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"... the billowy columns of tulip poplars; the lateral spread of an oak; the stately, upright posture of a walnut; the translucent, effeminate tremble of a wild cherry. The small, lacy locusts were faintly brown this late in summer, and the catalpa at the corner post wore a pale-green color you could pick out on a hillside a mile away, or even farther when it was dangling all over with the long pods that made people call it a bean tree. The sourwood had its white flowers reaching out like skeleton hands in the spring. Trees. Every kind assumed a different slickness in the rain, its particular color in the fall, its own aspect - something you couldn't describe in words but learned by heart when you lived in their midst."



~ Barbara Kingsolver

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Goal:

To provide information that will enhance understanding of the basic structures of trees and how to use these structures for identification purposes.

Objectives:

- To distinguish between different types of trees
- To recognize different types of leaf forms
- To differentiate textures of bark
- To see differences in twigs
- To learn about the variety of fruits and seeds

I. What is a tree?

- Must be at least 20 ft. at maturity
- Has a single main trunk that, at maturity, is unbranched for several feet
- Has a well-defined crown

There is a difference between trees and shrubs:



Tree

Single main trunk
Well-defined crown
At least 20 ft. tall



Shrub

Multiple branching at base
No crown present
Less than 20 ft. tall

II. Why is a tree useful?

For Humans:

Medicine
Food
Shelter
Furniture

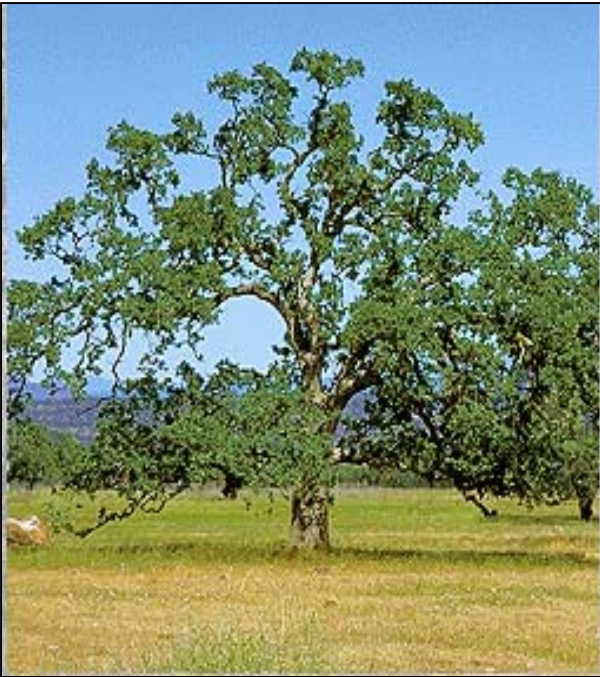


For the Environment:

Food
Shelter
Clean Air
Clean Water



III. Types of Trees



Angiosperm -

An angiosperm is a taxonomic class of plants in which mature seeds are surrounded by an ovule (like a fruit or a nut). An ovule is where the embryo sac is located, which develops into a seed after fertilization. Most angiosperms are broadleaf, deciduous, and lose their leaves in winter.

Angiosperms include trees like oaks, maples, birches, and many other species.

Gymnosperm -

A gymnosperm is a taxonomic class of plants whose seeds are not enclosed in an ovule. Because gymnosperms lack an ovule, they are said to have a "naked seed."

Gymnosperms include trees like pines, firs, spruces, and most evergreens. Ginko trees are also considered to be gymnosperms because of their naked seed.



IV. Steps to Identify a Tree

- 1) Is it a tree or a shrub?
- 2) Is it an angiosperm or a gymnosperm?
- 3) What do the leaves look like?
 - For an angiosperm:
 - a) Are the leaves opposite or alternate?
 - b) Are the leaves simple or compound?
 - c) Are the margins serrated, smooth, or lobed?
 - For a gymnosperm:
 - a) Are the leaves scale-like or needle-like?
 - b) If a tree has needles, are they single or clustered?
 - c) If single, how are they attached?
- 4) What does the bark of the tree look like?
- 5) What do the twigs look like?

Look at: The pith, size, hair, color, pattern, thorn, or spine, and leaf scars.
- 6) What type of fruit or seed does it have?

Is it a nut, berry, acorn, fruit, samara, or cone?
- 7) What does the form of the tree look like?

Look at the silhouette, the form of the branches, and abnormalities in the trunk.
- 8) Does it have any unique miscellaneous features?

Look at features such as taste, smell, or leaf variability.



Step 1 - Is it a tree or a shrub?



Tree

A tree is at least 20 ft. tall at maturity, has a single main trunk that is unbranched for several feet, and a well defined crown.



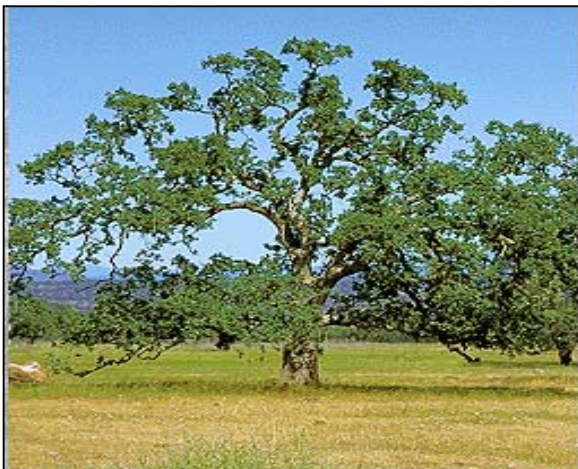
Shrub

A shrub is less than 20 ft. tall, has multiple branching at the base, and has no crown.

Step 2 - Is it an angiosperm or a gymnosperm?

Angiosperm

Angiosperms have mature seeds that are surrounded by an ovule. Most are broadleaf, deciduous, and lose their leaves in winter.



Gymnosperm

Gymnosperms have seeds that are not enclosed in an ovule. Are considered evergreen and include pines, firs, hemlocks, spruces, and ginkos.



Step 3 - What do the leaves look like?

For angiosperms:

A) Are they opposite or alternate?



Opposite

Opposite leaves grow in pairs along the twig. In the mid-Atlantic region of the U.S., a good way to remember trees with opposite leaves is to use the acronym M.A.D., which stands for Maple, Ash, and Dogwood. (If you're MAD, you're opposite!). *Note: there are two additional tree species found in Virginia that have the opposite pattern: Horse Chestnut and Royal Paulownia.*



Alternate

Alternate leaves are staggered along the twig in a zig-zag pattern. The buds will also be in the same alternate pattern.

B) Are they simple or compound?

Simple



Simple leaves have a single leaf blade that is attached to the twig at a defined node. (The node is the point on the twig or branch where the leaf is attached). Look at the place where a leaf or leaflet attaches to a twig or branch. It is the presence or absence of a node that determines if it is a simple leaf on a twig or a leaflet on a rachis. Examples - Maple, Oak, Aspen, and Sycamore

Compound



Compound leaves have several leaflets attached to one rachis. Each rachis is attached to the twig. A node will be present at the base of the rachis, but not at each leaflet. This is key to being able to tell a compound leaf on a rachis from a simple leaf on a twig. Examples - Ash, Walnut, Sumac, and Hickory

C) Are the margins serrated, smooth, or lobed?



Serrated

A serrated margin has teeth along the edge of the leaf. Some margins are doubly serrated meaning that each major tooth is also serrated, as in this photograph of a birch tree.

Examples - Birches, Beeches, and Elms



Smooth or Entire

A smooth margin is untextured around the edge. This type of margin is also called entire.

Examples - Dogwoods and Redbuds



Lobed

Leaves that are lobed have spaces that are similar to the spaces between your fingers. The number of lobes varies for each species. The spaces between the lobes are called sinuses and can be deep or shallow. Oak trees typically have lobed leaves.

Examples - Oaks and Sassafras

For gymnosperms:

A) Are the leaves scale-like or needle-like?



Scale-like

Scales are actually very small, flattened, leaves that form a covering over the twig (like scales on a fish).

Example - Cedars



Needle-like

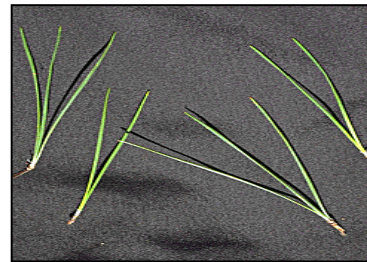
Needles are leaves that are long, slender, and pointy. Needles can occur singly or in clusters (bundles).

B) If the leaves are needle-like, are they single or clustered?



Single

Trees with single needles include spruce, fir, and hemlocks. Single needles are attached in one of three ways: a petiole that resembles a woody peg, a flat petiole, or a suction cup. (See below).



Clustered

On pine trees, needles occur in clusters (bundles). The clusters are attached by a fascicle, which is an extremely short branch. Many pines have needles that are 2 per fascicle, 3 per fascicle, or even 5 per fascicle. Some trees can have both groups of 2 needles and 3 needles found on the same tree.

C) If they are single needles, how are they attached?



Woody peg-like petioles:

Needles can be attached by petioles that look like woody pegs such as with spruce trees.

Woody peg-like Petiole

Flat Petiole:

Some needles have petioles that lay flat against the twig causing the needles to look flat. Hemlock trees are attached by flat petioles.



Flat Petiole



Suction Cup

Suction cup:

Some trees have single needles that lack a petiole altogether. In this case, the needles appear to be attached to the twig by suction cups. Fir trees have single needles with suction cup attachments.

Step 4 - What does the bark of the tree look like?

The bark of a tree can vary from species to species and can even be variable depending on the growth rate of the tree. However, there are many tree species with unique bark patterns that can be helpful when identifying these species. Here are a few examples of different types of bark.



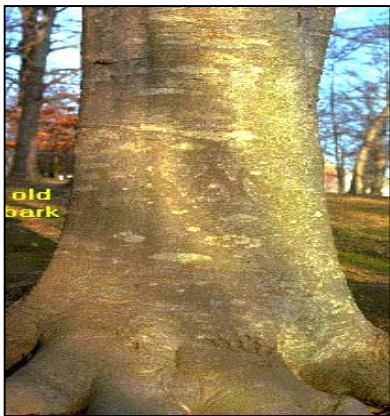
Peeled bark of an American sycamore (*Platanus occidentalis*)



Shaggy bark of a shagbark hickory (*Carya ovata*)



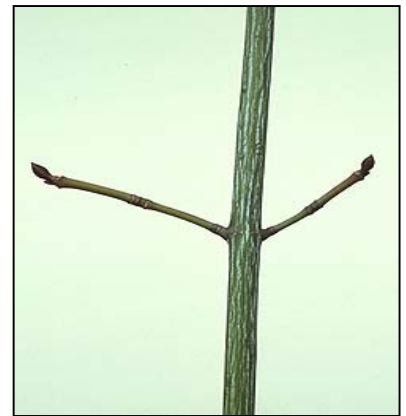
Diamond shaped pattern with white valleys and dark ridges of a yellow poplar (*Liriodendron tulipifera*)



Smooth bark of an American beech (*Fagus grandifolia*) characteristic of more mature trees.



Persimmon (*Diospyros virginiana*) has a charcoal briquette type bark.



The young bark of a striped maple (*Acer pennsylvanicum*) is green with white stripes.

More examples of different tree bark:



The inner bark of a sassafras (*Sassafras albidum*) is orange in color, with a cinnamon smell. Black oaks (*Quercus velutina*) also have a bright orange inner bark that distinguishes them from all other oak species.

Bark at different growth stages of a tree:



Young Bark

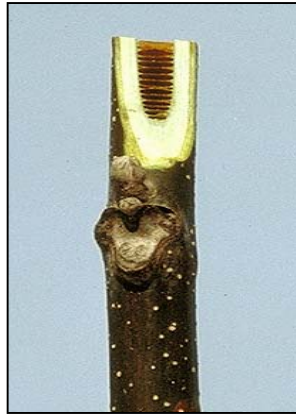
Intermediate Bark

Mature Bark

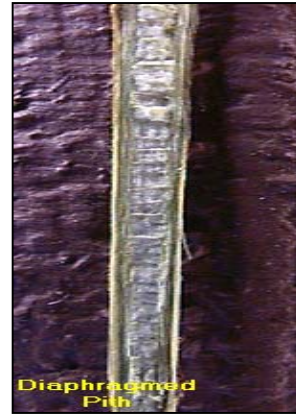
The bark of many species, including the above river birch (*Betula nigra*), looks different at different stages of growth. It is often possible to find all three stages of bark present on one single tree. The faster the tree grows, the younger the bark will look, for its size. The different stages of bark represent growth rate, not the age of the tree.

Step 5 - What do the twigs look like?

Pith: The center of a twig is called the pith.



The pith of a black walnut (*Juglans nigra*) is chambered and hollow, unique to this species.



The pith of a blackgum (*Nyssa sylvatica*) is also chambered, but has diaphragmed chambers, unique to this species.

Size and Hair: The shape of a twig can also be an identifying feature, as well as the presence or absence of hair.

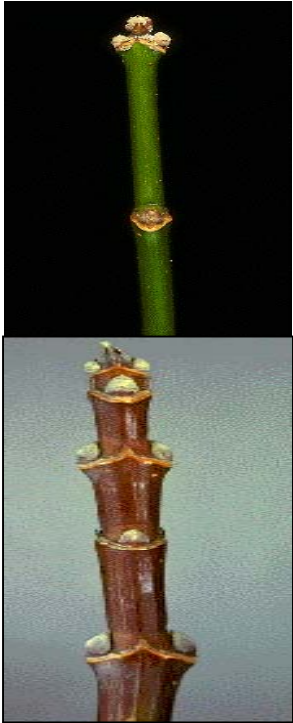


There are many tree species that have very slender twigs. Black cherry (*Prunus serotina*) is an example of a tree with thin twigs.



Some trees have twigs that are very thick and stout. Staghorn sumac (*Rhus typhina*) has thick twigs. It also has hairy twigs. Hair (also known as pubescence) can be found on both twigs and leaves of many tree species and can aid in identification.

Color and Pattern: Twigs can come in a variety of colors and many can have unique patterns.



Boxelder (*Acer negundo*) twigs can be either green or purple. The younger, growing twigs are green and the older twigs are purple with white streaks. They also have a unique widows-peak pattern at each bud making this species easy to identify. (Note the opposite budding pattern on this twig. Boxelder is a member of the maple family, an opposite branching species. Remember M.A.D.?)

Thorn or spine: Some trees have twigs with either thorns or spines. A spine is a modified stipule that only appears in pairs at the base of a leaf. Thorns are modified twigs and can grow sporadically on a tree at any place where a twig might grow. (Note: an easy way to remember the difference between a spine and a thorn is that spine and stipule begin with an "s" while thorn and twig begin with a "t".)



Spine

Blacklocust (*Robinia pseudoacacia*) have spines that appear in pairs at the nodes.



Thorn

Honeylocust (*Gleditsia triacanthos*) have thorns that grow sporadically along the trunk and sometimes occur in clusters.

Leaf scars and bundle scars: Leaf scars can also be used to identify individual species. A leaf scar is the mark on the twig left after a leaf drops and where the terminal bud emerges to form the leaf. Leaf scars appear in three forms: (1) thin, (2) elliptical, or (3) have other shapes (such as a monkey face). Bundle scars are the marks that appear within a leaf scar and they indicate where minerals used to flow between the leaf and tree.



Thin scar
(Acer platanoides)



Elliptical scar
(Nyssa sylvatica)



Monkey face scar
(Juglans cinerea)

Step 6 - What type of fruit or seed does the tree have?

There are different types of fruits and seeds, including cones, berries, pods, samaras, nuts, fruits, and acorns. Fruits and seeds can be distributed in a wide variety of methods, including animals, wind, fire, water, and humans.



Cone Type:
gymnosperms have cones
Distribution:
wind, fire, and animals.



Fruit Type:
can be in the form of
berries, apples, etc...
Distribution:
animals



Pod Type:
can be round or flat and
of varying lengths.
Distribution:
wind and animals



Winged Samara Type:
found on maples. *Note
the 180 degree angle on
this species indicates a
Norway maple (Acer
platanoides)*
Distribution:
wind



Round Samara Type:
found on elm trees
Distribution:
wind



Nut Type:
can come in a variety of
shapes and thickness of
husks
Distribution:
animals and humans



Warty cap
White oak



Bristly cap
Bur oak



Flaky cap
Southern red oak

Acorn Type:

Oak species have acorns, which have an incredibly wide range of characteristics relating to size, shape, and acorn cap. For example, the acorn of the white oak (*Quercus alba*) has a warty cap that covers half of the acorn. The cap of a bur oak (*Quercus macrocarpa*) almost completely covers the acorn and is bristly at the cap edge. Southern red oaks (*Quercus falcata*) have circular rings around the base of the acorn, and caps that look flaky.

Distribution:

In many eastern forests, oaks are key species in the ecosystem. Many animals eat and/or store acorns in preparation for fall migration or winter survival, thus contributing to the distribution of the acorns.

Step 7 - What does the form of the tree look like?

Silhouette: Silhouettes show the basic outline of the tree, which can be round, triangular, straight, and tall, etc.... Many pines, spruces, and firs have a triangular silhouette. Other species, such as the yellow poplar (*Liriodendron tulipifera*), typically have a straight silhouette. *Note: silhouettes can be difficult to determine in crowded forests and is most helpful in identification when individual trees stand alone, such as in school yards.*



Triangular



Straight

Form of the branches and trunk abnormalities: Look at how the branches grow out from a tree. Some branches droop or dangle, like on a weeping willow (*Salix babylonica*), European birch (*Betula pendula*), and Norway spruce (*Picea abies*). Pin oaks (*Quercus palustris*), on the other hand, have a unique silhouette created by the angle of the branches, which emerge from the tree trunk in the shape of an asterisk (branches at the top point up at a 45-degree angle, branches in the middle point out at a 90-degree angle and branches at the bottom point down at a 45-degree angle). Some trees have abnormalities that are unique to that particular species. Scarlet oaks (*Quercus coccinea*), for example, sometimes have a swollen area at the base of the trunk (called a butt swell), caused by a form of the chestnut blight.



Drooping branches of a Norway spruce



Angled Branches of a pin oak



Butt swell abnormality of a scarlet oak

Step 8 - Does the tree have any unique miscellaneous features?

Taste and Smell: Many trees have unique tastes and smells that can come from the twig, leaf, or bark.



Bitter Almond Taste
Black Cherry



Root Beer Taste
Sweet Birch



Aspirin Taste
Weeping Willow



Tangerine Smell
White Fir

Leaf variations: Some tree species have variations in the shape of the leaf, which can help (or sometimes hinder) identification. For example, young sassafras (*Sassafras albidum*) leaves can appear in three different shapes, while in older trees, the single unlobed leaf is the only shape present. The number of leaflets in a compound leaf can also sometimes vary in a single tree. For example, the pignut hickory (*Carya glabra*) can have either 5 or 7 leaflets per rachis, while the mockernut hickory (*Carya tomentosa*) can have 7 or 9 leaflets per rachis, making identification tricky when they are found in the same forest.



Leaves of a young sassafras tree can have varying shapes, even on the same tree.



Leaf variations of hickory trees can have varying number of leaflets, even on the same tree.

V. Making a Specimen Collection

A specimen collection is a preserved representation of unique species of plants found in a particular area. You can create a collection that includes only trees or you can choose to include both trees and all other herbaceous species, such as flowers and vines.

You can choose to create a formal collection and adhere to strict guidelines for preserving specimens and recording data, or you can choose to have a more informal collection. If your goal is to have examples of each tree species to serve as a guide for identification in your classroom only, then an informal collection may be enough to suite your needs. However, if your school would like to have a long-term reference collection of voucher specimens preserved for future scientific use, then a formal collection may be more appropriate.

An informal collection contains specimens of each species present, but the specimens can be sterile (meaning that the flowering part of the plant is not included in the collection). A formal collection must have preserved fertile specimens that include either the flowers or fruits for each species. Also, in a formal collection, there should be two specimens preserved for each species to serve as vouchers.

Whichever type of collection you choose to create, you will need to know seven key steps in collecting and preserving voucher specimens: (1) what to collect, (2) how to collect, (3) what to document, (4) how to press the plant, (5) how to dry the plant, (6) how to mount the plant, and (7) what to put on your label.

(1) What to collect:

The goal of a formal collection is to have preserved specimens that provide adequate representation of the individual species in your survey area. To achieve this, each specimen must show all the features exhibited by the plant. This means collecting all parts of a plant you might need for future identification, including leaves, stem, root, flower, and/or fruit. Include a full branch to show opposite or alternate leaves, etc. The more material you collect the better. Plants shrink on drying, which is especially true of more succulent plants. Keep this in mind when collecting and pressing. What may appear to be ample material when fresh may be skimpy once it is dried.

In an informal collection, you might not need to be as rigorous in collecting all parts of a plant. You may choose only to have a single leaf from each tree (being careful to collect complete compound leaves, of course). During a school year, it may not be possible to collect both flower and seed, but you may be able to time collections to obtain one or the other.

(2) How to collect:

Some specimens will be easy to collect with basic tools. However, other specimens, such as a leaf from a tall tree, may require that you use more advanced equipment. For ideas on different collecting techniques and tools check out the Missouri Botanical Garden website at:

<http://www.mobot.org/MOBOT/research/library/Fieldtechbook/frontpg.html>.

When collecting, you have the option of placing the specimens into bags to press later, or pressing them in the field. In either case, fold the specimens to the correct length for a herbarium sheet (usually 11x17 inches which matches the dimensions of a standard leaf press). Then either place carefully into your bag for temporary storage and transport back to your lab or classroom to press, or immediately place your specimen between a folded piece of newspaper and then put straight into the plant press. If you are using the bag method to collect plants to press at a later time, you can prevent significant wilting by wrapping the specimen in moist newspaper and placing in a plastic bag, which should be kept shaded.

Collectors carefully tag their collections in the field to prevent later mix-ups. A small, white tag should be securely tied to the stem or fruit, with the collector's name, collection number, and a field determination (species name) written in permanent ink or pencil. Other collectors use stick-on type tags. This field identification tag should match data recorded in a field notebook (see below). Tagging can be a difficult undertaking if field conditions are rugged, or if it rains, but it is key to maintaining accuracy.

(3) What to document:

Along with the field identification tag, you should keep a notebook with more detailed information on each specimen, including the date and general vicinity where you are collecting, the plant's relationship to a permanent landmark (roads, rivers, creeks, bridges, etc.) and the type of habitat where it is located (for example marsh, swamp, upland forest, vacant lot, or edge of a field). Coordinates from a GPS are great to document, if you have access to the technology.

General locality data should include:

- Date
- Collector(s)
- Country; state, province, and/or county
- Distance and direction from nearest city or major landmark that would appear on a map; use descriptive terms like "km" or "mi", and "N-S-E-W", rather than words like "from" or "near". (Note: smaller geographical localities are not always on standard maps.)

- Habitat or vegetation type, including the dominant tree species or associated species, if possible (for example oak-hickory)
- Indicate if plants were preserved in alcohol, or received any other chemical treatment in the field before drying
- Latitude/Longitude and/or Township/Range, altitude (m or ft), and GPS reading, if available

Individual specimen should include:

- FAMILY (in capital letters)
- Genus
- Species
- Author (The author is the person who first collected and documented the species. You can locate this information on International Plant Names Index website: www.ipni.org. You can leave this blank if you are unable to locate the author, or if you are doing an informal specimen collection.)
- Determiner (The determiner is the person who identifies the specimen. This person can be the same as the person who collected the specimen, but not always.)
- Description of plant type (e.g. tree, shrub, liana, vine, etc...)
- Description of flower and/or fruit color, scent, height, and unusual features, such as shaggy bark, buttressed trunk, colored sap, any attribute which cannot be obtained from the prepared specimen.
- Any additional information or notes on locality and habitat (near stream, on rock, in water, etc...). Include information that is specific to that particular individual specimen.

(4) How to press the plant:

Press the plants folded in a sheet of absorbent paper, such as a half sheet of newspaper (a standard plant press is 11 x 17 inches, and any larger would be too big to mount). Arrange the specimen nicely to show both sides of leaves. Press some flowers open, some closed, and others split to show the internal structures. Cut or break off excess leaves, but always keep part of the petiole to show the position:



Part of petiole
left behind to
show position
of leaf.

Never cut off the petiole base and the stem attachment of a compound leaf. If possible, keep some of the petiole bases of the other leaves and the apex (top) of the stem. Do not mistake a large compound leaf for a branch with simple leaves. Do not split the twig, because the opposite or alternate arrangement of the leaf will no longer be evident. A specimen of two sheets or more may be necessary with very large leaves. Write the collector's initials and the unique collection number on the paper. (Note: start your numbering system with the number one, and never ever repeat a number your whole life!)

The plant press is made up of five parts: newspapers, blotter paper, ventilators, frame, and straps. The outside frame is typically made of wood and holds the newspapers, blotters, and ventilators in place. The folded newspapers contain the specimens to be pressed. Place a piece of blotter paper (a thick piece of acid free paper) between several pieces of newspaper every so often, depending on the fleshiness of the plants (in other words, you don't always need a blotter between each specimen—it depends on how moist the plants are when you start).

Air needs to flow between the specimens in order for them to dry thoroughly, so in between your specimens, add a ventilator (simply a piece of corrugated cardboard). You can press up to two or three specimens before you add a ventilator.

Repeat this process of layering several times (e.g., ventilator, blotter, specimens, blotter, ventilator, blotter, specimens, blotter, ventilator, etc.). Place your short stack in the plant press frame and wrap securely with the straps and tighten.

(5) How to dry the plant:

Place the press in a plant dryer or in a dry place with good ventilation. You may need to tighten the straps after a day or so.

The drying time depends on many factors, such as temperature, humidity, and types of specimens. For temperate areas, such as the mid-Atlantic region, plants can dry sufficiently if left in the press for several days in an air-conditioned room. You probably don't need to purchase a commercial drying system, but you can find information on alternatives at the Missouri Botanical Garden website.

(6) How to mount the specimen:

Always use the best quality materials available for mounting specimens. If properly stored, the lifetime of a specimen is nearly indefinite. So it only makes sense to use mounting materials (label paper, mounting paper, glue, etc.) that will not deteriorate over time and will last as long as the specimen.

If a specimen is going into a permanent collection it should be mounted on stiff paper, ideally an 11x17 acid-free herbarium sheet available at any herbarium supply company (see Chapter VI: Additional Resources). Attach your specimen to the

herbarium sheet with several dabs of gum arabic, sew it to the sheet, or loop small paper straps over the stem and leaves.

Print a label using the instructions below (also using acid-free paper) and place in a lower corner of the sheet.

You can store your preserved herbarium sheets in folders in any cabinet, but for formal, long-term reference collections, you might consider purchasing a proper herbarium cabinet from an herbarium supply company.

(7) What to put on a label:

Print a label on acid-free paper and place in a lower corner of the sheet, giving information about the specimen, such as the county and state of collection, the plant family, scientific name (*in italics*), author code (an abbreviation for who discovered the specimen, such as L. for Linnaeus or Muhl. for Muhlenberg), determiner (who identified the specimen), location and habitat, plant description, collector (who collected the specimen), specimen number, and the date of collection.

Sample of specimen label:

Arlington County, Virginia	
ULMACEAE	
<i>Ulmus rubra</i> Muhl.	
Det. T. Hollwell, 1993	
Tree, 20 in. diameter, approx. 80 ft. height. Streamside forest in Potomac Overlook Regional Park, 30 feet from the N. bank of Donaldson Run and 200 feet upstream of the George Washington Parkway bridge. <i>Liriodendron</i> and <i>Quercus</i> dominant.	
Tom Hollowell #131	Nov. 14, 1993

VI. Additional Resources

CD resources:

"Woody Plants in North America" by John Seiler, John Peterson, and Edward Jensen;
ISBN 0-7872-7437-2

For purchasing information contact Curtis L. Ross, Associate Editor,
Kendall/Hunt Publishing Company 1-800-228-0810

Order online at www.fw.vt.edu/dendro

"The Central Hardwoods Virtual Forest" by Indiana DNR Division of Forestry

Inquirees can be made to Education Director

IDNR - Forestry Director

402 W. Washington, Rm. W296

Indianapolis, IN 46204

Phone: 317/232-4105

www.biology.iupui.edu/v_forest

Web resources:

www.si.edu/crc/ep/forest/forest.htm - Conservation and Research Center Forest
Biodiversity website

www.fw.vt.edu/dendro - Forest Biology and Educational Site of Virginia Tech with
access to fact sheets for tree identification, leaf key and twig key, FORSite,
and information on "Woody Plants in North America"

<http://www.mobot.org/MOBOT/research/library/Fieldtechbook/frontpg.html> -
Missouri Botanical Garden plant collection website with information on
establishing and maintaining botanical specimen collections, including collecting,
drying, and mounting

www.herbariumsupply.com - Herbarium supply company catalog with information on
collecting and mounting materials. (800)-348-2338

www.ipni.org - International plant names index with information on scientific names
for plant species and the author associated with a species.

Guide Books:

- Peterson Field Guide to Eastern Trees
- The National Audubon Society Field Guide to North American Trees: Eastern Region
- Tree Finder: A Manual for the Identification of Trees by their Leaves
- How to Make a Plant Collection - Steven R. Hill, 1995. Provides an overview of collecting, pressing, and mounting plant specimens. (Can be ordered from the Herbarium Supply Company Catalog.)

VII. Glossary

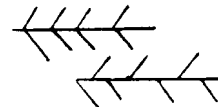
- Angiosperm** - a taxonomic class of plants whose mature seeds are surrounded by an ovule
- Author** - the person who originally collected and identified a particular species
- Berry** - a fleshy fruit that contains small seeds
- Bundle scar** - the mark left in a leaf scar that shows where the minerals flowed from the tree to the leaf
- Chambered pith** - pith divided crosswise by numerous plates or membranes
- Collection number** - your own personal number sequence beginning at the number 1, with each plant collected thereafter numbered in consecutive order
- Cone** - a mass of pollen-bearing scales in gymnosperms
- Determiner** - the person who identifies a specimen for a plant collection (this could be the same person that collected the specimen, but not always)
- Duplicate** - additional specimens or sheets collected for each species of plant in a collection
- Entire** - smooth margin; having the leaf margin continuous or free from indentations
- Fascicle** - an extremely short branch that holds a small or slender bundle (as of pine needles)
- Gymnosperm** - a taxonomic class of plants that produce naked seeds not enclosed in an ovule
- Leaf** - an outgrowth from a plant stem that functions primarily in food manufacture by photosynthesis
- Leaf scar** - the mark left on a stem after a leaf falls off
- Leaflet** - one of the divisions of a compound leaf
- Lobe** - a curved or rounded projection or division of a leaf separated by a sinus (like fingers on a hand)
- Needle** - a needle-shaped leaf that is long and slender and found on conifer trees
- Node** - the place on the stem where the leaf is attached, or where a bud or leaf scar occurs
- Nut** - a hard-shelled dry fruit or seed with a separable shell and interior kernel
- Ovule** - an outgrowth of the ovary of a seed plant that encloses an embryo sac within a nucleolus; the outer shell that contains the seed (fruit or nut)
- Petiole** - a slender stem that supports the blade of a leaf
- Pith** - central strand of spongy tissue in the stems of most vascular plants that probably functions chiefly in storage of minerals and nutrients
- Pod** - the dryish fruit of some plants containing one or many seeds; the pod is usually flattened, splitting down one or both sides.
- Pubescent** - covered with fine, soft, short hairs

Rachis - an extension of the petiole of a compound leaf that bears the leaflets
Samara - a dry, usually one-seeded winged fruit
Scale - a modified form of leaf found on a gymnosperm
Serrated - having a leaf margin that is toothed, resembling the blade of a saw
Sinus - a cavity (space) on a leaf between two lobes (like the space between fingers)
Spine - a stiff pointed structure that is a modified stipule
Stipules - a pair of structures at the base of the leaf (node) in many plants
Taxa - a biological category, such as genus or species
Thorn - a short, sharp-pointed, and leafless modified branch which can occur anywhere on a twig

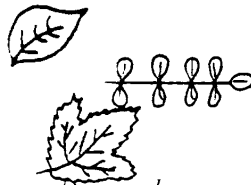
VIII. A Dichotomous Key to Trees at CRC

- 1. Leaves present all year: needle shaped (2)
- 1. Leaves not remaining on tree all year (6)
- 2. Needles in bundles on twigs (3)
- 2. Needles borne singly on twigs (5)
- 3. 5 needles in a bundle, flexible, 3-4" long; cone 4-8" long - White Pine
- 3. 2 needles in a bundle (4)
- 4. Needles 4-5" long, brittle when bent sharply; cone 4" long with smooth scales - Red Pine
- 4. Needles 3" long, stout, slightly twisted; cone 4" long with prickly scales - Scotch Pine
- 5. Needles flat, blunt; tiny cone $\frac{3}{4}$ " long - Hemlock
- 5. Needles 4 sided, sharp; cone 4-8" long with papery scales - Norway Spruce

- 6. Arrangement of leaves and branches is opposite (7)
- 6. Arrangement of leaves and branches is alternate (11)



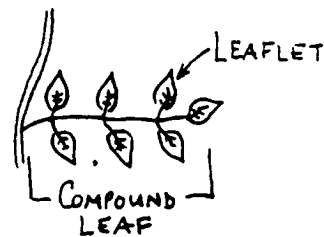
- 7. Leaves simple (8)
- 7. Leaves compound (10)




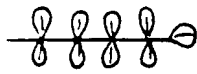
- 8. Leaves palmately lobed (9)
- 8. Leaves not lobed - Flowering Dogwood

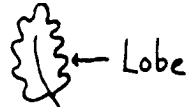
- 9. Leaves 3-5 lobes with shallow V-shaped notches between lobes; usually whitened beneath - Red Maple
- 9. Leaves mostly 5 lobed with moderately deep U-shaped notches between lobes; rarely whitened beneath - Sugar Maple

- 10. Leaflets 3-5, coarsely toothed, not white beneath - Box Elder
- 10. Leaflets 5-9, white beneath; found in upland areas - White Ash
- 10. Leaflets 7-11; leaf buds black; found in bottomland areas - Black Ash



11. Leaves simple (12) 

11. Leaves compound (23) 

12. Leaves, all or some lobed (13) 

12. Leaves all unlobed (17)

13. Fruit an acorn (14)

13. Fruit not an acorn (15)

14. Leaves, deeply lobed; bark becoming shaggy towards top of the tree - White Oak

14. Leaves, coarsely toothed, with 10 or more rounded teeth on each side; bark looks same from base to top of tree - Chestnut Oak

14. Leaves lobed less than halfway to midrib, tips of lobes are pointed; bark of tree becoming smoother towards the top - Red Oak

15. Lobes of leaves toothed on margin - Sycamore

15. Lobes of leaves smooth on margin (16)



16. Leaves all lobed - Tulip Poplar

16. Leaves lobed or unlobed on same tree - Sassafras



17. Leaves smooth or wavy on margin (18)

17. Leaves toothed along margin (19)



18. Leaves obovate to orbicular and extremely aromatic when crushed - Common Spicebush

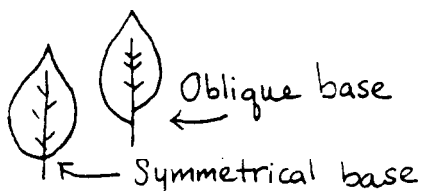
18. Leaves heart-shaped - Redbud

18. Leaves ovate to lanceolate, 5-12 cm long and abruptly short-pointed - Blackgum

18. Leaves very wavy with oblique base - Witch Hazel

19. Leaves with oblique base (20)

19. Leaves with symmetrical base (21)



20. Bark covered with warty projections - American Hackberry

20. Under-bark slimy to the touch - Slippery Elm



20. Leaves large and heart-shaped - American Basswood

21. Bark black, broken into flat, peeling scales that resemble burnt potato chips; twigs with very bitter smell - Black Cherry

21. Bark not broken into flat scales (22)

22. Bark almost black, smooth, may be peeling slightly; twigs with very strong wintergreen smell - Black Birch

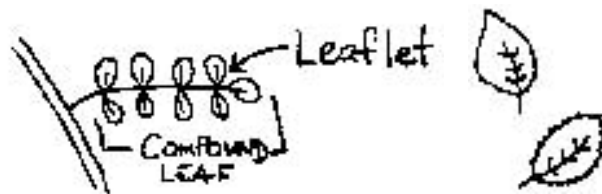
22. Leaves elliptic; bark steel gray, and very smooth; twigs without wintergreen smell - American Beech

22. Leaves with U-shaped base; trunk with distinctly muscular appearance - Ironwood

22. Leaves small, dark green; branches with long slender spines - Hawthorn

23. Leaflets with entire margins (24)

23. Leaflets with toothed margins (25)



24. Leaflets orbicular to obovate; stems thorny - Blacklocust

24. Leaflets ovate; twigs and bark with coffee-like smell - Tree of Heaven

25. Leaflets 15-23, slightly hairy beneath; bark has a braided appearance - Black Walnut

25. Leaflets 7-11 (26)

25. Leaflets 5-7 (27)

26. Bark peeling in large plates; twigs and leaves hairy - Mockernut Hickory

26. Bark not peeling, but tight; buds yellow - Bitternut Hickory

27. Bark peeling in large plates; leaves and fascicle hairy - Shagbark Hickory

27. Bark not peeling; leaves and twigs not hairy - Pignut Hickory

IX. Appendices

Appendix 1 -

- List of trees at CRC

Appendix 2 -

- Collection notebook and data form
- Collection notebook example

Appendix 3 -

- Sample of tree species fact sheets from the Virginia Tech Dendrology website

Appendix 4 -

- Tree Lore

Tree Species at the
Smithsonian National Zoological Park's
Conservation and Research Center
Front Royal, Virginia

<u>Common Name</u>	<u>Genus</u>	<u>Species</u>	<u>Species Code</u>
Red Maple	Acer	rubrum	ACRU
Sugar Maple	Acer	saccharum	ACSA
Downy Serviceberry	Amelanchier	arborea	AMAR
Pawpaw	Asimina	triloba	ASTR
Ironwood	Carpinus	caroliniana	CACA
Bitternut Hickory	Carya	cordiformis	CACO
Pignut Hickory	Carya	glabra	CAGL
Shagbark Hickory	Carya	ovata	CAOV
Mockernut Hickory	Carya	tomentosa	CATO
Eastern Redbud	Cercis	canadensis	CECA
Hackberry	Celtis	laevigata	CELA
Flowering Dogwood	Cornus	florida	COFL
Common Persimmon	Diospyros	virginiana	DIVI
American Beech	Fagus	grandifolia	FAGR
Green Ash	Fraxinus	americana	FRAM
Black Ash	Fraxinus	nigra	FRNI
Witch-hazel	Hamamelis	virginiana	HAVI
Black Walnut	Juglans	nigra	JUNI
Yellow Poplar	Liriodendron	tulipifera	LITU
Blackgum	Nyssa	sylvatica	NYSY
White Pine	Pinus	strobus	PIST
Sweet Cherry	Prunus	avium	PRAV
Black Cherry	Prunus	serotina	PRSE
White Oak	Quercus	alba	QUAL
Scarlet Oak	Quercus	coccinea	QUCO
Northern Red Oak	Quercus	rubra	QURU
Eastern Black Oak	Quercus	velutina	QUVE
Blacklocust	Robinia	pseudoacacia	ROPS
Sassafras	Sassafras	albidum	SAAL
American Basswood	Tilia	americana	TIAM
American Elm	Ulmus	americana	ULAM
Slippery Elm	Ulmus	rubra	ULRU
Blackhaw	Viburnum	prunifolium	VIPR

Data for a Collection Notebook

Date:

Collector(s):

Country/State:

Region/County:

Locality:

Lat./Long.:

Elevation

Vegetation (associated species):

Habitat description:

Collection Data

Collection number:

Duplicates:

Family:

Taxa:

Collected by:

Description:

Common name: