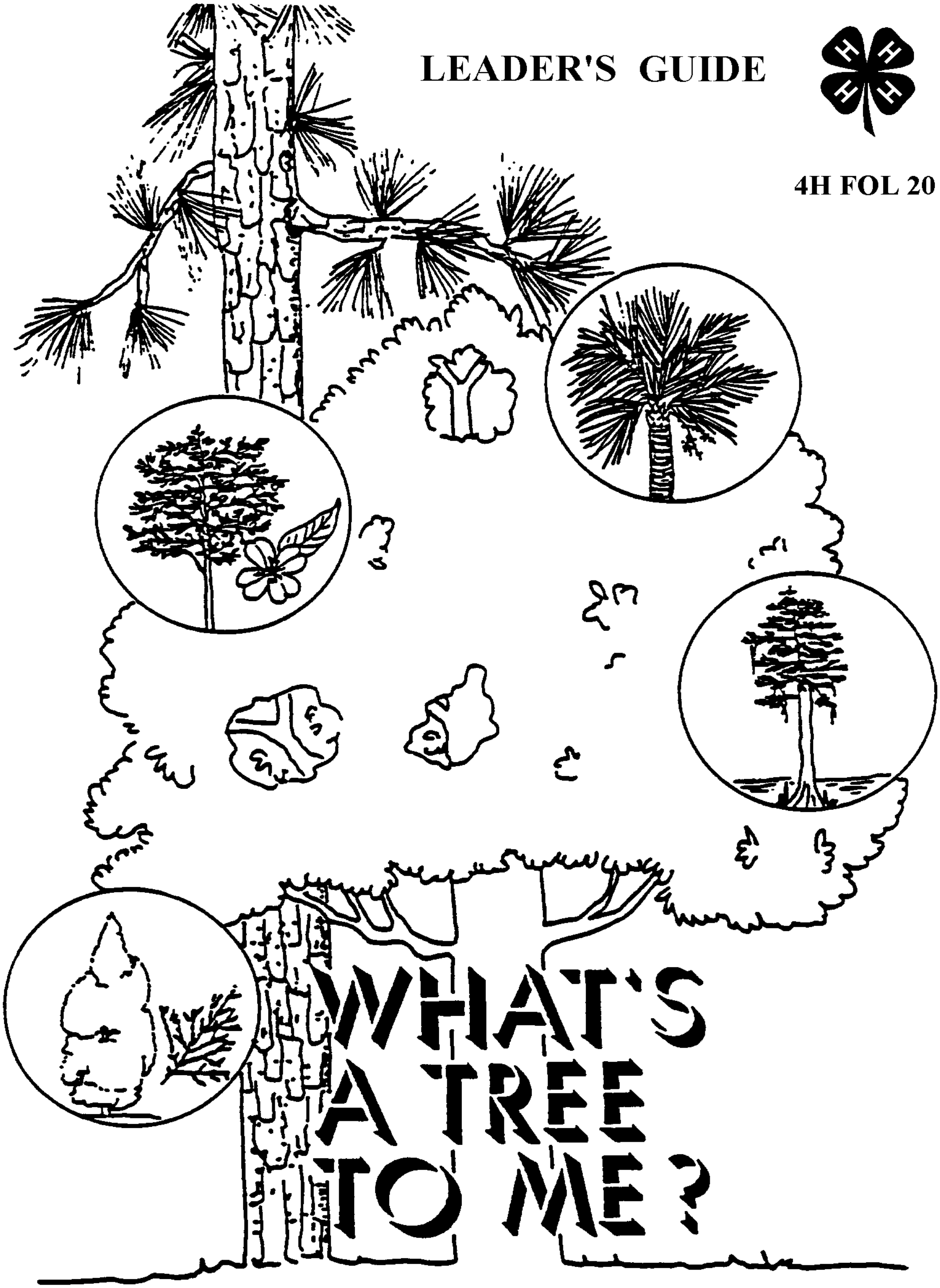
HISTORIC NOTE

LEADER'S GUIDE

4H FOL 20



FOREWORD

What's a Tree to Me? was developed for leaders/teachers who are working with 9-to-14-year-olds on the importance, value, usefulness, and pleasure derived from trees in an urban, suburban, or rural setting. The booklet was originally developed in New York; this edition has been adapted for use in Florida. Ten diverse and motivating units are included, each filled with practical, interesting activities that are built around cheap and easy-to-get-hold-of materials. A listing of these materials as well as a set of learning objectives precedes each unit in this guide. The 10 units may be studied in any order.

This program is meant to accommodate the particular needs of your group. There is no time limit on completion of the material; it could involve up to two years of work. Nor are there any requirements regarding how many units must be completed for satisfactory achievement. Even though 10 chapters or themes are introduced, the actual number of units you undertake should depend upon your group's interests and the total number of activities and field trips planned. Groups living in the city will have different interests and opportunities from those who live in a forested region. Some groups may add special field trips between activities listed in both the *Member's Manual* and the *Leader's Guide*. More activities are suggested than some groups may want to attempt, or your group may think of an activity that is not suggested.

You may choose to have the children work on the Record Section of each chapter individually or as a group. Most of the answers to the questions in the Record Section can be found in the text. Others require some creative thought and have no exact answer. The projects in section II of the Record Section are merely suggestions. You or someone in your group may think of others.

You can greatly affect the group's interest level and the amount of material they comprehend by your use of the material. In the initial meeting, involve them in the formation of goals and the planning of work. Plan each meeting carefully and well in advance. Allow your group to assume greater responsibility as they gain experience. Some may require extra help; encourage other members to assist them.

Above all, keep the group interested. Teach through experience and discovery. Read the booklet and keep ahead of the group, so that you can anticipate where you are leading them. Leaders are more effective when their groups are highly interested in the subject matter. Keep to the topic at hand, and speak with confidence. Help the group in their reading of illustrations, graphs, and photos for information. Raise questions that will encourage the group to find the answers themselves.

- Both **open** and **focusing** questions can encourage keener observation during field work:
  "What did you notice?" "Why are things like that?"

- **Interpretation** questions include:
  "What are the differences between ___ and ___?"

- **Capstone** questions help members summarize and reflect on their experiences. Such questions include:
  "What can we say about...?" "What did we do today?"

Resource People

You don't have to do the whole job yourself. There are always knowledgeable people around who can serve as resources. Contact the state, county, or city departments of forestry, conservation, or natural resources, or the regional office of the U.S. Forest Service. Call on resource people such as community leaders, landscape gardeners and architects, industry and extension foresters, wildlife biologists, or college students majoring in the physical or natural sciences. Ask them to become technical advisors, especially on tours or field trips. Talks by such people are included in at least one of the units; arrange to procure them well in advance. Take advantage of their knowledge and enthusiasm.

Educational Aids

Another help is the array of educational aids available from many different sources. Your local or state Extension office will have many publications, references, and audio-visual materials that could be utilized. The American Forest Institute and other industry associations have various educational aids that you may purchase, often for only the charge of postage. International Paper Company has free material on forest management and research. Your local librarian can assist you in locating references and in ordering films.

Additional Forestry and Wildlife Publications and Activities*

Table 1. PUBLICATIONS

Forest Ecology		Florida Forests	
UNIT I			
Introduction to 4-H Forest Ecology	(4-H 246)	4-H Forestry Project Record Book	(4-H 272)
UNIT II			
Introduction to Common Florida Plants	(4-H 247)	4-H Tropical Forestry Record Book	(4-H 265)
UNIT III			
Introduction to Florida Animals	(4-H 248)	**Wildlife**	
UNIT IV		UNIT I	
Common Forest Insects and Diseases	(4-H 249)	The World Around Us	(4-H 286)
UNIT V		UNIT II	
Common Forest Ecosystems	(4-H 250)	Beginning Bird Study	(4-H 287)

Table 2. ACTIVITIES

Florida Forestry Festival in Perry, Florida (Forest Ecology Judging Event)
County, District, and State Demonstrations or Illustrated Talks in the Agricultural Category

* Contact your local 4-H Agent for additional information on these Publications and Activities.

Acknowledgments

This educational material has been adapted for use in Florida by Cynthia L. Thomson, Graduate Assistant, School of Forest Resources and Conservation, University of Florida, in cooperation with Florida 4-H.

The material was originally prepared for 4-H use by the Department of Education, New York State College of Agriculture and Life Sciences, through a special grant from the International Paper Company Foundation. Administration of the grant was by Cornell Cooperative Extension Service - New York City 4-H Office. Original publication was through the National 4-H Council, 7100 Connecticut Avenue, Chevy Chase, Maryland 20815.

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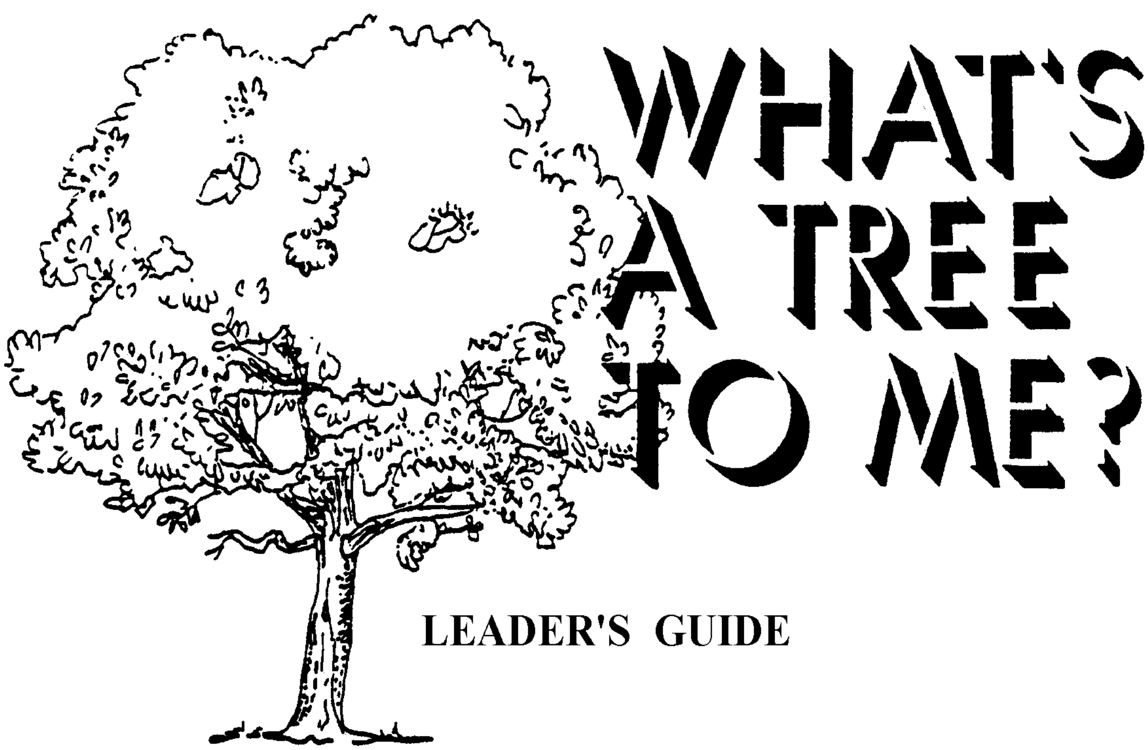

BATTER UP!

Materials

- Demonstration bat(s)
- Cross-section sample(s) of wood
- Magnifying glass(es)

Background

Of all the wood products other than paper, one of the most cosmopolitan, and one with which children of all races and socio-economic levels, at least in North America, can identify, is a baseball bat. Girls as well as boys! Since baseball bats are not hard to come by, or would be obtainable upon request, get at least one for demonstration to your group. If possible, ask in advance for a couple of broken bats. Then cut them in two so that no one will want to take them home or start swinging them when they shouldn't.

Most wooden bats come from white ash trees - trees common in much of the eastern United States. White ash grows to large size - two to three feet (30 to 90 cm) in diameter, and 75 to 80 feet (25 to 30 m) in height or 8 stories high. White ash is also used for hockey sticks, wooden tennis rackets, polo mallets, and other sporting equipment. It is a hard wood, takes a shock without breaking (usually), and is strong for its weight. Wherever strength and lightness are needed, white ash is a good wood.

Since the annual rings of wood show up unusually well in ash, a bat is a good vehicle for introducing annual rings and tree growth. Children who might not take an interest in tree growth are more likely to do so via a bat.

Objectives

At the end of this lesson, your group should be able to:

- estimate how long it took to grow a piece of wood that shows annual rings
- determine, from a cross-section of wood, about where the center of the tree was from which the wood came
- distinguish between the early- and latewood of any growing year in a piece of wood that shows annual rings

Table 1. NEW OR DIFFICULT WORDS

cell	cylinder	dormant	handle	layer	pore
compare	diameter	growth	hurry	pit	product
curve					

Teaching Strategy

Begin by asking who has handled a baseball bat. Continue by asking for some current statistics about baseball - for instance, who's the leading hitter in the National League? The American League? The local team? This will bring a number of disinterested kids into the discussion. Continue by asking where on a bat the ball should be hit, and why. You may not know who, but there will be plenty of volunteer "experts" in most groups, and perhaps some interesting opposing points of view.

Then bring out a broken bat. You probably can get one with a little advanced notice to the local team coach, the school coach, or one of the kids in your group. CAUTION: Some children cannot be trusted to carry a bat without trying it out on something or someone; use judgement in who you ask, and what arrangements are made for its delivery. Also, set some rigid guidelines as to how the bat is used (only for LOOKING).

Let the group examine the bat while you go over the text of the lesson with them. Pause where discussion is useful, and let some of the children who have interesting comments inject their comments, anecdotes, or questions.

A hand magnifier will expose pores in the earlywood of the bat. One annual ring will consist of the light earlywood *and* the darker, latewood band. These together are one year's growth. The earlywood is toward the inside of the annual ring, and the latewood is toward the outside - because the earlywood grew first as the tree got larger in diameter. To demonstrate how trees grow in cylinders, you can use paper cups. Stacking one on top of the other will illustrate tree growth; each cup represents a year's growth.

For your information, it is the layer just under the bark of the tree that produces the early and latewood. This layer, called the ***cambium***, is the living (wood-producing) part of the tree. Injury to the cambium is serious. Cutting through the cambium all the way around the tree (***girdling*** the tree, as it is called) will kill the tree. Occasionally, porcupines will girdle trees when they gnaw through the bark around the base. Sometimes a wire wrapped around a tree will girdle it as the tree grows and gets "choked" by the wire. Sometimes insects will eat through the cambium just under the bark and thus may kill the tree. For those who are interested, point out where the cambium is and what it does.

In trying to determine how big a tree produced the bat, you might have the group make a sketch of the end of the bat handle, showing the annual rings. Then let them lay this sketch on a large piece of paper and **extrapolate** (extend beyond the visible data or evidence) the rings to a circle. To find the age of a tree this size, use the spacing of the annual rings in the bat, and let the group estimate how many such rings would fit inside the circle they drew to represent the diameter of the tree. It may come out to be a hundred, or even more for a large tree.

Record Section I - Answers

1) Most wooden bats are made from white ash trees.

2) Soft wood grows during the wet season. Here in Florida, our wet season is usually late spring through summer. Soft wood is soft because it is composed of cells of relatively large radial diameter with thin cell walls.

3) Hard wood grows during the dry season. The hard wood tissue is more dense, being composed of cells of relatively small radial diameter with thick walls.

In other sections of the country, spring is the wet season and summer is dry. Therefore, soft wood is sometimes called spring wood or earlywood and what we refer to as hard wood is called summer wood or latewood.

Don't confuse the terms "hard wood" with the word ***hardwood***, or "soft wood" with the term ***softwood***. ***Hardwoods*** are angiosperms, which mean they produce seeds within ovaries. They usually bear broad leaves. ***Softwoods*** are gymnosperms and produce seeds that are largely unprotected. Needle-like leaves characterize softwood trees.

4) The answer to this question will vary, but will usually be 7 or 8 years old.

5) If you compared a narrow annual ring with a wide annual ring from the same tree, you would find that there is about the same amount of earlywood in each, but more of the latewood in the wider ring. Latewood tends to be stronger than earlywood, so a ring that is wide (from a fast-growing tree) has more latewood in it than does a narrow ring (from a slow-growing tree). Large, fast-growing trees should produce good wood for baseball bats.

However, many of the best trees have already been cut. Also, batters who are big and strong, but not professional, often break wooden bats. So many baseball teams in high schools and colleges are using aluminum bats. It is in the major leagues that the best wooden bats are still found. Cheap wooden bats are also sold in quantity in supermarkets because they are strong enough for kids and cost a lot less than aluminum bats.

6) There is no ready answer to this question. Its purpose is to stimulate creative investigation. There isn't an easy way to tell which end of the bat was up when it was in the tree. Many of the questions that will arise concerning trees do not have easy answers. But that does not detract from the fun in trying to find an answer. If someone has a suggestion, let him or her explain it to the rest of the group. You may be surprised at what creative ideas come out when you invite a no-holds-barred discussion or investigation.

7) Hockey sticks, wooden tennis rackets, and polo mallets are all made from wood.

Suggested References

Harlow, William M., *Trees of the Eastern and Central United States and Canada*, Dover Publications, New York, NY, 1957. A small, complete, paperback guide to common trees and their characteristics. For leader/teacher.

Peattie, Donald C., *A Natural History of Trees: of eastern and central North America*, Houghton Mifflin, Boston, MA, 1960. A delightful book for its history, popular treatment of trees, and interesting anecdotes. A good book to read to your group because of its ease of style and non-technical language. For leader/teacher.

White, Marshall S., *Wood Identification Handbook: commercial woods of the United States*, Scribner's Sons, New York, NY, 1980. Good explanations of heartwood, sapwood, earlywood, latewood, and growth rings. For leader/teacher.

ON PINES AND NEEDLES

Materials

- Cones from various species of conifers
- Branches and/or twigs from common conifers
- Small conifers (a few meters tall)

Background

Evergreens, as they are commonly called, are among the most important of our trees. They are the source for much of the lumber used for building. They supply most of the wood pulp used in paper-making. Some become Christmas trees. Evergreens provide shade, wind-breaks, and greenery in parks and around homes. And they provide protection for animals and soil, as well as helping to slow erosion and water run-off.

To call these trees evergreens is not really correct. Larches and cypress trees, for example, lose their needles each year and so are deciduous, not evergreen. But most evergreens appear green because they keep needles for two years before losing them. So the trees appear never to lose their needles. A look at the ground beneath an evergreen, however, will show that they do.

The needles of evergreens are really slender leaves. In pines, needles are grouped in fascicles, each wrapped at the base. In each fascicle the needles fit together to form a cylinder. In a tree with five needles per fascicle, each needle in cross-section would look like a piece of a five-cut pie. Most of the so-called evergreens produce their seeds in cones. Hence they are called ***conifers***, meaning "cone-bearing." It is more correct to call these trees conifers than to call them evergreens.

On some conifers, buds are produced in rings or ***whorls*** on the twig. Branches growing from the buds grow outward in circles, like spokes on a wheel. Since a new whorl of buds forms each year, you can tell how much a conifer grows each year by the distance between whorls. It is also possible to tell the approximate age by the number of whorls present on the tree - except that it may take a few years for the young seedling to produce the very first whorl near the ground.

Objectives

At the end of this lesson your group should be able to:

- describe why evergreens appear never to lose their needles
- tell the approximate age of a conifer from the whorls of branches
- describe some of the benefits of conifers to the environment of a city
- identify common conifers by use of a taxonomic key

Table 1. NEW OR DIFFICULT WORDS

cones	deciduous	fir	needles	whorl
conifer	fascicle	pine	spruce	

Teaching Strategy

Try to bring in some twigs from common conifers. A good time to do this is before Christmas, when trees usually are for sale. Get some branches or twigs from pines, firs, and spruces so that your group can compare the different kinds of trees. Let them look closely at the fascicles of pines. Let them count the needles in several of these and decide whether the number is constant or variable for that kind of tree. Then let them compare the twigs of pine with those of fir (whose needles don't leave little spurs when they drop off) and of spruce (whose needles leave roughened spurs when they drop off).

Show the group where the present year's growth began, and where the year before that began. Let them decide which year's growth needles can be found, and perhaps why there can be needles under a conifer even though the tree seems to look as if it never loses needles.

Bring in some cones, or invite someone to bring some in. Then have the group look for:
- the size of the cone
- the places where seeds lie on the top of the scales
- the shape, thickness, and placement of the scales

How do the cones of one species of conifer differ from those of another?

Let the group look at some Christmas trees or other conifers that are only a few meters tall, and see if they can identify (from the top down) which section of the trunk grew in each of the preceding years.

Finally, let the group try to key out a common conifer, using the key on page __ . Perhaps they can even devise a key for themselves as a group. Then invite a stranger into the group, explain how to use the key, and see if the stranger can identify one of the conifers that he has never seen before. That is the test of a good key.

Some Things to Think About

• What would happen to the shape of a conifer if the terminal bud (the bud in the center of the cluster) were destroyed by an insect? Would one of the lateral buds bend and become a "leader"? What would that do to the shape of the tree?

• Pine paneling often shows rows of knots, or groups of knots. Why are such knots grouped, and why isn't this typical of deciduous trees?

Record Section I - Answers

1) The needles of a pine tree are wrapped in fascicles.

2) A deciduous tree drops its leaves at the end of each growing season (in autumn) and usually has broad leaves.

3) Conifer literally means "cone-bearing." The conifers are mostly evergreen and include the pines, spruces, firs, cedars, Douglas firs, hemlocks, and sequoias. Two genera found in North America, larch and bald cypress, are deciduous.

4) Pine trees keep their needles for two years before losing them.

5) The seeds of conifers are formed between the scales of the cone. The seeds of pine form an important source of food for seed-eating birds, rodents, and other animals.

6) Conifers are used to make lumber and paper. They often serve as windbreaks. These trees provide animal food and shelter, and conifers are used for ornamental purposes.

Suggested References

Harrar, E.S., and Harrar, J.G., *Guide to Southern Trees*, Dover, New York, N.Y., 1962. Field guide to southern trees. Includes conifer key. For leader/teacher.

INCREDIBLE EDIBLES FROM TREES

Materials

- Dictionaries
- Drawing paper
- Drawing pens
- Candy bars (chocolate, coconut, and almonds)
- Bulletin board (optional)
- Encyclopedias (optional)
- 3 x 5 cards (optional)
- World map (optional)

Background

In one respect, the inner-city leader or teacher is in a better position to teach about trees than the rural leader/teacher. Products of trees from around the world are available in the cosmopolitan environment of the inner-city. While the rural child eats apples and oranges, the urban child may consume mangoes, pomegranates, and litchi nuts. Even if your group is not familiar with them, exotic tree-fruits are readily available in urban supermarkets and specialty shops.

Objectives

At the end of this lesson, your group should be able to:

- identify some of the edible products obtained from trees
- name products obtained from the following tree parts: leaf, fruit, twig, bark, root, flower, nut, and sap
- define "processed" and "unprocessed"

Table 1. NEW OR DIFFICULT WORDS

bark	flower	incredible	root	supermarket
brew	fruit	nut	sap	twig
edible	ingredients	processed	unprocessed	

Teaching Strategy

Begin by distributing the books and reading the selection as a group. Once begun, alternate group and individual activities. For example, a discussion in which the terms "tree" and "tree-fruit" are explained might be followed by a period in which individuals, with the aid of dictionaries, write down as many tree-fruits as they can think of. Similarly, after a group discussion of tree parts, have each member draw and label the parts of an Incredible Edibles Tree. A "homework" assignment may be based on this drawing.

You can add real flavor to this lesson by providing students with candy bars to "dissect." Or you may want to bring in some native Florida vegetation that is edible.

Answers to the rhymes, in the order they appear on page 20 of the Member's Manual, are: clove, maple syrup, cinnamon, and sassafras.

Before sending the group home to fill-in the blanks on their tree drawings, complete the "twig" and "leaf" sections in a group session. We simply do not eat many twigs or tree leaves, so these are tough ones to complete. Here are a few...

- **TWIGS**

  - **Black Birch:** Wintergreen flavor is obtained from black birch (sweet birch) twigs. The black birch is native to the Northeastern United States. Its twigs contain an aromatic substance which is used to flavor candies, gums, and soft drinks (birch beer). Wintergreen Lifesavers, although artificially flavored, taste somewhat like black birch twigs. Wintergreen is a processed tree product.

- **LEAVES**

  - **Red Bay:** This tree is probably known to many because of its aromatic leaves, which are used as flavoring for soups and meats.

  - **Coca:** One of the flavoring ingredients in Coca-Cola® is obtained from the leaves of the South American coca tree (not to be confused with the cocoa tree which is the source of chocolate beans). The coca leaf also contains cocaine. Cocaine once was an ingredient in Coca-Cola® (Coke's™ last name comes from the Africa cola tree whose nuts are used to flavor Coke™ and other cola drinks). Coke™ is a fine example of a product which contains processed tree parts.

  - **Tea:** Tea is a shrub or small tree whose leaves are utilized by man. Loose tea is a relatively unprocessed tree product. If your students examine the contents of tea bags, they may recognize pieces of leaves.

The individual results of the student investigators can be compiled to form a joint list. This makes an especially good bulletin board project. The design for the bulletin board can be patterned after the Incredible Edibles Tree on page 21 of the Member's Manual.

The following lists will help you check the validity of student answers.

- **TREE FRUITS**

Table 2. TREE FRUITS - Helpful Check List

apple	fig	loquat	orange	pomegranate
apricot	grapefruit	lychee	papaya	pomelo
avocado	guava	mango	peach	quince
breadfruit	kumquat	mulberry	pear	tangerine
citron	lemon	nectarine	persimmon	ugli
date	lime	olive	plum	

Technically, the **banana** grows on a non-woody plant rather than a tree.

• **TREE NUTS**

Table 3. TREE NUTS - Helpful Check List

acorn	Brazil	cocoa	hazel (filbert)	pecan walnut
almond	butternut	coconut	hickory	pine nut (pignolia)
beechnut	cashew	cola	macadamia	pistachio
black walnut	chestnut	gingko (silvernut)	mace (nutmeg)	

• **TREE FLOWERS**

- **Jasmine**: Jasmine flowers are an ingredient in jasmine tea.

- **Cloves**: Cloves are flower buds of an evergreen tree native to the Spice Islands (Moluccas).

• **TREE BARKS**

- **Cinnamon**: Cinnamon is cultivated as a small evergreen shrub. However, in the wild state, the plant may reach tree size. Cinnamon was discovered growing wild in Ceylon. It is now cultivated in Ceylon, the Seychelles, Jamaica, and South America.

- **Bitters**: Angostura bitters (used in some mixed drinks) are made from "angostura" which is the bark of a South American tree.

• **TREE SAPS**

- **Maple syrup**

- **Birch syrup**

- **Chicle:** Chicle was the "gum base" of most chewing gums before World War II. It is still used by some manufacturers, but many have switched to synthetic substances. Chicle is obtained from the Sapodilla tree of Honduras, Guatemala, and Mexico. General Santa Anna (Antonio Lopez de Santa Anna, 1795 - 1876, Mexican general) introduced chicle to the United States. He may have been chewing some when his troops engaged David Crockett at the Alamo.

- **Spruce gum:** Spruce gum is still chewed by children in the northern forests. It is a resinous substance which appears at the site of injuries on spruce trees. At least one company (in Maine) still produces spruce gum commercially. Your group may enjoy Robert Frost's poem "The Gum Gatherer."

• **TREE ROOTS**

- **Sassafras**: Sassafras is a small tree native to Eastern North America from Maine to Iowa to Florida and Texas. An extract is obtained from its roots which is used to flavor root beer and some candies.

Follow-up Activities

In the course of completing this section, members of your group may ask where the various trees grow. A combination social studies/research skills lesson can be based on this interest.

Have them use encyclopedias to discover where each tree grows. If a wall map of the world is available, record the information on 3 x 5 cards (one tree per card) and tack them to the map on or near the appropriate region.

The Answer to the Puzzler

Plants have special means to disperse their seeds. Some plants, such as the milkweed, depend on the wind. Burs and sticktights "hitchhike" on fur, feathers, and clothing. Apple trees depend on animals and man to carry their seeds into new environments. They attract mammals and birds with their brightly colored, sweet smelling, tasty fruit. When the fruit is eaten, the apple seeds pass through the alimentary canal unharmed. Shortly thereafter the seeds are "planted" - fertilizer and all - in new territory. Man and the apple tree are true friends; both have prospered through their relationship.

Many other trees tempt animals into carrying their seeds by surrounding them with attractive foods. The seeds may be small and tough enough to pass through the alimentary canal (figs, apples, oranges, cherries), or they may be so large and tough that they are discarded rather than eaten (peaches, avocados, mangoes).

Record Section I - Answers

1) The edible parts of a tree are (*examples may vary*):
   - a) Bark - ex. cinnamon
   - b) Flowers - ex. jasmine
   - c) Fruit - ex. apple
   - d) Leaves - ex. red bay
   - e) Nuts - ex. pistachio
   - f) Roots - ex. sassafras
   - g) Sap - ex. maple syrup
   - h) Twigs - ex. wintergreen

2) A nut is a rather large fruit whose wall becomes hard, stony, or woody upon ripening.

3) Yes, some nuts do come from trees. A few examples are the hickory nut, the pecan, the coconut, and the walnut.

4) When referring to edible tree parts, the word "processed" means that the tree part (fruit, flower, whatever) is changed in some way before you eat it. In other words, you would not eat it straight off the tree.

Suggested References

Bianchini, F., and Corbetta, F., *The Compleat Book of Fruits and Vegetables*, Crown Publishers, New York, N.Y., 1975. For both group members and leader/teacher.

Brouk, B., *Plants Consumed by Man*, Academic Press, London, England, 1975. Too difficult for most youngsters, but a valuable text for teachers.

Harrison, S.G.; Masefield, G.B.; and Wallis, M., *The Oxford Book of Food Plants*, Oxford University Press, London, England, 1969. This is a helpful book for both group members and leader/teacher. The reading level may be too high for most, but the pictures are a delight. If you can only get one of these books, this is the one.

Morton, Julia F., *Plants Poisonous to People in Florida and Other Warm Areas*, J. F. Morton, Miami, FL, 1982. For leader/ teacher.

Rahn, Joan E., *Grocery Store Botany*, Atheneum, New York, NY, 1974. For grades 4 through 6.

TREE MATHEMATICS

Materials

- Rulers
- Tape measures
- Round objects such as paper plates, empty cans, a frisbee, etc.
- A ball
- Tree measuring instruments such as an increment bore, a DBH tape, a biltmore stick, calipers, a relaskop

Background

In measuring trees, there are two basic measurements that are made - the diameter and the height. This chapter emphasizes diameter. Foresters often refer to the "diameter at breast height," known as "DBH" (the diameter of a tree at 4.5 feet or 1.3 meters above the ground). The diameter is measured at breast height because the girth is larger just above the soil level due to the root system. So when a tree diameter is measured, it usually is taken above this swollen root portion, where the tree trunk is more uniform.

In finding the diameter of a tree, some simple mathematical relationships can be employed. If children have not learned about the ratio of circumference to diameter, measuring circular objects and then measuring tree trunks can be both fun and instructive. Let them find out on their own, from comparing circumference and diameter of various objects, the value of *pi*. Try to impress upon them that *pi* is a ratio, and has no units. It is not 3.1416 somethings. It is just 3.1416. It is only a ratio.

Objectives

At the end of this lesson, your group should be able to:

- state the approximate ratio of circumference to diameter for any circle.
- measure the circumference of a tree and from the circumference determine the diameter.
- demonstrate the use of various tree measuring devices.
- state some reasons for many of the record diameters or heights of trees long-gone, and few record-holders among trees still living.

Table 1. NEW OR DIFFICULT WORDS

biltmore stick	circumference	DBH tape	pi	relaskop
calipers	clinometer	increment borer	ratio	

Teaching Strategy

The illustration that opens this lesson is just to elicit a laugh. But you might ask the group, "How would you find the diameter of a tree without drilling a hole through it?"   From answers to this question, you can tell whether or not they understand the term "diameter."   Even if a few do, write the word up on the board, and explain what it means.   Then tell the group that today they are going to measure diameter, but they are going to do it in a "roundabout" way.

Let the group, working in pairs, try to measure around the inside of a circle made by curving their arms out in front of them and touching their fingertips together at the far side of the circle. Who can make the biggest circle? Who can make the smallest circle?

Before using a tape to measure around the circle, you might let the group try to use rulers to measure the circumference of something such as a record or a wastebasket. (Paper plates, empty cans, or plastic tumblers will work well, too. In fact, anything circular will do at first). Point out that there is a chance that the ruler will slip. And it is too hard to hold accurately, anyway. So a tape measure is better.

If you can get a few different kinds of tape measures, show what they are like. Examples might be a cloth or plastic tape measure such as a seamstress uses, a metal tape such as a carpenter uses, a tape such as the track team uses to measure shot-put or broad-jump distance, and the kind of tape a surveyor uses. Try to get some cloth or plastic tapes for your group to use. Or, you can let them make their own tapes from doubled masking tape, string with marks made on it or tabs fastened to it at intervals, or adding machine tape with marks on it.

Encourage the group to use metric measures whenever possible. If they rebel, are exceedingly uncomfortable, or you yourself feel threatened by metric measure, then use English units. But meters, divided into decimeters (to give a decimal notation to the meters), will prove to be very useful . And as you and the group get used to these units, you will come to prefer them to English units.

Finding Pi

When several records of circumference and diameter have been recorded, "discover" with your group that the ratio is about three to one. If they want to be more accurate (a little more than 3:1), tell them that to five decimal places it is 3.14159. And to ten places it is 3.1415926536. Point out that pi is a ratio, and thus has no units. It is not 3.1416 feet, ot 3.1416 degrees, or 3.1416 *anything*. It is just a ratio, just as 1/2 is a ratio. It is a ratio of the circumference of a circle to the diameter of that circle. It doesn't apply to anything except a circle.

After the group has measured several disc-shaped objects where the diameter can be accurately measured, let them find the diameter of something where it cannot be measured directly. For example, the diameter of a ball cannot be measured directly. You cannot put a ruler through a ball; you can only measure around it.

Record Size

When the group has learned how to find diameter from having measured the circumference of objects, let them try measuring the diameter of some local trees. By measuring some, they will come to know what the bark is like, what the shape of the trunk is, and how the trunk varies with height. Most of the mature trees in your area probably will not be more than one meter in diameter. For comparison, some of the largest trees ever reported in the United States are given in the text. The General Sherman tree, a giant sequoia that grew in California, holds the U.S. record for diameter. Its diameter of about 8 meters (26 feet) was about as wide as a classroom is long! Its circumference was about 25 meters or nearly 80 feet.

For the information of your group, the largest tree diameter ever recorded (which may not be the largest one that ever lived) was a chestnut near Mt. Etna, Sicily, which was about 21 meters (nearly 70 feet). Its circumference was about 66 meters (over 200 feet)! In the state of Oaxaca in Mexico, a Montezuma cypress tree has a girth of about 36 meters, or a diameter of 11.5 meters. That was in 1949, and it may still be living and growing.

The largest and finest trees were cut long ago for lumber. The magnificent white pines of the eastern United States, the white oaks of the eastern states, and many other trees were cut and much of them wasted by early settlers and shipbuilders. There seemed to be an unlimited supply of trees at that time, and people just didn't think they'd disappear. Today we know that while trees are a renewable resource, the supply is not inexhaustible. That's why so much effort is being directed at keeping the beautiful, gigantic seguoias and redwoods of the West, and some of the oldest and biggest pines, oaks, and other trees of the East.

Measuring Equipment

There are many pieces of equipment used to measure tree diameter, height, and age.

A DBH tape, a biltmore stick, calipers and a relaskop all measure the diameter of a standing tree. To use the **DBH tape** you simply wrap it around a tree at a height of 1.3 meters (4.5 feet) and take a reading.

A **biltmore stick** is held at arms length at DBH with the zero end appearing to be at one side of the tree and the diameter read at the value which appears to intersect the other side.

Calipers yield high accuracy measurements but are rather clumsy. The movable arm must form a 90 degree angle with the scale when a tree is being measured.

A **relaskop** is more expensive than the previously mentioned instruments, and it is used to measure upper-stem, out-of-reach diameters.

Using an **increment bore**, you can determine the number and width of annual rings. As a tree is drilled with the increment bore, a core of wood is cut out of the tree. The borer is twisted in a counter-clockwise direction to break the core of wood loose. The wood is then pulled from the borer with a part of the instrument called an extractor. It’s best to demonstrate the use of this instrument on a pine tree (softer wood).

Tree measuring equipment is probably easier to find than you think. Contact the county, city, or extension forester for your area. They could supply the equipment and demonstrate its use to your group.

Some Things to Think About

1) For a tree whose trunk is not perfectly round, would the circumference indicate a larger than normal, a smaller than normal, or the same diameter that a round trunk would have?

> ***Answer***: *larger than it really is*

2) If a tree grew rings that were 1/2 cm thick each year, how much would it increase in circumference each year?

> ***Answer***: *about 3 cm, because its diameter would increase 1/2 cm on each side of the tree, or 1 cm, and so its circumference would be about 3 times that much*

3) Suppose that wooden power poles supported a wire that went all around the earth at the equator (about 37,500 km, or 25,000 miles). If each pole were shortened 1/2 meter, how much wire would be saved? A few meters? A few hundred meters? A few kilometers? A few thousand kilometers?

> ***Answer***: *about 3 meters. The diameter of the circle of wire would be decreased by one meter. Three times this would be a change in circumference of three meters - not nearly so much as one would guess*

Record Section I - Answers

1) The diameter of a round object is the length or distance of a straight line passing through the center of the object. The circumference of this same round object is the length or distance of a line encompassing the outside of the object.

2) The ratio of the circumference of a round object to its diameter is approximately 3.14. This ratio is called “pi.”

3) Some of the largest types of trees found in the United States are the giant sequoias and redwoods of the West, and the oldest, biggest pines and oaks of the East.

4) 3.28 feet equal a meter.

Suggested References

Harlow, William M., et al., *Textbook of Dendrology*, 6th ed., McGraw-Hill, New York, NY, 1979. For a leader/teacher.

Hutchins, Ross E., *This is a Tree*, Dodd, Mead, and Company, New York, NY, 1964. For group members. A chapter on big and famous trees.

McWhirter, Norris, and Ross, *Guinness Book of World Records*, Bantam Books, New York, NY, 1979. For leader/teacher and group members.

Peattie, D.C., *A Natural History of Trees: of Eastern and Central North America*, Houghton Mifflin Company, Boston, MA 1950. For leader/teacher.

Peattie, D.C., *A Natural History of Western Trees*, Houghton Mifflin Company, Boston, MA 1953. For leader/teacher.

Silverberg, Robert., *Vanishing Giants: the Story of the Sequoias*, Simon and Schuster, New York, NY 1969. For group members.

WOOD THAT IS KNOT

Materials

- Paper
- Pencils
- 2 bananas
- Pieces of wood that contain knots
- Fine sandpaper
- Construction paper (various colors)
- Hammer
- Nails

Background

Almost all exterior plywood, much of the wood in paneling, and most boards or boxes that children see will have knots. These are usually darker, harder spots in the wood, where the grain is different from that of the rest of the wood. Knots can be troublesome when a nail is driven into them. They are hard, they often are loose, and sometimes they simply come out and leave a hole in the wood. Since knots are so common, and their importance in wood varies, it is good for children to know what they are and how they come to be in wood.

A knot is simply a cross-section of an embedded limb or branch. First, consider what a cross-section means. A cross section is a cut across the limb, across the tree trunk, or across the grain. A cross-section of a baseball bat would be round. A cross-section of most tree trunks would be nearly round. So would a cross-section of a tree branch. But a cross-section of a paddle-blade would be long and narrow.

You might have the group sketch what they think the cross-section of some common objects would be. Here are some to draw:

Table 1. DRAWING OBJECTS

apple	dollar bill	hair pick	peanut	tongue depressor
bamboo stick	flashlight battery	hockey stick	pencil	

When trees grow, they put on a layer of wood all over the tree - over the trunk, the roots, and the limbs. But since the limbs grow at right angles to the tree trunk, any layer of wood that is formed around them is at right angles to the layers in the tree trunk. That is why the grain in a knot is at right angles to the grain in the wood around it.

Most trees have limbs all along their trunks. But even on young trees, some of the limbs die or break off. Many die because light is kept from reaching them by higher branches. This is especially true of conifers growing close together. If the limbs that die fall off soon afterward, then the tree trunk simply grows out over the spot where there was a limb, and soon the trunk is smooth at that spot. But if the limb doesn't fall off, the tree trunk grows out over the dead limb, enclosing it in the trunk. When lumber is cut from that tree-trunk later, the dead limb is embedded in it. But the wood of the dead limb doesn't join the wood around it; it is separate. So the knot formed by this dead limb is a "loose" knot, and may fall out.

Where the tree trunk grows out along a living limb, the wood of the trunk and the wood of the limb are continuous. The limb is part of the wood in the trunk even though its grain is at right angles to the grain of the trunk. When lumber is cut from this part of the tree, the wood of the limb makes a "tight" knot. This knot may be very compressed, and the rings in it close together because of the squeezing of the trunk around it as it grew. But the knot was a living part of the board before it was cut, so it tends to stay in the board. The knot may be very hard though, and nails do not go into it easily. A big knot means a big limb. A small knot means a small limb. A loose knot means a limb that was dead. A tight knot means a limb that was living.

Many years ago, when trees were huge and plentiful, knotty wood was considered cheap, coarse wood. But today it is almost impossible to buy large boards without knots. In fact, the difficulty of getting clear wood, and the changing style of furniture and paneling, has made knotty wood desirable. Even imitation wood has designs in it that imitate knots. Tight knots, especially in some furniture and in wall panels, are considered attractive.

Objectives

At the end of this lesson, your group should be able to:
- distinguish between a tight knot and a loose knot, and describe the causes of each
- describe some of the desirable, and some of the undesirable, features of knots in wood
- tell why it is good to trim away branches in a stand of timber that is to be cut for lumber at some future date
- describe the shape of one year's layer of wood in a tree

Table 2. NEW OR DIFFICULT WORDS

attractive	cross-section	grain	knot	lengthwise	trunk

Teaching Strategy

Introduce the lesson by asking the group to write the word "NOT." Do not write it on the board, and don't answer questions about whether you mean "no" or the "knot" in a rope. Just see how many different kinds of NOT are spelled. Then ask what each of these spellings mean. One may have written "not," meaning no. One may have written "knot," meaning a kink in a rope. Another may have written "knot," meaning a dark, hard spot in a board.

How many meanings and spellings can the group come up with? Here are some:
- not: negative
- knot: a lump in a muscle
- knot: one nautical mile per hour
- knot: a dark, hard spot in wood, where a branch once grew
- knot: a small group of people standing together
- knot: a marriage bond (such as "tying the knot")
- knot: a way of tying two pieces of cord or rope together

Explain that this lesson is about the **knot** that refers to wood - the dark spot that one can see in some boards.

Next, since it is important that children be able to imagine a cut through various parts of the tree, explain the meaning of ***cross-section*** and ***longitudinal section***. Perhaps you can use two bananas.

Slice one as you would on cereal, or in a molded gelatin salad (making a cross-section). Give each child a slice to eat, to reinforce this kind of section.

Then slice another banana in two, lengthwise, as you would for a banana split. This is a longitudinal section.

Some suggestions for disposing of these are:

a) give them to those whose birthdays are closest to today's date, or
b) eat them yourself, or
c) cut them into cross-sections and give them to those who didn't get any the first time (or give everyone a second helping).

Next, pass around for examination and discussion some pieces of wood that contain knots. You can usually get scrap pieces of knotty wood from a lumber yard at no cost, or you can salvage some pieces from packing crates, nearby building projects, or ask the group to bring in some scrap pieces of wood that have knots. Also, if you can find a tree that is about to be pruned, or a limb that has recently been pruned (don't overlook discarded Christmas trees!), cut several slices from along a limb - one near the trunk, and others at intervals out toward the tip. With some fine sandpaper, the group can polish these slices so that the rings can be counted.

In the case of a discarded Christmas tree, prune most of the branches a few centimeters from the trunk, then bring in the "scalped" tree for the class to cut up as they wish. (A coping saw with a fairly coarse blade is a safe saw, so long as you oversee its use, and insure that it is used only on the discarded tree or on blocks of wood that you designate.) Make a clean cut across the discarded Christmas tree at the level of one of the pruned branches.

Or, you might have the group make a paper-layered "tree" by stacking hollow cones made of various colored construction paper, then cutting across the stack at various levels to see how many layers penetrated to that level.

Or, someone could fashion a modeling-clay tree by rolling out thin layers of various colors of clay, then sticking layer after layer to the model tree. When it is complete, designate someone to make a cut across the tree near the base, another mid-way up the tree, and another near the top. Let the group see, once more, that only the more recent layers project all the way to the tip; the older layers stop lower down.

Now, review how the layers are stacked up in a tree, and how they continue out into the limbs. See if the group can, by drawing or by discussion or written description, tell what the shape is of a layer of wood produced:

a) this year
b) five years ago, or
c) long ago in a tree that is still living.

Return to the scraps of wood that were brought in. From the way the grain runs in a block that has a tight knot, see if the group can tell how the block lay in the living tree. (Remember that the knot is a cross-section of a limb). Let someone put a block with a tight knot on another block of wood, then try to drive a nail into:

a) the wood beside the knot, and
b) into the knot.

Which is harder to do? Why do they think so?

Once knotty pine was considered inferior wood. But when the best of the large clear pine was gone, then knotty pine had to be used. Now the knotty pine is considered beautiful.

Let the group look for knots in all sorts of wood products, and also think about why knots wouldn't be acceptable in some. Why shouldn't a knot be acceptable in a tongue depressor? A baseball bat? A hockey stick? Why doesn't a knot make much difference in a sheet of exterior plywood? How about a sheet of interior plywood that is going to be used to panel a wall? In what kinds of uses would wood with knots be O.K.? In what kinds of places would wood with knots not be O.K.?

Some Things To Think About

Here are some questions to think about, and perhaps try to find answers:

1) When a branch breaks off a tree, or dies, does that wood decay at the same rate, faster, or slower than the rest of the wood on the tree? *(Hint: Do birds tend to find holes in trees where a branch once grew, or do they make holes where they want them?)*

2) How does the price of clear pine compare with that of knotty pine?

3) Do knots move up in a tree as it grows, or do they stay at the same level?

> ***Answer**: Limbs do not rise as a tree gets older; swings do not have to be adjusted constantly. Knots are where branches or limbs were, so they do not move up in a growing tree.*

4) When a board is cut from pine, would the knots tend to be grouped at intervals along the board, or would they be randomly scattered? *(Hint: Check the location of branches on a Christmas tree!)*

5) Find out what bird's-eye maple is, and where it comes from.

6) Find out what kind of wood is used for the back of violins, and where that wood comes from.

7) Try to have someone bring in a slice of wood cut across the trunk, through a branch, a slice slanting through the trunk and a branch, and one cut vertically through the trunk and a branch. Then the group can see the difference in appearance of the grain at a branch.

Record Section I - Answers

1) A tree branch or limb makes a knot.

2) A knot is a cross-section (cut across) of a branch. The grain in the knot is at right angles to the wood surrounding it because the branch grows at a right angle to the tree trunk.

3) If a branch is a living part of a tree, the wood of the branch is continuous with the wood of the tree. So when lumber is cut from this part of the tree, the knot left by the branch is a tight knot. When a tree grows out over a dead branch, the wood of the dead branch does not join the wood around it. Thus, if lumber is cut from this tree trunk, the knot formed by the dead limb is a loose knot.

4) Bottom branches of trees grown close together often die because the upper branches are shading them, and they are not getting enough light.

5) The wood in a knot has been compressed by the wood of the trunk growing around it. This pressing makes the knot wood very hard.

6) True. See the above answer.

Suggested References

Harlow, William M., *Inside Wood*, American Forestry Association, 1970. Contains numerous excellent photographs and photomicrographs of wood, plus excellent sections on dendrochronology, knots, and other wood-related topics. For leader/teacher.

E PLURIBUS UNUM

Materials

- A quarter
- A dozen or so unsharpened pencils or sticks
- Tape
- Scrap paper
- A dollar bill
- Two aluminum roll or pie pans (8" x 5" roll pans or 10" pie pans)
- A fine mesh window screen (12" x 12")
- A plastic or metal basin (2 gallons)
- Newspaper
- Two tablespoons of liquid laundry starch
- One box of paper clips
- One rolling pin
- One electric iron
- One electric blender
- Wire (copper, iron, or aluminum)
- Natural dyes or food colors
- Sponges
- Wastebaskets
- A table to work on

Background

Paper may be the most useful and versatile substance yet invented by man. In this lesson, your group has the opportunity to consider paper as a man-made product of many uses. The paper-making process is summarized, and a piece of paper is made.

Objectives

At the end of this lesson, your group should be able to:

- describe the basic paper-making process
- state the motto of the United States and explain what it means

Table 1. NEW OR DIFFICULT WORDS

appreciate	digester	filter	mill	rectangular
blender	*E Pluribus Unum*	individual	motto	recycle
deckle	fiber	Latin	pulp	sandwich

Teaching Strategy

Distribute the book, and begin reading the lesson. After reading the first paragraph, ask your group if they can name ways we use paper in addition to those mentioned. When discussing the motto *E Pluribus Unum*, you may wish to introduce its corollary: "united we stand, divided we fall." Strength in numbers, be they people or fibers, can be demonstrated with sticks, rulers, or unsharpened pencils. Anyone can snap one new pencil in two, but who can sna, say, thirteen pencils - taped tightly together?

Ask if there is a paper mill in your city. Although cities are often manufacturing centers, most do not have paper mills. In order to limit transportation costs, paper (or pulp) mills are usually located close to their source of fibers - the forest.

Have an assortment of scrap paper available for the fiber examination exercise. Fiber shape and size varies with paper type. If no one asks, be sure to mention that some high quality papers are not made from tree fibers alone. Rice paper and high quality stationery contain fibers from plants that are not trees (rice and cotton respectively). Papers that claim a high "rag content" (like the dollar bill) may contain fibers of wool, linen, and cotton. Have your group look at a dollar bill closely; they will see fibers of various colors in it.

Before starting the actual paper-making process, explore the subject of renewable and non-renewable resources with your group.

Explain that our society is beginning to realize that we can not continue to use our natural resources wastefully. We must place more emphasis on managing them wisely. Recycling is one way of doing just that.

The renewable resource game is a good ice-breaker for this topic. Bring a box full of renewable or recyclable (glass bottles, aluminum cans, paper egg cartons, etc.) and nonrenewable (plastic soda containers, plastic egg cartons, etc.) products. Go through the items in the box asking which is renewable and why. This would be a good time to mention the recycling projects in the Record Section.

Making Paper

First you'll need to gather all the materials together. Fiberglass screen is available at hardware stores. Laundry starch does for paper what it does for clothes: it stiffens paper a bit and gives it a smooth finish. It acts as a binder between the wood fibers suspended in the mixture. You may be able to borrow a blender. No harm will come to the blender if you follow the directions in the book.

The directions provide for one deckle (technically, what you'll make is not a deckle, but it is similar to a device of that name used by primitive paper makers) and enough pulp to make five or six sheets of paper. As the fibers in the pulp mixture are depleted, the sheets of paper will become thinner. When they become too thin to work with, add a batch of fresh pulp mixture to the basin. You'll probably want to make several deckles and have several basins of pulp available to eliminate waiting. Plan accordingly.

At least half the fun of an activity of this sort is the delightfully messy aspect. Don't try to avoid it. You'll simply irritate yourself and your group. Provide for it. Sponges, extra basins, several wastebaskets, and lots of cleared table space will come in handy.

Once your group has made several sheets of paper, they may want to try some variations...

Watermarks

If you hold a piece of high quality paper to the light, you may see a design or trademark on it. These are called "watermarks." Members of your group can produce watermarks of their own quite easily. Use a piece of copper, iron, or aluminum wire (about as thick as a mechanical pencil lead) to form the design. Place the piece of formed wire in the center of the deckle screen, then proceed with the paper-making process as usual. The pulp sheet will be thinnest over the wire. Hence, when the paper is completed, light will shine through the thin area, revealing the maker's personal watermark. Keep the design simple, and use only one piece of wire. The wire must not cross itself.

Color

This is a fine opportunity to experiment with natural dyes. Tree bark, berries, fruit juices - you name it. If natural materials are not available, food colors will do just as well. Just add them to the pulp mixture.

Texture

Different materials can be added to the pulp mixture to create different textures. Fibers stripped from the stem of a dry weed, pieces of colored thread, dried grass, flower parts, glitter, coffee grounds - almost anything is worth a try.

This lesson provides you with a basic procedure. What you do with it depends on you and your group. Use the directions as a starting point. Feel free to modify the process experiment - and encourage your group to do the same.

Record Section I - Answers

1) *E Pluribus Unum* means "out of many, one" in Latin. It is the motto of the United States and can be found on U.S. currency.

2) *Many* fibers are required to make *one* sheet of paper. *E Pluribus Unum*.

3) Paper is made of many hair-like wood fibers.

4) There are many answers to this question. But, put simply, most of our natural resources are finite. We will run out of them some day if steps to prevent their depletion are not taken. When we recycle, we are not depleting the resource but rather reusing what has already been harvested.

5) Aluminum, glass, brass, copper, and lead are a few recyclable materials.

Suggested References

Adler, Irving, and Adler, Ruth., *Fibers*, The John Day Co. New York, NY, 1964. A general discussion of textile fibers, with an interesting section on rayon and acetate, both of which are artificial fibers obtained from wood. For upper elementary and junior high school students.

Cooke, David C., *How Paper is Made*, Dodd, Mead, and Co., New York, NY, 1959. See this book first. It has excellent step-by-step photographs of the paper-making process, each of which is accompanied by a clearly written account. This book is intended for upper elementary and junior high students, but anyone interested in the paper-making process will find it interesting.

Eberle, Irmengarde., *The New World of Paper*, Dodd, Mead, and Co., New York, NY, 1969. This book describes and pictures some of the many uses of paper. For upper elementary and junior high students.

Fisher, Leonard Everrett., *The Papermakers*, Franklin Watts, Inc., New York, NY, 1965. A short history of papermaking in the United States. Primitive paper-making techniques are described in interesting detail. For upper elementary and junior high students.

STUMP DETECTIVE

Materials

- Wood scraps
- Section of wood from a tree trunk or a large limb
- Sand paper
- Brightly-colored pushpins
- Magnifying glass
- Small jar of water

Background

The science of **dendrochronology** is the study of growth rings in tree trunks to learn about past events or climatic changes. Real "stump detectives" examine the patterns of annual rings in stumps, logs, and timbers in buildings. By piecing together recognizable sequences in annual rings, they have been able to **infer** or draw reasonable conclusions about the climate for the past 2000 years or so. They can also estimate the age of old buildings by determining when its timbers were cut.

For your group, however, the study of stumps is for a different purpose. It will allow them to explore further the nature of tree growth and to use their logical abilities to collect evidence, to apply their knowledge, and to make inferences about the life of a tree.

This lesson is a companion to **BATTER UP**, which provides an introduction to the concept of annual rings.

The difference between an observation and an inference should be explained. While examining stumps, we cannot observe exactly what did happen; we can only see evidence in the character of the rings in the stump and from them surmise, infer, or make an educated guess as to what happened. This is a good exercise for children, who often jump to conclusions that are not well based, and then act as if their conclusions were, indeed, observations of fact. It might be good for them to infer, without ever knowing for sure what really did happen. Then one child never does have the final advantage over another.

Objectives

At the end of this lesson, your group should be able to:

- explain events in the life of a tree by interpreting evidence on its stump
- list at least three environmental factors that influence the rate of tree growth
- indicate where the cambium (growing part of a tree) is located

Table 1. NEW OR DIFFICULT WORDS

annual	detective	injury	rainfall	solve
cambium	heartwood	insect	sapwood	stump
clue	infer	mystery		

Teaching Strategy

Begin the lesson by asking about the group's favorite television detective show. Ask them what a detective is and how he or she works. Emphasize that detectives use clues (evidence) to piece together the facts about a particular situation. That is exactly what they will do in this lesson.

Try to provide scraps of wood at the outset. Then, as they read the beginning of the lesson, the group can refer to the blocks of wood at hand. You may be able to get scrap blocks of wood at a building project, a lumber store, or from the industrial arts room at a school.

Each annual ring consists of *both* the light-colored spring growth and the dark-colored summer growth. The rings are produced by the ***cambium***, a layer of growing cells that covers the entire tree like a blanket just under the bark. Wood is always produced from the outside in. Therefore, it is always the inner part of the trunk (and of each annual ring) that is the oldest. If the cambium is cut through all the way around, the tree will die. This is called ***girdling*** and is sometimes done intentionally to kill unwanted trees.

You may find examples where the heartwood is apparently missing. This is because heartwood and sapwood look exactly alike in some kinds of trees. Heartwood, although it no longer carries water, still performs a useful purpose for the tree. It continues to provide support for the rest of the tree.

The section on width of annual rings and the rate of tree growth (*page __ in the Member's Manual*) should stimulate discussion. In general, the width of the rings is related to the rainfall during the growth season, although other factors can be involved.

If a tree's roots are cut or disturbed because of walks, roadways, or trenches; if insects eat a lot of its leaves; or, if buildings or other trees shade the tree, it will grow slowly. If competing trees around it are cut, a tree will have more water, light, and soil nutrients, and will grow faster. If it is dug up and moved, it will grow slower for a time but may then grow faster if the new location is favorable. Some trees grow more on one side than the other because their growth is hampered by a building or another tree. Trees that grow on slopes also have uneven growth because they need to produce extra support wood on one side. Your group will probably be able to come up with still other factors that influence the rate of tree growth.

Trees can be injured in many ways - from lightning to fires to automobile accidents. They form scar tissue which may or may not close over the wound. Injuries can kill trees indirectly by making an opening through which insects or disease may enter the tree.

A Mystery to Solve

This section may be difficult for some. The key to the answer is recognizing that the annual rainfall and the amount of growth are related. If the pattern of growth is compared with the pattern of rainfall, it should be clear that the outermost ring grew in 1980 and the tree must have been cut in that year.

If possible, try to get a cross-section from a tree trunk or a large limb. Sometimes a crew that is felling trees to make way for power lines, or that is simply pruning trees around the city, will cut a slice of a large limb for you. Then your group can work at sanding it smooth on one side so they can see the rings clearly.

Here are some hints on how to make this study go smoothly. Have on hand:

- some brightly colored pushpins to mark particularly interesting rings
- a magnifier; some rings may be very close together
- a small jar of water to pour on the stump; the water will sharpen the contrast between dark and light rings

Have the group gather around the cross-section of a limb, or a stump, and go through the questions on page __ of the Member's Manual. Emphasize the use of observational clues rather than guessing to answer the questions.

Here is what to look for:

1) The youngest part of the stump is the outermost ring. The oldest visible part is the center ring. Actually, there may be older parts inside the stump (especially if the stump is tall). See if the group knows why. Ask how many rings they would count if the stump was several feet taller. Remember that heartwood is not visible in some trees. The cambium, of course, will not be visible either, but the group should know where it is even if they can't see it.

2) You can estimate how long ago the tree was cut by studying the amount of decay. You may want to make a guess on this just so you can answer the next few questions. You can compare the age of the tree with any date just by counting back on the rings.

3) Look for the widest and narrowest rings. The difference is most likely caused by variations in rainfall, but other explanations may be valid.

4) If the tree grew more on one side than the other, look for something that may have hindered growth such as a building or another tree.

5) You may see the result of prior injury in the wood. You will probably have to guess about the cause.

6) Decay is a gradual but continuous process in tree stumps. Different kinds of tree stumps decay at different rates. In general, though, the stump will probably be partly rotted in five years and may be nothing more than a mound of soil in 20 years.

As a final activity, let the group contrive a story about the tree whose stump or section they have studied. They can include any "wild" ideas that come to mind, so long as they fit the dendrochronology of the tree. Let them put to work whatever creativity and imagination they can. It is fun and worthwhile.

Record Section I - Answers

1) The cambium of a tree is the meristematic, wood-producing tissue that envelopes the tree just underneath the bark. The cambium manufactures all the wood in the tree.

2) The sapwood is the most recently made part of the tree trunk. Its "tubes" conduct the water from the roots to the leaves. As the sapwood gets older, these tubes get clogged with deposits. Then it is called heartwood. The heartwood is often a darker color than the sapwood.

3) A year of heavy rainfall will produce a wide annual ring, whereas a year of drought will yield a thin growth ring.

4) Other factors such as insects, light, disease, and mechanical damage can make a difference in the width of the annual rings.

Suggested References

Hutchins, Ross E., *This is a Tree*, Dodd, Mead, and Company, New York, N.Y., 1964. An introduction to trees for young people; includes a chapter on tree rings. This would make a fine addition to any library.

Selsam, Millicent, *Play With Trees*, Morrow, New York, N.Y., 1950. An older, but probably still-in-your-library book with many activities for children to do with trees. For middle- and upper-grade children.

WILDLIFE AROUND US

Materials

- 5 x 7 index cards
- String
- Clipboard
- Paper
- Pencil
- Pine cone (optional)
- Bird seed
- Peanut butter
- Old trash can lid or old tire cut in half (optional)
- Drill (optional)
- Wire
- Saplings/shrubs (optional)

Background

All wildlife requires habitat - a place to live. The four basic requirements of all animals for life - food, water, shelter, and living space - must be satisfied. In nature, trees, shrubs, grasses, vines, and flowers provide food, cover, and space to rear young. Today we see fewer "wild areas" where wildlife can thrive. Urban sprawl is gobbling up many natural or untouched spaces.

Urban wildlife is an integral part of the urban ecosystem. An ecosystem includes living organisms interacting with each other and with their non-living environment to exchange energy and materials such as water, carbon dioxide, nitrogen, oxygen, and minerals. Within the ecosystem, water and minerals are constantly being recycled. Energy from the sun can not be recycled. It is lost as it flows one-way through the ecosystem.

Each component of the ecosystem is affected by every other component. Understanding the interrelatedness of life is vital to understanding the world around us. One concept that helps to convey these relationships is a food chain. Humans are at the top of many food chains, and phytoplankton (microscopic plants in water) or grasses are at the bottom of these chains. An example of a short food chain starts with grass which synthesizes energy from the sun. A cow feeds on the grass, and man consumes beef from the cow. A longer food chain starts with algae which is eaten by protozoa which insects feed on. A bluegill eats the insects. A bass eats the bluegill, and once again man consumes the bass.

But food chains overlap and interconnect to form food webs. Grass may be eaten by a rodent, a bird, or a cow. A flying insect may be part of a food chain for a skink or a skunk, a snake or a raccoon, a trout or a sparrow hawk, and so on.

Many times we may not be aware of the interdependence of organisms within a community. For example, pest control officers sprayed DDT on certain areas in Borneo to control mosquitos and the malaria they spread. Soon after, the roofs of native houses began to fall because thatches were eaten by caterpillars, which because of their particular eating habits had not absorbed much DDT. So the caterpillars reproduced explosively.

Obviously, it is vital that we learn about these interrelationships. Most children are fascinated by wildlife and - believe it or not - there is plenty to be found in the urban ecosystem.

Objectives

At the end of this lesson, your group should be able to:
- identify what all animals require to survive
- define the terms "producer," "herbivore," “consumer," "carnivore," "omnivore," and "decomposer"
- describe what a food chain is and how producers, consumers, and decomposers fit into one
- explain the meaning of the statement, "all living things depend on or are related to one another"

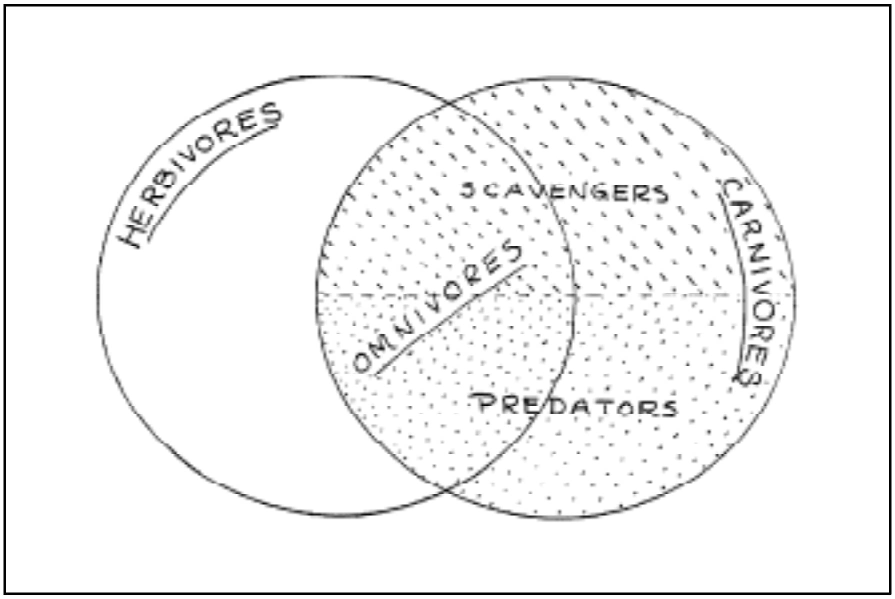

Table 1. NEW OR DIFFICULT WORDS

adapt	consumer	herbivore	necessity	omnivore
carnivore	decomposer	interconnected	niche	photosynthesis
carrying capacity	food chain	mammal	nutrient	producer
competition	habitat	microscopic		

Teaching Strategy

Begin by reading the chapter with your group. Answer or discuss any questions that come up. Ask your group what they need to survive. What do they feel are the "bare necessities" required for them to continue living healthy lives? What does their community consist of - school, home, church, friends, family, food, hospitals, stores, etc.? Help them understand their roles and importance, how are they dependent on people and things. Then relate these concepts to the animals you have been reading about.

Your group could improvise a play about the animals in their city, with each child acting out the role of an animal. They must *be* the animal and do what they feel that animal would do. For instance, a mockingbird would search out food, feed its young, build a nest, etc. The individuals of the group could each build a bird’s nest. This activity will acquaint them intimately with what a bird must do and use to build its nest.

Another fun activity for the group is building a living food chain or web. You will need cards with the individual components of the web written on them, and string. Don’t forget the sun and the decomposers. Pass out the cards and have the children "form" the chain by linking up with string. Let the kids do it themselves rather than telling them what is correct.

You may also want to build a bird house as a group activity. Then the group members could hang it in a tree outside of your meeting place. Projects two, three, and four in the Record Section could be tackled as a group.

You could end the meeting by taking your group on a field trip to a nearby park. Count the number of animals you see and have one member record them. Or simply observe the animals long enough to learn something new about them. If you know, point out which animals are herbivores, which are omnivores, or which are carnivores.

Record Section I - Answers

1) All living creatures need food, water, shelter, and living space to survive.

2) A habitat is the place where an animal lives and includes its sources of food, water, shelter, and living space.

3) Energy from the sun is transferred to plants by a process called photosynthesis.   Carbohydrates are synthesized from carbon dioxide and water by chlorophyll in the plant, using light as energy and releasing oxygen as a by-product.

4) Plants are called producers because they "produce" energy. The flow of energy through the community starts with plants fixing light from the sun.

5) A herbivore is an organism that feeds on plants. Two examples are white-tailed deer and rabbits.

6) Carnivores feed on animal tissue. The Florida panther, an endangered species, is a carnivore.

7) Omnivores are organisms that consume both plants and animals. Squirrels and foxes are omnivores.

8) Decomposers break down the complex substances of dead plants and animals into simple substances such as carbon dioxide, water, and minerals. Bacteria and fungi are both decomposers.

9) Producers, consumers, and decomposers are connected by a food chain. Plants trap the sun's energy and are then eaten by consumers. Decomposers then break down the dead organic matter of plants and animals. The nutrients are then released back into the environment where they are again used by the producers or green plants.

10) This is a true statement. The energy from the sun flows through the food chain. It is lost as it flows one-way through the ecosystem. Nutrients, on the other hand, cycle through the food chain and are reused by the green plants.

11) The ***carrying capacity*** of a habitat is the maximum amount of plants and animals that the area can support simultaneously and continuously.

12) ***Niche*** refers to a plant or animal's role in its community.

Suggested References

Dillon, Olan W., Jr., *Invite Birds to Your Home: conservation plantings for the southeast*, United States Department of Agriculture, Soil Conservation Service, Washington, D.C., 1975. Table of which trees and shrubs attract which birds, along with descriptions of the plants. For leader/teacher.

Hendry, Laurel Comella, Goodwin, Thomas G., and Labisky, Ronald F., *Florida's Vanishing Wildlife*, Florida Cooperative Extension Service, Gainesville, Florida, 1980. Booklet covering thirty of the threatened and endangered Florida species. For leader/teacher.

GREAT OAKS FROM LITTLE ACORNS

Materials

- Common fruits and vegetables
- Tree fruits
- Flowers such as Easter lilies
- Magnifying glass(es)
- Cutting tools such as single-edge razor blades
- Blocks of soft wood
- Toothpicks

Background

All seeds come from flowers, and nearly all flowering plants depend upon seeds for their reproduction. A few, such as strawberrie, produce runners that grow new plants from their tips. Potatoes reproduce by means of buds (eyes) on the potato. Willow trees reproduce mostly by twigs that break off, float away, and take root, but most trees (oaks, pines, maples, cherries, etc.) reproduce by seeds.

Inside each seed is an embryo plant that began to grow, and then, for some reason not entirely known to scientists, stopped. Around the embryo plant food was stored, and a hard cover formed over the embryo plant and its food. After a period of dryness and cold, the embryo plant can begin growing again in the presence of moisture and warmth.

Seeds begin as ovules inside the ovary, the swollen base of the pistil in the center of the flower. A pollen grain from the same kind of plant must land on top of the pistil (stigma), grow down through the style and into the ovary, where a sperm nucleus joins with an egg cell in an ovule to start the new plant. An ovary with 10 ovules could produce 10 seeds, each ovule becoming a complete seed.

As the seeds begin to grow and mature inside the ovary, changes occur in the ovary itself. Some ovaries become soft and red, and enclose only one large seed (cherries, for example). Some ovaries become crispy green and juicy and have a hundred or more seeds (cucumbers). Some become very large, with a thick green outer wall, a spongy, juicy red inner wall, and many seeds (watermelons). Some become shaped like inverted bells, with scaly "hats" (acorns). And some become pods, inside which are silky hairs at the end of a flat brown seed (milkweed pods). It is both fun and educational to investigate the manner in which various seeds are scattered, and where they finally land and germinate. The scattering of seeds is a way to prevent lots of them landing right at the base of the parent plant, and thus competing with the parent for survival. The most successful plants may be those that have developed the most efficient means of scattering their seeds far and wide.

Objectives

At the end of this lesson, your group should be able to:

- describe the process by which a seed is produced by a plant
- identify the female and the male parts of a flower
- identify the embryo plant in a seed such as a lima bean or peanut
- describe the manner in which several common seeds are scattered
- state some reasons for seeds being widely scattered

Table 1. NEW OR DIFFICULT WORDS

abounding	dormant	ovary	pistil	ripen
compete	embryo	ovule	pollen	stamen
disperse	germinate			

Teaching Strategy

Bring in a number of common fruits and vegetables that have seeds in them. Include a tomato, a cucumber, an apple, an orange, a peanut, an ear of corn, and some tree fruits such as an acorn, a maple samara, a magnolia "cone," a coconut, a sweetgum head, a pine cone, and perhaps the pod from a redbud. Any fruit indigenous to your area will do. Let the group open the fruits, remove the seeds, and count them. Then let them open some of the seeds to see what’s inside.

Follow this with an examination of some large, discarded flowers from a florist's shop. Right after a holiday is a good time to request discards, or you may have some suitable flowers growing in your yard. Wilted flowers are just as good as fresh ones for studying the flower parts. Lilies have about the simplest and biggest parts to study.

Let the group dissect some of the ovaries to see the tiny ovules inside (be sure to count all cutting tools and magnifiers before beginning this activity, and make sure the same number come back). Single-edge razor blades used on blocks of soft wood make good cutters for dissection but only when used with extreme caution. Use toothpicks to separate small bits of the dissected material.

If possible, bring in some small cucumbers to slice crosswise and lengthwise, so they can be compared with the sectioned ovaries of the flowers. Discuss some common fruits (ripened ovaries), and remind the group that "fruit" in the common sense doesn’t mean the same as in the botanical sense. To a scientist, a tomato, a peanut, an apple, and an ear of corn are all fruits in a general sense. That is because they all come from flowers and are all (or contain) ripened ovaries.

Some Things to Think About

- Raspberries are clusters of ovaries, each with a tiny style attached.
- Peanuts ripen underground, even though they flower above ground.
- The edible part of an apple or pear is the base of the flower that swells around the ovary and encloses it.
- The ovary wall of a horse chestnut is yellow, thick, and prickly.
- You eat the whole ovary in string beans; in peas, you eat ovules (seeds).
- On red oaks, tiny acorns are visible a year in advance; mature acorns take two years to grow. On white oaks, they take only one.

Things To Do With Seeds

Once the process of seed development is understood, have the group collect some tree seeds. Some they might collect in the city include acorns, sweetgum heads, maple "keys" or samaras, dogwood drupes, pine seeds, and sycamore heads.

Things they can do with these seed include:

- Plant a few, and see what the seedlings are like.
- Open some and look for the embryo plant in them (but soak them first).
- Study how they are scattered, and by what agents (wind, animals, etc.).

- Cut away varying parts of the stored food in one kind of seed, plant the reduced seeds, and see how much of the food is needed for germination.
- Plant one kind of seed in varying positions (right-side up, upside-down, sideways, etc.), and see if it makes any difference in germination.
- Make a sample count of seeds on a nearby tree, and from it determine the total population of seeds on the tree.
- Make a study of the kinds of things that happen to most seeds to prevent them from germinating and becoming mature plants.

Record Section I - Answers

There is no "right" answer to this question. But, in 1513 Ponce de Leon claimed our state for Spain and named it Florida. In Spanish, Florida means "full of flowers," and he used this word because of the many flowers he saw here.

1) Seeds begin as flowers. After a flower has been pollinated and then fertilized, its development into a mature fruit begins.

2) The pistil is the female part of the flower and contains the reproductive system. Each pistil has three parts. The stigma receives pollen and often secretes a sticky substance to which the pollen adheres; the style is the stalk which connects the stigma to the third part, the ovary, which encloses one or more ovules.

3) The stamens, or male parts of the flower, each consist of a stalk or filament supporting an anther, which is a chamber where pollen grains develop.

4) After pollen has been transferred from a stamen to the pistil, each pollen grain produces a pollen tube which digests its way through the surface of the stigma and into the style. The tube grows down the style and into an ovule in the ovary of the flower. The pollen tube then releases a sperm nucleus which fuses with an egg nucleus. Then fertilization is complete, and the seed forms. This is a simplified explanation of seed origin. The individuals in your group may give an even simpler explanation.

5) Put very simply, a seed is a tiny plant surrounded by some food and a cover.

Suggested References

Dowden, Anne O., *Look at a Flower*, Crowell Company, New York, NY, 1963. For grades five and up.

Earle, Olive L., and Kantor, Michael., *Nuts*, William Morrow, New York, NY, 1975. For grade three through seven.

Harlow, William, M., *Fruit Key and Twig Key*, Dover, New York, NY, 1946. A picture key to common fruits of northeastern trees. For leader/teacher.

Menninger, Edwin A., *Color in the Sky: flowering trees in our landscape*, Horticultural Books, Stuart, FL, 1975. Beautiful photographs of flowering trees. For leader/teacher.

Webber, Irma., *Bits That Grow Big*, Young Scott, New York, NY. For middle to upper grades.

A GREEN PLACE!

Materials

- Soil test kit (if available)
- Tape measure
- Neighborhood map
- Paper and pencils
- Clipboard

Background

Trees are such an important feature of a city landscape (for beauty, noise abatement, shade, and a place for birds, as well as for people) that they should be accented in the teaching of both science and social studies. It is easier to see how trees can be used in a science lesson than in a social studies lesson. But by considering unused spaces in a city block, and how these spaces can be made attractive and useful by planting trees, children can be introduced to both social needs and routes of action in a city.

It is important for children to see spaces in light of their realities and their potential. The reality may consist of a visit to the site (a vacant lot, a place where a building has recently been torn down, or any similar unused and unattended place). There, measurements, descriptions of objects, drawings, write-ups describing the place, and soil samples can be used for determining soil acidity and type of soil (sandy, loamy, clay, etc.), and can be used for preliminary experiments with seed germination - just to "test" the soil. Your group should find out all it can about the site - ownership, plans for its use by the owners, tax status, etc. This initial study will provide an opportunity to learn about basic interrelationships within the neighborhood.

If the group decides that it would like to undertake an "urban renewal" effort of the site, including planting trees, serious thought and effort are needed. Before a group tackles this action, you and they must agree that

a) it will be carried out in good faith, with solid commitment and cooperation, and

b) the final decision on the part of city officials may be negative, but the effort must be made in spite of that possibility.

Contacting city officials or their representatives can be an enlightening experience. Often, city officials and government are distant, unreal, and impersonal. To find out that they are real people with names, faces, and responses to suggestions may come as a pleasant surprise.

Once a group tackles the project of improving and planting a site with trees, they will grow in responsibility as their investment in time, effort, and money grows. This is the most important objective of this lesson - that community improvements don't just happen; they are caused, and they are work, and the effort is worth protecting.

Objectives

At the end of this lesson, students should be able to:

- identify some of the spaces in a city that both have been or could be improved with the planting and maintenance of trees
- describe the parts of city government that are involved with improvement and renewal of unused spaces
- describe some practical benefits of trees in an inner-city setting
- organize and implement a plan for action that involves neighborhood as well as city representatives
- draw up and circulate a petition in support of some specific, locally beneficial cause

Table 1. NEW OR DIFFICULT WORDS

accent tree	departments	forester	official	symbol
compact	engineering	government	shade tree	tolerant
crown	flowering tree (sapling)	maintenance	street tree	vacant
deciduous				

Teaching Strategy

Probably few groups will actually carry out and succeed in this lesson to the point where a vacant lot will actually be cleared of debris, trees and perhaps shrubs planted, and long range maintenance set up. But even considering such a project has social pay-off. First, ask the group to identify some *specific* areas of their neighborhood that *might* lend themselves to improvement, including planting trees. For each space, ask the kids to find out who owns it (name and address), and what the plans are for it. Once a site seems to be favorable for study, take them there to examine it.   Take along a tape measure, a neighborhood map (or one made by the group) on which to note dimensions, compass directions, and major features. Make a list of plants already growing there, and of objects that pose hazards or need removal.

Set up some committees to:

a) draw up plans for how the area might be used (with diagrams, sketches, and verbal accounts)
b) find out what city officials might be contacted for help in planning and supplying grading equipment and trees
c) what kinds of trees might be best suited to life at the site
d) draw up a well-worded petition for circulation in the neighborhood, and
e) make plans for publicity and maintenance once it is a reality.

Remember that not every space that looks like a possible green space can become one. Remember, too, that city officials may take a dim view of a lot of groups making demands on their time and money. But a committed group can be a real force in a project that will obviously *benefit* a neighborhood and give visibility to official effort. Remember above all, learning about spaces, city government, and how to launch a cooperative venture are worthwhile returns even if plans don't materialize. Just taking a closer look at vacant spaces in the neighborhood and thinking about how they could be improved are steps in the right direction.

Some Things to Think About

Every bit of land is owned by someone. The "someones" are real people with names, faces, addresses, and telephone numbers. Some of them are eager to have the land used in the best way and would support an effort to make a space green with trees. Try to have the children see things from the viewpoint of the owner, whoever it is. What are the taxes on that piece of property? What does the owner get from the taxes paid? Who would want to purchase such a piece of property, and for what reason? Some of the questions that might be asked about vacant spaces, and their answers, are real educational opportunities.

Often a particular vacant space has a lot of potential for improvement and needs only the fortunate bringing together of a group of kids who are willing and the authorities who can give the O.K. One such successful venture is the Magnolia Tree Project in New York City. On a vacant lot, neighborhood children managed to grow vegetables, plant trees, and make a beautiful site. Your group may want to find out about Magnolia Tree and how it came about. It might give them some ideas for their own neighborhood.

Remember that it is easier, sometimes, to improve a site than it is to take care of it in the years that follow. Taking care of something after it has been built is not so spectacular, nor so popular, but it is necessary. See what plans the group can come up with for sustained maintenance that will insure the future of the green space they create, if they do create one.

Finally, let the group think about the phrase, "the greatest good for the greatest number" and how it applies to the use of space around them. What spaces are used efficiently by the neighborhood? What spaces are not used efficiently used? Is a golf course an efficient use of green space? Is a park? How about a basketball court? Is it efficient? For whom? What and who should be considered in thinking about "efficient?"

Record Section I - Answers

1) A sapling is a young tree with a trunk not over four inches in diameter. Most trees are planted when they are saplings.

2) An exotic tree is a tree that has been introduced to a particular area from a foreign country. In other words, you wouldn't find it growing naturally in that place.

3) A native tree would be found living or growing naturally in a particular place.

4) The answer to this question will be different for each particular location.

Suggested References

Bush, Charles S., and Morton, Julia F., *Native Trees and Plants for Florida Landscaping*, Florida Department of Agriculture and Consumer Services, Bulletin No.193. Covers native plants suitable for Florida landscaping. For leader/teacher.

Forest Trees of Florida, Florida Department of Agriculture and Consumer Services, Division of Forestry, 1981. A standard handbook for tree identification. For leader/ teacher.

Project Learning Tree, The American Forest Institute, 1619 Massachusetts Avenue, Washington, D.C., 20036. *Supplementary Activity Guide, For Grades K through 6,* and *Supplementary Activity Guide, For Grades 7 through 12*. Excellent classroom environmental projects with trees.

Recommended trees: for home planting in your area, Florida Department of Agriculture and Consumer Services, Division of Forestry, 1979. Guide for tree planting and maintenance with suggested species. For leader/teacher.

Tree Tips, Magnolia Tree Earth Center, 677 Lafayette Avenue, Brooklyn, N.Y., 11216. Tips on how to engage city people in caring for city trees. For leader/teacher.

Urban Trees for Florida, Florida Department of Agriculture and Consumer Services, Division of Forestry, 1979. Excellent booklet on which trees are suited to which conditions. Very good photographs. For group members and leader/teacher.

1. This document is 4HFOL20, which supercedes 4H-481, one of a series of the School of Forest Resources and Conservation for 4-H Youth Development Program, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Date reprinted September 1987. Please visit the FAIRS Website at **http://hammock.ifas.ufl.edu**.

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