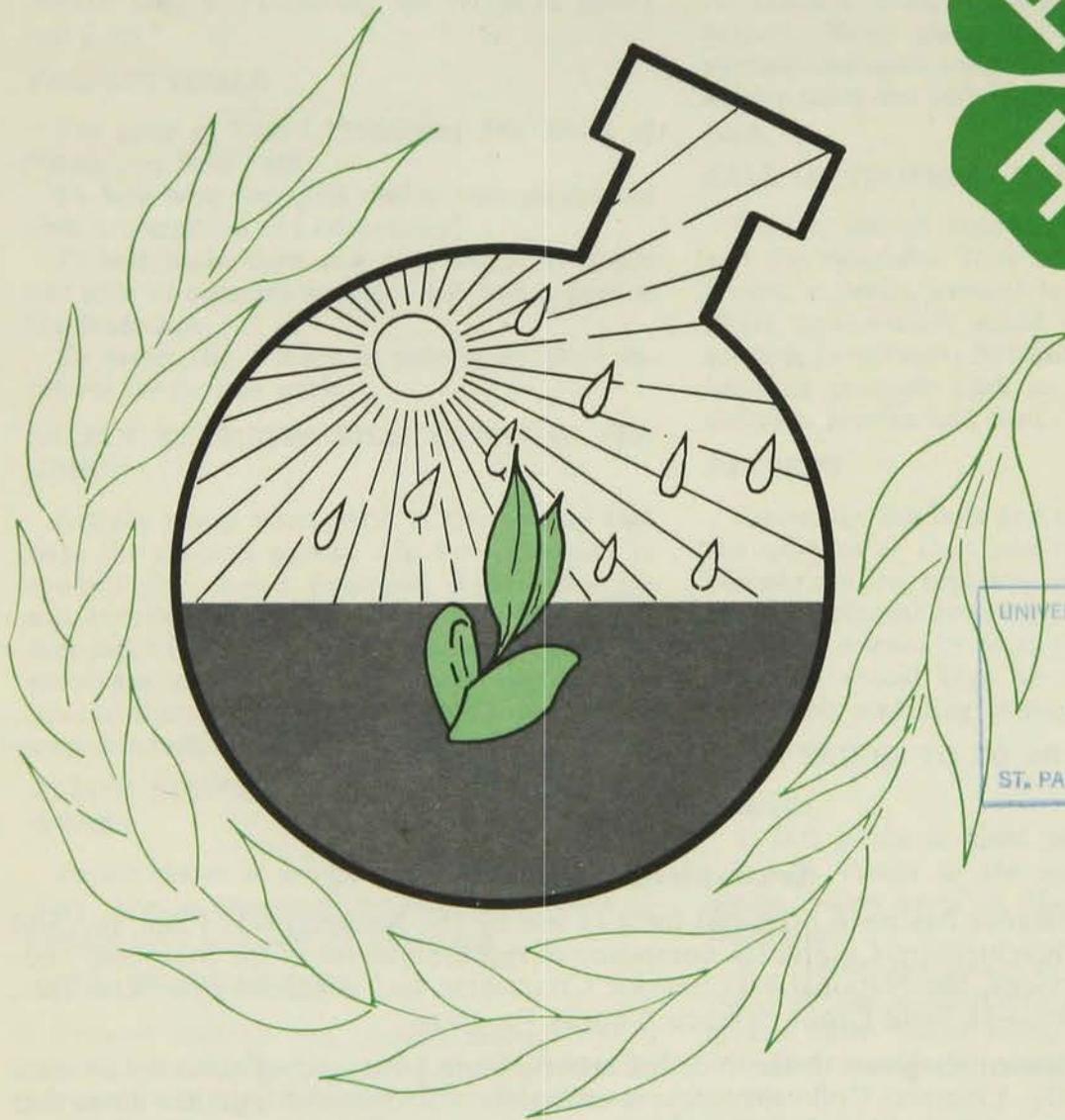


1969

● Exploring the World of Plants and Soils

UNIT I
PLANT & SOIL
SCIENCE
LEADERS GUIDE



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● **LEADERS
GUIDE
UNIT I**

This manual introduces the wonderful world of plants and soils. It leads boys and girls into the science of plants, soils and other adventures.

This archival publication may not reflect current scientific knowledge or recommendations.
Current information available from University of Minnesota Extension: <http://www.extension.umn.edu>

Acknowledgement

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Special acknowledgement is given to the North Carolina State University Extension Service and to the editor, Dr. Emerson Collins, professor emeritus, who brought together ideas that are now in use in one or more States. These ideas are graciously offered for use by all States. Appreciation is expressed to Amchem for financial support in producing this publication.

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Exploring the World of Plants and Soils

Leaders Guide

PUBLICATIONS THAT HELP

Two publications should help you lead this project—this leaders guide and the members manual Unit I—“Exploring the World of Plants and Soils.”

PROJECT GOALS

The goals of Unit I “Exploring The World of Plants and Soils” are:

To help boys and girls realize that plants and soils are exciting and interesting;

To help make boys and girls aware of plants and soils as separate entities—not just a part of the landscape;

To assist the 4-H’ers in developing their interests for further work.

SELECT EXERCISES THAT INTEREST THE GROUP

Let the group select parts of the manual that have the greatest appeal. Ask for volunteers to conduct the chosen exercises. Then have the members demonstrate the exercises at later meetings and tell what they have learned. In addition, encourage members to carry out exercises that interest them most, even though the exercises had been demonstrated to the group.

ALLOW INDIVIDUAL, TEAM OR GROUP WORK

Permit teams or groups to carry out the exercises. Always encourage individuals or teams to explain their exercises to the group.

KEEP INTEREST HIGH

Proceed through the project material at a rate in line with the groups’ interest. Go to more advanced exercises and activities before interest lags.

TAKE ADVANTAGE OF THE SEASONS

Plan your meetings to take advantage of seasons of the year. For instance, fall would be best for studying how seeds distribute themselves in nature. Spring or summer are ideal for studying flowers and sexual reproduction.

USE JUNIOR LEADERS

Use junior leaders wherever possible. Many older 4-H members have excellent qualifications for teaching much of the material offered in the project. Many also have good rapport with younger members and, younger members tend to admire them and look to them for help and guidance.

CALL ON PROFESSIONALS FOR HELP

Call on subject matter persons to assist you and the members. They could explain technical project material, conduct tours, lead discussions. These professionals would include florists; nurserymen; seedsmen; fertilizer dealers; merchants handling products such as furniture, groceries, clothing, textiles and feed.

RECORDS

Encourage the boys and girls to keep notes on the margins of their manual. The notes can be summarized on separate sheets of paper. The most meaningful record is a statement of what they have learned by doing the exercise. The boys and girls should keep all records together for submitting according to county requirements.

SOME THINGS TO DO AS A GROUP

Inside

1. List plants or plant parts used for food.
2. List things in the room that come from plants. Name parts of the plants from which items come.
3. Compare two plants, such as a carrot or beet, (tap root like a bulb) with grass (a stringy root system called fibrous roots).
4. List reasons why soil is important to all people.

Outside

1. Stroll through yards, a park, field and forest. Point out individual plants, flowers and trees. Note differences in leaves, flowers, size.
2. In winter look at buds on tips of branches. Can you tell which are flower buds and which are leaf buds? (Leaf buds are glossy and coated, flower buds are usually shorter and wooly.)

3. Also look at ways plants survive the winter cold. Some seeds can resist cold and wet weather. Some roots, stems and buds are in a resting stage (dormant). Some evergreens survive freezing because of the low moisture content of leaves and needles.

4. As indicated by the groups' interest, visit places where they can see growing crops, harvesting crops, processing crops, seed laboratories, soil testing laboratories, fertilizer plants and livestock feeding operations where plant parts are fed.

Explanation of Exercises in Members Manual

AREA IA. PLANT REPRODUCTION

Exercise IA-1 Life Cycle of a Plant

Look at the seed (the resting stage). The seed contains the young plant (embryo) with both the roots and young leaves apparent. The seed swells and sprouts (germinates) under favorable conditions of light, temperature, moisture and air. The young plant grows, develops and produces flowers.

Complete flowers produce pollen grains (male) on the stamen. These pollen grains are carried by bees, insects or wind to the stigma of the flower. The pollen germinates and sends a tube down the style. The single cell pollen (male) unites with the single cell ovules (female) in the ovary.

The cell of the fertilized female element divides and multiplies to produce a full-sized seed. This completes the life cycle of sexually reproduced plants.

This story of pollination and fertilization provides an excellent introduction to human reproduction. See ID-2 "Parts of a Flower" in the members manual for further information.

Exercise IA-2 How Seeds Germinate

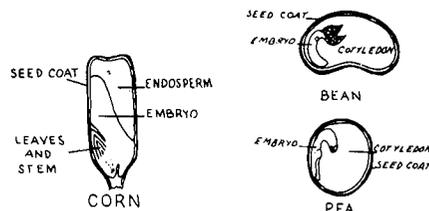
The Growth Process

A seed starts growth under favorable conditions of temperature, light, air and moisture. It absorbs water and swells until it bursts the seed coat. The root starts growing first, then the stem. As the root gets larger, new roots begin to grow from the main root. The stem grows out of the soil and starts new leaves. Roots continue to grow, develop and add new roots. The stem makes more growth and more leaves are added.

Three Basic Parts of Seed

There are three basic parts to a seed:

1. The protective covering (seed coat)
2. The small plant with stems, roots and leaves (embryo)
3. Food stored for the young plant.



The area of food storage is called **cotyledon** in peas, beans and other seed with two halves (dicotyledons). It is called **endosperm** in seeds like corn (monocotyledon).

The young plant (embryo) is a complete plant with roots, stem and leaves. The young plant remains dormant (resting) until conditions of air (oxygen), temperature, light and moisture are all favorable for germination. Seeds spring to life when they are brought to the surface in favorable conditions. Some seeds remain inactive deep in the soil for years.

When Are Seeds Alive?

A seed's ability to grow (viability) varies from a few weeks to several years depending on the kind of seed and storage conditions. Some seed stored for 80 years have germinated.

Here is a list showing the number of years some seed remain alive: one year—, onion, and parsnips; two years—beets, pepper, corn and soybeans; three years—bean, carrot, lettuce, tomato and radish; four years—squash, okra, eggplant, cabbage and tomato; five years and longer—zinnia, marigold, petunia, cucumber, melon, turnip, wheat, alfalfa and black locust.

Activities To Support the Exercises

Visit a seed store, seed processing plant, a farmer harvesting seed, the state seed testing laboratory, the state crop improvement association and others producing, processing, testing, distributing or using seed.



Exercise IA-3 Germinating Seed Are Strong

Cell walls of the seed permit water to move out of the seed (dry out). Cell walls also permit water to move into the seed (swell and germinate).

Water moves into a seed because salt concentration in the cell sap is higher than in the water.

Activity To Support the Exercise

Place a tablespoonful of table salt in a glass of water. Put a seed in this salt solution. Compare this with a seed in a glass of clear water. Pour the salt solution around an unwanted plant. Note how the plant wilts (loses water) and perhaps dies.

Exercise IA-4 How Seeds Distribute Themselves in Nature

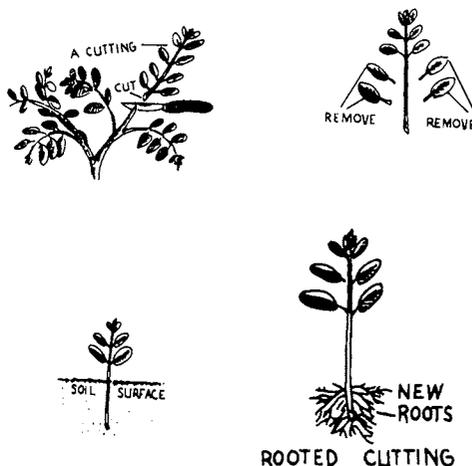
Nature provides means of distributing seeds. The tumbleweed blows over the land sprinkling seed as it bumps along. Dandelion seeds are attached to a fuzzy carrier that is easily caught in the wind and carried long distances. Maple tree seeds have wings that soar through the air as they fall from the tree. Animals eat apples. Some seeds survive the digestive system and are deposited for later growth. The same is true of many seeds eaten by birds. Many seed have spines to attach themselves to the fur of animals or people's clothes. These seed are later released or brushed off far from their place of origin. Moving water also carries seeds.

Exercise IA-5 Plant Reproduction Asexually

Rooting a cutting from a plant is one of several

methods of asexual reproduction of plants. This method is used widely by commercial nurseries.

The steps for making a cutting for rooting are shown in the illustration. You must remove most of the leaves of the cutting to reduce the loss of water in the plant until the root system is established.



You can dip the cut end of the cutting in a rooting hormone, a growth promoting substance. You can also change growth with chemicals as shown in exercise ID-4.

Put holes and then gravel in the bottom of the container to help drain out excess water. Too much water in the soil would encourage the stem to rot instead of root. The leaf surface can lose more than the cut end of the stem can take up. Cover the container with plastic to decrease evaporation of water.

AREA IB. SOILS

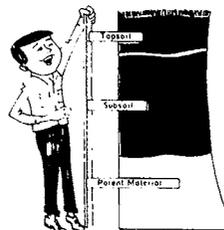
Exercise IB-1 What Is Soil?

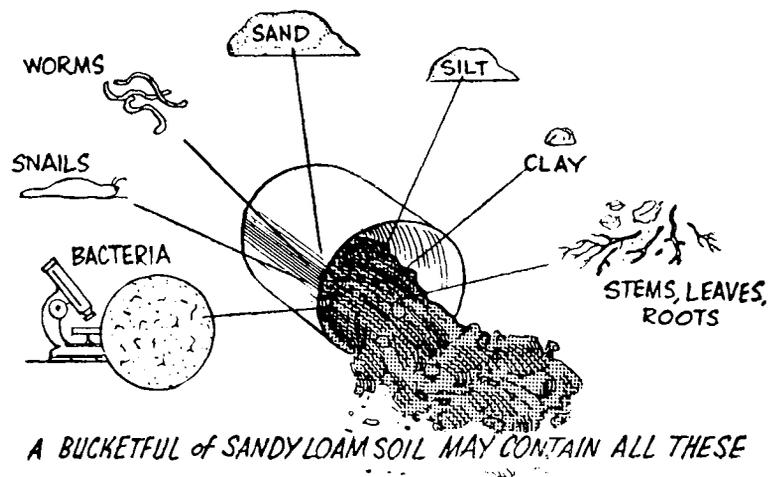
It is easy to see types of soils along roads. The same is true at building sites that are excavated. In level country, we can dig down to see the subsoil. A soil auger or tube also helps us to see the deeper soil layers.

Soil Depth (Distance between soil surface and subsoil layers)

Soil depth refers to the total of surface soil, subsoil and parent material which is reasonably favorable to growth and development of plant

roots. The depth of soil can cause the growth of plants to be good or poor. Deep-rooted crops, such as alfalfa, will not grow well when planted on a shallow soil.





Measuring Soil Depth

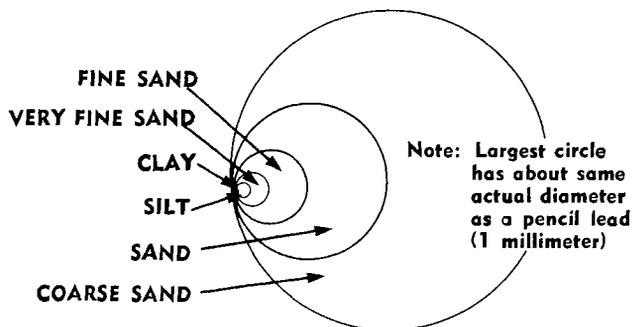
Measure the distance between the soil surface and the subsoil layer which is unfavorable for root penetration and growth. It may be classified as follows: deep, 36 inches or more; moderately deep, 20-36 inches; shallow, 10-20 inches; very shallow, 10 inches or less.

Activities To Support the Exercise

Ask each boy or girl to get a different soil. Spread the soil out thinly on a paper. Crush the lumps carefully. Separate out all the different things found in the soil and make a list of them.

Exercise IB-2 Separate Sand, Silt and Clay

Soil is made up of very small rocks or mineral particles, organic matter, air and water. Particle sizes are classified as sand (coarse large particles), silt (intermediate) and clay (particles seen only with a microscope; it takes 12,000 to measure one inch). The relative size of these soil particles can be seen in the illustration. The largest circle represents the size of coarse sand, which is about the size of a pencil lead. The small circle represents the relative size of clay particles. This difference in size causes the different particle sizes to separate out in layers.



Any gravel and coarse sand will settle out almost immediately; finer sands will settle out in less than half a minute. Material settling out in the next two hours will be silt-sized particles. Most of the clay will settle out on top of the silt during the next two days.

Activity To Support the Exercise

1. Repeat the separation of sand, silt and clay with soils that feel different when rubbed between your thumb and finger.
2. Try your hand at guessing the relative amount of sand, silt and clay by rubbing a few soils between your thumb and finger. This demonstrates how soils differ in their texture.

Grow plants on the sand, silt and clay fractions of the soil. With several doing this exercise there may be enough of each fraction of soil to grow a plant in a paper cup or other small container with holes in the bottom. Observe the plants and record any differences noted. The finer fractions will hold more moisture and fertility for better plant growth.

Exercise IB-3 How Soil Is Formed

How Weathering of Rock Takes Place

1. Water expands when it freezes. Water gets in small cracks in rocks. Then it freezes and expands. This breaks the rocks into smaller pieces. This process continues until the rocks become so small that they are considered soil particles.

2. Heat helps weather rocks. The sun warms rocks during the day. They expand, or get larger. At night rocks cool and shrink, or get smaller. This expanding and shrinking causes small pieces of rock to break off.





3. Wind picks up small pieces of soil and other material. The battering action of the wind breaks the rocks into smaller and smaller pieces.

4. Streams roll rocks along. The force of the moving stream causes pebbles to rub together, knocking off rough parts. The rubbed-off particles become soil. Notice how smooth pebbles are on beaches and along streams.

5. Plant roots penetrate cracks and crevices of rocks. These roots break large rocks apart forming smaller rocks. Observe how tree roots raise up sidewalks or concrete close to a tree. Also remember the force of germinating seed in forcing the seedling through the soil.



6. When plant and animals die and decay, they help make soil. Bacteria, fungi, molds and protozoa are little plants and animals living in the soil. They help decay dead plants and animals.

AREA IC. PLANT GROWTH FACTORS

Exercise IC-1 Effect of Weather on Plant Growth

Temperature and Rainfall

Plants develop in an area because the weather and temperature are suitable for growth and reproduction. Frequency of rainfall, water holding capacity of soils, soil drainage, length of day, extremes of temperature during and between night and day and many other factors determine kind and extent of native vegetation. Water plants live and reproduce in ponds and lakes, cactus in the desert. Citrus grows in warmer climates, apples in the cooler climates.

You are familiar with wilted plants in hot dry weather, frozen plants in cold weather and lush vigorous growth in warm damp weather. Point out these effects of temperature and moisture on plant vigor and growth at appropriate times of heat, drought and cold.

Activities To Support the Exercise

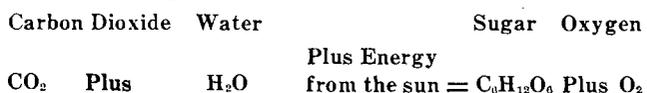
Listen to the local weather reports on radio or TV. Read weather reports and study weather maps in local papers. Visit a local weather station or the local radio or TV station. Talk to the person giving the daily weather news. Ask if they will explain briefly how weather predictions are made.

Exercise IC-2 Light and Plant Growth

The food-making process of plants depends on energy from the sun. Therefore, plants kept in the dark can neither produce food nor grow.

The green plant is a chemical factory. It uses energy from sunlight to convert carbon dioxide from the air, and water from the soil, into sugar and oxygen. This process is called photosynthesis. The sugar is used inside the plant to make starches, protein, fats, oils, and coloring materials. Oxygen given off into the air is used by animals and other plants.

Photosynthesis furnishes us with the oxygen we breathe and the food we eat. It is one of the most important chemical processes to man. The chemist refers to this photosynthesis process by the following chemical formula:



The photosynthesis process is in the members manual. The 6 bottles of carbon dioxide gas (CO₂) are mixed with 6 buckets of water (H₂O) by the green leaf. Sunlight is used as energy. The leaf produces a bag of sugar (C₆H₁₂O₆) and 6 extra bottles of oxygen (O₂). The plant uses the sugar as food to make other kinds of food. The oxygen is put back into the air for man and animals to use.

Exercise IC-3 Effect of Depth of Planting on Germination

Germinating seeds require moisture, air (oxygen) and a suitable range of temperature. Seeds also have different needs or tolerances for germination. Aeration (air) is limited in the lower depth of moist soil. This prevents germination and the seed may rot. Different seeds have varying requirements for germination. The exclusion of light at the lower depth can prevent some seeds from germinating.

Exercise IC-4 Direction of Plant Growth

The direction of plant growth depends on a chemical (auxin). Gravity pulls the auxin in the roots down to the bottom side of the root.

The chemical (auxin) on the bottom side of the roots slows the growth of the cells. The normal growth on the top side of the roots is then faster



than the growth on the bottom side of the root. This curves the growth of the roots towards the earth.

The chemical (auxin) also goes to the bottom of the stem. However, the chemical makes the bottom side of the stem grow faster. This curves the growth of the stem away from the earth, or up.

When the light strikes a plant from the side, the auxin accumulates on the dark side of the plant, away from the light. The presence of the auxin makes the cells on the dark side of the plant grow faster. The stem then bends towards the light.

AREA ID. PLANT CHARACTERISTICS

Exercise ID-1 Know the Parts of Plants

Help the boys and girls select suitable common small plants or weeds:

1. Plants that can be dug up easily.
2. Plants that have different root systems (tap root like a carrot, parsnip, radish) or fibrous roots like grass.
3. Plants that have both flowers and seed during the period of study.
4. Plants with different age level at the same time, or seeds that can be germinated to show the small plants (seedlings).

The objective here is to let the boys and girls see the wide differences in plants and be able to identify specific parts of each. Have them give a short description of the function of each part of the plant: stem (to support the plant); leaf (to manufacture food); flower (reproduction); seed (to go through unfavorable conditions for growth); fruit (to hold the seed); roots (to take up minerals and water from the soil).

The boys and girls should examine different plants to see the different kinds of leaves, stems (cut them open), flowers (take them apart), seed (open them up), and roots (dig up a few small plants).

The Growth Cycle of Plants

Annual Plants (corn, wheat) complete their life cycle in one year. They grow from seed, produce seed and die in one year.

Perennial Plants (trees, bluegrass, grapes) live

for many years. A tree, for example, puts out a coat of new leaves in the spring, makes new limbs and twigs, grows a larger trunk (or stem) and root system, produces flowers and seed, and drops its leaves in the fall. It is ready for a rest during winter, but starts new growth in the spring.

Suggest that the members include both annuals and perennial plants in their study of plant parts.

Exercise ID-2 Parts of a Flower

The rose, peach blossoms and other flowers serve a useful purpose for beauty and for producing seed.

Complete flowers usually have four parts: sepals, petals, stamen and pistil.

1. Sepal—small green leaf-like structure.
2. Petals—brightly colored, many have glands that secrete nectar. This sweet liquid attracts insects and humming birds.
3. Stamen—composed of filament and the anther that produces the male cells (pollen).
4. Pistil or female organ is composed of: the **stigma** where the pollen is deposited; **style** (tube) connecting the stigma to the ovary; **ovary** containing one or more of the ovules (female element). These immature seeds develop upon contact with the pollen.

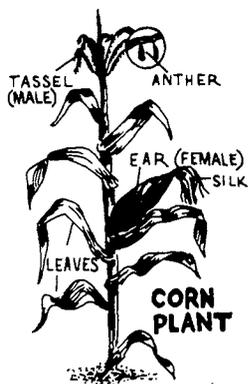
Male or Female Flowers

Plants with both male and female flowers are called "monoecious." Examples are cucum-



ber, watermelon, cantaloupe, pumpkin and other members of the gourd family. Also included is corn, with the tassel as the male portion and the ear as the female portion.

Plants with flowers of only one sex (male or female) are called "dioecious." Holly trees with female flowers have berries when trees with male flowers are near. Trees with only male parts do not have berries.



Activities To Support the Exercise

With the boys and girls, observe bees gathering pollen and nectar. Point out how bees help spread pollen from the stamen of one flower to stigma of the same, or another flower. This process unites the male and female elements for reproduction.

Point out that most flowers are arranged so that when the bees get nectar, they must brush against the stamens, that produce the pollen and the stigma, that receives the pollen. The bees make honey from this nectar.

Ask the boys and girls to draw a complete flower or press one between pieces of newspaper in a big book.

These parts of the flowers should be labeled:

1. Sepal at the base of the flower.
2. Petals that form the outside of the flower.
3. The stamen that is supported by the filament.
4. The pollen (male element) that is produced on the anther.
5. The pistil that includes the ovules (female element); the ovary that surrounds the ovules; the style that carries the pollen down to the ovules; the stigma that attracts the pollen.

Refer to the discussion under exercise ID-2 in the members manual for more information on flowers. Encourage the boys and girls to classify the flowers as to male, female or complete. Also, they should make notes on the ease of pollination with or without insects. Classification can be made on this basis:

1. Complete flower (containing sepals, petals, stamens, pistils)—beans, peas, soybeans, clover.
2. Incomplete flowers (lacking petals and sepals)—wheat, corn, oats. A plant which has both types of flowers (complete and incomplete) would be lespedeza.
3. Monoecious flowers (staminate and pistillate flowers on the same plant)—corn.

4. Dioecious flowers (staminate and pistillate flowers on different plants)—spinach and asparagus are good examples but there will be a variability in the degree of expression.

5. Incompatible flowers. Some plants are found to cross-pollinate because of the genetic control of pollen tube growth. Pollen tubes from pollen developed on the same plant will not grow down the styles of flowers on that plant; example, clover. Other types of incompatibility include those where the male and female parts of the flower arranged so that self-pollination cannot take place; for example, the styles may be long and the anthers short or vice versa. Example—common buckwheat.

6. Apomictic flowers—In some plants seeds are formed without sexual fertilization, best known example being Kentucky bluegrass. Seed from an apomictic plant would produce plants which resemble the parent plant.

Explain how plant breeders can control pollination to cross two plants by removing the male element of a flower; covering the flower to prevent pollen from getting on the stigma; putting pollen from another plant on the stigma.

Exercise ID-3 Plant Stems Carry Water

How seeds take up water was discussed under exercise IA-3. Here, also we can discuss the "plumbing system" of a celery. The cell sap of the celery is more concentrated than the water. Water moves into the cells and up the stalk. Water moves in faster if there are leaves on the celery to speed up evaporation of water.

Exercise ID-4 Growth Regulators

Growth regulators are common in plants. We suggested the use of a rooting hormone in rooting plant cuttings (exercise IA-5). The presence of a chemical (auxin) in the plant makes roots grow down and plant stems grow up (exercise IC-4).

Here we demonstrate a selective chemical (2,4-D Amine) that will kill many broad leaf plants (beans), but will not kill grasses (oats, barley, rice) at suggested rates.

Many chemicals have been used in developing selective plant killers. This permits killing undesirable plants (weeds) growing with desirable plants (crops, flowers, shrubs). Other chemicals are used to slow growth or speed up growth. Chemical weed control has developed into a large and rapidly expanding enterprise.

AREA IE. GROWING AND USING PLANTS

Several methods are given so inexperienced persons can see how plants grow with proper care and attention.

Exercise IE-1 Growing a Carrot from the Root

The carrot can send out new shoots from the carrot root. New shoots also usually develop when a tree or bush is cut off near the ground. This is another asexual reproduction method (exercise IA-5).

New shoots develop when temperature, moisture and adequate air are present. These are the same requirements as for germinating a seed. The leaves develop chlorophyll (green color) and manufacture food for the plant to grow (exercise IC-2).

Exercise IE-2 Build and Grow a Terrarium (any enclosure for growing and observing plants)

You can start with about any container. But a glass one lets you see the plants below the top of the container. Covering keeps the air moist and cuts down on the amount of watering needed.

Encourage the boys and girls to visit homes where the owners are enthusiastic about growing flowers, shrubs, lawn or garden. Let these people talk to the youngsters about their experience with plants as a hobby or for profit. Encourage the boys and girls to grow plants in which they are interested.

Their plants can be grown in containers, in the yard, garden or field. Members can present these plants to their family and friends.

Exercise IE-3 Using Plants

Encourage the boys and girls to look around the house, in each room, the garage and all kinds of stores. They should list the things that are used as plant parts and things that are made directly or indirectly from plants.

Everyone is vitally interested in using plants. We all depend on plant products such as wood for siding, floors, furniture; fiber for curtains, paper, rugs, tire cords, clothes; grain for corn and wheat bread, cereals, rice; fruit for eating fresh, preserved, pickled, or dried; leaves for shade, tea, spices; roots for horse radish, carrots, beets.

This exercise on the utilization of plants will help boys and girls recognize the importance of plants in their life. The production, marketing, processing, and merchandising of plants and plant parts, presents unlimited interesting opportunities for a life's work. It includes every known pure, and applied science, among them chemistry, physics, pathology, entomology, food processing and engineering.

Processed Seeds and Seed Parts

Oil is extracted or squeezed from seeds such as soybeans, corn, castor bean, sunflower and peanuts. These oils are used in making margarine, salad oil, cooking oils, paints, soap, plastic. Some are used for medicinal purposes, others in jet airplanes and missiles.

Starch and carbohydrates are processed from many seeds and used for baking, puddings, thickening for gravy, glue, paste and breakfast cereals.

Proteins are high in the residue after removing the oil. They are used for poultry, livestock; other animal food and human food.



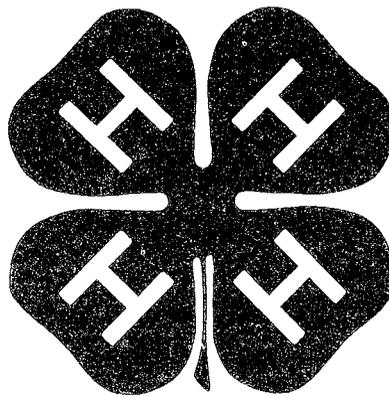
DEFINITION OF TERMS

Anther	The tip of a stamen where pollen grains are produced
Auxin	A chemical in plants responsible for roots growing down and plant tops growing up
Branch	A lateral stem
Bud	Specialized cell tissue from which a new plant part can develop
Carbohydrates	The chief constituents of plants including sugars, starches and cellulose (see photosynthesis)
Cell	The basic unit of structure in plants
Characteristic	Something that distinguishes or identifies
Chlorophyll	Green coloring matter of plant cells which takes part in the process of photosynthesis
Dormant	A state of reduced activity in which neither cell division nor growth takes place. Activities like respiration are reduced to a very slow rate.
Embryo	The undeveloped plant within a seed (germ)
Endosperm	The interior food storage area of a kernel (seed)
Fertile soil	Soil capable of sustaining abundant plant growth
Fertilizer	A material used to make plants grow better
Filament	Stalk or stem of stamen
Food	The product of photosynthesis which is stored, or used in respiration as a source of energy
Flower	Reproductive structure of a plant.
Germination	A seed takes up water, swells and the embryo starts to grow
Growth	Progressive development
Imperfect flowers	Flowers lacking either stamens or pistils
Internode	Part of a stem or a branch between two nodes
Kernel	Seed of a cereal
Life cycle	Series of stages through which a plant passes before arriving at the starting point (seed to seed, for example)
Nucleus	Heredity-determining part of a cell containing the chromosomes and genes
Nutrient	A chemical element taken into a plant that is essential to its growth, development or reproduction
Ovary	Basal portion of a pistil in which the embryo or seed develops
Ovule	The female reproductive cell
Parent material	Rock from which soil was produced
Perfect flower	Flowers containing both stamen and pistil
Photosynthesis	A process by which carbon dioxide and water are converted to carbohydrates (food) and oxygen in the presence of chlorophyll, using the energy of light

(Continued on back)

DEFINITION OF TERMS (Continued)

Plant	To put or set in the ground to grow. Also a young tree, vine shrub or herb planted or suitable for planting.
Pollen	The male germ cells produced in the anthers
Pollination	The transfer of pollen from the anther to the stigma
Propagate	To increase by sexual or asexual reproduction
Reproduction	Process by which plants and animals give use to offspring.
Respiration	A process constantly going on in every living cell by which food is broken down into carbon dioxide and water with a release of useable energy (reverse of photosynthesis)
Root	The below-ground part of the plant which lacks nodes
Root cap	A mass of cells protecting the tip of a root
Root hair	A single-celled protrusion of an epidermal cell of a young root
Seed	A dormant embryo enclosed in a seed coat with the endosperm (contains food reserves necessary for germination)
Seedling	Early growth stage of a plant
Soil	Loose surface of the earth in which plants grow
Stamen	Pollen-bearing organ of a flower
Translocation	Movement of food, water and nutrients from one part of the plant to another
Transpiration	The loss of water through plant tissue, primarily the open stomata (openings in the leaf)
Xylem	A complex in the vascular bundle of roots, stems, leaves and other plant parts through which water and minerals are transported from the soil to positions of use



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