CONTENTS

INTRODUCTION 1
UNDERSTANDING YOUTH NEEDS 2
4-H EDUCATIONAL EXPERIENCES 2
THE 4-H MEETING 3
RESOURCES 4
PROJECT MATERIALS 6
HOW TO USE THIS GUIDE 7
LESSON/MEETING 1: WHAT ARE PLANTS? 8
LESSON/MEETING 2: PLANT PARTS 18
LESSON/MEETING 3: USES OF PLANTS 26
LESSON/MEETING 4: HOW PLANTS GROW 29
LESSON/MEETING 5: PLANT PROPAGATION 33
RECORD AND REVIEW 37 - 38
ROUNDUP PROJECTS 38

This project material was developed by M. Joy Cantrell, Assistant Professor of Agricultural and Extension Education, Dennis J. Wolnick, Associate Professor of Floriculture, and Merry Wind Goodson, 4-H Horticulture Project Assistant in consultation with the state 4-H Horticulture Program Development Committee. Committee members were: Antoinette Bilik, Walter Bullet, Justina Campbell, Al Homan, William Kleiner, William Pencek, Robert Pollock, Judith Stoudt, and Kathy Wychock. The Katherine Mabie McKenna Foundation supported the committee and the development of this 4-H horticulture project. This project material was revised by Timothy J. Rollins, assistant professor of agricultural and extension education.

Visit Penn State’s College of Agricultural Sciences on the Web: http://www.cas.psu.edu

Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available from the Publications Distribution Center, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802. For information telephone (814) 865-6713.


This publication is available in alternative media on request.

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. Discrimination or harassment against faculty, staff, or students will not be tolerated at The Pennsylvania State University. Direct all inquiries regarding the nondiscrimination policy to the Affirmative Action Director, The Pennsylvania State University, 201 Willard Building, University Park, PA 16802-2801, Tel 814-865-4700/V, 814-863-1150/TTY.

© The Pennsylvania State University 1992 R1.5M2/01ps
INTRODUCTION

Welcome to the 4-H plant science projects! *Meet The Plants* is a five lesson project book which supports the 4-H program. Four-H is an educational program designed to develop the attitudes, values, and skills that help make young people productive members of society. "4-H" stands for head, heart, hands, and health and corresponds with educational, moral, work, and health ethics. Specific goals of the organization supported in the project are for youth to develop:

- a concern for society and the world at large
- an understanding of science and appreciation for nature
- consumer skills
- life skills, including
  - creative use of leisure time
  - leadership
  - marketable attitudes and skills leading to a career
  - communication skills
  - sense of responsibility
  - desirable interpersonal relationships
  - responsible citizenship

*Meet The Plants* is an introduction to plant science designed to promote personal development as well as illustrate the important relationship between plants and people. It will excite curiosity and guide youth as they pursue areas that interest them. This project opens up the world of plants to youth giving them some basic knowledge about plants as a foundation for more advanced projects. It introduces plants grown indoors and outdoors - those that give us beauty and those that provide us with food. Following this introduction to plants, 4-H'ers may select one or more projects from the Unit 2 projects shown below:

![Indoor Gardening](image1)
![Vegetable Gardening](image2)
![Landscape Gardening](image3)

*Indoor Gardening*  
*Vegetable Gardening*  
*Landscape Gardening*

We hope you and your group will find the material in this guide exciting and interesting.
UNDERSTANDING YOUTH NEEDS

To fulfill the objectives of the 4-H program, it is important to understand children's basic needs. These needs must be met, if youth are to progress to adulthood in a healthy manner. They include:

- Developing a satisfactory self-concept
- Experiencing a sense of achievement
- Becoming independent
- Having adventure
- Being accepted by peers and adults
- Developing and accepting one's sex role

Although children develop as individuals, they share certain characteristics. Listed below are some general traits of 8 to 10 year olds and the ways in which you can strive to meet their developmental needs:

**Characteristics of youth**

- Self-interest
- Short interest span
- Capacity for great intellectual curiosity
- Desire for adult approval and acceptance
- Extension of interest beyond the home into the community

**Implications for leaders**

- Allow for individual activities to foster a positive self-image. Conduct some group activities so members learn to work with others.
- In small doses, give short-term tasks with clear, brief, and often-repeated directions.
- Make sure members see tangible results quickly and often.
- Take responsibility first, then assign leadership jobs. Encourage at-home project completion to invite family involvement. Conduct special "parents' night" programs.
- Conduct a project or presentation in a community environment (e.g., a demonstration or exhibit for a parents' night or senior citizens' group).

4-H EDUCATIONAL EXPERIENCES

As a leader you can keep interest raised by allowing members to help plan and conduct events in the community. 4-H members gain leadership and group skills by participating in making plans and carrying them out. Here are some ideas:

**Family Involvement.** A kick-off party or fun F for present and prospective members and their parents generates enthusiasm for the new year.

Parents' events can take the form of an evening program presented by members, a potluck supper with a short 4-H program, or a summer family picnic.

**Tours and Field Trips.** Tours and field trips can be educational as well as recreational. See "Resources" for suggestions.
Demonstrations. A demonstration meeting at the local level is good preparation for a similar county wide event. Have 4-H'ers give demonstrations to community organizations such as parent-teacher and service groups, and at nursing facilities and retirement communities.

Decision-Making and Judging. Judging begins by making choices between two or more things and knowing the reasons for these choices. It is a way of learning to make decisions based on standards of quality. You can teach these standards by providing opportunities to choose and compare products and discuss a product's strong and weak points. Contact your county extension office for publications such as the 4-H Manuals for Flower and Vegetable Judging.

Discussion and Problem-Solving. Discussions can be an effective way for youngsters to teach themselves different subjects, to gain experience in presenting their views before a group, and to learn the art of perceptive listening. You can stimulate thinking and problem-solving abilities through many of the hands-on activities. Posing questions can be useful in generating discussions.

Exhibits. Exhibits used at local events for parents and friends are a good way to show recognition of 4-H'ers and to promote the 4-H program.

Community Service. Community service is an integral part of 4-H. Sharing with others (member's guide, p. 40) allows youth to practice leadership and communication skills, develops commitment to the community and its needs, and encourages family involvement. Suggested means of sharing will contribute to youths' sense of membership in the community. Consult your telephone directory's guide to human services for listings of agencies and centers that might appreciate your group's contribution. Organize a presentation to be given at a health-care facility or for a senior citizens' group. Make a tape for the blind (contact the Pennsylvania Association for the Blind) or identify other ideas youngsters might be interested in.

THE 4-H MEETING

The 4-H meeting is the central activity of the 4-H program. What happens at meetings influences the success of the local program and what an individual learns. The first meeting is very important, because it will affect how much you and your members enjoy 4-H.

The first meeting should be fun and should emphasize getting acquainted. Games and refreshments will help you accomplish this purpose. You might arrange for some of your older members or teen leaders to tell new members about 4-H. Parents and former 4-H members might be invited to help them become a part of the 4-H program.

After members and parents have had a chance to become acquainted with each other and with 4-H, you can organize the club by:

• Electing officers and making program assignments

• Selecting a committee of members, parents, and teen and adult leaders to plan the year's program

• Discussing what members want to do during the year

• Distributing and discussing possible projects
For more information on program planning and organizing, see *The ABC's of Planning Your 4-H Club Programs* and *Pennsylvania 4-H Leaders Program Planning Workbook*, available from your county 4-H office.

**RESOURCES**

Part of the fun in leading a 4-H group is the learning that can take place for you. Enlist community expertise to supplement your program and expand your knowledge.

**Suggested Field Trips and Guests**

- retail and wholesale nurseries
- garden stores and centers
- seed companies
- feed and seed stores
- city parks
- supermarkets
- florists
- nursery growers
- local garden club members
- extension agents
- community recreation parks
- local farms and markets
- agricultural experiment station
- museums
- arboretums
- greenhouses
- garden hobbyists
- horticulture society members
- community college or university faculty
- horticultural specialists

**Literature**

*USDA and Penn State Cooperative Extension publications*

Write or call your county extension office.

*Business and industry publications*

*A Child's Garden.* Elementary teaching guide on anything and everything you want to know about planting and growing. Single copy free to teachers or 4-H leaders. Write to:

Chevron Chemical Company  
Public Affairs  
6001 Bollinger Canyon Road  
San Ramon, CA  94583

Other free and inexpensive educational materials are listed in the *Resource Guide to Educational Materials About Agriculture.* For a copy, contact your county extension office or write to:

Agriculture in the Classroom  
Room 536A  
U.S. Department of Agriculture  
Washington, D. C.  20251

*Gardening books*

Time-Life, Ortho, and Sunset produce many useful books available through local bookstores, garden centers, or your public library.
Youth Gardening Book ($14.95). A very helpful book with over 70 activities that teachers/leaders can use in school/community gardening projects to make growing fun. To order, write:

The National Gardening Association
Department 171
180 Flynn Ave.
Burlington, VT 05401

Magazines
Organic Gardening, Flower and Garden, Farmstead, Mother Earth News, Green Thumb, National Geographic

Audiovisual Aids

Available from Penn State Cooperative Extension
Secrets of the Plant World. Catalog #57. A Disney video cassette that uses time-lapse photography to show the development of a seed into a mature plant.


For other resources contact your county extension office or write to:

Audio-Visual Services
Special Services Building
University Park, PA 16802
(814) 865-6314

Other sources
Growing, Growing. 16-mm film. Primary to adult, introduction to seeds, gardens, plants, and other living things. Write to:

University of Illinois
Visual Aids Services
1325 South Oak Street
Champaign, IL 61820

Public libraries
Visit your local branch or write:

Free Library of Philadelphia
Regional Film Center
114 N. 19th Street
Philadelphia, PA 19103

Carnegie Library of Pittsburgh
Regional Film Center
Allegheny Square
Pittsburgh, PA 15212

Catalogs

Educator's Guide to Free Films and Film Strips: Write to: Educator's Progress Service, Randolph, WI 53956
Guide To Government and Military Loan Films. Write to: Serina Press, 70 Kennedy Street, Alexandria, VA 22305

For other catalogs, write to:

Eastman Kodak Company
Audio-Visual Distribution
343 State Street, NW
Rochester, NY 14650

The Farm Film Foundation
1425 H Street, NW
Washington, DC 20005

Association Films
324 Delaware Ave.
Oakmont, PA 15139

Computer Software

Plants and How They Grow. Introduction to plants, plant parts, and trees, what each part does, how seeds are dispersed, and how a plant uses water to grow. Game follows. E2 C3. Disk, Apple II and IIe. $18. Write to: Right on Programs, 140 E. Main Street, Huntingdon, NY 11743

PROJECT MATERIALS

Materials are recommended for each activity. You may buy products or improvise at little cost. Decide in advance which materials you will provide and which will be provided by group members.

Many useful items can be collected from almost any institution with a cafeteria. Maintain a collection box for popsicle sticks, styrofoam cups, and plastic forks and spoons. These can be used as labels, containers, and tools. Food service employees may be willing to donate old sponges, aluminum pans and trays, bleach bottles, produce trays, margarine tubs, and milk and egg cartons. Paper towels, measuring spoons, and cups are also useful.

Plant supplies such as cuttings, bulbs, seeds, and torn bags of soil and fertilizers might be donated by generous greenhouses, florists, garden centers, retail stores, supermarkets, vocational schools, or community colleges. Local garden clubs and plant enthusiasts are always potential sources. Seed catalogs and other supply catalogs are commonly available free of charge. Some reputable companies are:

Park Seed Company
Hwy 254 North
Greenwood, SC 29647

Mellinger's
2310 W. South Range Rd.
North Lima, OH 44452

Thompson and Morgan
Box 1308
Jackson, NJ 08527

W. Atlee Burpee Company
2386 Burpee Building
Warminster, PA 18974

Stokes' Seeds
1456 Stokes Building
Buffalo, NY 14240

Hand tools, labels, seeds, and soil mixes are sold commercially. The best potting media are synthetic mixes. They are sterile and lightweight, and consist of different combinations of vermiculite, perlite, peat moss, and/or fertilizer. They have trade names such as Jiffy Mix, Pro-Mix, Redi-Earth, Super Soil, and First Step.

The most commonly used containers are made of plastic and clay. Containers used should have one or more holes in the bottom for water drainage. Other containers are formed from compressed peat, perlite, fertilizer, vermiculite, and synthetic fiber. These allow for safe and
easy transplanting and are relatively inexpensive. Some common trade names are Jiffy 7 Pellet, BR 8 Blocks, Peat Pots, and Fertl-Cubes.

Other useful items include electric heating cables, which furnish bottom heat to hurry seed germination and root cuttings, and seed-starting kits. Starter kits include trays, jiffy pots, seed sowing trays, planting mix, label stakes, an electric heating cable, and a handbook. Finally, a magnifying glass will prove invaluable for observing the results of experimentation.

HOW TO USE THIS GUIDE

This guide supplements information given in the member's guide. You are encouraged to expand and rearrange lessons to meet the needs of your group, whether it’s a community or project club or school enrichment program. Be innovative! To guarantee high success rates, you might want to set up extra experiments or use more samples than suggested. At the same time, emphasize the importance of following directions. This way, failures are less likely to result in disappointment.

Meet the Plants is designed for at least six meetings or lessons, with the first session devoted to organizing your groups. Each section will help you organize a lesson/meeting on each of the five topics in the member's guide. Each lesson/meeting within the leader's guide has five major parts:

I. Topic Introduction
II. Purpose and Educational Objectives
III. Teaching Aids
IV. Procedure
V. Looking Ahead

The topic introduction will give you a deeper understanding of the subject. Use it to introduce the lesson, provoke thought, stimulate discussion, and finally to summarize the lesson/meeting. If you need additional information about the topic, contact your county extension office for materials such as the 4-H publication, Science of the Growing Plant.

The members' guide presents a variety of activities. Each is designed to give you flexibility in regard to time, resources, and youth interests. Depending on the time limits of your meetings, you may need to choose some activities and have members try others at home. You do not have to complete all activities, however, it is recommended that at least one activity for each lesson/meeting topic be used. Optional Activities are included in the leader's guide in case:

- meetings are held more often
- some members are more advanced than the rest of the group
- interested youth want to pursue subjects between meetings and to involve parents or other family members in the 4-H project experience

Materials for Optional Activities are listed in the leader's guide only.

Since this is an introductory project designed for ages 8-10, we encourage you to have older children in your group teach some of the lessons, with your guidance. They can learn the basics about plants as they prepare to teach younger members.
LESSON/MEETING 1: WHAT ARE PLANTS?

I. INTRODUCTION

The World of Plants: The Plant Kingdom

In the traditional system of classification, all living things are categorized into groups called taxa. Of these, the broadest is the kingdom, and all living things are divided into the plant or the animal kingdom. The plant kingdom has a great many divisions. The most advanced division includes the plants we know best. These are the so-called higher plants—those with roots, stems, leaves, and a vascular system. Other divisions are made up of "lower" plant forms—mosses, algae, fungi, bacteria, and slime molds. Lower forms generally include no horticultural crop plants except for edible mushrooms, but do provide chemical derivatives used in such diverse products as salad dressing, turpentine, and medicines. Some are responsible for serious crop diseases.

While it may seem simple to distinguish living organisms as plants or animals, closer examination by modern-day botanists makes this distinction debatable. A recently developed classification system considers many of the lower plants separate from the plant kingdom, based on their cellular makeup. Another recent system has identified fungi as a separate kingdom, placing blue-green algae and bacteria into a separate kingdom and other kinds of algae into yet another kingdom.

Most important to a basic understanding of plants is that not all of them are alike. They have many variations as well as similarities. Studying their classification and groupings can help us recognize their characteristics and understand how they grow, as well as what they need to grow.

Plant growth and reproduction are primary distinguishing traits. The simpler the plant, the greater the part played by moisture in its growth and reproduction. The progression of plants from lower to higher forms can be represented this way:

- **Simple types**
  - grow in water from nonvisible spores

- **More developed**
  - grow on moist land from visible spores

- **Highly developed**
  - grow on dry land from complex flowers and seeds

Mosses, fungi, and ferns reproduce by spore and survive only in damp surroundings. Evergreens and flowering plants inhabit relatively dry ground and reproduce by seed. The plant groups presented in Lesson 1 are scientifically basic to more advanced forms.

II. PURPOSE AND OBJECTIVES

- Establish the understanding that common traits are used for grouping and naming plants.
- Identify differences among plants:
  - All plants are not green.
  - All plants don’t have leaves.
  - All plants don’t have flowers.
  - All plants don’t grow from seeds.
III. TEACHING AIDS

Review in advance all activities in the member's guide and Optional Activities in the leader's guide to determine their suitability for your program. The materials outlined are those required per individual. You may choose to share materials or complete activities as a group and therefore need fewer materials. But to ensure a greater success rate, prepare more rather than less (remembering to emphasize for youth the value in the process over the results). You may want to prepare extra experiments so that some materials can be taken home for daily observation and others remain at the meeting place for future observation and discussion.

Suggested materials for teaching:

- flipchart, poster board, or chalkboard
- markers or chalk

Materials for project activities:

- 3 mushrooms
- index card
- plastic cup
- bread
- jar with a lid or ziplock sandwich bags
- magnifying glass
- 3 to 4 melon, pumpkin, or squash seeds
- 2 containers for planting
- 2 to 4 pebbles
- 2 drip catchers
- 2 labels
- avocado pit
- 3 toothpicks
- small jar of water

*Mushrooms.* The stem and the thin skinlike tissue called the *veil* should be removed to allow spores to drop freely. This can be done in advance, as it requires fine motor coordination, or it can be done with youth during the meeting. A quick twist should remove the stem. Peel the veil gently.

*Index card.* Recommended for the sake of convenience. What is more important is that the paper be white for good visibility and somewhat porous so that spores are held in place for observation.

*Plastic cup.* Recommended as a safety precaution. Glass cups or jars can also be used.

*Bread.* The size of the piece is not so important. A whole slice per child is wasteful. Make sure the bread has no preservatives (BHA or BHT), as they deter mold growth.

*Magnifying glass.* Invaluable and almost essential. So much occurs in the plant world that is invisible to the naked eye. A magnifying glass brings drama and excitement to a new subject.

*Avocado pit.* Open the fruit with the group to allow tasting for those who haven't eaten it before. A well-ripened fruit will give slightly when squeezed gently. If none is ripe, skip the taste-testing. Prepare the pit by washing it and allowing to dry for 24 hours. The brown skin will peel away easily.

*Melon, pumpkin, and squash seeds.* Although these seeds germinate readily, you may also experiment with others, for example, pepper and tomato seeds. Seeds of citrus and other fruits can be used and are identified for you with this activity. However, these seeds can sometimes be difficult to germinate.
**Potting mix.** To 2 parts sterile soil, mix 1 part perlite and 1 part peat moss. A "part" means some consistent measurement of volume (a cup, a bucket, a wheelbarrow). Commercial blends contain good mixtures of perlite, peat, vermiculite, and other materials, and they eliminate the mixing steps. Potting mixes don't absorb water well without a good manual mixing, so they should be mixed and moistened before being put in pots. Keep adding water while stirring the mix in the bucket or tub. You may choose to do this in advance, but it is a good exercise for children. Adequate water has been added when the potting mix holds together without dripping water when it is formed into a ball. Good potting mixes are sterile, easy to use, and support good plant growth.

One important thing for you as well as youth to understand: this is called a "potting mix" because that's what it is. It is a combination of ingredients used as a plant-growing medium. It may or may not contain soil and therefore isn't considered "soil." "Dirt" is a definite misnomer. (Did it come out of a vacuum cleaner?) Using the correct term, potting mix, is a good habit to establish early.

**Containers for planting.** Many recyclable kitchen containers can be adapted for this purpose (yogurt, margarine, sour cream tubs, 1/2 pint milk containers, styrofoam cups, egg cartons). Commercial products (obtained through garden catalogs, hardware and variety stores, garden centers, and Agway centers) range from pots to various fiber blocks and compressed peat moss containers to complete seed-planting kits.

For the beginner it is best to seed directly into individual containers to avoid the stress of separating and transplanting tender seedlings. Jiffy pellets, compressed peat pots surrounded by nylon netting, expand when set in a tray of water. They are inexpensive, space-saving, and convenient. A container's material is very important, because it's common for beginners to be overzealous and to overwater. Plastic containers don't "breathe" and therefore do not allow excess water to evaporate through their walls. Unglazed clay containers, on the other hand, are porous and can compensate for the heavy-handed overwater. It's much easier to spot and correct a problem of underwatering than it is of overwatering.

![Images of peat pots and blocks, egg trays, milk cartons, and plastic meat and produce trays]

Related to water balance is drainage. If there is a large hole in the bottom of the container, place a pebble over it to prevent the escape of potting mix but to allow water out. Pebbles are usually not necessary, however, if no holes are present, the container must be punched with a sharp object.

**Drip catchers.** Saucers, recycled kitchen containers (lids from yogurt, margarine and sour cream, styrofoam meat and produce trays), baking sheets, ice cube trays, and commercial saucers, trays, or flats.
Labels. While gardening labels are available commercially, popsicle sticks, tongue depressors, or masking tape are fine substitutes. Write on labels with pencil. Ballpoint pens and felt markers will run when wet.

IV. PROCEDURES

Introduce the world of plants by posing the question, "What are plants?" Ask youth to identify different plant characteristics. You may wish to list these on a flipchart, chalkboard, or poster board for the group to refer to as you go on with the lesson. This will help you discover what children consider plants to be.

Before members explore their project books, you may wish to begin with an activity to test their knowledge. Have examples of a variety of Lesson 1 plants and ask members to identify those they consider plants.

Examples:
- moldy bread
- typical house plant
- moss
- picture of a tree
- dried seaweed
- mushroom

Discuss the characteristics of each plant group presented in the member’s guide. Some questions for discussion are:

1. Where do the plants grow?
2. What kind of conditions do they grow in?
3. Do they all need the same things to grow?

Use the activities in Lesson 1 to stimulate thinking about these questions and to illustrate different characteristics of plants, the groups they belong to, and why this information is important. Additional discussion points may be presented with the activity.

ALGAE

Activity 1: Seaweed Match

![Palm seaweed](image1)
![Mermaid's wineglass](image2)
![Sea lettuce](image3)
Optional Activity: Seaweed Examination

Before the meeting (what you will need):

- *Dried seaweed*—various types may be found in specialty shops, Oriental markets, or the ethnic food sections of supermarkets.

- *Bowl of water*—soaking dried seaweed overnight in advance is necessary to restore it to its original condition.

At the meeting. Examine the various types of seaweed, comparing features and textures. This is a good activity for tactile stimulation.

Discussion. Seaweed is a food source in many parts of the world. Some types are processed for use in many of the foods we eat. (Agar, for example, is added to ice cream to aid in gelling.)

Mosses

Optional Activity: Moss Museum

Before the meeting (what you will need):

- Moss specimens
- Digging tool
- Jar with lid or a flat tray with plastic wrap for cover
- Pebbles for drainage
- Magnifying glass

At the meeting. Walk through various wooded areas to collect different moss specimens. Dig up moss with a small amount of surrounding soil. Put into the bottom of the jar. Keep the cover on the jar to maintain high humidity. (Remove the cover for a few hours if the jar gets so clouded you can't see inside). Observe the moss's development over time and watch for spore formation.

Fungi

Activities 2 and 3 provide hands-on experience with plants that grow via spores. The Optional Activity is an experiment older members may try.

Activity 2: Spore Print

Before the meeting (what you will need):

- See member's guide for materials.
- Select mushrooms with veils still intact or only slightly torn to ensure spores' presence within.
• You may want to remove the stalk and veil in advance, depending on time limits and youths' abilities.

Twist and remove

Peel back veil (attached to stalk) to reveal spores

Place mushroom cap on toothpicks or match sticks and put on paper or index card; cover with plastic cup or jar

At the meeting. Follow procedures in Member's Guide.

Discussion. Different kinds of mushrooms form different spore prints, which experts use to identify mushroom varieties. Although mushrooms are delicious and highly nutritious, one should never eat one found growing wild. Leave identification of all types to the experts!

Activity 3: Mold Gardening

Before the meeting (what you will need):
• Bread slice (without preservatives)
• Small jar with lid

At the meeting. Follow procedures in Member's Guide. Bring to the meeting as an example and as a specimen for members to observe under magnification.

Discussion. This activity provides an opportunity to discuss invisibility and widespread distribution of fungal spores: beneficial types and detrimental types. Since fungal spores are small, they can float easily and are widely dispersed. As the bread mold activity demonstrates, spores can be found almost any place. They need only moist conditions to grow. Mold grows on food that has not been refrigerated or on food that has been refrigerated for too long. Preservatives are added to many foods to prevent the growth of mold. Mildew grows on clothing stored in damp attics and basements. Athlete's foot is often caught in communal showers where someone has inadvertently transported and "planted" a spore or two. But like the mushroom, some fungi and molds are benign. Penicillin is a type grown for use in treating disease. Yet many people are allergic to mold spores and may react severely to penicillin. Roquefort or blue cheese gets its distinctive flavor and color from the mold that grows in it.

Optional Activity: Fern Spores

This activity requires patience—it can take from four months to a year to complete. Very clean materials must be used.
Before the meeting (what you will need):

- **Fern leaf**—Ask the owner or manager of a commercial greenhouse, florist, or plant shop for the "donation" of a frond to provide spores for your entire group. Look for one with bright golden yellow or dark brown spore clusters, indicating maturity, on its underside. (Many people mistake the clusters for an insect infestation.) Place the fronds in an envelope or on a sheet of white paper in a bag for 48 hours. Fine spores will be released from the clusters and should be separated from other leaf parts or debris.

- **Potting mix**—Prepare a mix of 1 part finely shredded sphagnum moss or fine peat moss and 1 part sand. Commercial African violet mix is a good substitute. Moisten well.

- **Plastic film**
- **Plant mister**
- **Flat tray with good drainage**

**At the meeting.** Fill the tray halfway with potting mix. Sprinkle the spores evenly across the surface. Cover it with film, lifting only to mist every other day. Place the tray in light but not in direct sun.

**After the meeting.** Greenish fuzz will appear in about a month. Plants should be about 1/4 inch tall in three months. When they reach four to five inches leave the plastic open during the day to let them adapt to the environment. After two weeks they can be potted into individual containers.

**EVERGREENS**

Evergreens are a more highly developed plant group that reproduce via seed. They grow on relatively dry ground, as compared to mosses and ferns.

**Activity 4: Evergreen Match**

Have youth identify and match illustrations with tree names using the Member's Guide. The Golden Press publishes several tree identification guides that could be purchased or borrowed from your local library for further study.

**Optional Activity: Cone Bird Feeders**

Before the meeting (what you will need):

- Cones
- Peanut butter
- Birdseed
- Piece of string 1 foot long

**At the meeting.** Tie the string around the cone. Smear peanut butter onto the cone and roll it in birdseed until coated. Attach the string to a branch near a window for bird-watching fun.
FLOWERING PLANTS

At the meeting. Discuss why this plant group is important to people. These plants, called angiosperms, are important because we rely on them for food. (See discussion below.)

Many fruits are traditionally thought of as vegetables, but this is a culinary or dietary distinction. Tomatoes, peppers, and pumpkins are swollen flower parts that contain seeds and are either fleshy or dry and hard. Botanically, they are fruits.

Seed catalogs are useful in identifying fruits. Often "vegetables" are pictured sliced in half to display their fleshy tissue and seeds. To request catalogs for use during the project, you can help members write to seed companies. A note on an index card will suffice.

Discussion. Almost every flowering and fruiting plant serves people in some way. The balance of oxygen in the air we breathe is maintained in part by vast jungles of trees and their by-product of photosynthesis. Virtually everything we eat comes from plants, either directly or indirectly. Without air and food we would never be able to appreciate their ornamental value.

Activity 5 allows youngsters to recognize some fruits and "vegetables" that come from flower plants. Further discussion of these can take place in the lesson on plant parts.

Activity 6 asks youngsters to identify and list other plants that produce pods or fleshy fruits that cover the seeds. Some others are: grapes, lemons, raspberries, peas, tomatoes, peppers, peaches, and gourds.

Activity 5: Seeds from the Kitchen

Before the meeting (what you will need):

• Melon, pumpkin, or squash seeds
• Potting mix—be sure it is well moistened.
• Saucers—any type of drip-catcher
• Pebbles—for drainage
• Avocado and/or avocado pit
• Toothpicks
• Small jar of water
• See Member's Guide for other materials

At the meeting. Follow procedures in the Member's Guide for planting. Having an extra avocado, melon, or squash at the meeting can provide an interesting opportunity to taste-test new foods. Because avocados are expensive, you may wish to use this activity as a demonstration for the group rather than as an individual activity.

After the meeting. In two to six weeks leaves will form. When the second set of leaves have formed, the seedlings can be transplanted into individual containers.

Discussion. Foods have seeds that we usually discard. Some can be salvaged for experimentation and can become beautiful house plants. Further experimentation with recycled seeds can be saved for future lessons.
Looking Closer: Seeds from the Kitchen

Other kinds of seeds you may want to experiment with require more time and care. More exotic fruits can be found in supermarket produce sections during various seasons.

Citrus. Grapefruit seeds grow the fastest. Collect only filled-out seeds (shriveled ones are not usually viable) and soak them in water overnight.

Papaya. Rub seeds in a layer of newspaper to remove their jelly coat. Use a mix of 1 part perlite and 1 part peat moss. Cover the seeds with 1/2 inch of mix. Keep in a warm location. Growth will appear in a month.

Mango. Wash the husk with a stiff brush to remove pulp and fiber. Dry for one or two days. With a nail clipper clip a piece of husk and remove the seed. Soak it in water for 24 hours. Use a mix of 1 part potting mix and 1 part perlite. Laying the seed horizontally, cover it with 1/2 inch of mix. Growth will appear in two to three weeks.

Pomegranate. Roll seeds on paper towel or newspaper to remove the juicy coat. Use a mix of 1 part potting mix and 1 part perlite. Cover the seeds with 1/4 inch of mix. Growth will appear in six weeks.

Kiwi. Roll seeds on a paper towel to remove fruit. Mix seeds in moist peat moss and place in a small plastic bag in the refrigerator for five to six weeks. Use a mix of 2 parts potting mix and 1 part perlite. Cover the seeds with 1/4 inch of mix.

These kinds of seeds may be mail-ordered from the following companies:

Alberts and Merkle, Inc.
2210 S. Federal Highway
Boynton Beach, FL 33435

John Brudy's Rare Plant House
Box 1348
Cocoa Beach, FL 32931

Desylva Seed Co.
21994 Tanager St.
Colton, GA 92324

J. L. Hudson
Box 1058
Redwood City, CA 94064

Hurov's Tropical Tree Nursery
Box 10387
Honolulu, HI 96816

Rare Fruit Council
3280 S. Miami Ave.
Miami, FL 33129

Christopher Whitman Rare Fruit Nursery
23430 S.A. 122 Lane
Princeton, FL 33032

Activity 6: A Quick Review

This activity could be a review for the group at the meeting's end or it could be done individually. Answers are easily found in the member's guide.
V. LOOKING AHEAD  (Lesson/Meeting 2: Plant Parts)

Decide in advance which materials you will provide and which materials members will provide. Also decide which activities will be done individually. Materials and procedures for Optional Activities are listed in Lesson/Meeting 2. Review in advance.

Materials needed:

- *Radish seeds*—One teaspoon per member should be soaked for several hours in water to soften seed coats. This speeds up the germination process. Root hairs are especially obvious on radish seeds.

- *2 tablespoons of alfalfa seeds* —Be certain these are of edible quality. This type can be purchased from natural foods stores and through seed catalogs. The planting variety is likely to be treated with pesticides and can be hazardous if consumed. Alfalfa sprouts have the most delicate flavor, but others can be tested. Mung is another common sprouting seed.

- *Carrot, beet, turnip, and/or sweet potato*—Search for one of these in the produce section of your supermarket, and look for some sign of green growth near the tip. Since these crops are commonly treated to prevent such growth, you may need to hunt to find a suitable sample.

- *2 celery stalks* —For this demonstration, the stalks should have leaves.

- *Bulb*—Although expensive, an amaryllis is fast-growing and provides immediate gratification. Tulips and daffodils may be used, but they won't give as spectacular a display. Onions and garlic cloves may be substituted. They are generally treated with a growth inhibitor to maintain their supermarket shelf life, so look for those showing some sign of growth.

- *Potting mix*—Use a commercially prepared type or mix your own as described under "Teaching Aids," this section.

- *Seed containers* —egg cartons, jiffy pots, or seed flats.

- *Container for bulb* —Select a pot one inch larger in diameter than that of the bulb.

- *Sponge*

- *2 small jars* —Cups may be substituted.

- *Shallow saucer*

- *Quart jar*

- *Clean, sharp cutting tool*

- *Old telephone book*—Newsprint is equally absorbent.

- *Heavy books or bricks*

- *Glue*

- *Poster board or notebook*

- *Rubberband*

- *Cheesecloth or a clean nylon stocking*
LESSON/MEETING 2: PLANT PARTS

I. INTRODUCTION

People and plants are somewhat alike. We need food and water to make the tissues of our organs and muscles work together to keep us alive and growing. Plants, too, need food and water to live and grow. Their roots, stems, and leaves work in specific ways to keep them alive and growing.

*Roots* have a dual purpose: to anchor the plant in the ground and to absorb nutrients and water. Roots take up soil elements that are dissolved in water.

*Stems* function mainly to transport water and minerals from roots to leaves. In addition, stems support the aerial portion of the plant. Some types are specialized and store nutrients for the plant's use underground. Examples are tubers (potato and caladium) and corms (gladiolus and crocus). Other types grow on the ground (strawberry) or have climbing devices that support the plants (grape, ivy, melon, philodendron).

*Leaves* are connected to the stem by stalks called petioles. Dissolved minerals travel to leaves through veins in the petioles. A leaf carries out its primary function, photosynthesis, when soil nutrients dissolved in water react with sunlight to produce a food form that plants can digest and metabolize. (See p. 25 of the member's guide for an illustrated explanation.) What is important is the ability of plants to convert inedible elements into forms that humans can eat and metabolize.

Some plants form specialized underground leaves that store nutrients during seasons of nongrowth. When weather conditions are desirable, growth resumes and the nutrients are used. These underground leaves, which we know as bulbs, occur in lilies, tulips, onions, and garlic.

The sexually reproductive portion of a plant is its flower. Any large blossom (amarilis, lily, azalea, or tulip) affords a good display of male and female flower parts. This lesson is an excellent opportunity to build a scientific foundation for the subject of reproduction.

II. PURPOSE AND OBJECTIVES

- Identify common plant parts.
- Identify the functions of different plant parts:

  Roots absorb and transport water and minerals; they anchor aerial plant parts.
  Stems transport water and minerals from roots and leaves.
  Leaves undergo photosynthesis, a food-production process. They also function in food storage.
  Flowers serve as reproductive organs.
  Fruits serve as seed containers.
  Seeds contain embryonic plants.
III. TEACHING AIDS

Optional teaching materials:

- poster board, flip chart, flannel graph
- construction paper, scissors, paste

You may want to consider the following educational supplements for your program:

What Is a Seed? Describes different kinds of seeds, how they develop into living things, and ways they travel. Learning kit with booklets, read-along cassettes, teacher's guide, and activity masters. Write to:

National Geographic Educational Services
Department 83
Washington, DC 20036

Secrets of the Plant World (catalog #57). Disney Productions video cassette that uses time-lapse photography to show the development of a seed into a mature plant. Contact your county extension office, or write to:

Audio-Visual Service
Special Services Building
University Park, PA 16802

Materials for project activities
(See page 18 for a listing of materials needed.)

IV. PROCEDURES

In this lesson/meeting you will introduce the basic parts of plants—roots, stems, leaves, flowers, fruits, and seeds. The activities are presented in the order of a plant's growth cycle. For younger children, however, you may wish to begin with the "whole" plant. You can identify parts and "build" a plant. This can be illustrated with cut-outs on a bulletin board, poster board, flannel graph, blackboard, or construction paper. Using colored construction paper, each child can draw the parts, cut them out, and paste together a plant.

After a discussion of the total plant, you can have group members "take it apart." Use the activities in this lesson/meeting for hands-on experiences to show each part and demonstrate what it does.

Review the activities and select the ones you will do as a group, those to be done by members at home, and those you will do in advance. If your schedule permits, you may wish to have several lesson/meetings about plant parts rather than one.

ROOTS

Activities 1, 2, and 3 in the Member's Guide are devoted to plant roots. Sponge Farming, if prepared in advance, would be especially helpful in your discussion of root types, because it allows children to see tiny root hairs. Sponge Farming and Root Recycling may be done as group activities to provide fun for younger children as they see how roots develop. Root Recycling is also a good activity to use at the beginning to teach members responsibility for taking care of their plants, especially for future
plant projects. If time allows, members could bring their recycled plants to the next club meeting for a "show 'n tell."

**Activity 1: Roots**

Illustration 1—beet, carrot, Queen Anne's lace  
Illustration 2—grass, wheat, rose, cactus, lily of the valley

**Activity 2: Sponge Farming**

Follow instructions in the member's guide.

**Activity 3: Root Recycling**

Follow instructions in the member's guide.

**STEMS**

Activity 4 in the member's guide illustrates the basic function of stems: to carry food and water to different parts of the plant. It is important for youngsters to know that not all plants have the same types of stems. Some grow horizontally, some grow underground. Members will learn more about these different stem forms in later projects. This part of the lesson merely introduces stem function and how stems differ. A good illustration is the Irish (white) potato, an underground stem.

**Activity 4: Plant Plumbing**

Follow instructions in the member's guide. Further experimentation can be conducted with warm and cold water and in dark and light conditions. Warm water and light will speed up the process.

[Image: Dyed water-carrying vessels]

**Looking Closer: Patriotic Celery**

Follow instructions in the member's guide. The principle behind coloring plant parts can be applied to flower dying. White carnations or roses can be dyed green for Saint Patrick's Day.

**LEAVES**

The member's guide introduces the importance of leaves to a plant's growth. Leaves are a plant's "factory": they process raw materials into food which the plant uses for growth. Photosynthesis, the process of turning air, water, nutrients, and light into sugar, will be covered in Lesson 4.

Activity 5 allows youngsters to study the different shapes, sizes, and types of leaves plants produce. Activity 7, Plant a Bulb, shows that some leaves store food for seasonal growth. This concept will be important later as you continue to identify plants by their characteristics. Activity 6 would be great for demonstration at a club meeting as well as for a family project at home. Getting parents involved with their child's leaf collection and exhibiting it at a club roundup may create additional interest for future lesson/meetings! Many Optional Activities are included for further leaf study and fun.
Activity 5: Leaf Match

Activity 6: New Life for a Leaf


Optional Activity: Leaf Splatter Print

Before the meeting (what you will need):

- leaves with different shapes and designs
- old toothbrush
- 3 x 3 inch square piece of screen
- water-based paint
- absorbent paper such as newsprint (large sheet for wrapping) or construction paper (small sheet for stationery)

At the meeting. Place the leaf flat on the paper. Hold the screen 3 to 5 inches above the paper. Dip the brush into the paint and rub it across the screen, splattering paint onto the leaves and paper. Continue until the paper is thoroughly dotted. Remove the leaves when the paint is dry.

Optional Activity: Leaf Rubbings

Before the meeting (what you will need):

- collection of leaves having different shapes and vein patterns
- tracing paper
- crayons with paper removed

At the meeting. On a flat surface, place the paper on top of the leaf. Hold the crayon flat on its side and rub it gently over the entire leaf so the leaf shape and vein design appear on the paper.

Optional Activity: Leaf Flash Cards

Before the meeting (what you will need):

- collection of leaves having different shapes and vein patterns
- stiff paper or cardboard
- crayon or marker
• scissors
• leaf identification guide (see Activity 6 for suggested guides)

At the meeting. Trace the leaf shape onto the cardboard. Cut out the shape and draw in the veins. Identify the tree from which the leaf came and write it on the back of the card. Use cards as flashcards to practice leaf recognition.

Activity 7: Plant a Bulb

An amaryllis will bloom in five to six weeks. With proper care, it will produce more than one flower. To observe the various stages of growth, plant a different bulb every two weeks, beginning in mid-fall. Follow instructions in Member’s Guide.

After the meeting. When leaves emerge, give the plant more water and place it in a sunny window. In five to six weeks (mid-winter) the stalk should be nearly 2 feet tall and have two to four large flowers. Move to a cooler location to prolong blooms. Fertilize monthly after flowering and cut back the stalk. Provide good light, water, and fertilizer to allow the developing bulb to store energy for next year’s flowering. In fall, when the foliage yellows, water in lesser amounts. Cut back foliage as it withers. Next spring, add a layer of soil, water and place in sunlight.

Mid-fall Early winter Late summer Early spring

Optional Activity: Bulb Prints

Before the meeting (what you will need):
• onion
• knife
• ink pad
• large piece of absorbent paper (newsprint to make wrapping paper) or smaller, folded paper (to make stationery)
At the meeting. Slice the bulb in half. Press it onto the ink pad and create a design on the paper.

Discussion. Scales are specialized storage leaves. Slice the bulb vertically and use a magnifying glass to observe the concentric rings formed by the onion's scales, or fleshy leaves. These leaves are made of stored food the plant uses for growth. Have group members examine the stem, which is the hard, flat plate at the base of the bulb.

FLOWERS

Just as people need a father and mother to produce a child, flowers have male and female parts for reproduction. The male parts produce a powdery material, pollen, which must reach the female part, the pistil, to fertilize the egg inside. Pollen falls to the pistil or is carried there by wind or by animals. The honeybee, visiting flowers in search of nectar, carries most of the pollen. Pollen sticks to the hairs of the bee and gets brushed onto the pistil. The role of bees and other animals (such as birds) in the pollination process resulted in the expression, "the birds and the bees."

Activity 8: Flower Label

FRUIT

What is a fruit? How are fruits formed? How do seeds and fruits differ? These and numerous other topics related to fruits can make interesting adventures. For instance, what we call "fruit" is usually the fresh apples, peaches, pears, and cherries we see on a fruit tree or at the market. However, when botanists speak of "fruit," they not only refer to apples, peaches, and cherries but to many vegetables, cereals, seeds, and nuts as well. A fruit grows or develops from the female part of the flower or pistil where the seeds are located. Therefore, fruits are the containers that hold seeds. For this reason, such vegetables as squash, eggplant, and melons are actually fruits because they contain seeds—as are tomatoes, cucumbers, peppers, and bean pods.

While fruits usually contain seeds, they can also develop without them, as the seedless orange and banana do. Fruits are not always easily distinguished from seeds.

While fruits may be classified in various ways, the fruit is the final product of a plant, and the seed inside is the beginning of a new plant. Most, but not all, of the plants you know produce fruit in the course of their lives. Many fruits are edible and so especially interest us. Other fruits such as gourds become decorative or showy and are grown for that purpose by florists. Yet others, such as cereals, are the seed itself. For further information on fruits, ask for a copy of Science of the Growing Plant, a 4-H publication available from your county extension office.
Activity 9: Fruit Match

crerry—fleshy
maple—hard and dry
cucumber—fleshy

Optional Activity: Fruit Prints

Before the meeting (what you will need):
• slices of citrus or apple
• ink pad
• large piece of newsprint or other absorbent paper (for wrapping paper) or smaller folded paper (for stationery)

At the meeting. Press slices onto the ink pad. Stamp onto paper to create a design for gift-wrapping paper or stationery. Experiment with different designs by cutting fruit at different angles.

SEEDS

The member's guide presents two activities that will help in teaching youngsters about seeds. "Looking Closer" allows children to look closely at the parts of seeds, and Activity 10 may give them a new taste experience—edible seed sprouts! For a further discussion of seeds, refer to the 4-H publication *Science of the Growing Plant*.

Activity 10: Seed Sprouting for Food

Follow instructions in the member's guide. It's very important to emphasize the use of edible-quality seeds only.

Optional Activity: Seed Collections

Before the meeting (what you will need):
• bulletin board or poster board
• plastic baggies
• collection of seeds from home or outdoors

At the meeting. Package seeds by category, such as grains, weeds, trees, flowers, vine crops, fruits, and root crops. Or mount seed collections. Individual seeds may be mounted on index cards and their names put on the back to use in identification exercises; or a poster of several seed types may be made for display.

Identify seeds and label with their name. This activity can be done individually or as a group project over a long period of time.
Optional Activity: Seed Mosaic

Before the meeting (what you will need):

- variety of dried seeds usually found in the kitchen (green and yellow split pea, lentil, sunflower seed, chick-pea, and black, kidney and lima bean)
- piece of cardboard, wooden plaque, or a cigar box
- tweezers (optional)
- glue
- varnish

At the meeting. Draw a design on the cardboard, wood, box, or on old ceramic tiles. Needlework books or children's coloring books have easy patterns that may be traced. Apply glue to small areas at a time. Using tweezers, apply seeds to pattern. Allow to dry 48 hours. Coat with varnish for protection.

V. LOOKING AHEAD (Lesson/Meeting 3: Uses of Plants)

Materials needed:

Magazines
Seed catalogs
Scissors
Tape or glue

Other suggestions:

Have youngsters complete Activities 2 and 3 at home before coming to the meeting. This will give them information to discuss and share, and it will help parents become more knowledgeable about what their youngsters are learning!

Optional Activity: Organize a field trip to a supermarket for a "treasure hunt."
LESSON/MEETING 3: USES OF PLANTS

I. INTRODUCTION

We rely on plants for medicine, decoration, clothing, shelter, paper, and fuel. But the most important thing we get from plants is food. Plants use water, gases, and soil minerals to produce new cells. We consume these cells in the form of roots, flowers, stems, leaves, and seeds to get the vitamins and minerals we need for growth and energy.

Although plants are useful in so many ways, some pose hazards to people and animals. Weeds compete with cultivated plants for water, light, nutrients, and space.

II. PURPOSE AND OBJECTIVES

- Examine the uses of plants for food and fiber, decoration, and extracts.
- Reinforce knowledge of plant parts by examining the foods we eat.
- Identify detrimental aspects of plants: weeds and poisoning.

III. TEACHING AIDS

Suggested materials for teaching:
- flip chart, posterboard, or chalkboard
- markers or chalk
- examples of canned and processed food products

Materials for project activities:
- pencils and crayons
- old magazines and seed catalogs
- scissors
- tape or glue

IV. PROCEDURES

The Member's Guide helps you begin this lesson/meeting by asking youngsters to look around them and identify at least 10 things that come from plants. Ask each youngster to share his or her list. You may have someone record these on a flip chart, posterboard, or chalkboard to display the variety of uses we make of plants. Categorize plants by use as food and fiber, for decoration, other.

Foods and Plants: Making the Connection

Activities 1, 2, and 3 allow youngsters to explore plants as food sources. You may have asked them to complete these activities before the meeting; or this lesson's topic is a great opportunity for field trips. If transportation is a problem for large groups, you may want to organize your own 4-H Club Store! Collect and display empty containers
of canned and processed goods to use for activities at your club meeting or in your classroom.

Activity 1: Parts We Eat

Leaves: collard, oregano, cabbage, kale, beet greens, parsley, dill, celery*
Flowers: cauliflower, artichoke, broccoli
Roots: carrot, radish, turnip, sweet potato
Fruits: apple, tomato, melon, strawberry, cucumber, pumpkin, eggplant
Seeds: bean, nut, oat, corn, rye, wheat, pea
Stems: white potato, sugar cane

*celery and rhubarb are leaf petioles

Activity 2: Food for Thought

corn flakes - seed
tossed salad - leaf
orange juice - fruit
roll - seed
french fries - stem
mashed potato - stem
tomato soup - fruit
peanut butter - seed

Activity 3: More Food for Thought

At the meeting. You may take a field trip to the supermarket or create your own market at the meeting with samples of processed and canned foods. This activity can make a "treasure hunt" for youngsters as they read labels and discuss their findings with you.

<table>
<thead>
<tr>
<th>Food product</th>
<th>Plant</th>
<th>Plant part</th>
<th>Process (cooked, dried, frozen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: bread</td>
<td>wheat</td>
<td>seed</td>
<td>ground</td>
</tr>
<tr>
<td>potato chips</td>
<td>potato</td>
<td>stem</td>
<td>cooked</td>
</tr>
<tr>
<td>raisins</td>
<td>grape</td>
<td>fruit</td>
<td>dried</td>
</tr>
<tr>
<td>spaghetti</td>
<td>wheat</td>
<td>seed</td>
<td>ground</td>
</tr>
<tr>
<td>spinach</td>
<td>spinach</td>
<td>leaf</td>
<td>frozen</td>
</tr>
</tbody>
</table>

Plants and Our Environment

Plant materials give us a means of making shelter, and they provide shelter and protection for wildlife. Plants also protect our soil from eroding.

The topic introduces the roles plants play in our environment. Members will discover more about this in future projects.
What is a weed?

- Maple tree growing through a livingroom floor
- Rose bush growing in a cornfield
- Tulip growing in a flower bed

Plants growing in the wrong place

Plants and Fibers

Many objects in our environment are made of plant fibers, a fact that reinforces our daily dependence on plant life. Activity 4: A Personal Space is an enjoyable and creative way to summarize the many uses of plants.

V. LOOKING AHEAD (LESSON/MEETING 4: HOW PLANTS GROW)

Decide in advance which materials you will provide and which will be supplied by group members. Also decide which activities will be done by the group and which will be done individually.

Materials:
- labels
- petroleum jelly
- mirror
- black construction paper
- 8 straight pins or paper cups
- 4 bean plants
  Kitchen-quality dried beans will suffice. They should be about two weeks old. Soak kidney, pinto, or lima beans in water overnight before planting. Have members plant the beans during Lesson/Meeting 3 to prepare for the following lesson/meeting. If the group meets less often, plant the beans two weeks before Lesson/Meeting 4.
- small plant in plastic bag
  Enclose a small plant in a plastic bag 24 hours before the meeting, as a demonstration of plant breathing.
LESSON/MEETING 4: HOW PLANTS GROW

I. INTRODUCTION

This lesson contains experiences that teach youngsters about plant growth. Illustrating how people's growth and physical needs compare with those of plants should help younger members understand the basic processes. The appropriateness of terminology to discuss will depend on youngsters' ages.

Youngsters will discover more in-depth knowledge as projects advance. It is important at this stage that they understand the basic needs of plants (water, food, light) for proper growth.

The physiology of plants is similar to that of people. Both need air, water, and nutrients for metabolism. Most plants take in air and soil minerals and convert them to energy. This process, called photosynthesis, works like this:

\[
\text{CO}_2 + \text{H}_2\text{O} + \text{Light} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 + \text{H}_2\text{O}
\]

Or like this:

carbon dioxide (from the air) +
water and nutrients (from the soil) +
chlorophyll (green pigment in leaves) +
energy (from the sun)

Some plants, such as fungi, do not undergo photosynthesis. They get their nutrition by absorbing minerals from once-living matter that is decomposing.

II. PURPOSE AND OBJECTIVES

• Determine three basic needs of plants for survival.
• Understand that water, minerals, and gases, in the presence of light, are converted into sugar, oxygen, and water vapor.
• Observe the production of water vapor as a by-product of respiration.
• Understand that some plants obtain nutrition from other living or once-living material.
III. TEACHING MATERIALS

Materials for teaching:

• *Breathing plant*—a small plant (or cutting such as Swedish ivy) enclosed in a plastic bag for 24 hours before meeting

Materials for project activities:

• labels
• mirror
• petroleum jelly
• black construction paper
• 8 straight pins or paper clips
• 4 bean plants

IV. PROCEDURES

Activity 1: Breathe Deep

Follow directions in member's guide. This activity demonstrates how plants and humans alike exhale vapor during respiration. We don't usually think about water vapor coming from our noses and mouths or from the leaves of plants. Plant respiration can be demonstrated by placing a potted plant inside a sealed plastic bag. Observe the moisture that forms on the bag after 24 hours.

Activity 2: Plant Needs

Follow directions in member's guide. Plant #3 should look healthy after one week of its treatment. All of its basic requirements have been met. The other samples should lack vigor.

Activity 3: Know Your Mushrooms

![Mushroom Diagram]

Cap
Stalk
Gills

Optional Activity: Mushroom Farming

Mushroom farming comes as a kit that contains growing box, compost, and spawn. Mushrooms take four weeks to harvest. Kits are available at many garden centers or may be ordered from:

W. Atlee Burpee Company
300 Park Avenue
Warminster, PA 18991
V. LOOKING AHEAD (LESSON/MEETING 5: PROPAGATION)

At this point, youth are to decide which area of 4-H plant science they wish to pursue next in Unit 2—Indoor Gardening, Landscape Gardening, or Vegetable Gardening.

The following charts show plant materials and other supplies needed for project activities. As you will see, many of the planting supplies are basic to different propagation methods and are easy to acquire.

Decide which materials you will provide and those which group members will supply. Also, decide which activities will be done as a group or which will be done individually. All activities do not have to be done—choose the most appropriate.

### Plant Materials

<table>
<thead>
<tr>
<th>PROPAGATION METHOD</th>
<th>INDOOR GARDENING</th>
<th>LANDSCAPE GARDENING</th>
<th>VEGETABLE GARDENING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CUTTINGS</strong></td>
<td>Swedish ivy coleus</td>
<td>Forsythia (late spring/summer) dogwood (late summer/autumn) azalea (late summer/autumn) holly (autumn) arborvitae (autumn) yew (autumn) geranium poinsettia (late summer/autumn) (4-6 inch cut from growing tip)</td>
<td>Blueberry (spring/summer) herbs, perennial (spring/summer) grape (autumn)</td>
</tr>
<tr>
<td></td>
<td>wandering jew begonia philodendron pothos</td>
<td>(4-6 inch piece of stem)</td>
<td>(4-6 inch cut from growing tip)</td>
</tr>
<tr>
<td><strong>DIVISION</strong></td>
<td>Snake plant African violet fern begonia</td>
<td>Ferns (early spring/mid summer) iris (mid summer) peony (late summer) tulip daffodil (summer) lily (summer)</td>
<td>Planting of onions or Jerusalem artichokes</td>
</tr>
<tr>
<td><strong>SEEDS</strong></td>
<td>Begonia herb schefflera</td>
<td>Allysum cosmos petunia* aster marigold zinnia * must be started indoors to accommodate growing season</td>
<td>Tomato bean eggplant sunflower cabbage lettuce belts squash peas</td>
</tr>
<tr>
<td><strong>LAYERING</strong></td>
<td>Pothos Swedish ivy philadendron spider plant strawberry begonia with plantlets</td>
<td>Forsythia cotoneaster ivy vinca</td>
<td>Raspberry bush blackberry bush strawberry plants with runners</td>
</tr>
</tbody>
</table>
### Other Materials

<table>
<thead>
<tr>
<th>PROPAGATION METHOD</th>
<th>INDOOR GARDENING</th>
<th>LANDSCAPE GARDENING</th>
<th>VEGETABLE GARDENING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cuttings</strong></td>
<td>clean, sharp cutting tool, glass of water, potting mix, 3 inch pot(s)</td>
<td>commercial rooting hormone, styrofoam cups, perlite or vermiculite, water, plastic bag &amp; twist ties</td>
<td>styrofoam cup, commercial rooting hormone, perlite or vermiculite, water</td>
</tr>
<tr>
<td><strong>Division</strong></td>
<td>clean, sharp cutting tool, potting mix, water, 3 inch pot(s)</td>
<td>digging tool, knife</td>
<td>digging tool, knife</td>
</tr>
<tr>
<td><strong>Seeds</strong></td>
<td>seed containers, potting mix, labels, plastic bag &amp; twist tie, fertilizer, wire to support plastic bag</td>
<td>If seedlings are started indoors: seeding containers, potting mix, labels, plastic bag &amp; twist tie, soluble powder, fertilizer, wire to support plastic bag</td>
<td>For starting seedlings indoors: seeding containers, potting mix, labels, plastic bag &amp; twist tie, soluble powder, fertilizer, wire to support plastic bag</td>
</tr>
<tr>
<td><strong>Layering</strong></td>
<td>sphagnum moss, water, plastic wrap, twist ties, commercial growth hormone, small paint brush, toothpicks</td>
<td>digging tool, knife</td>
<td>digging tool, knife</td>
</tr>
</tbody>
</table>
LESSON/MEETING 5: PLANT PROPAGATION

I. INTRODUCTION

Plants reproduce by sexual and asexual means. In sexual propagation the union of male and female flower parts produces a seed. Once planted, the seed must be given warmth and moisture to stimulate embryo growth.

Asexual or nonsexual propagation from a root, stem, or leaf can be achieved by several methods. A cutting can be made of a leaf or stem. Plants can be divided when their underground parts send up shoots that begin to crowd each other. In a method known as layering, roots can be grown on a section of stem, which is then removed from the plant. Simply stated, soil layering is growing a plant from a stem in a soil medium. Air layering is growing a plant on the stem of a plant strictly regulating the environment on the stem for the new plant to grow.

Once plants are established in the potting mix and actively growing, keep the mix damp to the touch. Fertilize every two weeks in spring and summer. Excellent all-purpose fertilizers are sold in many plant and hardware stores. Peter's 10-10-10 is a reputable brand. Read label directions for diluting in water.

Members are to pursue the area of gardening that most interests them. You may want to use visual aids for inspiration and help in making this decision. Some colorful, weatherproof wall charts (25" x 38") that picture bedding plants, flowering plants, houseplants, and perennials are available from:

Bedding Plants, Inc.
P.O. Box 286
Okemos, MI 48864

Another means of whetting gardening appetites is to use seed catalogs. They are typically packed full of vivid photos and are free. Have members write to seed companies to request catalogs. (For names and addresses, see "Project Materials" at the beginning of this guide.)

II. PURPOSE AND OBJECTIVES

• Practice decision-making skills in choosing an area of interest for a gardening project
• Experiment with various propagation techniques: cuttings, division, seeding, layering

III. TEACHING AIDS

See page 31-32 for a detailed list of required materials.

IV. PROCEDURES

Each project in the gardening series gives youngsters an opportunity to observe how plants reproduce. Your situation, resources, and the season of the year will dictate decisions to be made about project experiences. Division and layering may best be used as group demonstrations. Activity 4 presents experiences in basic soil layering for
both indoor and outdoor plant material. An **Optional Activity** is provided to introduce the technique of air layering. Further experience with these methods will be provided in advanced projects.

**Activity 1: Propagation by Cutting**

**Indoor Plants:** Follow instructions in Member's Guide.
When roots reach 1 inch in length (2-6 weeks), plant cuttings in pots. Planting several cuttings in one pot is attractive.

Poinsettias and geraniums are good plants to propagate from cuttings for indoor plantings. See page 30 in the Member's Guide for instructions. The process for these plants is the same as the more wood, outdoor flowering plants.

**Outdoor Flowering Plants:**
**Before the meeting (what you will need):**
Forsythia roots best when cuttings are taken in late spring or summer. Dogwood and azalea cuttings should be taken in late summer or autumn. Autumn is the most appropriate time to root cuttings of holly, arborvitaes, and yew.

**Outdoor Fruit and Vegetable Plants:**
Follow instructions in Member's Guide.

**Activity 2: Propagation by Division**

**Indoor Plants and Outdoor Fruit and Vegetable Plants:**
Follow instructions in Member's Guide.

**Outdoor Flowering Plants:**
**Before the meeting (what you will need):**
- a dense planting of fern, iris, peony, daffodil, or lily (flowering plants should be divided two months after flowering)
- digging tool
- clean, sharp cutting tool
- 5 pounds of bonemeal (or 2-3 handfuls per plant) for each 100 square feet of planting area
- 1-3 pounds of 5-10-5 fertilizer for each 100 square feet of planting area
- bucketful of humus (peat moss or well-composted manure) per plant

**At the meeting.** Select a planting site with well-drained soil. Light conditions should be as follows:
- ferns and tulips prefer shade
- lilies prefer partial shade
- others prefer a sunny location

Loosen the soil 8 inches deep, working in the fertilizer, humus, and/or bonemeal (ferns prefer humus to bonemeal). Replant at the following spacings:

<table>
<thead>
<tr>
<th>Plant</th>
<th>Depth</th>
<th>Spacing between plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>iris</td>
<td>6 inches</td>
<td>10-12 inches</td>
</tr>
<tr>
<td>peony</td>
<td>1-2</td>
<td>8-10</td>
</tr>
<tr>
<td>tulip</td>
<td>5</td>
<td>7-8</td>
</tr>
<tr>
<td>daffodil</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>lily</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>

3 4
Activity 3: Propagation by Seed

Indoor Plants: Follow instructions in Member’s Guide. When the second set of leaves appears, place the seedlings in sunshine. When four true leaves are formed, transplant into individual 3 1/2 inch pots.

Outdoor Plants: Planting seeds indoors is much less expensive than buying transplants, and it gives plants a longer growing season. Starting them early allows them to bloom earlier and, therefore, longer. New or fresh seed germinates best. Old seeds lose their ability to germinate. How fast this happens depends on the variety.

Seeds for the outdoor garden should be started indoors 4 to 12 weeks before the last killing frost of spring, depending on variety. (Check with your county extension office concerning the last frost in your area.) Bottom heat should be furnished to encourage germination. Instructions specify a warm location, approximately 70°F. Many homes may not be heated consistently to this temperature, which could affect germination. The tops of refrigerators are good locations for this temperature. Electric heating cables can be purchased through catalogs and at garden centers. They are inexpensive, accurate, and produce good results. Once germination has begun or the first two leaves emerge and you begin to place seedlings in the sunshine, be sure to remove the plastic or seedlings will stretch and weaken. Damping off can occur when the seed or germination mix is contaminated with bacteria or fungi. Affected seedlings lose their vigor, wilt, and die. Some may not germinate at all. Always use sterile germination mix and new seed. Some seed may be treated with fungicide to prevent damping off. The fungicide coating will usually be pink and is easily identified when present. Treated seed should be handled carefully and never eaten. Wash hands after handling.

Outdoor Flowering Plant Guide:

<table>
<thead>
<tr>
<th>plant</th>
<th>last killing frost</th>
<th>depth to sow</th>
<th>temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>allysum</td>
<td>8-9</td>
<td>lightly</td>
<td>70°F</td>
</tr>
<tr>
<td>cosmos</td>
<td>4-6</td>
<td>1/8-1/4 inch</td>
<td>65-75°F</td>
</tr>
<tr>
<td>aster*</td>
<td>6-8</td>
<td>1/8-1/4 inch</td>
<td>65-75°F</td>
</tr>
<tr>
<td>marigold*</td>
<td>6-8</td>
<td>1/4 inch</td>
<td>65-75°F</td>
</tr>
<tr>
<td>petunia</td>
<td>10-12</td>
<td>uncovered</td>
<td>65-75°F</td>
</tr>
<tr>
<td>zinnia</td>
<td>5-6</td>
<td>1/8-1/4 inch</td>
<td>70°F</td>
</tr>
</tbody>
</table>

* Asters and marigolds can be planted directly outdoors after all danger of frost is past.

Outdoor Fruit and Vegetable Plant Guide:

<table>
<thead>
<tr>
<th>plant</th>
<th>last killing frost</th>
<th>temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>lettuce</td>
<td>2</td>
<td>50-75°F</td>
</tr>
<tr>
<td>squash</td>
<td>3-4</td>
<td>65-75°F</td>
</tr>
<tr>
<td>cabbage</td>
<td>5 - 7</td>
<td>50-75°F</td>
</tr>
<tr>
<td>eggplant</td>
<td>6 - 9</td>
<td>65-75°F</td>
</tr>
<tr>
<td>tomato</td>
<td>5 - 7</td>
<td>65-75°F</td>
</tr>
</tbody>
</table>

After the meeting. Move plants outdoors to a semi-shady location during the day and bring indoors at night. (Be sure last killing frost is past.)

Gradually expose to more sunlight. After two weeks in full sunlight, plant in ground by removing individual seedlings with knife.
Activity 4: Propagation by Layering

**Indoor Plants:** Follow instructions in member's guide.

**Outdoor Plants:**
Roots form in 4 to 6 months. Tug on the branch gently to feel for resistance. Resistance indicates root development.
Cut mother branch off the newly rooted tip. Dig up the new plant and replant where desired.

**Optional Activity:** Propagation by Air Layering

**What you will need:**
- rubber plant
- sphagnum moss, thoroughly soaked then squeezed of excess water
- plastic wrap
- 2 twist ties
- clean, sharp cutting tool
- commercial growth hormone
- small paint brush

**What you will do:**
- make 2 diagonal slits one third of the way through the stem.
- place pieces of toothpick inside slits to keep open (Figure A).
- brush with hormone and pack into a ball the size of a fist.
- pack moss into slits and around the stem the size of a baseball.
- wrap plastic around the ball and seal with twist ties (Figure B).
- examine closely every two weeks and add water if moss has dried. A new root system should be well formed in four to eight weeks. Remove from parent plant with a knife by cutting just below moss ball. Remove plastic and pot the newly-rooted plant into a container. (Figure C)
Activity 5: How Did Your Garden Grow?

Transplant seedlings when the second set of \( L E A V E S \) forms.

\( D I V I S I O N \) involves separating a plant at its root.

The powder used to help roots grow when rooting a cutting is a \( H O R M O N E \).

Warm temperatures and moisture are very important when growing a plant from \( S E E D \).

Plants will crowd one another unless they are \( S E P A R A T E D \).

New roots are grown on a portion of the plants \( S T E M \) when layering.

What did you do in the Plant Science project?

\( M E E T \) \( T H E \) \( P L A N T S \)

What is the most popular plant in 4-H?

\( C L O V E R \)

RECORD AND REVIEW

Record-keeping allows youngsters to reflect on their experiences. Youth are encouraged to develop this skill early in the 4-H program. Page 38 of the member's guide provides spaces to record planting dates and observations of growth. Please review this page and encourage youngsters to make these notations.
PROJECT REVIEW

The fill-in-the-blank review on pages 39-40 of the member's guide gives you a chance to assess what youngsters have learned. On page 42 youngsters are encouraged to write their own ideas about what they've learned. Answers to the fill-in-the-blanks are easily found in the member's guide. Answers to the new word search are diagrammed below.

SHARING WITH OTHERS

Ideas for individual or group activities are listed on page 41 of the member's guide. Plant science projects make ideal community beautification projects.

ROUNDUP PROJECTS

Three ideas for exhibits are listed for youngsters to develop and display their knowledge as they complete this project. The attached certificate may be copied for member recognition.
This certifies that

__________________________
(member's name)

has completed "MEET THE PLANTS", unit one

of the Pennsylvania 4-H Plant Science Project.

__________________________
(leader's name)

__________________________
(date)