can be positive or negative, related to gardening or any part of their lives. Some examples include:
   - having to change schools,
   - having a pet die,
   - moving to a new city,
   - not winning a competition,
   - finding out that the racoons got all the sweet corn before you did,
   - having blossom end rot get the best of your prize tomatoes, etc.
2. Ask volunteers to talk about the feelings that were part of the change the group mentioned.
3. After each discussion, have the group match one or more of the comments they heard to a corresponding stage of accepting loss. Some comments will fit in more than one stage.

SHARE

- *What happened as you talked about a change and the loss?*
- *What does the expression "mixed emotions" mean to you?*

PROCESS

- *Why is it important to understand the feelings that go with a loss?*
- *Why is it important for people to know their feelings are normal?*

GENERALIZE

- *How can you help a friend who is having a difficult time dealing with change?*
- *What kind of comments are helpful when a friend has to deal with a significant change in his/her life? What kind of comments are not helpful?*

APPLY

- *How can you prepare for a loss or change you know is going to happen?*
- *How will you deal with changes differently in the future?*

STAGES OF ACCEPTING LOSS

STAGE	COMMENT HEARD
Denial ("This can't be happening.")	
Anger or blaming self and others ("I'm really angry and upset.")	
Sadness ("Every time I think about it, I want to cry.")	
Depression ("I don't feel like doing anything.")	
Acceptance ("I remember the good things and I'll start planning for the future.")	

A Garden Journal

Project Skill: Learning how to keep different kinds of records
Life Skill: Solving problems

Materials:
- paper
- pencils
- notebook or flip chart, optional

Time Required:
30 minutes to 1 hour

Preparation before Meeting:
- Using a notebook or flip chart, consider making sample records for weather, crop rotation, harvest quantities, rainfall, weeding and hoeing activity logs, and any other type of record related to gardening as examples for youth to see. Read this entire activity for more ideas as well.

Keeping records may or may not be a fun thing to do for youth. Some find it exciting, others become discouraged because they don't know what to write or how to keep track of their garden-related activities. As a leader/helper, how you introduce records may determine youth's attitude toward keeping records for the rest of their lives. This activity explores how and what youth can learn through good records. It may come in handy the following year when they have to solve a garden-related problem. For example:
- what seeds produced the best yield?
- how much did it rain?
- how many days were over 90°F?
- how did this year's harvest compare to last year's?

All of these kinds of questions can be solved by record keeping. Over many years, a personal garden journal will become a valuable resource; indeed, many successful gardeners keep such a journal.

The end of a growing season is a good time to catch up on records and notes a gardener wants to jot down for next year's garden. It is always a good idea to keep track of successes and failures of the season, so a gardener can determine which cultivars turned out the best and which were disappointments. Seed varieties change every year or two; new ones are introduced and older ones discontinued. Although some gardeners like to make marks right in the seed catalogs and keep them for future reference, it may not be very practical to store all the catalogs. Another way would be to combine the idea of a notebook for the garden records along with cut-out pictures and the descriptions from the seed catalog pages.

EXAMPLES OF GARDEN RECORDS

Soil records	• when fertilizer was applied and other amendments, such as conditioners and mulches, were added to the soil, as well as what kinds and amounts are important to know to avoid a mineral imbalance.
Rainfall amounts	• water stress sometimes causes symptoms that look very much like symptoms caused by insects or diseases, so it is important to know how much rain the garden receives.
Comparison records	• how well certain plants resisted heat, pests, and/or diseases, as well as how well they were received at the dinner table.
Crop rotations	• helps give the gardener a visual reference for planning and planting this year's crop; makes sure the gardener does not plant crops from the same family in the same spot year after year and thus make them more susceptible to diseases.
Daily temperature readings	• data on weather conditions helps a gardener make a better judgement about the real cause of symptoms seen in the garden.
Harvest quantities	• records of pounds and number or pieces is helpful to determine if certain cultivars had a better yield, etc.
Frost dates	• first and last frost dates are important for garden planning.
Seeds/transplants purchased	• quantity and cost are handy for planning a garden in future years.
Planting time for each cultivar	• helps with scheduling planting dates and determining when to start seeds indoors.
Pest problems and treatment used	• helps determine which treatments are the best for the garden.
Harvest preservations methods used	• includes cooking, freezing, and canning records as well as favorite recipes used.

EXPERIENCE

1. Explain to youth that this activity is about keeping records. They will have an opportunity to be creative and design their own kind of record.
2. Ask youth to recall things that have happened in their garden in the past two or three years. Remind them that a lot happens in a garden. It is not just planting seeds and harvesting. Explain to youth that records can be a great resource, especially if kept for several years, and many successful gardeners do just that.
3. Review some examples of what type of records youth can keep.
4. Ask youth how they would organize their record keeping. Discuss if anyone knows a gardener who keeps records and the type of records that are kept. Grandparents and neighbors might be possibilities.
5. Explain that many successful gardeners keep a notebook ring binder or file near the place where garden tools are stored. It may contain the garden plan along with:
   - planting and harvest dates,
   - notes on the cultivars planted,
   - reminders for next season's garden,
   - rainfall amounts, and
   - weather conditions.

   Some gardeners cut up the seed catalog and use the plant descriptions as part of their permanent gardening notes.
6. Suggest to youth the following ideas for a personal garden journal:
   - Any notebook can be used as a journal; it can be decorated in a special way, if desired. One way to decorate the front of the notebook is to:
     - glue on pictures of vegetables, flowers, etc. that have been cut out from magazines, seed catalogs, or old greeting cards;
     - draw some illustrations yourself; and/or
     - use stickers of vegetables, flowers, birds, butterflies and create a garden scene.
   - To keep the decorated notebook from getting wet or dirty, cover it with a piece of clear adhesive shelf paper which can be found at hardware or department stores.
   - If desired, keep pencils and markers in a zippered pencil pouch right in your notebook. Also, add some pocket pages for items, such as seed packets and magazine clippings.
   - The journal could begin with a map or plan of the garden showing planting location and dates, if possible. If desired, photographs or drawings of the garden can be added.
   - If using a loose-leaf ring binder, divide it in one of several ways, after deciding which is best for you:
     - by months, or
     - by daily entries, or
     - by sections, such as assigning one page for each vegetable in the garden.
   - Recording monthly activities in the garden and/or making daily entries in a journal are easy to understand. If youth choose to record monthly activities, plastic index tabs can be used to label months, or pages from a calendar could be used instead. It would be a good idea to keep an extra page or two in a notebook for each month to write down personal thoughts and ideas, or to draw pictures of the garden. Then, every month the gardener would write down:
     - what seeds were planted (and when);
     - other things that were planted (when and where);
     - which seeds sprouted (and when);
     - which plants bloomed first (and when);
     - how many vegetables were picked (and when);
     - how tall were the full-grown plants (and did they have enough room where they were planted);

- which days the garden was watered;
- when the garden was fertilized (and what kind);
- any plants that were pruned;
- which visitors came (birds, bees, butterflies, and others);
- what problems with garden pests did the garden have (and what did you do);
- what was the weather like (when did it rain, frost; what were the high and lowest temperatures, etc.); and
- any other information.

- If youth choose to assign one page for each vegetable in their garden, they could jot down any interesting or important facts that they may have heard or read about under the entry for that particular vegetable. This sort of personal record book contains the best ideas of all the authors and "experts" they have ever heard or read. Consider including on each page the:
  - cut-out picture and description of those vegetable seeds you have purchased,
  - yearly record of how well each variety performed,
  - dates of first and last frosts,
  - planting time for each cultivar,
  - quantities of harvest for each cultivar, and
  - any other idea you may have.

  Youth could also add pages for: soil preparation, fertilizer used, mulch piles, various pests, cooking methods used, and favorite recipes. This vegetable-on-a-page journal would turn out to be a reference of unusual value to the gardener. No book has everything a person wants in it, but a personal garden journal is tailored specifically to the gardener's own garden.

SHARE

- *How did you feel about keeping records before you did this activity? After you brainstormed on this activity?*
- *When are records important?*

PROCESS

- *How can a personal garden journal help solve a problem in the future?*
- *What parts of keeping records seemed most difficult?*

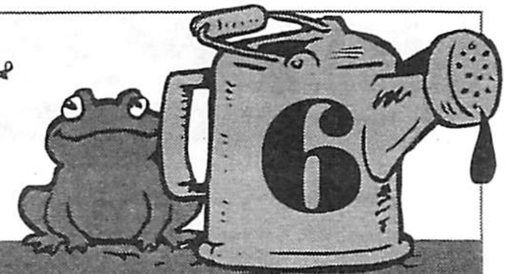
GENERALIZE

- *How does record keeping help you plan? Solve problems?*
- *What other kinds of records does your family keep?*
  Medical and dental records, checkbooks, school report cards, etc.

APPLY

- *How will you change how you keep records to make it easier to complete a record sheet for your next project?*
- *In what other areas of your life will you use record keeping to learn from and solve problems in the future?*

Careers

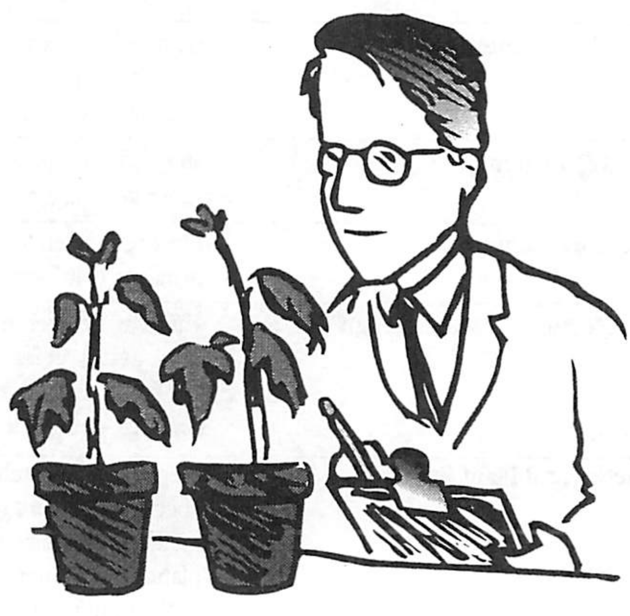


BACKGROUND INFORMATION

To prepare for an exciting career in gardening, the following describes some of the undergraduate programs that youth who are interested in gardening might want to pursue at a university.

UNDERGRADUATE PROGRAM	DESCRIPTION OF CAREER POSSIBILITIES
Crop Protection	Study entomology, plant pathology, weed science, and related areas for employment with chemical manufacturers, distributors, farm management firms, government agencies, and agribusiness.
Entomology	Protect our food supply from pests while working as a pest-control operator, research entomologist, medical entomologist, pesticide service representative, extension specialist, taxonomist, or teacher.
Environmental Soil Science	Qualify to be a technically-trained specialist to help protect and improve the environment. Demands for environmental scientists will continue to grow with job opportunities in government, environmental consulting firms, public health services, or federal research laboratories. Or, prepare for graduate study in environmental sciences, soil microbiology, soil chemistry, and soil physics.
Farm Management	Understand the challenges of managing a farm. Work as a professional farm manager for a landowner or on the home farm. Emphasis is placed on production, finance, marketing, and management strategies.
Horticultural Production and Marketing	Learn how to grow horticultural crops and manage greenhouses or nurseries, floral or plant shops, garden centers, orchards, vegetable farms, and farm markets.
Horticultural Science	Work in a scientifically oriented career as a technician in plant breeding, propagation, or research industry; or prepare for graduate studies.
International Agronomy	Gain technical and cultural training for international careers in agronomy with commercial companies or with technical assistance or social action agencies, such as Peace Corps.
Landscape Architecture	Study the design and construction of land use. Pursue a career in private practice, government agency employment, or related land-use areas.
Landscape Horticulture	Prepare to operate a landscape construction or maintenance firm, be a grounds manager, distribute equipment, supplies, or plant materials in the landscape industry.
Landscape Horticulture and Design	Train for a career in design, construction, installation, and maintenance of landscapes. Work as a grounds manager, small-scale landscape designer, or plant installation specialist, or be involved in the development, distribution, or sales of equipment, supplies, or plant materials.
Plant Genetics and Plant Breeding	Prepare for research and technical positions in industry, government, or university. Specialize in *plant genetics* which emphasizes biochemistry, plant anatomy, and plant molecular biology. Or specialize in *plant breeding* to emphasize crop breeding and plant-disease interrelationships. A professional internship involving practical aspects of the option is required.

UNDERGRADUATE PROGRAM	DESCRIPTION OF CAREER POSSIBILITIES
Plant Science	Gain a strong basic education in plant structure, development, physiology, classification, and ecology. Enter a research career or graduate studies in an area, such as plant physiology, plant pathology, weed science, and plant biotechnology.
Public Horticulture	Train for a professional position in the public sector in education, therapeutic horticulture, garden writing and editing, or management and curatorial maintenance of plant collections in public gardens and conservatories.
Recreation Resources	Work professionally in nature centers, reservoirs, camps, wilderness areas, national parks and forests, state and local parks, wildlife refuges, Bureau of Land Management lands, and private recreation businesses. Interpretive naturalists, recreation area managers and planners are the three most common entry-level positions.
Sales and Marketing	Train for a career in professional selling and marketing of agricultural products and services.
Soil and Crop Management	Use knowledge of soil and crop production to manage land for efficient crop production and to advise others on land use and environmental management issues. Work as a soil conservationist, fertilizer or chemical salesperson, soil testing director, seed producer, crop farmer, or extension educator.
Soil and Crop Science	Work as a soil scientist, crop physiologist, research agronomist, plant breeder, soil chemist, pollution research scientist, conservationist, or soil physicist who understands plant growth, genetics, soil, crop responses, and classification of land for government agencies, colleges, or private research organizations.
Turf Science	Train in chemistry and plant and soil science to work as a park supervisor, turf-supply dealer, landscape contractor, teacher, researcher, extension educator, or manager of golf courses and athletic facilities.



Exploring What Careers Are Really Like

It is important to know what work is really like. In order for youth to understand the choices, the following activities inform youth about work and careers. They are good ways to improve the chances for youth to reach their goals.

Visiting a Job Site	Description
Informational Interviews	• meetings with someone in a job that you might like; prepare questions about the job and things related to it before going.
Job Shadowing	• spending time with someone on a job; provides an inside view; ask many questions and take notes when observing the person; talk with others at the workplace about the job.
Workplace Tours	• allows viewing of different areas of a workplace; to with a group or call and ask to tour with someone from the company.
Volunteer	• gives an idea of what the job is really like; experience is gained and more information about jobs in that field can be learned.

If a youth would like to plan to visit a job site, tell him/her to:

- plan ahead by arranging a day and time to tour, interview, orjob shadow;
- contact the personnel office if he/she does not know anyone in the company;
- research the job and the company before going to the job site;
- prepare questions before going;
- dress neatly;
- speak clearly;
- be on time for the interview, tour, or job shadow; and
- listen carefully and take notes.

Summary of Career Activities in the Garden Project Member Manuals

The following list is a summary of the activities that explore garden and garden-related careers in the 4-H Vegetable Garden project manuals. The *Did You Know?* section and the options provided in the *Dig Deeper* section of each activity provide additional ways to learn about careers.

In the Garden Level A:
See Them Sprout manual:

- interviewing someone working at a greenhouse, nursery, or garden center; and
- brainstorming on careers that deal with vegetables and other plants.

In the Garden Level B:
Let's Get Growing! manual:

- learning about growing vegetables for cash (truck farming, on- and off-farm outlets); and
- checking off an interest chart on horticulture careers.

In the Garden Level C:
Take Your Pick manual:

- brainstorming on related-horticulture careers, such as soil scientist, entomologist (insect specialist), etc.;
- teaching a topic related to the garden project to younger youth; and
- arranging for a speaker to talk about vegetable-related food industry careers (inspectors, food technologist, distributors, marketers, etc.)

In the Garden Level D:
Growing Profits manual:

- completing a self-analysis profile;
- understanding the role of a plant scientist by conducting a cultivar resistant trial; and
- investigating a garden-related career that is personally interesting.

Hear the Speaker!

Project Skill: Learning from a garden expert
Life Skill: Acquiring knowledge

Materials:
- paper
- pencils

Time Required:
20 to 30 minutes

Preparation before Meeting:
- Arrange for a garden expert to be a guest speaker. This could be an extension professional, garden center personnel, 4-H leader, a local person who is an avid gardener, etc. If the speaker would like to have a hands-on demonstration as part of the presentation, consider options where this could take place. Transportation may need to be provided for youth.
- Ask the guest speaker about any supplies, materials, and/or video equipment that may be needed.
- Arrange transportation, if necessary.

EXPERIENCE

1. Before the guest speaker arrives, tell youth about the gardening expert who will be talking to them and answering their questions.
2. Ask youth if anyone knows an "expert" gardener or had contact with someone who works in a greenhouse or garden center.
3. Brainstorm together on questions to ask the guest speaker.
4. Introduce the garden expert to the group and proceed according to your arrangements.
5. After the presentation, have youth ask their questions.
6. At the next meeting, have youth write a thank you note to the guest speaker, telling him or her how they will use the information they learned.

SHARE

- *What did you learn about gardening?*
- *What surprised you about something the speaker said?*

PROCESS

- *Why is it important to know how to garden?*
- *What would happen if you forgot to weed, water, mulch, or fertilize when you garden?*

GENERALIZE

- *There are many different ways to learn things: reading about something in a magazine or book, playing a game, watching a video, listening to an expert, writing for information, etc. What are the ways you like to learn?*
- *How can you teach someone what you learned in this activity?*

APPLY

- *How will you use what you learned in this activity?*
- *In what other areas of your life will you always be learning?*

On the Go!

Project Skill: Learning about garden-related careers
Life Skill: Making career decisions

Materials:
- paper
- pencils

Time Required:
one hour plus transportation time

Preparation before Meeting:
- Arrange to visit a garden-related business where a representative (assistant manager or manager) may provide a tour and/or will talk to youth about the types of garden-related career/job opportunities available at that business. Inquire whether it is possible for some workers to explain their job responsibilities. For additional ideas, see the *People and Places* section in the Garden Resource section at the back of this manual, under *Learning Tools to Help Youth*.
- Arrange transportation, if necessary.

EXPERIENCE

1. Tell youth that this activity will expose them to job/career opportunities at a garden-related business.
2. Before starting the field trip, ask youth to make a list of questions to ask.
3. At the garden-related business, introduce the contact person to your group and proceed according to your arrangements.
4. After the tour, have youth ask their questions.
5. On the way back, discuss the opportunities available and possibly list some pros and cons of the job/careers that were learned about.
6. At the next meeting, have youth write a thank you note to the garden-related business.

SHARE

- *What did you learn from this activity that you didn't know before?*
- *What did you think of this activity?*

PROCESS

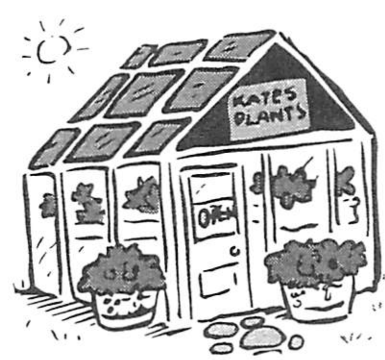
- *What reasons or criteria did you use to determine which job you were interested in?*
- *Which job/career sounded like something you would like to do?*

GENERALIZE

- *Why is it important to have plenty of information before making a decision?*
- *In what ways do people help each other learn – especially about jobs/careers?*

APPLY

- *If you wanted to find out more about a job, how could you do it?*
  Some possibilities include the following:
  - write a letter to a person or the company;
  - interview a worker at a company you might be interested in working at;
  - use library references to find books and other information related to your interest.
- *What did you learn about making career decisions that will help you in the future?*



Questions that have "no right answer" or involve personal feelings are not listed.

UNIT 2 - DIG IN

Activity 2a   Plant It!

What's It All About?

2. *Why is it important to know how soil must be prepared before planting a garden?*

To have a successful garden. Vegetables will not grow well in ground that is hard as a rock.

Activity 2b   Make it Different!

Dig Deeper

- *You learned that Native Americans planted "the three sisters" in a mound. Under each mound they usually placed a dead fish. Why did they do this? Where did they get the seeds? Do some investigating and find out!*

  The fish, covered by plenty of soil, rotted and acted as fertilizer, or food for the soil. Fish is an excellent source of nitrogen, one of the three nutrients (along with phosphorus and potash) necessary for plant growth. Today fish "emulsion", or mixture, is made that you can purchase at a store to fertilize plants. Some people prefer not to water with a fish emulsion because a fishy smell stays around for a couple of days after using it.

  Scientists think the ancient plant was a tall stalk with one ear at the top and a tassel growing out of the ear. Each kernel was probably wrapped in its own husk or pod, but they grew loosely so that they could fall off the cob and plant themselves. Scientists believe that the pollen of another grass, called teosinite, may have fertilized the corn. Hundreds of years later, the plants grew taller and formed larger ears. In time, people in all the Americas were growing different kinds of corn, and Indian tribes planted corn in different ways. Some tribes planted five seeds in a hill; others planted two; still others planted bean seeds with corn kernels and some even learned to bury fish in each hill to make fertile soil.

- *Find out why spacing is so important. There are two experiments you can do:*
  1. *Vary the spacing between onion sets in your garden. Place sets in one row 2 inches apart, in the next 4 inches apart, and in the third 6 inches apart. Water all rows equally. Record the number of onions in each row, the weight of onions after harvesting, and the biggest individual onion. Which row did the largest onion come from?*
     Generally, onions grow best spaced 2 inches apart in a row. Crowded plants produce poor results. Plants spaced too far apart may "waste" valuable garden space for other plants.
  2. *Count out 60 bean seeds, all the same kind. Plant 20 of them 2 inches apart in a row. Plant 20 seeds each 4 inches apart in another row; plant the last 20 seeds 8 inches apart in a row. Water all rows equally. Watch how the seeds grow. Which shade the ground? How much was harvested from each row?*
     Generally, snap beans (bush type) grow best when spaced 2 feet apart in a row.

UNIT 3:
WHILE YOU WAIT

Activity 3a Seeds Up Close

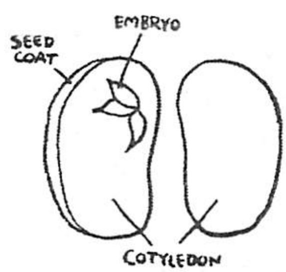
Did You Know?

Learn what new words mean by matching the words in the list below with their definitions.

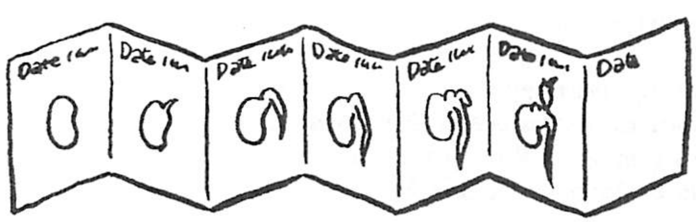
seed coat	• a tiny plant complete with leaf, stem, and root parts
cotyledon	• to begin to grow; sprout
shoot	• contains temporary food until the plant can grow up to make food with its leaves
embryo	• contains the stem and leaves
germinate	• protects the embryo

What's It All About?

1. *Share with your project helper what you predicted would be inside the seed and what really was inside the seed.*



2. *How did different parts of the seeds change during your week of observation?*
   When a seed is exposed to water and warmth, water is taken in through the seed coat and the seed germinates. The seed coat breaks open. The root emerges first and grows downward; then the shoot emerges and it grows upward.



Dig Deeper

- *Go on a scavenger hunt in your kitchen to find other examples of seeds. How many different seeds did you find? Sort them by color, shape, size, texture (how it feels), and/or weight. Is the s eed size an indicator of the plant size? Why or why not? Give an examples.*
  In the kitchen, it's easy to find seeds that are inside of vegetables and fruits, such as: sweet pepper, tomato, cucumber, peach, melon, lemon, orange, grapefruit, pears and grapes. Also, there are seeds that we eat, such as: sunflower, pumpkin, sesame and poppy seeds; green beans, peas, corn, and legumes; and herbs such as dill seed, fennel seed, mustard seed, and others used to flavor foods.

Seed size is not an indicator of plant size. For example, the seed in a peach is very large while apple seeds are much smaller; cucumber seeds and peas also show this feature. The tallest tree in the world is the redwood, but its seeds are about the size of the head of a pin. The biggest seed is the coconut seed; it grows into a palm tree that is less than half the size of the redwood.

- *What seeds do we eat? Make a list. The next time you eat a peanut, take a close look at it. It's a seed, too. Find all the parts of a seed. Try to sprout a roasted peanut. What happened?*
  Seeds we eat because they are already inside the vegetable include those from: tomatoes, cucumbers, zucchini, and green beans. Other seeds we eat include: sunflower and pumpkin seeds, peas, corn, rice, legumes, such as peanuts, lima beans, kidney beans, lentils, etc.

  A roasted peanut cannot be used to sprout a new plant because the cooking process destroys the seed's ability to grow. However, an uncooked peanut could be used to sprout a new plant.

Activity 3b What's it For?

Did You Know?
We eat many plant parts: the fruit, the leaves, the stem, the root, or the seed. Below is a list of vegetables. Write the part you eat. (Hint: there is one vegetable for each plant part.) Add the vegetables you grew in your garden. What part of the plant did you eat? The first one is done!

Vegetable	Plant part I eat	Other vegetables (in my garden)
carrots	*root*	*radishes, beets, turnips*
celery	*stem*	*asparagus, rhubarb*
peas	*seeds*	*peanuts, corn, green beans, kidney and lima beans, etc.*
lettuce	*leaf*	*other greens, such as spinach, chard, kale, etc.*
tomato	*fruit*	*cucumbers, eggplant, zucchini, and various melons*

What's it All About?

1. *Share the results of your mini-experiments with your project helper or a friend.*

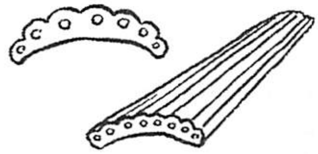
Part 1: Root Top Garden

What happened?
The carrots tops generally produce tiny green stems and leaves. The carrot top is the base of the stem, and it has a portion of the root on it. It is essentially a complete plant. Since the carrot portion is the root, it contains food for the plant and it also supplies the plant with water.

Part 2: Stems Alive!

What happened?
The leaves on the celery stalk standing in the sweet water taste sweet, while those of the celery standing in water do not. Water is carried up the stems of plants through tubes called xylem. This is how nutrients in the soil that dissolve in ground water travel throughout the plant to help the plant grow.

In the next part of the experiment, the xylem tubes in the celery stalk can be seen. The colored water travels up the celery stalk, causing the celery leaves to change color.



Part 3: Look at Leaves!

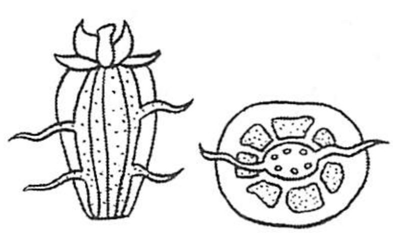
What happened?

The leaf which is covered by the black construction paper is much paler than the uncovered leaves. This happens because all the food the plant stored in its leaf was used up since there was no sunlight to make the food that was necessary. Plant leaves are green due to a green pigment (chlorophyll) which needs sunlight to make the nutrients a plant needs.

Dig Deeper

- *Instead of the celery in Part 2 for the coloring dye experiment, use a carrot and blue food coloring. After soaking, cut 2 inches across the cut end of the carrot. What part of the carrot is colored? Then, cut along the length of the rest of the carrot. Can you see which part of the root carries water and food up the plant?*

  The xylem tubes are different in a carrot than in the celery. Compare the illustrations.



UNIT 5 - NOW WHAT?

Activity 5a Is it ready?

Did You Know?

What's the best way to harvest your greens, such as lettuce, spinach, Swiss chard, or others? See it for yourself! Harvest part of your greens when they're about 3 or 4 inches tall by cutting off the entire plant about an inch above the soil. Harvest another part by picking the outside leaves of the plant. Which method sends up new tender growth? Which leaves taste the best? Which are tougher?

Harvest most greens by cutting off the entire plant, about an inch above the soil to encourage tender new growth, which also tastes the best. It's possible to have 2 or 3 harvests from a row of lettuce. The outside leaves are tougher because they are older. For harvest, combine a mix of the older leaves with young tender ones. Greens, such as New Zealand Spinach, kale, and collards should be harvested by picking outside leaves only. They taste best when they're cooked.

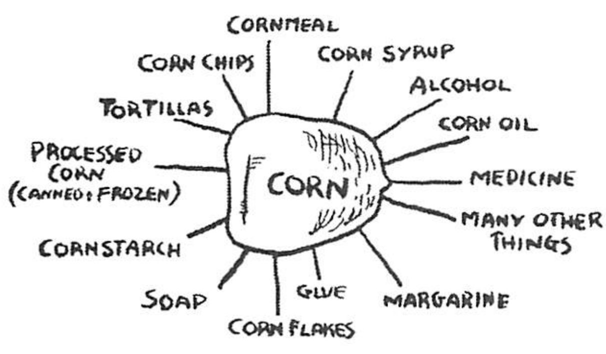
UNIT 6 - CAREERS

Activity 6a Check out the Veggies!

What's It All About?

1. *What other products made from vegetables did you find in the grocery store? For example, think about all the things that come from corn. We eat only sweet corn and use popcorn for popping, but corn is used to make a variety of products you might be surprised about! Fill in the CORN diagram with your answers.*

   Answers vary, but in the case of corn, some answers could include:
   corn syrup in bread; chocolate; cornmeal; cornstarch; corn chips and other snack foods; popcorn; breakfast cereal (cornflakes); hominy; corn oil; margarine made from corn oil; processed corn (canned and frozen forms); high fructose corn syrups in soda pop, frozen desserts; medicine; alcohol; soap; glue; baby powder; and many others.



Activity 6b At the Greenhouse

Did You Know?

There are many careers that deal with vegetables and other plants. Here are a few, but you can probably think of 3 more:

- *researcher*
- *soil scientist*
- *horticulturist*
- *farmer*
- *teacher*
- *greenhouse grower*
- **buyer**
- **landscape design/planting**
- **canning/freezing companies**
- **consultant**
- *food processor*
- *plant breeder*
- *company sales person*
- *farm manager*
- *forester*
- **florist**
- **pest control service**
- **tree care service**

Questions that have "no right answer," involve personal feelings, or have no answers at all are not listed.

UNIT 1 - LET'S PLAN!

Activity 1a Plant a Transplant

Did You Know?

FAMILY NAME	COMMON CROPS	CHARACTERISTIC
Cruciferae	*broccoli, Brussels sprouts, cabbage, kale, cauliflower, radishes, turnips, kohlrabi, etc.*	*cool-season vegetables*
Curcurbitaceae	*cucumbers, melons, pumpkins, gourds, summer and winter squash, watermelons*	*warm-season vegetables*
Leguminosae	*beans, peas, dry beans, peanuts, etc.*	*seeds form in pods*
Liliaceae	*onions, garlic, asparagus, leek, shallots, etc.*	*bulbs or crowns*
Solanaceae	*eggplant, peppers, potatoes, tomatoes, etc.*	*leaves have a similar shape*
Umbelliferae	*carrots, parsley, dill, fennel, coriander, celeriac*	*tall, feathery-like leaves*

UNIT 2 - DIG IN!

Activity 2a On the Move!

Dig Deeper

- *This activity describes transplanting by setting a plant vertically straight into the hole dug in the ground. Tomatoes can also be transplanted horizontally! Try both ways yourself to find out why someone would want to transplant horizontally. To transplant horizontally, first strip the bottom leaves off the plant. Then, lay it down on the ground horizontally. Cover the stem with about 3 inches of soil. Which plant blossoms first? Which produced the first harvest? At the end of the season, dig up both plants and look at the root growth along the buried stem. What differences do you see?*
  Results may differ, but the tomato transplanted horizontally may take longer to start growing than the vertically transplanted tomato plant; thus, it would blossom later, also. However, the horizontally transplanted tomato plant could produce more tomatoes than the vertically transplanted tomato plant since the root system would be more extensive.

- *Find out more about the shock of transplanting. Take 2 cabbage transplants and pinch off all the leaves but one. Do not pinch off the center sprout. On another 2 transplants, leave all the leaves in place. Treat all your transplants the same and watch what happens. Which plants respond best to the shock of transplanting? Which grow fastest? Which produce the first heads?*
  The plants that had all the leaves pinched off (except for one) responded the best to the shock of transplanting, grew fastest, and produced the first heads.

UNIT 3 - WHILE YOU WAIT

Activity 3a A-Maze-ing Plants

Did You Know?

The word "vegetable" is really a non-botanical term that refers to any edible part of a non-woody-stemmed plant. This includes leaves, roots, stems, flowers, or fruits. If the part of the plant you eat (stems, leaves, roots, seeds, or fruit) is the part that contains the seeds, you're actually eating the fruit of that plant. Check off which of the following foods, usually considered to be vegetables, are really fruits in disguise!

___lettuce	_x_ cucumbers	_x_ peppers	_x_ watermelon
_x_ tomatoes	___carrots	___potatoes	___radishes
_x_ eggplants	_x_ zucchini	___cabbage	_x_ pumpkin
___celery	_x_ squash	_x_ beans	___spinach

Dig Deeper

- *Find out what happened to seeds that astronauts took with them in space where there is no gravity. What did their experiments with seed germination show? If you can't find the answer, write a letter to NASA (NASA Lewis Research Center; 21000 Brookpark Road; Cleveland, Ohio 44135) or access NASA electronically (with your computer) via the World Wide Web using the following NASA Homepage address: http://www.nasa.gov/*

- Auxins are one kind of plant hormone, a chemical messenger that tells plants to grow in response to the environment. Find out about other plant hormones like gibberellins and cytokinins. What parts of a plant respond to these hormones?
  - *Gibberellic acid* is produced in the young leaves of plants and it controls stem growth, leaf growth, and root elongation. It is also important in germination for cereal grain seeds, such as corn and barley; when embryos release gibberellins, that causes food to be released from the endosperm.
  - *Cytokinins* are produced in the roots. Together with auxins, cytokinins stimulate cell growth and the production of fruits and seeds; it also slows the process of aging in picked leaves.
  - *Abscisic acid* may control root growth response to gravity (geotropism). Gravity causes abscisic acid, to collect on the underside of the root and shoot. Interestingly, the root and shoot cells react differently to the chemical. In the shoot, it causes the underside of the shoot to grow more rapidly, so the shoot rises up. In the root, the chemical has the reverse effect. It causes the top side of the root to grow more rapidly, so the root grows downward.

Activity 3b Not From Seeds Only

What's It All About?

2. *Show the results of your experiment to a family member. Ask them if they know whether most farmers and gardeners grow potatoes from pieces or from seeds. Explain your results.*

   The results probably showed the following. Within a week of planting, the potato plants grown from pieces will be tall and sturdy while seeds will be just germinating. Since the potato pieces provide substantial nutrients for early growth, there will be a dramatic difference in growth.

UNIT 6 - CAREERS

Activity 6b What's in a Name?

Did You Know?

Horticulture careers can be divided into 10 areas. Match the following areas to the job descriptions.

A. *Landscape Horticulture*	__H__ marketing by sales representatives for greenhouse and nursery supplies, chemical companies, and including fertilizer and pesticide salespersons
B. *Turfgrass Management*	__G__ teaching and conducting research at universities, including consultants, communicators (writers and educational speakers), and extension educators
C. *Floriculture*	__E__ producing and marketing fruits and vegetables for commercial purposes as well as for homeowners and gardeners. Commercial fruit and vegetable production involves storing fresh produce, preserving (canning, freezing, pickling, and drying), and distributing products to all parts of the country and internationally
D. *Production of Plants and Seeds*	__B__ managing sod production, supervising golf courses, athletic and recreation fields, parks, private & industrial grounds, etc.
E. *Fruits and Vegetables*	__I__ participating in activities designed to prevent the spread of pests among plants through an inspection service performed by inspectors at the federal, state, and sometimes county governments. Inspections occur at commercial nurseries, garden centers and sometimes field plantings to insure that plants are free of certain pests
F. *Horticulture Therapy*	__D__ breeding and propagating plants at large firms that specialize in the development of new cultivars and plant propagation
G. *Education and Research*	__A__ preparing sites for landscaping (purchasing and planting trees, shrubs, vines, sod, etc.), maintaining landscapes, and landscape design, at nurseries, botanical gardens, etc.
H. *Horticulture Business Sales*	__F__ using horticulture in therapy because of the physical and emotional benefits that result from working with plants. Specially trained people work with those who are emotionally and mentally disabled, senior groups, and troubled youth. Projects may include growing & \ propagating plants, making flower arrangements, gardening, etc.
I. *Plant Inspector*	__J__ includes numerous opportunities abroad for individuals with horticultural training, especially in developing countries through private corporations, Peace Corps, agricultural assistance programs sponsored by the USDA, private foundations, etc.
J. *International Assignments*	__C__ growing and distributing cut flowers, bedding, and potted plants or marketing florist supplies at the wholesale and retail levels

Questions that have "no right answer," involve personal feelings, or have no answers at all are not listed.

UNIT 1 - GARDEN PLANNING

Activity 1b Stretch it Out!

Did You Know?

Match the season extender with its description.

Cold frame	• Usually a covering for an individual plant, such as a cone-shaped "hat," or a plastic tunnel-shaped covering that is slit (for ventilation and watering) and suspended over the row; usually has closed ends. Another example can be made from a plastic milk jug with the bottom cut out. (Note: Plastic or glass should not touch the plant.)
Cloche	• Sheets of transparent plastic or fabric suspended with metal, plastic, wire or wooden hoops over a row; the ends are open.
Row cover	• Usually a rectangular frame made of wood with a transparent glass or plastic slanting top; can also be tent style or flat-topped.

Dig Deeper

- *Find out some information about hotbeds. Why is a hotbed used, and how is it different from a cold frame?*
  A hotbed is merely a cold frame with special electric heating cables buried in the floor. It is useful for germinating seeds early and quickly. Seeds can be sowed directly in the soil above the heating cables and cool-season vegetables crops can be raised when outdoor temperatures would prohibit it.

UNIT 2 - PLANTING A GARDEN

Activity 2a Scattering Seeds

Did You Know?

Match the following nutrients with their action.

Nutrient	Action
Phosphorus	helps leaves grow
Nitrogen	needed in small amounts for health, like vitamins
Potassium	encourages roots and fruit development
Trace elements	contributes to overall hardiness and to fight disease

Dig Deeper

- *Try a lettuce and fertilizer experiment. In a container, germinate lettuce seeds. Give one container fertilizer; the other none. After 20 days, what happened?*
  The lettuce that was fertilized should have grown best and have the most leafy growth after 20 days. Note that too much fertilizer can "burn."

Activity 2c Thyme for Planting

Dig Deeper

- *Make a list of annual, biennial, and perennial herbs.*
  Annual herbs include: basil, borage, calendula, chervil, coriander, dill, nasturtium, and summer savory.
  Parsley is actually a biennial herb, but it is grown as an annual.
  Perennial herbs include: catnip, chives, garlic chives, lavender, lemon balm, mints, oregano, sage, tarragon, thyme, winter savory, and yarrow.

UNIT 3 - WHILE YOU WAIT

Activity 3a Acid Basics

What's It All About?

2. *What color does your indicator (the cabbage juice) turn in acid, such as white vinegar?* **Red**
   In a base, such as a baking soda solution? **Green**

Dig Deeper

- *Find out what a lab analysis would recommend be added to soil if the soil's too acid? Too alkaline?*
  If the soil is too acid or too alkaline for the plants you want to grow, materials can be added to adjust the soil:
  - lime, in the form of ground limestone, is added to decrease soil acidity,
  - sulfur is added to increase soil acidity.

Activity 3b Getting Green

Did You Know?

Now you write the words for the equation for photosynthesis. Use the illustration to help.

$$6CO_2 + 12H2O \xrightarrow[\textit{chlorophyll}]{\textit{with light and}} C6H12O6 + 6O_2 + 6H_2O$$

carbon dioxide + water ⟶ glucose + oxygen + water

Step 7

What colors do you see? Can you explain it?

When chlorophyll is analyzed, it is found to be a mixture of several pigments:
- green pigments (chlorophyll a and chlorophyll b),
- orange pigment (carotene), and
- yellow pigment (xanthophyll).

Chlorophyll is able to "mask" the other colors because there is so much more chlorophyll present in most leaves. It is only in the fall, when less chlorophyll is produced by leaves that the other colors become visible.

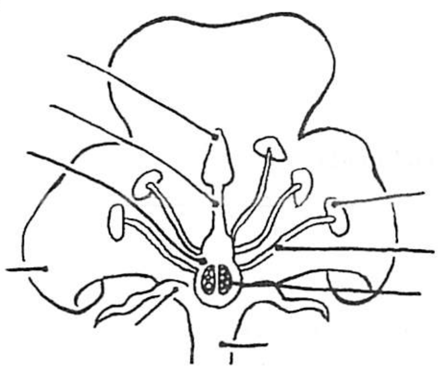
What's It All About?

2. *Explain why the color of leaves changes in autumn.*
   In the fall, when leaves stop producing chlorophyll, other pigments become more prominent; leaves turn orange, yellow, and red. These other colors are normally "masked" by chlorophyll.
3. *Why is it important to understand photosynthesis? What does it mean to life on Earth?*
   Without photosynthesis, there wouldn't be enough oxygen to support life on Earth.

Activity 3c Flower Power

Did You Know?

Label the diagram.



UNIT 4 - GARDEN CARE

Activity 4a Be a Bug Buster

Match the damage symptoms with the insect pest.

INSECT PESTS	DAMAGE SYMPTOMS
1. Thrips	6 larvae tunnel into corn stalks both upward and downward
2. Armyworms	9 brownish with 16 black spots arranged in three rows across the back; larvae are lemon yellow with spines on back; feed on undersides of bean leaves, eating all but leaf veins
3. Cabbage looper	1 feed on leaves and leave whitish streaks
4. Cabbage root maggot	7 oval-shaped beetles that are greenish-yellow with black spots or stripes and that like to eat all parts of cucumber, squash, and melon plants
5. Colorado potato beetle	8 green or brown wedge-shaped adults that hop about, feeding on undersides of leaves and causing stippling of leaf surface; especially fond of beans; flies off quickly when disturbed
6. Corn borer	11 brownish-black or gray and flat across the back; feed on vines and fruit of squashes and melons, sucking juices and causing leaves and shoots to blacken and die back
7. Cucumber beetles	3 greenish caterpillar, also called inch worm, that feeds on cabbages
8. Leaf hoppers	5 yellowish-orange and black-striped beetles that eat leaves of potato, tomato, and eggplants
9. Mexican bean beetle	2 light green to black; striped with a white inverted Y on front of head; feed in groups on young plants
10. Mites	4 white larvae of flies that eats roots; plants are wilted or stunted
11. Squash bug	10 tiny, spiderlike creatures that spin fine webs, suck juices on undersides of leaves; early damage appears as yellow-speckled area on leaf undersides

Activity 4c What's with Weeds?

Did You Know?

List six ways you can think of to water a garden. Two are done for you.

- furrow irrigation – furrows (little trenches) are dug before planting, then filled with water.
- drip irrigation – plastic tubing on the soil surface carries water to individual plants.
- watering can
- soaker hose
- hose-end sprinkler
- hand watering with a hose and sprinkler nozzle

Dig Deeper

- *Find out more about drip irrigation. What would it take to set one up in your garden?*
  Drip irrigation soaks the soil for individual plants. It is good to use where water is scarce, water pressure is low, and the land is sloping.

UNIT 6 - CAREERS

Activity 6c Making Contacts

Dig Deeper

- *Categorize the list of food industry-related careers in the Did You Know? section by the specific step of the food handler chain; by Production, Processing, Marketing, and Transportation.*
  Production: farmer, inspector, packer at a company
  Processing: chef/cook, dietitian, restaurant owner, waiter/waitress, food technologist, recipe developer, food processor, home economist, food scientist
  Marketing: grocery store produce manager, food salesman, food photographer, grocery store owner, food broker, stock person

Questions that have "no right answer," involve personal feelings, or have no answers at all are not listed.

UNIT 1 - GARDEN PLANNING

Activity 1a It's In-Between

Dig Deeper

- *Investigate how companion planting relates to allelopathy. Allelopathy can sometimes be responsible for otherwise unexplained poor plant growth.*
  Allelopathy is defined as the inhibition of seed germination and plant growth by certain plant-produced natural compounds. Plant toxins are usually exuded by roots, but can also be present in varying amounts, in stems, leaves, and fruits. Juglone from walnut trees is an example; a garden should be placed more than 50 feet away from a walnut tree(s).

UNIT 2 - PLANTING A GARDEN

Activity 2a All in the Row

Dig Deeper

- *Try this experiment. String off two sections in a garden bed. In one, transplant two rows of cabbage seedlings, 18 inches apart with the rows two feet apart. Do the same in the other block, but in that block, also transplant 2 rows of lettuce staggered between the two cabbage rows. What do you notice about the productivity of each plot? Which has more weed growth?*
  The interplanted cabbage and lettuce garden plot should have been more productive and should have had less weed growth than the cabbage-only plot.

UNIT 3 - WHILE YOU WAIT

Activity 3a The Air Up There

What's It All About?

1. *Share with your project helper how your experiment simulated acid rain. Describe the results.*
   The most dramatic effects occur with the more acidic solutions; pH 3 (Group D) and pH 4 (Group C). The evidence is immediate discoloration, curling, and overall growth stunting, followed by the death of the plant.

2. *What other factors could affect a plant's response in an outside environment?*
   Weather, including how hot or cold it is, and for how many days; the amount of rainfall and humidity.

Activity 3c Designer Genes

Dig Deeper

- *Find out how seedless watermelons were developed. Hint: It involves a specific type of genetic breeding called polyploidic breeding.*
  Polyploidic breeding hinges on the use of chemicals to multiply the number of chromosomes in a plant. Most plants are diploid, meaning they have two sets of chromosomes. When the chromosomes fail to separate as usual during reproduction, fertilization results in offspring with three (triploid) or four (tetraploid) sets of chromosomes. The resulting polyploids produce very large flowers and fruits.

UNIT 5 - HARVESTING AND STORAGE

Activity 5b Save the Best!

Dig Deeper

- *What can you do with all the tomatoes that are left on the plants when it frosts?*
  Cover with a plastic tunnel (cloche), if no other frosts are expected for a while, or choose some of the following ideas:
  - pick then for ripening indoors,
  - pickle small green tomatoes,
  - fry medium-size green tomatoes,
  - pull up the entire plant, tomatoes and all, and hang them in a garage or basement that is frost-free, or
  - store larger ones that are starting to turn color.

Tomatoes that are stored must be in perfect condition (free form cracks, etc.) or they will rot before ripening. Check at least once a week and remove those that have ripened or started to decay. Although it may be popular to set tomatoes on a sunny windowsill to ripen, they do not ripen properly there; they will shrivel up and have a taste bitter, or they will be watery and almost flavorless. Instead, store tomatoes in a dry, dark place, such as a cardboard box or ice chest with a few apples; apples naturally release ethylene gas which is needed for ripening. Do not store tomatoes where the temperature is below 54°F. This may damage the tomatoes so they do not ripen normally.

UNIT 4 - GARDEN CARE

Activity 4a Looking Closely

Did You Know?

Match the letter of the plant disease with the description of the disease symptoms in the right hand column.

PLANT DISEASE

A. Early blight
B. Anthracnose
C. Bacterial leafspot
D. Clubroot
E. Downy mildew
F. Late blight
G. Mosaic
H. Powdery mildew
I. Rust
J. Bacterial wilt
K. Wilt (Fusarium & Verticillium)
L. Blossom end rot

DISEASE SYMPTOM

_D_ Roots enlarge and swell, often cracking or rotting.

_B_ Dark brown circular, sunken spots on stems leaves, pods or fruit; centers of spots may ooze pink spores

_J_ Vine plants suddenly collapse from the top down.

_L_ Large brown or black spot on bottom side of all tomatoes; it spreads, usually occurs after a hot, dry spell.

_K_ Plant wilts and has darkening veins; leaves may curl upward before they yellow between veins and drop off.

_C_ Brown circular spots with light-colored centers cover leaves, which then wither and die.

_E_ Powdery, white to purplish patches appear on undersides of leaf and stems.

_I_ Numerous, tiny red- or dark brown-colored spots on leaves, stem, leaves turn yellow and then die.

_F_ Water-soaked or light spots on lower leaves; then spots turn black and a white growth on leaf undersides is seen; characteristic strong odor.

_G_ Mottled green and yellow leaves or veins; leaves may be wrinkled or curled; fruit is bumpy and misshapen.

_H_ White to grayish powdery growth, usually on the upper surface of leaves.

_A_ Leaves develop brown to black spots with a series of concentric rings like a target, usually appears on older leaves first.

Garden Talk

This glossary is a compilation of all four Garden Talk glossaries in the member's Garden Manuals, Levels A, B, C, and D.

A

acid precipitation – rain, snow, sleet, or hail with a pH less than 5.6; caused by sulfuric and nitric acids that come from the burning of fossil fuels containing sulfur and nitrogen.
acid rain – liquid form of acid precipitation.
aeroponics – a method of growing plants by watering and feeding plant roots in a cloud of water vapor as opposed to immersion in water (hydroponics).
allelopathy – an inhibitory effect of a chemical from one plant on a neighboring plant; an example is juglone from the black walnut tree which inhibits most plants from growing around it.
annual – a plant that completes its whole life cycle in one year or less; its roots do not live to make a new plant the next year.
anther – one of the male parts of a flower; the top part of the stamen that produces pollen.
aphid – a tiny sucking insect usually found in groups on the underside of a leaf or on a stem.
aquaponics – a method of growing plants in a nutrient solution instead of soil and without a growing medium for support.

B

biennial – a life cycle of two years.
biological control – a pest control measure that uses living organisms to fight pests and diseases, including releasing, attracting, and protecting natural insect predators and parasites, and using microbial sprays to control problems.
biotechnology – the use of living organisms to make or change products; sometimes with the aid of genetic manipulation, such as genetic engineering.
blanching – boiling food, such as raw vegetables, for a certain length of time to stop the action of enzymes that otherwise will continue to ripen the vegetable; necessary before freezing raw vegetables.
broadcast planting – broadcasting or scattering seeds over a wide row or area, about 2 to 3 feet across; used for crops that can be eaten when very young.
bulb – an underground structure made up of a shortened stem that stores food and then makes a new plant during the growing season; onion and garlic are bulbs.
burn – damage caused to a plant by applying too much fertilizer or getting it on its leaves. It injures roots, causing browning and wilting of leaves; it may kill the plant.

C

carbon dioxide – a gas in the atmosphere that plants absorb and use to produce glucose during photosynthesis.
cash crop – any crop that is sold for money rather than consumed on the farm.
castings – the waste left behind by earthworms.
chemical control – a control method that involves substances that kill pests; organically acceptable chemical controls are naturally occurring minerals or plant products which tend to break down into harmless substances faster than synthetic pesticides. They could have toxic side effects and are used only as a last resort for IPM.
chlorophyll – the green color (pigment) of plant cells that traps and absorbs the energy of sunlight for use in photosynthesis.
chloroplasts – structure within a plant cell that contains chlorophyll and in which photosynthesis occurs.
clay – very fine soil particles that are "plastic" when wet, hard when dry and used for brick, tile, etc.
club root – a fungal disease that attacks cabbage family crops, causing grossly deformed, slimy roots that are unable to absorb adequate nutrients from the soil.
companion plants – certain plants that may be beneficial to other plants if they are planted close to each other; for example, although not scientifically substantiated, marigolds have been known to help discourage certain insects that bother tomato plants.
compost – mixture of rotted plant material (kitchen and garden/yard waste) that is rich in nutrients; also, helps keep soil light and fluffy and can be used as mulch; a soil amendment.
composting – the practice of combining organic materials under controlled conditions so that the original raw ingredients change into a rich, dark brown or black complex, called *humus*.
cool-season vegetable – can be planted either early or late in the planting season when the weather is cool and nights chilly.

cotyledon – contains temporary food for the embryo until leaves form and the plant can make its own food.
cover crop – a crop grown to prevent soil erosion and/or as green manure; some species can be both.
crop rotation – the practice of changing the location of vegetable crops grown in a garden each year to help promote soil nutrient balance and prevent disease and insect pest buildup.
cross pollination – the transfer of pollen from the anther (the male part) of one plant to the stigma (the female part) of a flower on another plant.
crown – the roots and dormant buds of certain one-year-old and other plants, such as asparagus.
Cruciferae – a plant family that includes broccoli and cabbage.
Cucurbitaceae – a plant family that includes cucumbers and pumpkins.
cultivar – a cultivated variety of a plant. For example, tomato cultivars have different color, taste, shape, texture, days to maturity, disease resistance, etc.
cultivate – to dig the soil around plants; it lets air in and removes weeds, too.
cultural control – a way to control or reduce pest problems by using gardening practices such as keeping plants healthy, choosing disease-resistant cultivars, keeping the garden clean, etc.
cutworm – a caterpillar that cuts off the stem of transplants, such as cabbage and tomatoes, at ground level during the night.

D

damping off – 1. what happens when seeds are planted in wet places or are planted too deeply; these seeds may not germinate; 2. kills young plants when soil borne fungi attack the plant at the soil line. The stem rots and the plant falls over and dies.
disease-resistant – refers to plant varieties that have been bred to withstand attack from certain diseases. For example, some tomatoes are labeled V.F., which means it is resistant to verticillium and fusarium wilt, both common tomato diseases.
DNA – an abbreviation for deoxyribonucleic acid, which contain the directions (the genetic code) for growth and reproduction.
double-cropping – growing two or more vegetable crops in one growing season in the same space.
drainage – a way for water to move through the soil so a plant does not get too much water.

E

ear – the fruiting spike of sweet corn that includes the kernels, cob, and husks.
elements – the basic particles that compose matter; of the more than 100 chemical elements, 16 are known to be essential for plant growth (carbon, oxygen, hydrogen, and 13 minerals).
embryo – the undeveloped plant in a seed; a tiny plant complete with leaf, stem, and root parts.
enzyme – a special protein found in small amounts in all plants; promotes ripening in fruits and vegetables.
eye – the bud of a potato tuber.

F

fertilization – in plants, the fusion of male pollen with a female ovule inside the ovary, resulting in seeds surrounded by a fruit.
fertilizer – plant food (nutrients) added to soil to help plants grow better; can be organic (rotted manure, plant materials, etc.) or inorganic (man-made chemicals). The three main nutrients in fertilizers are nitrogen, phosphate, and potassium, known by their chemical symbols N, P, and K.
filament – the stalk of the stem of the stamen, the male part of a flower.
flower – the reproductive structure of a plant; produces seeds.
fruit – 1. the seed-bearing product of a plant; the part of a plant that develops from the flower's ovary and encloses the seeds; 2. as distinguished from a vegetable, it is usually pulpy, fleshy, and often sweet.
fungicide – a chemical used to prevent or control fungus diseases on plants, such as powdery mildew, tomato blight, and fusarium wilt.
furrow – a narrow ditch, or planting line, into which seeds are placed when planting; or for watering.

G

gene – the unit of inheritance passed from one generation to the next and governing a particular characteristic, such as a fruit's color.
genetic engineering – transferring specific genetic material from one organism to another.
germinate – to begin to grow or sprout.
germination – the process by which a seed takes in water, swells, and the embryo (tiny plant inside the seed) begins to grow.
global warming – the expected increase in the earth's temperature caused by the increasing levels of carbon dioxide and certain other gases.
glucose – a carbohydrate (sugar) produced by plants during photosynthesis; many glucose molecules join together in long chains to form starch.

green manure – a crop which is dug into the soil to provide nutrients for soil enrichment; sometimes called a *cover crop.*
growing medium – something that will support a plant and let air get to the roots, such as soil, sand, gravel, perlite, paper towels, etc.

H

hand cultivator – used for weeding and breaking up soil in a small area around growing plants.
hand pollination – human transfer of pollen from the anther (male part) of a flower to the stigma (the female part) of a flower.
herbicide – a chemical that kills or controls weeds.
hardening off – the process of letting a plant, which has been started indoors, become gradually accustomed to being outdoors before it is planted in the garden.
hill – a group of seeds planted together in a circle on flat ground; can also be soil mounded into small hills for vining plants, such as squashes.
hoe – used for making planting furrows, cultivating, chopping weeds, breaking up lumps in the soil.
horticulture – 1. deals with developing, growing, distributing, and using fruits, vegetables, nuts, and ornamental plants for gardens, orchards, and nurseries; 2. the science and art of finding new ways to grow plants and creating new and better varieties.
humus – the dark organic materials in soils, produced by decaying vegetable or animal matter.
hybrid – a new plant (an offspring) created by crossing two different strains of a certain plant together; seeds of hybrid plants should not be saved because they will not produce the same hybrid plant (not true to type).
hybridizing – occurs when two distinctly different plants are cross-pollinated by humans to achieve a mix of desirable plants.
hydroponics – a method of growing plants in a nutrient solution instead of soil and with other means of plant support (a *growing medium*).
hydroponicum – a small hydroponic growing unit.
hypothesis – a guess of what you think will happen.

I

imperfect flower – a flower without stamens (thus, a female flower) or without a pistil (thus, a male flower).
insecticide – a chemical that kills or controls insects.
intercropping – the practice of growing two different vegetables alternately within a row.
IPM – Integrated Pest Management, a way of dealing with pests so that chemicals are used only when needed.
irrigation – watering with overhead sprinklers, plastic hoses, flooding, etc. to supply crops with moisture.

K

K – the chemical symbol for potassium.
kernels – seeds (actually, they are one-seeded fruits) of sweet corn that form on a cob.

L

leaching – the process by which nutrients are carried down through the soil by percolating water, often out of reach of plant roots.
leaf – makes food for the plant; site where most photosynthesis occurs.
legume – a member of a large plant family characterized by a pod-like fruit (also called a legume) and roots bearing nitrogen-fixing bacteria.
Leguminosae – a plant family that includes beans.
Liliaceae – a plant family that includes onions.
loam – the best kind of garden soil; soil made up of a balanced mix of sand, clay, silt, and organic matter.

M

manure tea – a liquid made by mixing manure with water; the resulting brown liquid is a mild, quick-acting fertilizer.
minerals – any chemical element or combination of elements occurring naturally in soil, rocks, etc., such as lime; 13 minerals are necessary for plant growth.
mulch – a ground cover, such as leaves, sawdust, shredded bark, or compost used to keep moisture in the ground and prevent weeds from growing near plants.
mulching – the process of blanketing the area around growing plants with mulch.

N

N – the chemical symbol for nitrogen.
nematodes – a group of microscopic worms, some of which harm plants, sucking plant juices from the roots; some are beneficial.

nightcrawler – deep burrowing earthworms that are 4 to 8 inches long and live in permanent burrows that may be 5 to 6 feet deep. They need dead plant material at the surface, so they are rarely found in plowed fields.
nitrogen – one of the major nutrients needed by plants for growth; encourages leafy growth and dark green color; it is the first number on fertilizer labels.
nitrogen-fixing bacteria – bacteria found in the soil and in the root nodules of peas, beans, and other legumes that are able to take nitrogen from the air and change it to nitrogen compounds that plants can use.
nodules – little lumps on the roots of peas, beans, and other legumes that contain nitrogen-fixing bacteria.
NSCORT – NASA Specialized Center for Research and Training.
nursery – a place where plants are grown and sold; a garden store.
nutrient – a mineral or chemical elements necessary for plant growth, development, or reproduction: nitrogen, phosphorus, and potassium are the major nutrients for plants. Plant roots take these nutrients from the soil; compost, manure, and chemical fertilizers replace them.
nutrient solution – a mixture of water and the 13 mineral nutrients required by plants for growth.

O

open-pollinated – a vegetable from which the seeds can be saved; unlike hybrids, seeds from open-pollinated varieties will produce plants that resemble their parents.
organic – made from things that have been alive or that come from a living thing, plant or animal.
organic fertilizer – food for plants originating from other plants, animals, or rocks rather than chemically manufactured; such as wood ash, blood meal, and ground lime respectively.
ovary – the female part of a flower that contains the ovules which form seeds when fertilized by pollen; the enlarged base of the pistil.
ovule – the female reproductive cell of a flower that becomes a seed after it is fertilized by a male cell contained in the pollen.
oxygen – an odorless, colorless, tasteless gas which is necessary for life; produced and released by plants during photosynthesis.

P

P – the chemical symbol for phosphorus.
parent material – rock from which soil is formed.
peat moss – partly rotted plant material (parts of moss plants) that is added to soil to loosen it up and/or help it retain moisture; used in potting soil instead of garden soil so the soil is light and fluffy for container gardening.
perennial – a plant that grows back year after year from the same roots; lives three or more years.
perfect flower – a flower that contains both stamens (the male part) and a pistil (the female part).
perlite – pieces of a white volcanic rock used in potting soil to help water drain out of the soil.
pesticide – a substance used to kill or control bacteria, fungi, insects, rodents, weeds, etc.; includes fungicides, insecticides, and herbicides.
petal – one of the leaves of a plant's flower.
pH – potential hydrogen; a measure of how "acidic" or "alkaline" a substance is, such as soil or water; tells gardeners if they need to add something to their soil to change the pH; on a scale of 1 to 14, 1 is very acidic, 14 is very alkaline, and 7 is neutral.
phloem – the part of a plant that moves the food which the leaves make to other parts of the plant and the roots, too.
phosphorus – one of the three major nutrients required by plants for growth; encourages development of flowers and fruit, as well as root growth; it is the middle number on fertilizer labels.
photosynthesis – a process occurring in green plants by which carbon dioxide and water are changed to food (a carbohydrate, called glucose or sugar) and oxygen in the presence of chlorophyll, using the energy of sunlight.
phototropism – the bending of a leaf, stem, root, or flower toward or away from a light source.
physical control – a way to prevent pests from reaching garden plants, or that are removed if they do appear; examples include barriers, traps, and hand-picking.
pistil – the female part of a flower consisting of the stigma, style, and ovary and growing in the center of the flower; where seeds are produced.
pollen – the dustlike grains produced by the anthers on the stamens (male part) of flowers to fertilize the stigmas (female part); distributed primarily by wind or insects.
pollinate – to transfer pollen from the anthers on the stamens (male part) of a flower to a pistil (female part) on the same or another flower.
pollination – the transfer of pollen from the anthers (male part) to the stigma (female part) of a flower in the same flower (self-pollination) or another flower (cross-pollination); results in fertilization.

potassium – one of the three major nutrients required by plants for growth; encourages root growth; it is the third number on fertilizer labels.
potting soil – a special mixture of materials containing organic matter, such as peat moss, and material that drains water, such as perlite or vermiculite.
powdery mildew – a fungus that attacks the outside of plant leaves, producing hollow tubes that penetrate the plant tissue and suck out the juices.

R

raised bed – a long mound or a raised row, generally 2 to 3 feet wide and raised 4 to 6 inches off the ground; may be bordered by wood, brick, or stone.
rake – used for breaking smaller clods in the soil, smoothing prepared soil, and spreading soil and organic material.
redworm – a type of smaller earthworm that is 3 to 5 inches long and that usually lives in the top 12 inches of soil. They do not make permanent burrows.
respiration – a process constantly going on in every living cell by which food is broken down into carbon dioxide and water with the release of usable energy; the reverse of photosynthesis.
root – the part of a plant that grows below the ground to be an anchor for the plant and to supply the plant with water and food.
rototilling – using a motor-driven rotary tiller which is used to churn and loosen soil to prepare it for planting; used in small gardens instead of a plow.

S

scoring – nicking a hard-coated seed (such as sweet pea, okra, and others) with a knife or nail file to allow the seed to absorb water more easily so it will germinate; also called scarification.
seed – the result of fertilization of an ovule with pollen; contained in the fruit.
seed coat – the outer covering of a seed; provides protection.
seedling – the first growth stage of a plant; a young plant grown from a seed.
selection – in nature, the way plants survive to produce offspring; can also be done by humans who for thousands of years, selected (saved) seeds with desirable traits to plant the following growing season.
sepal – a leaf-like part of the outside part of a flower; protects the bud.
sets – small onions grown from seed the previous year.
shoot – the new growth that comes from a seed or a main stem of a plant; contains the stem and leaves.
shovel – used for digging, turning, scooping, and moving soil.
side-dress – to apply fertilizer along rows or around plants (especially nitrogen) as a booster fertilizer and which should be worked into the soil.
silks – those portions of the female flowers on an ear of sweet corn that run from the end of the ear to the kernels on the cob; each silk must be pollinated for a kernel to develop.
soil – the top layer of earth where plants grow; it's made up of minerals, air, water, and organic matter from plants and animals.
soil amendment – organic matter that you add to soil to improve it; examples include compost, manure, peat moss, and wood products, like sawdust and ground-up bark.
Solanaceae – a plant family that includes tomatoes; also called nightshades.
spade – a shovel with a square end, used to dig soil to an even depth and to move soil.
spading fork – used for digging and breaking up lumps in the soil and spreading mulch
sprout – to begin to grow or germinate; to send up a shoot.
square foot gardening – a type of garden which makes use of every inch of space; it is arranged in a series of squares.
stamen – the male part of a flower consisting of an anther and a filament.
starch – a carbohydrate made up of many molecules of glucose; used to store food energy in plants; also found in stems, such as potato tubers and roots.
stem – provide a way for water and minerals to travel from the roots to other plant parts and for food made by the leaves to travel to other parts of the plant, too; also helps a plant to stand up straight.
stigma – the flat-topped "knob" at the tip of a pistil (female part) of a flower, which receives pollen that causes seeds to develop; the part on which pollen germinates.
stomata – the tiny openings in plant leaves that allow carbon dioxide, oxygen, and water vapor to be exchanged between plants and the atmosphere.
style – the stalk-like middle part of the pistil (female part) of a flower; the tube connecting the stigma to the ovary.
subsoil – the layer of earth that lies just under the soil on the surface.

succession planting – planting seeds in succession or at intervals of a few weeks apart so that the harvest period is extended, rather than planting all at once, so that only a small quantity of vegetables are maturing throughout the growing season; good to use with almost any crop, especially for small gardens.

T

tassels – the male flowers of a corn plant; produces pollen (male reproductive cell).
till – to plow or work the soil; to cultivate.
transpiration – the loss of water through the surface of plant parts, primarily through openings in the leaves called *stomata*.
transplant – to plant again in a different place or container.
transplants – young plants started from seed and grown indoors; later, planted in the garden.
treated seed – seed that has been coated with a chemical to prevent disease from killing it when planted.
trowel – used for digging small planting holes, digging out weeds, and scooping top soil.
tuber – a short, fleshy, and enlarged underground stem or shoot with buds (or eyes); the potato is a tuber. Pieces of potatoes having one or more eyes can be planted to grow new potato plants.
tuberous root – a thick, fleshy root like a tuber but having buds present only at the crown (stem end); the sweet potato is an example. The whole sweet potato must be planted to grow a new plant.

U

Umbelliferae – a plant family that includes carrots.
urea – a high-nitrogen fertilizer.

V

variety – a plant that has slightly different characteristics from other plants of its kind occurring in nature. For example, a plant that normally has blue flowers produces a seed resulting in a plant that has white flowers. The white-flowered plant is considered a variety of the blue-flowered species.
vermiculite – a mineral material used in potting soil that retains water, provides good drainage, and holds minerals.
verticillium wilt – a common soil-borne disease that can affect a variety of garden crops; the leaves turn yellow, often just on one side of the plant, then wither and die; resistant cultivars are available for some plants, such as tomatoes.
vining – a term describing vegetable varieties that are climbing plants, such as pole beans or peas; usually supported by a trellis, stake, or cage.

W

warm-season vegetable – vegetables that need hot sun and warm nights and days; plant these when a nice, warm spring is already underway.
watering can – used for giving plants water.
wheelbarrow – used to move soil, compost, mulch, manure, and other materials.
wire stakes – supports tomato plants and pole beans while they grow.

X

xylem – the part of a plant that moves water and mineral nutrients from the roots to the leaves and shoots.

WHERE TO FIND MORE HELP (Garden Resources)

The following resources can help you answer vegetable gardening questions you have.

BOOKS

Visit your local library and favorite bookstore for books related to vegetable gardening.

PUBLICATIONS

The entire Purdue Educational Media Catalog is now available through each county's Cooperative Extension Service. Ask your local county extension educator for timely information about current educational references in the electronic catalog.

Purdue University Cooperative Extension Service:

UNIT 1 **related to Planning:**

- *Herb Gardening* HO-28A, 1986
- *Home Gardener's Guide* HO-32A, 1990
- *Hotbeds and Cold Frames* HO-53, 1990
- *The Fall Vegetable Garden* HO-66A, 1994
- *Organic Gardening* ($1.00) HO-70, 1970
- *Collecting Soil Samples for Testing* HO-71A 1989
- *Winter Garden Calendar* HO-90A, 1993
- *Spring Garden Calendar* HO-91A, 1993
- *Summer Garden Calendar* HO-92A, 1995
- *Autumn Garden Calendar* HO-93A, 1992
- *Small Plot and Intensive Gardening* HO-124A, 1985
- *Home, Yard and Garden Publications* HO-179, 1991
- *Indiana Vegetable Planting Calendar* HO-186A, 1984
- *Container and Raised Bed Gardening* HO-200A, 1986

UNIT 2 **related to Planting:**

- *Growing Cucumbers, Melons, Squash, Pumpkins, and Gourds* HO-8A, 1983
- *Starting Seeds Indoors* HO-14A, 1983
- *Tomatoes* HO-26A, 1993
- *Leafy Greens for the Home Garden* HO-29A, 1986
- *Potatoes* HO-62A, 1985
- *Onions and Their Relatives* HO-67, 1987
- *Asparagus* HO-96, 1979
- *Rhubarb* HO-97A, 1985
- *Growing Sweet Corn* HO-98A, 1985
- *Recommended Vegetable Cultivars for Indiana's Home Gardens* ($1.00) HO-101, 1989
- *The Sweet Potato* HO-136, 1985
- *Growing Beans in the Home Vegetable Garden* HO-175, 1982
- *Chinese Vegetables* HO-187A, 1993
- *Black Walnut Toxicity* HO-193A, 1994

UNIT 3 **related to Fun with Plants:**

- *Growing Greenhouse Tomatoes in the Nutrient Film Hydroponic System* ($1.00) HO-167, 1987
- *European Greenhouse Cucumber Production in Nutrient Film Systems* HO-168, 1989
- *Lettuce Growing in the Nutrient Film System* HO-169, 1989
- *Identifying Horticultural Crops: A Manual for Judging Teams* ($2.00) ID-140, 1980

UNIT 4 **<u>related to Taking Care of a Garden:</u>**

- *Guide to Making Fertilizer Solutions* HO-163, 1981
- *Weed Control for the Garden and Landscape* HO-217A, 1994
- *European Corn Borer in Field Corn, Sweet Corn, Peppers, and Snap Beans* ($1.50) E-17, 1995
- *Grasshoppers* (25¢) E-19, 1990
- *Managing Insects in the Home Vegetable Garden* E-21, 1994
- *Curcurbit Insect Management* (50¢) E-30, 1995
- *Corn Earworm* (25¢) E-31, 1995
- *Dilution Table for Pesticides* E-46, 1981
- *Cutworms in Corn* (75¢) E-48, 1995
- *Managing Corn Rootworms* (75¢) E-49, 1995
- *Bean Leaf Beetle* ($1.25) E-51, 1991
- *Armyworm and Fall Armyworm* (50¢) E-57, 1995
- *Corn Leaf Aphid* (25¢) E-58, 1994
- *Pesticides and Personal Safety* E-62, 1992
- *Vegetable Insect Identification* E-65, 1989
- *Japanese Beetle* E-75, 1995
- *Nematodes* E-79, 1992
- *Common Vegetable Insects of Indiana* (50¢) E-88, 1989
- *Managing Striped Cucumber Beetle Populations on Cantaloupe and Watermelon* (50¢) E-95, 1993
- *Managing Insect Pests of Potato* (50¢) E-96, 1993
- *Root-Knot Nematode Control in Melons* E-212, 1993
- *The Pesticide Paradox* (50¢) HE-636, 1993
- *Five Steps to Healthy Garden Tomatoes* (50¢) BP-3, 1989
- *Common Scab of Potato* BP-8, 1994
- *Blossom End Rot of Tomato Fruit* BP-13, 1984
- *Bacterial Canker of Tomato* BP-14, 1995
- *Diagnosis and Control of Muskmelon Diseases* ($1.00) BP-15, 1985
- *Pumpkin Diseases and Their Control* BP-17, 1986
- *Fusarium Wilt Resistance in Muskmelon and Watermelon Varieties* BP-19, 1989
- *Damping-off of Vegetable Seedlings* BP-21, 1992
- *Identification and Control of Crucifer Diseases* BP-22, 1990
- *Identification and Control of Onion Diseases* BP-23, 1991
- *Diseases and Pests of Muskmelons and Watermelons* ($15.00) BP-44, 1993
- *Pesticides and Container Management* PPP-21, 1993
- *Pesticides and Food Safety* PPP-22, 1992
- *Pesticides and The Label* PPP-24, 1993
- *Pesticides and Their Proper Storage* PPP-26, 1993
- *Pesticides and Spill Management* PPP-28, 1993
- *Pesticides and the Home, Lawn, and Garden* PPP-29, 1995
- *Pesticides and Wildlife* PPP-30, 1994
- *Pesticides and Community Right-to-Know* PPP-32, 1995
- *Pesticides and Pest Prevention Strategies for the Home, Lawn, and Garden* PPP-34, 1994
- *Managing Yard Wastes: Clippings and Compost* ID-182, 1994
- *Diagnosing Herbicide Injury on Garden and Landscape Plants* ID-184, 1991
- *Identifying and Controlling Weeds* ($15.00) V-HO-3, 1988 (this is a video)
- *Recycling Yard Waste* ($20.00) V-HO-13, 1991 (this is a video)
- *Read the Label: parts 1 & 2* ($15.00) V-HO-14, 1991 (this is a video)

UNIT 5 **related to Harvesting and Storage:**

- *Let's Preserve Tomatoes* CFS-583, 1989
- *Let's Preserve Pickles* CFS-596, 1995
- *Freezing Vegetables at Home* (50¢) HE-134, 1986
- *Food Preservation Checklist* ($3.00) HE-138, 1986
- *Spotlight on Freezer Storage* HE-422, 1978
- *Let's Preserve Leafy Greens* HE-592, 1989
- *Let's Preserve Peppers* HE-593, 1989
- *Let's Preserve Snap Beans* HE-594, 1989
- *Let's Preserve Sweet Corn* HE-595, 1989
- *Storing Fruits and Vegetables at Home* HO-125A, 1993

UNIT 6 **related to Careers:**

- *What is the Indiana Master Gardener Program?* HO-184A, 1995
- *Starting in the Nursery Business* HO-212A, 1994
- *Guide to Information for Starting in the Nursery Business* HO-213A, 1994
- *List of Assistance and Regulatory Agencies for Starting in the Nursery Business* HO-214A, 1994
- *Guide to Production Information for the Commercial Nursery Crop Grower* HO-215A, 1994

available from your local county Cooperative Extension Service office or write to:

Media Distribution Center
301 South Second Street
Lafayette, IN 47901-1232
phone: (765) 494-6794

***some resource items will have a cost**

COMPUTER RESOURCES

A computerized Purdue University garden plan, called FACTS, can be developed at your local county Cooperative Extension Service office. You need to fill out a computer garden planning form 3 weeks prior to planting time. The computer will plan your garden! Test yourself and see if your plan agrees! Compare both plans and discuss any questions you might have with your adult helper, 4-H leader, or Extension educator.

If you have access to a personal computer and the Internet, a variety of resources can be found on the information superhighway, such as:

- garden tours;
- more gardening information from listings under:
  - state Cooperative Extension Services around the U.S.,
  - Purdue University's Home Page http://www.purdue.edu and look under garden related departments in the School of Agriculture,
  - magazines,
  - books,
  - catalogs,
  - even complete encyclopedias, such as the TimeLife Complete Gardener Encyclopedia.

Searchable databases make it easy to find information on a specific vegetable or topic.

- newsgroups offer open and lively discussion on a variety of garden topics. There are several freenets available to see what other gardeners are up to online. Check with your local Cooperative Extension Service educator for computer addresses.

MAGAZINES

The following magazines can be found at newsstands, bookstores, and the library.

National Gardening
National Gardening Association
180 Flynn Avenue
Burlington, VT 05401

Organic Gardening
Rodale Press, Inc.
33 East Minor Street
Emmaus, PA 18099

Fine Gardening
The Tauton Press, Inc.
Newton, CT 06470-5506

Horticulture
The Magazine of American Gardening
P.O. Box 2595
Boulder, CO 80323

Garden Gate
Woodsmith Corp.
2200 Grand Ave.
Des Moines, IA 50312

Flower & Garden
KC Publishing Inc.
700 W. 47th Street
Kansas City, MO 64112

Garden Design
P.O. Box 55455
Boulder, CO 80323-5455

Home Garden
Meredith Corp.
1716 Locust Street
Des Moines, IA 50309-3023

CATALOGS

Sources of vegetable seeds and plants can be found on the last page in the Purdue University CES publication.

Recommended Vegetable Varieties for Indiana HO-101,1989

Media Distribution Center
301 South Second Street
Lafayette, IN 47901-1232
phone: (765) 494-6794

GARDEN ASSOCIATIONS

National Gardening Association
180 Flynn Avenue
Burlington, VT 05401

National Junior Horticulture Association
5885 104th Street
Fremont, MI 49412

American Horticultural Society
7931 E. Boulevard Drive
Alexandria, VA 22308

American Seed Trade Association
1030 15th Street N.E.
Suite 964
Washington, D.C. 20005

PESTICIDE INFORMATION

Purdue Pesticide Programs (PPP)
(765)-494-4566

Note: PPP has developed a series of publications which discuss pesticide issues impacting the general public, including community right-to-know, pesticide alternatives, law, water quality, material safety data sheets (MSDS), and school pest management. Contact yout local county Cooperative Extension educator for more information.

National Pesticide Information Retrieval System (NPIRS) (317)-494-6616

National Pesticide Telecommunication Network 1-800-858-5220

ChemTree 1-800-424-9300

EPA Community Right-to-Know Hotline 1-800-535-0202

Indiana Department of Environmental Management
(317)-233-7745 to report a pesticide spill

GARDEN PROJECT MEETING IDEAS

There are many resources available to you when it is time to decide on an activity for the next meeting you plan. Activities in the member manuals, as well as this leader/helper's manual, can be used as you learn together what having a vegetable garden is all about.

A list of the activities in all four Garden Project member manuals is provided in the *Overview* section of this manual. Use the following list to help you develop your own additional activities. Other ideas are listed in the *Learning Tools to Help Youth* section in this manual.

Selecting and Judging

__ Identifying varieties and cultivars
__ Identifying plant parts
__ Selecting a vegetable cultivar
__ Constructing the ideal vegetable
__ Evaluating the garden harvest
__ Recognizing ripeness and faults
__ Recognizing disease damage
__ Recognizing insect damage
__ Recognizing weather damage
__ Talking like a vegetable judge
__ Presenting oral reasons
__ Scoring a judging class
__ Judging a class of vegetables

Management Practices

__ Identifying garden equipment
__ Setting goals
__ Making "collars" around seedlings
__ Thinning seedlings
__ Applying mulch
__ Applying fertilizer
__ Calendarizing garden management practices
__ Pulling weeds
__ Hoeing
__ Identifying seedlings from weeds
__ Watering
__ Making cloches and row covers
__ Building a cold frame
__ Identifying garden friends and enemies
__ Harvesting techniques

IPM Practices

__ Recognizing a healthy garden
__ Identifying plant diseases
__ Identifying weeds
__ Identifying insect pests
__ Treating diseases
__ Outlining alternative ways to have a healthy garden
__ Listing safe ways to deal with pests

Records and Recognition

__ Receiving recognition through 4-H
__ Understanding garden records
__ Advancing through your 4-H project
__ Keeping garden records
__ Making decisions based on records
__ Selecting cultivars on performance

Mulching and Fertilizing

__ Understanding plant nutrient needs
__ Formulating a fertilizer
__ Improving garden production
__ Evaluating mulches
__ Identifying and classifying fertilizers
__ Identifying mulches
__ Selecting and judging mulches and fertilizers
__ Fertilizing the garden

Reproduction and Genetics

__ Understanding selection and breeding
__ Hand-pollination and cross-breeding
__ Recognizing hybrids
__ Drawing what happens when a seed germinates
__ Comparing new products due to biotechnology

Vegetables and By-Products

__ Judging plates of vegetables
__ Identifying ways vegetables are sold
__ Processing vegetables for preservation
__ Dealing with too much *(your choice)*
__ Testing cooking or preservation methods
__ Taste testing unusual vegetables
__ Finding vegetable by-products in the home or at the grocery store
__ Identify products from vegetables

Other Project Activities

__ Giving a 4-H presentation
__ Doing an action demonstration
__ Attending a plant/garden show
__ Evaluating a 4-H project
__ Conducting tours and field trips

LEARNING TOOLS TO HELP YOUTH

Youth learn in different ways. As a project leader, you may wish to involve additional activities, different people, places, organizations, schools, communities, and other resources as you seek ways to help youth learn. This list is just the beginning. Use it in the same way a germinating seed uses stored plant food in the seed to "grow" other ideas about different ways of learning and watch youth blossom!

Additional Activities To Do with Youth

If an activity in this manual cannot be used for your meeting, the following idea starters for Garden Project meetings are designed to let youth's creativity, imagination, and enthusiasm create their own activities!

For Groups of All Sizes

Letter writing campaign
Pantomimes
Skits, plays and stage presentations
Games – original and commercial
Talent shows
Interviews and surveys
Debates and mock trials
Interviews and surveys
Charades
Scavenger hunts
Demonstrations
Mentoring younger youth

For Individual and Small Groups

Create-your-own:
News articles
Comics, cartoons
Essays
Poems
Songs, raps
Videos and tapes
Slide shows
Stories
Want-ads and advertisements
Journals and logs
Photography
Sculpture and art, especially using seeds and flowers
Models and prototypes
Riddles and jokes
Campaigns – informal and marketing
Posters
Other ideas:

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Involving People

Grandparents, parents, other family members
4-H and other Extension professionals
Garden growers
Girl Scouts, Boy Scouts and participants in other similar organizations
Health care professionals
Nutritionists
Pest and pesticide control officers
Greenhouse owners
School and public librarians
Teachers
University and college faculty
Industry representatives
Park rangers
Government officials
Farmers
Garden supply store owners
People who use plants in nontraditional ways (as vegetarians and herbalists, or in arts and crafts projects, etc.)
Computer newsgroups (freenets for gardeners)

At Places/Organizations

County Extension offices
Garden associations
Members' homes
Business offices
Government offices
University and other research facilities
Media stations (television, radio, newspaper)
Computer data bases
Community services projects
Garden tours
Day care centers
Retirement homes
Business offices
High schools
Park and recreation programs
Trade associations
Fairs
Nature centers
FFA (Future Farmers of America)
EPA (Environmental Protection Agency)
Libraries
Special interest groups
Civic clubs
Universities and colleges
Vo-tech schools
Museums
Zoos
Y programs
State Department of Agriculture, Natural Resources
State Department of Environmental Management
Pesticide companies
Career fairs
Commodity groups
Private industry
Science and art centers
Farm supply stores
Fertilizer companies
Greenhouses
Garden supply stores

Using Things

Magazines, books, and newspapers
Produce and travel brochures
Package labels – seeds, fertilizers
Advertisements – television, print and original design
Comics and cartoons
Posters
Newsletters youth write
Encyclopedia
Maps
Charts
Computers
Video tapes
Cassette tapes
Healthy living brochures
Vegetable brochures
Library pamphlet files
Yellow pages
Cameras (VCR, instant, and regular)
Catalogs
Commercial or make-your-own games

Table 1. Vegetable Planting Guide

Vegetable	Suggested cultivar* (not required)	Space between rows[1] (feet)	Space between plants (inches)	Yield per 50 ft.	Amount seed or no. plants per 50 ft.	Depth to plant (inches)	Times to plant Early[2]/Late[3]	Days to allow for 1st harvest
Beets	Ruby Queen, Detroit Dark Red	1	3	1 bushel	1 ounce	1/2-1	Apr. 1-June25	55-65
Blackeye peas	California #5							
Broccoli (plants)	Green Comet, Premium Crop	3	18	36 heads	36 plants	—	Apr. 15-June 15	40-55
Cabbage (plants)	Harvester Queen, Red Acre, Savoy Ace	3	18	36 heads	36 plants	—	Apr. 15-June 15	55
Cantaloupe (Muskmelon)	Early Dawn, Staticoy	4	48	25 melons	1 packet	1	May 15-June 1	85-90
Carrots	Royal Chantenay, Danvers Half Long	1	2	1 bushel	1/2 ounce	1/2	Apr. 10-June 20	70-75
Cauliflower (plant)	Snow Crown, Self Blanche	3	18	36 heads	36 plants	—	Apr. 15-June 25	50-60
Chinese Cabbage	Michili, Two Seasons Hybrid							
Collards	Vates, Georgia							
Cucumber (for slicing)	Marketer, Sweet Slice, Burpless Hybrid	4	18	3/4 bushels	1 packet	1	May 15-July 1	55-70
Cucumber (for pickles)	Liberty, Bush Pickle, Picklebush	4	18	3/4 bushels	1 packet	1	May 15-July 1	55-70
Eggplant (plants)	Dusky, Ichiban	2	24	60 fruit	24 plants	—	May 15-June 15	55-70
Potato (pieces)	Kennebec, Superior, Norland, Pontiac	3	10	1 bushel	60 pieces	4	Apr. 20-June 1	90-130
Sweet potato (plants)	Centennial, Porto Rico	3	12	1 bushel	50 plants	—	May 20-June 10	130-140
Leaf lettuce	Black Seeded Simpson, Buttercrunch, Ruby	1	4	150 plants	2 packets	1/2	Mar. 20-June 153	40-50
Lima beans (bush)	Fordhook 242, Thorogreen	2	6	1 bushel	1/2 pound	1-2	May 15-June 15	65-75
Okra	Clemson Spineless, Annie Oakley							
Onion (sets)	Southport Red Globe, White Sweet Spanish	1	2	1 bushel	1 pound sets	1-4	Apr. 1-May 1	90-120[4]
Onion (slips)	Sweet Spanish, Chiefton	1	2	1 bushel	300 slips	1-4	Apr. 1-May 1	60
Peas	Freezonian, Green Arrow, Sugar Snap	1	1 (no thin)	1 bushel	1/2 pound	2	Mar. 20-May 1	60-75
Peppers (plants)	Yolo Wonder, Bell Boy, Golden Bell	2	18	2 bushels	36 plants	—	May 15-July 1	55-70
Radishes	Cherry Belle, Champion	1	1	500 roots	1/2 ounce	1/2	Mar. 20-June 153	25-30
Snap beans (bush)	Tendercrop, Provider, Greencrop	2	2	1 bushel	1/2 pound	1-2	May 10-July 20	55-60
Spinach	America, Longstanding Bloomsdale	1	3	25 pounds	1 ounce	1-2	Mar. 20-June 153	40-45
Summer squash	Crookneck, Aristocrat, Gold Rush	4	48	100 squash	1 packet	1/2	May 15-June 15	50-60
Winter squash, and pumpkins	Waltham Butternut, Table Queen, Jack O'Lantern, Spookie, Jack Be Little	6	72	25-50 squash	1 packet	1	May 15-June 15	85-110
Sweet corn	Iochief, Honey and Cream, Silver Queen	3	12	50 ears	1 packet	1-2	May 10-July 10	65-85
Tomato (plants)	Jetstar, Better Boy, Burpee's VF (staked)	4	24	100 pounds	25 plants	—	May 15-June 20	40-70
	Heinz 1350, Roma (non-staked)	4	36	100 pounds	17 plants	—	May 15-June 20	40-70
Turnips	Purple Top White Globe, Tokyo Cross	1	4	1 bushel	1 packet	1/2	Apr. 1-June 15	60-90
Watermelons	Sugar Baby, Sweet Favorite, Crimson Sweet, Yellow Baby	6	48	15 melons	1 packet	1	May 15-May 25	75-90

* Note: For additional types of cultivars (cultivated varieties) that can be used, see reference to publication HO-101 in *Where to Find More Help* on page 34 of this manual.
[1] In large gardens, distance should be adjusted for cultivating equipment.
[2] Early date is for Indianapolis. Plant 20 days earlier in extreme southwestern part and 10 days later for northeastern part of state. Late date is about the same for entire state.
[3] For a late crop, plant spinach and lettuce from Aug. 15 to Sept. 1; plant radishes from Aug. 15 to Sept. 15.
[4] For green onions, allow 60 days until first harvest.

4-H GARDEN SCORECARD

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Name ______________________________ Entry No. ____________ Placing ________

Evaluated on:	Vegetable Name						
1. Excellent specimens							
2. Uniformity (Excellent-Fair-Improve)							
Size							
Shape							
Color							
Type							
Age (Development)							
3. Too many specimens (check mark)							
4. Too few specimens (check mark)							
5. Two (2) of the same vegetable type (check mark)							
6. Specimens are too: (check mark)							
Old							
Young							
Large							
Small							
Wilted							
Dirty							
Peeled							
Trimmed							
Scrubbed							
7. Stems or roots: (check mark)							
Not trimmed							
8. Injured by: (check mark)							
Insects							
Diseases							
Weather							
Growth							
Handling							
Sunburn							

Judge's comments: ______________________________

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National 4-H Curriculum