Marginalia

Guyton's PLT Extensions, Plant Stories and Supporting Activities

Marginalia From My Old PLT Guidebooks
This session will be a fast paced introduction to fun facts and plant stories guaranteed to enrich your workshops and pique your participant's interest! Expect a plethora of ideas, activities and extensions for PLT activities including historic uses, facts and mathematical explanations.

Indexed to PLT Activity Name and Number

John Guyton, Ed.D.
PLT Outstanding Educator 2003
Associate Extension Professor
Wildlife and Fisheries Department
Mississippi State University

International PLT Coordinators Conference
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Marginalia Contents

Introduction

PLT *is* one of the great portals into the outdoor world of children and adults. I often catch myself using short PLT activities during teachable moments in other workshops. And, in PLT workshops and facilitator trainings I find many opportunities to interject other activities, fun facts and extensions. I leafed through my old worn and torn PLT guides and extract all of the teachable moment notes that I have scribbled in the margins over the years. Many of these are extensions or stories that can be used to extend the lessons. I have a cedar-apple gall in my resource box as an example of why apple growers sought the extinction of cedar trees, a thorny twig from a Osage-orange that inspired the creation of barbed wire, Lycopodium (clubmoss) spores, lichens and willow bark for headache!

The **thorny twig on the cover** is ***solar barb wire*** – actually a twig from a Bois d'arc or Osage-orange tree that grows on the hedge row bordering our little piece of the Black Belt Prairie in Mayhew, MS. These trees form natural and inpenetratable fences and their thorns were the inspiration for barbed wire.

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The United States at Night: NOAA/ NGDC, DMSP Digital Archive
Lycopodium Illustration: USDA

Diversity

1 The Shape of Things - Winter is a good time to study tree shapes - void of the leaves it is easy to see what a tree looks like. Great opportunity for students to use stick figures and shapes to draw trees. A vase for elm is a natural. If you used shapes to draw a naked tree what shapes might be most useful for different trees? What shapes might be most useful when the tree is fully clothed in the summer? Maybe ovals for white oak leaves and triangles for red? A tree field guide or ID book that also showing bark or tree branching patterns may make it easier to decide what tree you are looking at.

2 Get in Touch With Trees - <u>While blindfolded</u> do a bark rubbing and then use the rubbing while looking for your tree. Later in class combine the bark rubbings into tree bark identification guide book. Good extension for building an awareness of how blind classmates perceive or differentiate trees. Harold Anderson, Mississippi PLT Coordinator has made trail signs shaped like leaves with veins for use on nature trails for blind students as well as other activities such as sandblasted tree cookies to remove some of the soft wood, so it is easier to feel the rings.

3 The Peppermint Beetle - How does the forest smell on different days or during different seasons. On low pressure days smells are much more obvious than high pressure. Woods often have a more earthy smell before a rain or during low pressure days. Sometimes blindfolds are useful in helping us focus on smells. List what you smell on different days and record the barometric pressure for those days.

4 Sounds Around - Sounds are sharper and carry further during low pressure days and birds seem to sing louder. Make a list of the sounds you hear while sitting silently noting the barometric pressure on each day's observations. Not only can our ears help us determining where a sound comes from but with a minimal amount of brain power we can tell how far away a lightning is. Count the number of seconds between a lightening flash and when you hear thunder and divide by five for the approximate distance in miles.

I saw a segment on TV where a blind boy clicked his tongue and used echolocation to identify obstacles while walking and running! Stand near a wall close your eyes and give it a try. Now repeat this in the dark while you walk toward the wall. In the segment he could differentiate trees and buildings and even counters and chairs!

Sounds are useful in identifying insects. Google the sonograms for crickets. Each species has a different chirp and you can compare the sounds you hear with those recorded on web sites to determine which species you have in your area. With proper equipment you can record crickets chirps and compart their sonograms with those archived on the web.

5 Poet-Tree - Invite each student to write a poem that could be used to describe a particular type of tree using the trees name in the poem. Combine the classes work into a poets field guide to trees. Suggest using park patterns, leaf and bud scars and branch patterns and leaves.

6 Picture This - It is easier to see the diversity of a woods when the leaves are on the ground. Have students go outside and draw something: a tree, bush, grass. Then assemble these into a winter bulletin board and look at the diversity is the shapes of the different trees and things.

7 Habitat Pen Pals - Arrange a list of trees typically found in each habitat from the arctic to the equator. Find pictures of these trees and see if a greater percentage of trees in colder climates have toothed leaves. National Geographic is a good source of pictures with a map showing the relative latitude. Or better, search for schools at different latitudes with web sites and see there is a science teacher that will swap some leaves with you of help make a comparison.

8 The Forest of S. T. Shrew - I guess this entire article is my response and I can certainly identify with Jackie in *The Forest of S.T. Shrew*, "She wanted to stop and talk to them..."

As a demonstration hold a millipede loosely in a paper towel and shake, then note the pleasant almond small. This odor is toxic to beetles, shrews and other predators. It was discovered in the late 1800s that in a jar the millipede's cyanide defensive chemical will kill other insects.

9 Planet Diversity - If different habitats, or stages of succession, are available have different groups visit each. Tell them the story about the blind men that each examined a different part of an elephant arriving at different conclusions.

Also fun to completely clear a 1 meter x 1 meter patch of school yard and use silt fencing to protect it and see what grows there - thousands of seeds are lying

dormant just waiting for conditions to allow them to grow.

How do you restore a prairie? Quit mowing it and watch the prairie return.

Planet diversity evaluation - how many places on Mars should we explore and why?

10 Charting Diversity - Insects are great here - in most places everyone can find a variety of insects, arachnids or an isopod. How many orders did we find? They can be captured in paper cups and a digital camera used to record the finds before their release. You will be surprised how much diversity is on many schools' yards. A school *Bioblitz*. Make a virtual collection or record of the biodiversity in the school yard.

11 Can it be Real? - A great extension to this activity that encourages problem solving is to provide groups of students with pictures of insect with interesting characteristics and have them *brainstorm a list of possible reasons for each adaptation*. The wheel bug, firefly, water scorpion and walking stick are good examples - and there are so many more.

12 Invasive Species - It is very important when doing this activity to bring some example of invasive species with you - 2 or 3 will suffice . I always take privet and usually mullein or buckhorn that were brought over from Europe by early European settlers. Children will learn 2 or 3. Too many is as bad as not bringing any. . .

I use a chewed Plantigo (buckhorn - not kin to the banana, (*Plantago lanceolata*) leaf held on minor cuts, scrapes or splinters for about 10 minutes to speed the healing or shrinking the skin exposing the splinter. It has antibacterial and antifungal properties. Plantigo can be used as a bitter green in a salad.

It is much fun to take students to a grocery store, at a time the store is not too busy, and set up a shelf displaying the products of different countries. This is fun for customers, educational for the children and a great cultural connection.

13 We all Need Trees - Outstanding activity. I try to bring in a few unusual examples. I enjoy bringing in a short branch from a bois d'arc or Osage-orange with those incredible thorns! Doesn't take children long to figure out this was where the idea from barb wire came from. A dethorned branch about 4 feet long and 1 inch in diameter makes a fair bow - forget the arrows just let them feel the springiness of the wood when they pull the string back. A

variety of woods could be displayed to show their different properties. My favorite woods to mention is adult workshops are white and red oak - wine barrels are made out of white oak but the bungs are made out of red. Clip a small twig of each before hand and allow them to dip one end of each in a cup of soapy water and blow through the other end. You can blow through the red oak, noting a characteristic of its vascular structure - and the reason bungs are made of red oak - they allow the carbon dioxide from fermentation to escape thus reducing the chances the barrel of wine will explode, wasting the wine! The white oak is better at not leaking. We just use the activity without wine reference with children.

14 Renewable or Not? - Give each child a package of native plant seeds (annuals) to take home. You could go over where to plant them and how to take care of them or leave it to them to research (not my favorite - just tell them!). Explain that they are only renewable if they plant and later harvest the seeds which they will replant over and over again. I live in the black belt prairie so I use prairie seeds...

15 A Few of My Favorite Things - This activity is much older than PLT and has had many names and variations. I still like a piece of the "Trace the Roots" version were students make a poster showing how their product got from the natural resources to where it is today and where it will end up and then acting it out.

16 Pass the Plants, Please - Children will try out plants that are good for them if you approach them right. One important group of vegetables originated with Wild cabbage (*Brassica oleracea*) a native of coastal western and southern Europe. Wild cabbage has yielded a plethora of different vegetables from gardeners selecting and replanting seed from plants with characteristics they wanted to enhance: kale most closely resembles the original plant, cabbage displays enlarged **terminal buds**, brussels sprouts represent numerous **lateral buds**, kohlrabi an enlarged **stem**, cauliflower an extensive **flower**ing structure (whiteness caused by outer leaves blocking sunlight) and broccoli with enlarged **stems and flower** structure and collards were developed to have large thick **leaves**. Wild cabbage has been in cultivation for over 2500 years dating back to Greek and Roman times. Today there are hundreds of cultivars. Gather a variety of seasonings, some cheese, bacon, oil and cooking vessels and each of the wild cabbage descendants and engage children in finding a way to cook each to find a way they can enjoy it. Check with the Extension service in your state to see if they have a demonstration kitchen in the county where you are doing your training and ask permission to do it there.

17 People of the Forest - It is amazing how many family names are forest related - Ash, Balken (Balk-beam or timber), Becher (German for one who turns wood or goblets), Benders, Branch, Carpenter, Cartwright, Carver, Coopers, Decker, Groves, Hoopers, Hunter, Hurst (Middle English place meaning "thicket of trees), Forest, Forester, Hatch, Holt (means "a wood" or "grove" in Old English or German), Joiner, Linwood (stream forest), Lockwood (enclosed forest), Lund (from Old Norse *lundr* "grove of trees"), Oakley (oak clearning), Ogden (oak valley), Parker (game keeper of a park or woods), Perry (from Old English for pear tree), Plank (lived near plank over a stream) Reed, Rowntree (live near a rowan tree or mountain ash), Ryder (Old English for mounted forest officer), Sawyer,, Skinner, Spooner (maker of wooden spoons or shingles), Stoud (thicket), Tanner, Thatcher (roofer, thatcher), Thorn, Timberlake, Turner, Underwood, Vine, Walton (wood town), Wright, Wood, Woodson, Woodward, Walden (from German for forest), Wheeler,

Continue adding to this list as the decedents of ancient forest people show up in your workshops. I left some space for your additions.

Even Linnaeus's (father of taxonomy) name was taken from the Linden trees on his family farm! This is fun!

18 Tale of the Sun - We are fortunate to live in a part of the world that experiences fall colors, thanks to our deciduous trees and temperate climate! Fall leaf color is characteristic of particular tree species and is influenced by temperature, moisture, hours of sunlight, leaf sugar, disease and other factors. Most of earth does not experience the fall colors we enjoy. So have your participants write a story conveying our enjoyment of trees fall coats.

As a side bar – this may be a good place to show participants what the black widow and brown recluse spiders look like.

19 Viewpoints on the Line - Listen to a political speech and rate each line as fact or opinion. Make a list of promises and keep in a place where you can find it later, if they are elected.

20 Environmental Exchange Box - What about pine cones, rocks and minerals, state symbols, sand, twigs with buds and bud scars from trees indigenous to the area, a set of indigenous leaves sealed in clear shelf paper for a leaf relay, seed pods such as helicopters, a magnolia or sweet gum, ... Besides tree cookies what about sharing twigs with buds...

Interrelationships

21 Adopt a Tree - The sap from liquidamber or sweet gum trees was chewed by my mother's generation, I enjoy chewing on sassafras twigs and when I have a headache willow twigs, the resin that drips from sugar pine cones when you roast them to make them less sticky is absolutely delicious and a marketable product waiting to happen, redbud blooms are edible... Take time to stop and eat a pecan. The small native ones are very oily and much more delicious than some of the larger hybrids.

Learn to tell the difference in male and female trees. City arborists are wont to plant make trees since the females are so messy, however, the increasing asthma problems are in part due to the overabundance of males dispensing their pollen.

22 Trees as Habitats - Examine an old falling apart bird nest and see if you can find the plants the birds used to make the nest. Jays often incorporate a piece of white material (paper or cloth in urban areas) or light colored lichens or bark into the outside of their nests. Starlings and house sparrows incorporate neem twigs in their nest to combat ticks and mites. Squirrels nest are easy to spot.

Hawks can often be seen sitting high in a tree before a rain. They are incredible meteorologists and know it is about to rain so they watch for mice, that know stream levels are about to rise and heading for higher ground, and eat a few!

Some shelf lichens have growth rings however these sometime are not annular. Other shelf fungus can be uses to draw pictures on the underside of - they will later harden and if kept dry will last for centuries. Resurrection fern is wonderful. Once while doing a workshop with Harold Anderson, Mississippi's PLT coordinator, at a church preschool we provided the teachers with a great set of activities and a religious experience when we placed a piece of dried resurrection fern, one teacher had pulled off a tree, in a bowl of water. By the end of the workshop it had revived.

Spanish moss, not Spanish or a moss, but a plant in the pineapple family, is sensitive to air pollution and therefore serves as a reliable indicator.

Moss is more common on the moist side of trees than the north and lichens can be somewhat indicative of the direction from which the wind blows.

23 The Fallen Log - Kick apart just enough of an old stump to find some termites. Draw circles on paper with several ink pens and sprinkle some termites on the paper. If you are lucky one of the pens will use an ink with a pheromone the termites will find interesting enough to line up on and follow in a circle! We call this a termite circus.

In natural forest situations, bark beetles role is to selectively remove over mature, stressed or damaged pines thus setting the stage for ecological succession. Ips or engraver beetles, are bark beetles that develop under the bark of pine or spruce trees and tunnel through the tree, damaging and eventually killing them. Ips egg galleries are beautiful and identifiable by their Y or H shaped patterns that radiate out from a central camber on the underside of bark plates. There are other bark beetles as well.

24 Nature's Recyclers - The rolly pollies (*Armadillidium vulgare*) also known as pill bugs or sow bugs are an isopod that arrived from Europe as a hitchhiker probably in straw used for animal feed. Rolly pollies are known to most people from their childhood because of their defensive posture of rolling up into a small ball. They hide in the moist shade of leaves or under rocks or logs during the day and forage for detritus after dark. If you see a rolly polly in the daylight it may be infected with a thorny-headed parasitic worm (*Plagiorhyncus cylindraceus*) they share with English starlings. The worm lives in the digestive track of the starling and its eggs are shed in the starling's feces. The rolly pollies eat bird feces with other detritus including the eggs where they begin to grow. When it has developed to the point where further development requires its alternative host, the starling, it causes the rolly polly to venture out into the daylight where it is easy prey.

The wonderful **smell we associate with soil** is actually produced by actinomycetes, a filamentous bacteria.

25 Birds and Worms - Insects are the camouflage experts on the planet. Provide students with some field guides and allow them to speculate on how they use camouflage. Be sure to point out that some use mimicry to discourage predators including moths that look like snakes or owls!

26 Dynamic Duos - Moths are active at night and butterflies during the day. Most night blooming flowers that are pollinated by moths are white because colors are not as visible during the night and nature does not waste its resources.

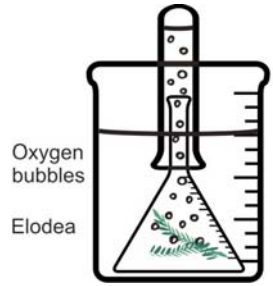
There are several common American silkworms that produce usable silk including: the cecropia moth (*Samia cecropia*), the largest North American moth and Glover's silkworm (*Samia gloveri,*), the promethea moth (*Callosamia promethea*), the polyphemus moth (*Telea polyphemus*), the io moth (*Automeris io*) and the luna moth (*Actias luna*). Do a little research and see which are found in your area and what trees they utilize. Find several of these trees near your home and watch them for the cocoons. After the moth emerges you will notice its exit hole. Collect these cocoons and drop them in boiling water and tease apart with a skewer. The silk strands will be broken because of the hole through the cocoon but students will get the idea. The mulberry tree is an important tree for silk production. Silk producers harvest the cocoons before the math emerges and sacrifice the moth.

Demonstrate nature does not waist its resources. White is not a pigment in nature and white flowers are white because of the refraction of light in the air filled cells of the flower. See my book to be released next year!

27 Every Tree for Itself - My fellow facilitators are very patient with me and even seem to enjoy it when my tree rings are actually replaced by dots and I claim to have been born near the equator where the growing season is continuous and rings not as prevalent! Then, I show some palm wood - sometimes a piece of wood and sometimes a piece of petrified palm wood. A piece of palm wood should be in every facilitators kit. The picture is of a piece of petrified palm wood that I cut in half to show the vascular structure.

Petrified wood forms after a tree dies and is quickly buried in sand. Minerals in groundwater (silica and trace elements that sometime produce vibrant colors) permeated the wood and slowly replacing the original organic material cell by cell until the wood is completely replaced and turned to stone. The minerals replace the wood on such a microscopic level that the structure of the wood was preserved in amazing detail. Petrified palm wood dates to the Oligocene Epoch, between 20 - 40 million years ago.

Pick a tree your own age. The age of some pine trees (fir, spruce and others) can be estimated by counting the number of whorls of branches. Many trees produce one whorl of branches per year. Trees less than 20, or so, years old work best since they have not yet shed many branches. Trees grow from their tip, so the earlier branches remain at the same height. Rainfall data can be correlated with the spacing of the whorls.



28 Air Plants - Place a sprig of Elodea (available at most aquarium shops) under an inverted funnel in a flask of water with a water filled test tube on the funnel spout. Easiest to assemble the entire apparatus under water in a sink to make sure no air is in inverted test tube. Then place in a sunny window. As photosynthesis produces oxygen it accumulates in the test tube. The test for oxygen is to right the test tube (oxygen is heavier than air) and stick a glowing splinter into it - where it will burst into flames in the oxygen.

29 Rain Reasons - The next time you see cottonwood seeds blowing in the wind collect a hand full. In fact you should always know where and when to collect these valuable seeds. Cottonwood seeds germinate quickly when they land on moist sand. Use this activity first in your workshops and place several on moist sand - near the end of the workshop examine the seeds with a magnifying glass looking for tiny leaves or roots.

If you happen to be doing a workshop on a rainy day, place similar sized cans under a large tree and in a field as an experiment to see if the same amount of rain reaches the ground under the tree as in the field (control). Determining if different species of trees affect the amount of water that reaches the ground is another experiment you could do with this activity.

30 Three Cheers for Trees - Hand a thermometer under a large leafed deciduous tree and another in a field on a sunny workshop day and compare. Evaporative cooling from the tree will be much in evidence! A mature tree can transpire more than 200 gallons of water per day while it is actively growing. Put a clear plastic bag over a branch with leaves and seal to the limb with a twist tie. Within a few hours you should begin to see water condensing inside the bag.

Bag the limb before the workshop and visit it during the morning break after doing this activity. Provide assorted fruits during the break.

Not so commonly known is that nurseries most often only sell male trees for use in cities because city workers object to having to deal with the fruit from the females. Of course citizens with respiratory problems are done no favors because of the disproportionately more pollen produced by the disproportionately more male trees.

31 Plant a Tree - The deeper you walk into a woods the more the city sounds fade... The tree you decide to plant is very important. Pine trees are not good trees to plant near your house or in a city because they get too tall and large and do a lot of damage when they fall. Select trees that do not get more than 40 feet tall. After Katrina I saw a lot of houses that were severely damaged by pine trees that should not have been planted in such close proximity to homes. Many of these trees were given out at Arbor Day and Earth Day ceremonies and conservation field days.

Trees have magnificent ways of protecting and distributing their seeds. Maple, ash, elm, catalpa, pine, tree of heaven, basswood, and box elder seeds have wings. Always stop and collect a few when you see them, for demonstrations. Do they all rotate in the same direction? Which ones travel the longest distance? Drop several of each species from the same height and determine an average for each species.

The Franklin Tree – William Bartram, later the first naturalist spokesperson for the US and his father, John, are credited with saving the *Franklinia alatamaha* (named for Ben Franklin a family friend), found along the banks of the Altamaha River in Georgia in 1770, from becoming extinct. The Franklin Tree became extinct in the wild about the time cotton was introduced. The wilt caused by *Phytophthora cinnamoni* (a root-rotting fungi associated with cotton plants) accompanied cotton and is credited with the demise of wild Franklin Trees. All Franklin Trees today are derived from the plants collected by the Bartrams. Recently a group of Bartram afficionados planted about a dozen Franklinias on the banks of the Altamaha River. The *Franklinia* that grows 10 to 20 feet height and is hardy in Zones 5 to 8 or 9 may perform best in an above ground planter where fungi are less of a problem.

32 A Forest of Many Uses - Invite a deer hunter to visit the classroom and bring some antlers to demonstrate rattling - Bucks will fight each other for a doe and the rattling of their antlers will attract other deer in the area. Ask a wildlife biologist to bring a set of plastic deer jaws and demonstrate how they are used to determine the age of a deer. Hunting is one of the few management techniques that control the size of deer populations. When populations grow too large, as they are now, the number of deer auto collisions increases. Trappers, for USDA Wildlife Services provide a valuable management strategy when other animals become a problem such as when beavers build dams flooding farmlands and roads. Virtually all early conservationists and environmentalist were hunters and most of our conservation laws resulted from their interest in conserving wildlife.
The wood from different trees is very different and there are different uses for different woods. Some, such as sassafras have insecticidal properties and was

used as cabin flooring to discourage insects. Osage-orange is very hard and resistant to decay so it has been used as railroad ties; they were also planted close together and even pulled down, or laid, to grow more horizontally thus forming a hedge or fence. The thorns of the Osage-orange is where the idea for barbed wire came from. The Osage-orange wood is very flexible and was used by Native Americans for making bows. Pine grows very fast so it is an ideal wood to grow and use for building the thousands of houses built every year. Oaks provide a hard wood often used in fine furniture, and their acorns sustain the squirrels and jays. Every tree has a use! Dogwood tree twigs, during an earlier time, were chewed and used for toothbrushes. Resinous pine knots are useful in starting fires. Check with someone who cuts firewood or a sawyer at a local sawmill to see what kind of woods are used in your area. They will most likely give you some small samples. Research the natural history of these woods to see how they have been historically used. What are the historical uses of the tree cookies in your collection?

33 Forest Consequences - To better understand the land needs for wildlife, draw circles on aerial photographs of land that contains streams, roads, fields and forest. Draw a vertical and horizontal line through each circle and sum the number of different the ecosystems, or stages of succession, change along these two lines. Generally speaking the greater the number the better the environment for wildlife. An area completely covered by forest is not the best habitat for most wildlife. *See activity # 50.*

34 Who Works in the Forest - would be an excellent activity to use before a forestry field day when you could invite some of the following professionals to manage various stations. Who really understands the needs of the forest and its natural inhabitants? Turkey hunters are often awake before the forest inhabitants and enjoy watching the forest wake up. Deer and squirrel hunters know the food plants and understand acorn cycles. Anglers understand the influence of weather on fish and when they will be biting and what they will be eating. A logger or sawyer could discuss what woods are valuable in the construction industry. A biologist from a tree nursery and a tree farmer could relay what trees are being grown for what purposes today. Naturalists, foresters or wildlife biologists could bring turtles, snakes and many other animals to the field day and describe their habitat requirements.

35 Loving It Too Much - There are a variety of places set aside to protect our natural resources and each has unique and common functions. Before using this activity check to see which ones are in the area where you will be teaching and ask them for their pamphlets. Might also check to see if they have a PLT facilitator on staff who would like to assist you with the workshop. There are National and State Parks, National Wildlife Refuges, National Estuarine Research Reserves, Wilderness Areas, US Fish and Wildlife Services, Bureau of Land Management, USDA Wildlife Services, National Forests and others. Find out which ones are near you and what the opportunities and restrictions are on them.

36 Pollution Search - Check with your states chapter of Keep America Beautiful and see if they have a *Litter Free Events* program. It usually comes in the form of a brochure describing how to manage litter free events such as ball games and field days. Students can immediately implement such a plan at their schools. Check and see if your community host household hazardous waste turn in days and help them advertise it. Identify illegal dump sites where tires, appliances and etc. are being dumped on a map and notify your state department of environmental quality of their location.

37 Reduce, Reuse, Recycle - Gary Anderson, a graphic arts student won a design contest for his 3 chasing arrows, inspired by the Mobius strip, designed by a mathematician, named Mobius, devised a surface that had only 1 side, and no end. Fold up a double wide piece of newspaper into a long 2 inch wide band. Form it into a ring and flip one end over and tape the two ends together. Start at any point near the center of the 2 inch band with a marker and begin drawing a line down the band - eventually you will notice there is not an inside and an outside - they are the same - a Mobius strip. Next gently fold the Mobius strip into a flat triangle noting that as a recycling symbol there isno end to a products life when it is continually recycled!

38 Every Drop Counts - Set up a rain barrel with a piece of plastic window screen over the top to keep leaves and insects out of it and use it for watering plants in various classrooms or the outdoor classroom.

39 Energy Sleuths - Electricity has been generated using nuclear energy for over 50 years and now generates as much global electricity as was produced then by all sources. Two-thirds of world population lives in nations where nuclear power plants are an integral producer of electricity. Half the world's population live in countries where nuclear power reactors are being planned or

are under construction. A rapid expansion of global nuclear power is underway. Currently there are approximately 440 nuclear reactors produce electricity world wide. Over 15 countries use nuclear power for 25%, or more, of their electricity. In Europe and Japan nuclear power is used for over 30% of their electricity. In the U.S. nuclear power produces 20% of our electricity. – *World Nuclear Association*

This activity is a great companion to a hands-on activity where energy sources are explored.
Most woodworkers are tinkerers, by nature, and every PLT coordinator who is not a woodworker should befriend one. Solar cookers are easy to make. windmills can be simulated with pinwheels, water can be siphoned from a high shelf and the falling water flowing from the end of a tube could be directed against the pinwheel demonstrating how falling water (from gravity) turns the fan that is connected to a generator that coverts the energy to electricity.

The heat content of various woods, fuel oil and coal can easily be measured with a homemade apparatus. Geothermal energy takes advantage of heat energy in rocks underground. Campers in cold climates have long heated rocks in their campfires and then wrapped them in a towel as foot warmers for their sleeping bags.

My favorite biofuel demo is to push a stick into the muck on the bottom of a swamp while igniting the methane bubbles that reach the surface. The methane is trapped underground by organic materials that are breaking down.

Ethanol is easy to distill from any fermenting brew. Gently heat the fermenting brew but do not allow it to even get close to a boil. Place a glass in the center bottom of the boiler to collect the alcohol that condenses on the bottom of, and drips from, an ice filled bowl set on top of the boiler.

Most states have a society of nuclear engineers and most have a couple engineers who will be happy to visit a few schools. If you ask they will bring some common radioactive materials and a Geiger counter. Google them up.

Model hydrogen cars, that use a fuel cell to produce electricity to run the electric motor that drives the wheels, are relatively inexpensive.

Many nuts can be easily ignited to demonstrate the use of a natural oil for fuel. Light a brazil nut, cashew, pecan, etc.

40 Then and Now - Check several Foxfire books out of the library and look at the topics investigated to give you some additional interview questions for the senior citizens. What medicinal plants did they use? How big were the trees when they were young? How did they heat their homes?

Systems

41 How Plants Grow - The effect of or need for water can be demonstrated with resurrection fern during a workshop. Harold Anderson, Mississippi PLT coordinator, and I were doing a workshop at a church preschool in Ocean Springs, MS when a teacher pulled some resurrection fern from a live oak commenting they really should clean up their school yard... I immediately stopped her and had her bring the brown resurrection fern inside where we put it in a bowl of water. By the end of the workshop it was green and revived and the teachers got a great set of activities (PLT) and had a religious experience to boot!

Willow tea (tea made by soaking willow twigs in water) is a very effective rooting compound.

Be sure to take some Kalancho or jade plant leaves for the participants to propagate. Roses are very easy to propagate. Clip off a 6 to 8 inch stem at least the size of a pencil in diameter and place in moist sand. After a few weeks it will have begun to grow roots and can be transplanted to the outdoor classroom.

Fast grow mustard seeds are available and they will grow from seeds to producing seeds in 30 days.

42 Sunlight and Shades of Green - Cover part of a leaf with aluminum foil, held in place by a paperclip for a day or two before a workshop. Then to observe the effect of sunlight on chlorophyll development remove the foil and note the faded portion of the leaf.

Raise your arms, wiggle your fingers. Where did you get the energy to do this? Breakfast, right? Wrong - the energy just passed through breakfast. Energy originated with the sun and has now reached you. Where is the energy now that you have let your arms down and stopped wiggling your fingers? You actually converted that energy to heat and transferred some of it to the air. Yep, you warmed the room up a tiny bit... All of the energy we need comes from the sun and plants are the original solar collectors.

43 Have Seeds Will Travel - Find a cottonwood tree near where you live or work and watch for its seeds to begin their aerial journey. Collect a few hundred and keep in a paper bag. During a workshop when you will be using this activity place some seeds on moist sand in a pan or bowl. Use a and lens to periodically inspect them because they will start rooting and leafing within a few hours.

Consider a seed relay where teams try to keep a seed in the air as they run a obstacle course blowing on the seed to keep it aloft.

Pine cones close up during moist weather to protect their seeds and open on sunny days when conditions are ideal to distribute the seeds.

Why do we see so many evergreen trees along fence rows? Seeds have been traveling in bird taxis!

44 Water Wonders - The following sampling technique has become a popular way this activity is introduced in Mississippi. Toss out a blow-up globe and have each of 10 people report how many fingers landed in the water. Sum these 10 samples to determine the approximate amount of water on earth.

The Earth As An Apple is another way we introduce this activity

$ Slice an apple into quarters and set three aside representing the oceans.
$ Cut the remaining quarter (representing the earth's land area) in half. Set one section aside. This portion represents uninhabitable land - polar areas, deserts, swamps and high mountains.
$ The remaining portion (1/8 of the original apple) represents land where people live. Slice it into four sections. Set aside three of these sections (3/32 of the apple) that represent areas too rocky, wet, cold, steep, or populated to grow food and land covered with homes, businesses, highways and parking lots.
$ Carefully peel the skin off the remaining section (1/32 of the apple). This tiny peel represents the portion of the earth's land that is cultivated. It is typically less than 5 feet deep and erosion is quickly reducing this. It takes from 100 to 500 years to create an inch of topsoil. “And, if we are not careful,” earing the sliver, “we will lose it!”

Zip top bags with a little water in them and taped to the classroom window will work as a water cycle demonstration for those students longing to be outdoors!

Making a cloud is a real attention getter! Pour a few tablespoons of water in a 5 gallon water bottle and then strike a match and drop it into the bottle. Use a tire pump with the inflated stuck through a hole drilled in the bottle cap to quickly

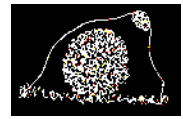
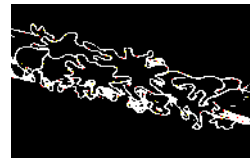
pressurize the bottle. When the top blows off the pressure will drop and a cloud will form. When high pressure moves back into the region (bottle) - put the top back on and repressurize - the clouds dissipate.

45 Web of Life - Lichens are an incredible group of plants to introduce within this activity. Reindeer moss, a lichen, is common from very high latitudes to the gulf coast is eaten be reindeer. Lichens represent one of the great symbiotic stories where representatives of two Kingdoms a fungi and an algae bond for life - "Alice Algae and Freddie Fungus took a lichen to each other." Alice was good at producing food from sunlight and Freddy, who was a house builder, and not a good cook, blew into town.

Lichens can be useful in determining when a stone wall was built by measuring its radius (center to edge) since they grow about 0.4 - 0.5 mm per year. Lichens begin growing on rock walls almost immediately after they are constructed.

Lichens can be used to determine air quality.

Lichen Types and Sensitivity to Pollution

Lichen Form & Examples	Sensitivity to Air Pollution	Characteristics	Illustration
Crustose map, bark barnacle, dust	least sensitive, can exist when air quality is poor	Crust like, entire body tightly adhered to substrate	
Foliose hanging leaf, lungwort,	intermediately sensitive air quality good	Flat leaf like or has distinct lobes, typically grey or green, bilaterally symmetric, partially attached to substrate by rhizines	
Fruticose British soldiers, old man's beard reindeer lichen	most sensitive air quality very good	miniature shrub, hair or strap like with free standing branching tubes - well developed 3-D form, firmly attached to substrate	

A pine tree with bark beetles makes another outstanding example for this lesson.

Look for the pitch tubes and pull off a bark plate to show students the "engravings" underneath. The tree is about dead so don't worry about this damaging it.

This is the perfect activity to lead into my Exotics in the Web of Life. Have students hold the web string tight and stumble through it or snip some strings with scissors watching students fall backward while describing the impact of non-indigenous species, that move into new environments without their predators, on plants and animals in their native environments.

It is very interesting to see how many insects in different orders can be collected on sumac or goldenrod. Use an insect ID book to see which are predators and which are prey.

46 School Yard Safari - Look at stages of succession on the school yard. You could use this activity before doing a Bioblitz. Will probably see more insects than other wildlife. List them by common name and quantify by orders present.

47 Are Vacant Lots Vacant? - A weed ID book is a handy book to have in your resource kit.

Narrow-leaved plantain or buckhorn (*Plantago lanceolata*) was brought to the New World by the first Europeans as a medicinal plant. It is now common in every state including Alaska and Hawaii and most of Canada. It can be eaten in a salad as a bitter green or drunk as leaf tea to help with coughs or diarrhea. But my favorite use is as a quick healer. Most species of Plantago have similar properties. Place a chewed leaf over a wound and hold it there for about 10 minutes. A longer time will give you a tannin tattoo. Try this out and learn this weed and you will always have a first aid kit nearby and a neat story to share.

If there is a berry bush you have a snack bar; a tree, an evaporative cooling unit.

48 Field, Forest And Stream - **Sunlight** - toss a clipboard with a sheet of graph paper on it onto the forest floor on a day when shadows are well defined. Sketch around the margins of places the sunlight is reaching the paper. Figure what percentage of the paper, or forest floor, is receiving direct sunlight.
Temperature - compare temperature in a field and forest.
Plant life - observe and point out plants in different stages of succession.

49 Tropical Treehouse - Sunlight activity from # 48.

Tropical trees grow all year so they do not have growth rings.
Conifers are more common at northern latitudes and their inverted cone shapes are ideal for capturing sunlight at those higher latitudes.
Plants in a forest are stacked and arranged in such a fashion that they get the sunlight they need. Where there are no leaves there is not enough sunlight.

Eat a tree
See list of edible tree parts, ***PLT Workshop Snacks,*** at end of booklet.

50 400-Acre Woods - Draw a circle on an aerial photograph with vertical and horizontal lines through it. Then sum the number of times the vertical and horizontal lines cross into an area in a different successional stage - this is easier than it sounds. If you count 6 to 12 changes in successional levels in the illustration you have the idea.

51 Make Your Own Paper

- As a state PLT coordinator you should know where the nearest paper mill is. If it is close consider asking them to help sponsor or participate in PLT workshops and suggest they bring some wood pulp to use in making paper.

If you are going to use your recycled paper for greeting cards incorporate some flower seeds in the pulp so the card can be planted and breakdown as the flower seed sprout and grow. Some seed work better than others by not germinating while the paper is being made.

52 A Look at Aluminum - All state coordinators should have a piece of bauxite, or aluminum ore, and I have samples for you.

53 On the Move - Identify as many trees on a map of the city as possible. Describe how to get to school by describing a tree at each turn. What kind of tree, descriptive characteristics, etc. Are there good shade trees at bus stops?

Is there a bike lane or space available for one? Consider doing a survey to see if there is enough interest in creating a bike lane, then approach the city council or board of alderman with your proposal.

54 I'd Like to Visit a Place Where... Find a tree at each special place and learn its name where it originated and a use for it.

55 Planning the Ideal Community - Provide students with tree field guides and invite them to select trees they would like to grow in their community. Encourage them to consider the height of the tree and other factors including evergreen as a wind break or sound screen or deciduous trees for energy conservation on the south side of houses or playgrounds that will allow sunlight in during the winter and provide shade during the summer.

Would you prefer male or female trees. Female trees provide fruit, male trees pollen. Allow them to leaf through an edible plants book to see if they would be interested in some edible plants in their community.

56 We Can Work It Out - Introduce and watch for examples of **Gerrymandering** – where redistricting is manipulated for an electoral advantage. Photo copy sample maps and add to your resource kit.

57 Democracy in Action - Select an appropriate plant for your group's coat of arms. Maybe an evergreen tree for continuous growth, strangler fig for a dominating group, Fleur de lys (Iris) for purity, rose (*sub rosa* - under the rose) for secret, etc.

58 There Ought to be a Law - Start a bicycling club and lobby the city for bike lanes or start a petition to make your community smoke free. Investigate the benefits for your city to become an Urban and Community Forest certified city.

59 Power of Print - I had access to an article clipping service in a former job and had environmental articles clipped for this activity. I am careful to collect the articles after each use and the comments that invariable get made on them are sometimes quite useful to the next reader!

60 Publicize It! - Suggest students take an inventory of the downtown trees with a local forester or Extension agent. Then research the natural history of each tree and write a story about its virtues or uses. Publish these in the town newspaper. These could also be bound into a book.

Structure and Scale

61 The Closer You Look - Have students take a digital picture of each tree showing as many characteristics from the list of observations in the activity as possible. They could then incorporate their photos into a page for a tree identification book describing their observations below the picture.

62 To Be a Tree - We have created outdoor classroom tree ID guides by stenciling leaves on the benches and writing their name beside them.

I once saw this activity done by selecting a "heartwood" leader who was subsequently wrapped in layers (blanket and green sheet), straws were thrown in for vascular structure, gummy worms were tossed in with the statement that the tree was getting pretty old, it was then loosely wrapped in rope to represent vines and appropriately adorned with leaves. This was absolutely hilarious with teachers! Oh, water was sprinkled on instead of the syrup, representing sap, much to the delight of the volunteer! And, when someone was dispatched to get the chain saw the tree became very animated!

Give each student a twig from a red oak and a white oak and let them dip one end of each in a glass of soapy water. They will be able to blow throw the red oak making bubbles but not the white demonstrating different vascular structures.

63 Tree Factory - This activity can be repeated later by adding a few new consumers or partners - fungi to the roots to aid in nutrient and water absorption and these can connect several trees together, mistletoe (I carry a piece of wood in my resource box that has both oak and mistletoe haustoria in the same piece), lichens and mosses. Birds and bees can inhabit the tree, or beetles. Fun to end the activity with the largest teacher or student representing a bear that is going to climb the tree to get at a bee hive.

Insecticidal Spices – The molecules responsible for black pepper, red pepper, ginger, mace, clove, nutmeg and aspirin

flavor and effectiveness are very similar and were manufactured by their respective plants for their insecticidal functions. Our livers detoxify them in the relative small doses we receive.

64 Looking at Leaves - In the fall collect different colored leaves, noting which trees produce which color leaves, and keeping the different colors separate in gallon size zip lock bags - grind them into fine particles by squeezing the bags. Then allow each student to assist in creating a leaf Mandala (temporary painting that is later destroyed or left to nature to recycle) in the spirit of the Tibetan Buddhist tradition. (The Buddhist use sand or crushed rock for theirs) In the Buddhist canon all things material are considered transitory - and this is certainly appropriate for leaves. To do this each student should collect a hand full of the crushed leaves of one color and gently let them flow from their hands onto the ground adding to the picture or pattern. The picture or pattern could first be scratched on the ground. Not good on a windy day!

Chlorophyll Fluorescence – Boil a few green crushed leaves for 3 to 5 minutes in 50-100 ml ethanol. The chlorophyll will be extracted and in solution. After a bright light has been shining on the chlorophyll for a few minutes turn the light off. The light will have excited and driven electrons to higher energy levels and they then emit this energy in the form of red light as they return to a more stable level.

Sassafras tree has 3 different shaped leaves: a trident, a mitten and an oblong or "boring" leaf.

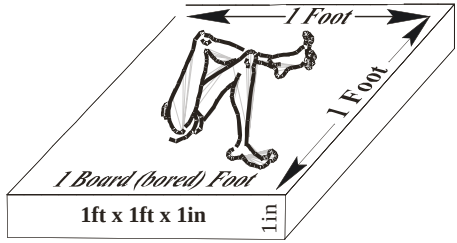
Mullein leaves are hairy and have been used for insulation, rubbing on the cheeks for a rosy appearance, used to stimulate the blood flow in limbs by rubbing, dried and smoked for relief of a sore throat or to make a soothing mullein tea, as a camp pot holder, blotter and toilet paper!

65 Bursting Buds - One of my favorite activities!!! Be sure to pull out some tree identification books and examine the buds of different trees. Try to learn to identify one.

Leaves, twigs and buds occur in the same patterns. An easy early tree identification strategy is to determine if the tree is alternate (most deciduous such as beech, birch, cherry, elm, hickory, oak, sweetgum, sycamore and yellow poplar), or opposite (a few can be remembered easily by acronyms such as MAD BB for Maple, Ash, Dogwood, Buckeye and Boxelder (a maple)) and whorled – more common in the evergreens including pones and conifers.

66 Germinating Giants - Keep some sea beans in your resource box to demonstrate seeds with an airspace that float from island to island.

If you don't have redwood pinecone start looking for something to trade with a friend in California who can send you one. One of the smallest cones and seeds produce the largest...



The Club moss or ground pine (*Lycopodium*) found today are minuscule remnants of the giant trees in the past from which they are descended. Among my favorite activities is using the spores to create a small explosion (flash photography in old west days sometimes involved igniting these spores), these spores have many other uses from coating pills to reduce the rate they dissolve in the stomach, as an early powder with talcum powder like properties and you can sprinkle some on top of water and insert your hand without getting your hand wet, etc.

67 How Big Is Your Tree? - To help students visualize a board foot have a wood worker make you a board that is 12 inches by 12 inches and 1 inch thick. Older students will be able to understand and enjoy using a Biltmore Stick.

Start a program of locating the champion trees in your community. As larger trees are found have your students write articles for the local paper.

Is There a Pi (π) in the Forest – If you don't remember that pi is the ratio of the circumference to the diameter of a circle, you probably did not learn the concept in the outdoor classroom.
The concept of a constant proportion was well known by 2000 B.C. This was probably an early development in mathematical thinking and could have developed as a natural progression of quantitative reasoning as Beckman describes, "If the volume of a stone is doubled, the weight is doubled; if you run twice as fast, you cover double the distance; if you treble the fields, you treble the crops; if you double the diameter of a circle you double its circumference." The concept of proportionality was a breakthrough in the evolution of mathematical thought. The circumference and diameter of a circle are proportional quantities, therefore the ratio of circumference to diameter is constant for all circles. The symbol "π" was not used until the 18th century. The Babylonians were using the value 3.125 as early as 2000 B.C. while the

Egyptians were using 3.16.

Involve your students in the determination of π; using materials found in their immediate environment. They will need: ruler, string, paper, pencil, and round objects such as a walnuts, acorn, or tree cookie.

1. Have participants collect as many different sized round objects as possible. The collection could be part of a scavenger hunt or nature walk.
2. Measure the circumference and diameter of each object and record.
3. Have each student divide the circumference by the diameter. Their answers should vary around 3.14.
4. Inform them that under ideal conditions with precise measurements they should get even closer to 3.14.
5. Sum all the circumferences and divide by the sum of all the diameters and arrive at a group estimate. This might be a good opportunity to discuss the importance of duplicating experiments in science or percentage errors.

68 Name That Tree - Be sure to collect leaves from the school yard so the students can periodically be reminded of the names and characteristics of these trees. If you have an amphitheater consider stenciling or tracing the leaves on the benches and write the tree names beside the leaves.

69 Forest For the Trees - Trees are rather easy to propagate. Decide on what trees you would like to plant in the school yard or which local plant seedlings show up in the gutters and hedgerows! Plant some extra in pots and sell them in a spring plant sale to raise money for your science class.

70 Soil Stories - Do a percolation test on houseplants in different classrooms to see how many have soil compaction issues - most will drain very fast as the water flows between the pot and root and soil ball - children, with a little guidance will catch on. Could use a moisture meter to demonstrate water is not perking. What should we do? How about poking holes in the soil? It will definitely help the plant and the students will after a few weeks notice healthier plants.

So what kind of soil do you have? Dig a hole about 6 to 10 inches deep and pour in enough water to get the soil wet. Take a hand full and see if you can form a ball. If it completely falls apart the soil is sandy, if it is sticky and holds its shape it has a high clay content and if it remains somewhat loose and is not sticky it contains a lot of loam.

71 Watch on Wetlands - If you have access to a bog consider this activity. As plant material breaks down under water methane is produced and trapped under layers of submerged vegetation. Gently push a stick or canoe paddle into the muck and hole a lit match near the surface of the water as the methane bubbles reach the surface. You will hear a pop pop pop sound as the bubbles explode.

I keep a box of *Foods from the Wetlands* in my resource box – and yes I have raided it when it was closer than the grocery store. Wetland foods include: Cranberries, shrimp, crabs, oysters, salmon, frog legs, lovage straws, marsh mallows, rice, cattails, bullrush (young shoots and pollen), crawfish, hackberry trees have small fruits with little meat but have a high sugar content, papaws produce pear-sized fruit, alligator, flounder, wild grapes, arrowhead's tubers, sarsaparilla roots were brewed by settlers into root beer and medicinal tea, Bunchberry fruits can be eaten raw or cooked like pudding, acorns, black cherry fruit, bracken fern fiddleheads, birch sap syrup, juneberries, chicory can be roasted and ground to make coffee, bay leaves, young unfurled pickerel leaves are edible in salads or boiled and served with butter, duckweed, water celery, mayhaw, blueberries and watercress. Swamp sago palms are important plants of SE Asian flood plain swamps - the pith produces starch from which flour is made. Palm oil - oil palms are one of the world's most important sources of edible and soap oil and originated in African wetlands.

72 Air We Breathe - Invite a Hazmat instructor familiar with radioactive materials to visit your class and discuss radon. They will most likely be able to bring some radioactive materials and a Geiger counter to demonstrate some characteristics of radioactive materials. You may also check the expertise directory for nearby universities for a resource person or the geology, physics or nuclear engineering departments for a speaker.

Radon kits are available to check radon levels. Check with your local health department.

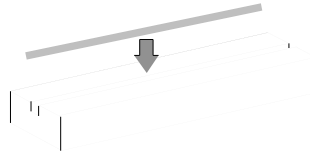
73 Waste Watchers - Most electric companies will loan you an electric meter to use in your programs. Some utilities also have a high voltage demonstration they can bring to a school to teach safety. Electricians have an amp probe that you can use to determine how much electricity various appliances use and you can observe that electric motors use more electricity starting up than while running.

If the room in which you are doing a workshop has adequate light turn the light off, or better yet, turn it off and going outside.

Starting a school program to reduce your electricity uses will get the school board's attention!

74 People, Places, Things - By the age of ten most children can easily learn to use GPS receivers to produce a track of their travels and maps. Consider inviting natural resource professionals in to describe what they do. Or better, challenge the students to discover who really "speaks for the trees."

75 Tepee Talk - Invite a trapper from USDA Wildlife services to come to your class and bring their pelts and skulls with them. Most likely there is a child in your class who accompanies his father on hunting trips. If he does not tan hides he most likely knows someone who does that can visit your class.



Patterns of Change

76 Tree Cookies - Check with a mechanic who works on chainsaws, most likely he had a lot of tree cookies you could pick through for unique specimens. Make tree cookie pancakes for a snack.

Core samples are easily protected by glueing them in a grove cut in a 3/4" x 3/4" strip of wood.

Examining mammal teeth for wear to determine their age is of only limited usefulness. A more accurate estimation of its age can be made by an examination of the rings of cementum (mineralized deposit that continues to grow below the gum throughout life providing a record of growth) in the cross section of most mammals teeth, including humans. A darker ring, or annuli, is deposited each winter providing information similar to a tree's rings. To see the rings a thin sectioned and stained mammal tooth also shows annual rings!

The age of a fish can be determined by counting its annular rings.

77 Trees in Trouble - Neighborhood Checkup is an excellent activity for children to conduct for parents on parents day.
Compressed rings may also indicate competition from other trees. In a managed pine plantation, foresters monitor this to help determine when some trees need to be harvested so others can grow at a more desirable rate. After the "release cut" the rings indicate more growth.

Irregular **leaf spots** are caused by bacteria and **round spots** are fungus caused.

78 Signs of Fall - Fall Colors

We are fortunate to live in a part of the world that experiences fall colors, thanks to our deciduous trees and temperate climate! Fall leaf color is characteristic of the particular tree species and is influenced by temperature, moisture, hours of sunlight, leaf sugar, disease and other factors. Warm sunny days and cool, but not freezing, nights seems to enhance fall colors, and drought seems to enhance the red colors. Fall coloration occurs earliest at higher elevations and latitudes. A severe summer drought or a late spring can delay fall colors.

Leaves contain pigments that give them their color. The three pigments include:

- $ Chlorophyll - green color
- $ Carotenoids - yellow, orange, and brown (always present in leaves)
- $ Anthocyanins - red and purple (produced in the fall, in response to intense sunlight and plant sugars in the leaf)

Consider the following as a general guide. Many trees have leaves of several colors, and many trees are not in the following list. As you make observations, go ahead and add to, or correct, this list.

Red leaves - red oak, flowering dogwood, maple, pin oak, scarlet oak, white oak, sourwood, sumac, sweetgum, tupelo gum, black gum, persimmon, hornbeam, ironwood, hawthorn, Franklin tree, Japanese maple, Chinese pistachio, and ornamental pear.

Orange leaves - hickories, ash, hornbeam, sassafras, maple, tulip, sweetgum, hornbeam, alder, Franklin tree and Chinese pistachio.

Yellow leaves - hickory, aspen, river birch, beech, tulip, gingko, yellow poplar, green ash, maple, black cherry, pawpaw, sycamore, willow, cottonwood, sassafras, elm, yellowwood, alder, basswood, bur oak, butternut, redbud, serviceberry, mulberry, hackberry, black walnut, honey locust, Osage orange, Ohio buckeye, bladdernut, hazelnut, Chinese pistachio and hophornbeam.

Green needles and leaves - The evergreen leaves of the pines, cedars, firs, spruces, and hemlocks survive winter because their needle or scale-like foliage is covered with a heavy wax coating and the rosins inside their cells resist freezing.

Purple leaves - dogwood, sweetgum, white oak, witch hazel, white ash and Franklin tree.

79 Tree Lifecycle - In Plant Personification after wiggling your toes, wiggle them some more as they each out and form an alliance with another Kingdom - fungi

To demonstrate how trees shift tannin from one part of a tree to another to fend of insect attack - begin tensing muscles in one hand and sequentially tense each muscle up your arm across your body and down the other arm to fend of an attack.

Have students tilt their heads back and exhale to simulate a trees ethylene production to warn other trees of an attack enabling them to begin producing defensive chemicals or other countermeasures.

80 Nothing Succeeds Like Succession -

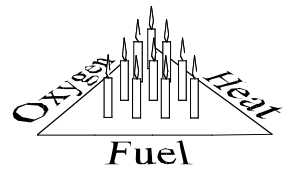
#4. On a map of your county identify where different successional stages are found. Leave the map on the classroom wall and record any wildlife reported or seen there throughout the year.

The 4-H WHEP (Wildlife Habitat Evaluation Program) manual is an outstanding resource for understanding the habitat requirements for numerous wildlife species and the intricacies of different successional levels.

Farmers often manage the "edges" of their fields or forest for quail and other wildlife species.

In Your Backyard - Collect and compare the insects that visit the "natural" area and the school yard.

81 Living With Fire - The longleaf pine that grows along the gulf coast is fire adapted and we often demonstrate this by bringing one to a school in a plastic pot. Its adaptations include an extensive root system and a thick trunk covered in long needles. Outside in the parking lot we ignite a bunch of paper beneath the tree or attempt to set the tree on fire with a propane torch. The needles singe but prevent the heat from reaching the trunk or crown. Once the tree had an extensive root system (after 5 to 7 years in its *grass state*) it grows rapidly positioning its crown above the height of most forest fires and it develops a thick protective bark.



PLT Name Badge Fire Triangle Lessons

Three elements are necessary for fire to occur: fuel, oxygen and heat; hence the three sides of the fire triangle. Remove any one of the three elements and the fire will be extinguished. Fuel is anything that is combustible. It is characterized by its moisture content, size and shape, quantity, and how it is distributed over the landscape. Live trees usually contain a lot of moisture while dead logs contain little. Air contains about 21% oxygen and fires begin to extinguish when the oxygen level is decreased to less than 16%. When fuel burns (oxidizes), it reacts with oxygen from the air, releasing heat, gases and smoke particles. The third element, heat, can come from lightning (about 80 percent of the remote wildfires), discarded cigarettes and matches, sparks from vehicles or equipment, fallen power-lines, campfires, arson, etc. The flash point (temperature at which fuel burst into flames) for wood is 572 degrees Fahrenheit (300 C). At this temperature wood releases hydrocarbon gases that burn where they mix with oxygen. Carefully examine a flame noting its height above the fuel.

Three factors **fuel**, **weather** and **topography** influence how and where a fire spreads. Fuel characteristics include: size and shape, arrangement and moisture content. Weather influences include combinations of wind (the most unpredictable factor), temperature and humidity. Fires tend to rage in the afternoon when temperatures are at their highest. Topography: the shape of the landscape, elevation, slope steepness and direction and sunlight exposure also influence the speed, direction and intensity of wildfires.

Possible Demonstrations

- The name-badge matchstick forest is laid out in a triangle reminiscent of the fire triangle.
- Demonstrate the fire potential for different density forest by leaving some trees (matches) out.
- Different age stands can be demonstrated with a combination of whole and broken matches.
- Slope - hold forest (Name Badge) at different angles lighting a single tree (match) at either the top or bottom. When a fire begins at the bottom of a slope, the trees uphill are preheated by the rising hot air, helping them more easily catch fire. The steeper the slope, the faster fire travels. Fire moves more slowly downhill, without the effect of preheating.
- Undergrowth is easily simulated with magician's flash paper.
- Moisture can be simulated with wet matches.
- Rain can be simulated with a spray bottle of water.
- Wind - Blow, without getting too close, on the matchstick forest.
- Fire lanes or breaks can be simulated by leaving out a row, or two, of matches.
- Natural barriers can be demonstrated by placing aluminum foil barriers

between rows of matches.

- Homes in the forest can be simulated by replacing a few matches with an origami paper house.
- CO_2 Fire Extinguisher function can be demonstrated by mixing baking soda and vinegar in a loosely covered pitcher or by dropping a block of dry ice in a little water and pouring the vapor down an inclined index card or aluminum foil trough to extinguish a lit match. CO_2 is heavier than air and can easily be poured from the pitcher like water.
- Wildlife response to forest fires can be simulated by placing ticks in the matchstick forest. Actually, in this demo, they respond to the falling CO_2 by becoming more active.
- Controlled burns can be simulated by breaking the head off every other match.
- If your name badge catches on fire doing these demonstrations, so much the better for demonstrating unexpected consequences.
- For entertainment, fill all holes with matches and remove one. Then see who can remove the most matches. A match can be removed by jumping an adjacent match, to an empty hole, then removing the jumped match. One person at a time plays.
- Smoke detectors can be tested by doing these demonstrations indoors.

What is the difference in a rusty nail, burning match, and the yellowing pages of a Harlequin Romance? All are forms of oxidation, they are just oxidizing (burning) at different rates.

Lycopodium spores (club moss) make excellent attention getters - blow some spores into the flame of a candle for a small flash

Fire cyclone makes a spectacular demonstration but all safety precautions should be in place. This activity actually creates an intense table top cyclone of fire - contact me for the directions - John Guyton, Mississippi State University College of Forest Resources Wildlife and Fisheries Dept.

82 Resource-Go-Round - Things to have in your resource box: Bauxite (aluminum ore), chunk of graphite (used in pencil lead), block of cedar and a piece of sandpaper to periodically refresh its odor, a cedar apple rust gall (Cedars are often disfigured by this fungus - long yellow gelatinous mass when in the damp spring; hard horned orange ball in the fall. The cedar-apple rust life

cycle involves cedar and apple trees. Apple growers have wanted to exterminate the cedars in their area; “cedar or cider”).

As long as we are thinking about resource-go-round look at the chunk of graphite. And ask students, how graphite could be removed from the slurry of broken down paper when recycling paper?

83 A Peek at Packaging - A tree is a package of life - nothing wasted - good model.

Many fruits and vegetables come in a “natural packaging” that protects them. On a grocery store survey compare the price of apples, oranges, etc. that do not need additional packaging to see if there is a difference and how much money bringing your own bag would save.

Classroom Landfill & Waste Management

The production of solid waste is growing and has become a significant problem. Each person generates between 2 to 7 pounds of waste per day. Seventy percent of the landfills currently accepting waste will be closed by the year 2000. The Environmental Protection Agency has suggested the following four strategies: Source Reduction - creating less garbage in the first place, Recycling and Composting - or getting multiple uses out of the products we use, Combustion - burning waste materials which cannot be recycled, and using Landfills - for waste which cannot be handled by other means. Recycling must become a way of life.

Note: Recycling programs can be used to help youth understand the importance of recycling or to solve a short term need, such as raising funds for a specific project. The purpose must be clear from the start. Youths are very impressionable and quickly learn our attitudes toward recycling. If it is not important to us and a part of our life, it will not be important to them. A recycling program can only be started once if it is a part of our way of life.

1.Find a cardboard washing machine box which will become the classroom transfer station and landfill. If students wish, they can paint flowers or other designs on it.
2. All classroom trash disposed of during the year will remain in this box or pass through it.
3. Inside the box there should be several smaller boxes. Place a plastic liner in each of these boxes. Use one for vegetable matter such as apple cores, orange rinds and chewing gum. Allow these materials to just begin to smell before introducing the idea of a compost pile. Monitored and graph the rate of decomposition of different materials. Another box could hold aluminum

cans until they can be recycled. When the volume of cans begins to exceed the space available introduce the idea of crushing them thus allowing better use of the space. The third box could hold paper which can be used again as scrap paper for notes. Note pads could be made by cutting the paper down to size and gluing one edge. Another box could contain plastic and, as with the aluminum cans, it will soon be evident that space is at a premium. Compressing the plastic bottles will save space (landfill operators prefer you leave the tops off bottles so they can be further compressed). Newspaper can be composted if there is not a better alternative. It can be used in animal cages as litter before being composted.

4. The only way materials can leave the box is by recycling. There will be some materials which cannot be recycled in some classrooms. For example, batteries used in science lessons should be discarded in the Classroom Landfill because they are difficult to recycle .
5. By the end of the year students will have encountered many problems experienced by landfill operators including the need for extra space, leaks, smells and problems associated with transportation of materials to a recycling center. Ideas such as using products which minimize packing material or which contain recycled or recyclable material should be rewarded.

84 The Global Climate - This is an excellent activity to use after a volcanic eruption. Suggest teachers and students monitor the color of sunsets. The huge amount of sulfur dioxide and other aerosols ejected during volcanic eruptions color the sunsets redder sometimes for months after an eruption. Each sunset will be a little less red as the atmosphere slowly returns to normal.

Mix baking soda and vinegar in a tall glass and place a piece of cardboard over the top. The reaction will yield carbon dioxide which is heavier than air. Make an aluminum foil trough and hold in such a way as to allow the CO^2 (gas) to be poured down the trough to a candle flame. The flame will be extinguished by the invisible gas (CO^2).

85 In the Drivers Seat - Under inflated tires decrease gas mileage so borrow an air compressor from the school shop or a student's family to adjust car's tire pressure at carwashes while raise funds for a school tree project.

Evaluate different routes to school to find the shortest with the least stop and go driving.

86 Our Changing World - Excellent activity to introduce non-indigenous species. Either walk through the web tripping over the string or have the students hold it tight and begin snipping strands with scissors watching the web collapse.

On the enrichment use brainstorming technique to generate a list of issues, without stopping to discuss it or argue an items merits.

87 Earth Manners – Biodiverse Art

The purpose of this activity is to illustrate the concept of biodiversity.
Materials: Masking tape or hot glue gun and glue

1. Allow participants to create a collage, diorama, bracelet, hat, or other artistic expression, using one plant or animal part from as many species as possible. The theme of the expression should be systems and interactions in nature. Complexity should be encouraged. Emphasize the need for variety and walk around while work is underway, suggesting additional systems or interactions and maybe even distribute a few unusual materials to individuals who are not using a wide variety of materials.
2. Invite participants to share the diverse nature of their creations, illustrating the numerous systems and interactions or co-dependents represented. If time is limited or the group is large, you could select a few representative examples. Keep in mind the purpose is to show need for a very diverse environment to support life as we know it.
3. Now the challenge begins. Involve participants in constructing another version of their creation omitting various species which were an important element in the first version. For example, if they have used pine needles to hold their hat together, you may delete pine needles as a component. This may be done individually by the leader while inspecting each creation or a global challenge can be issued by suggesting the omission of all pointed objects. This could be equated to extinction.
4. Invite participants to describe, for the group, the difficulties encountered recreating their artistic expression with fewer species.
5. Summarize by discussing biological diversity and the importance of every species.

88 Life on the Edge - Invasive species are a serious threat to many native species. Assist teachers in planting a privet (invasive non-native) bush and a blueberry bush in the same bed and monitor their competition. Once planted this can go on for years.

Use the NASA picture of US at night showing the lights of the cities and highways to describe anthropogenic fragmentation of the country.

Samples of discontinued carpet large enough to sit on are useful for many activities including *Habitat Scramble*

Use habitat destruction articles from the *Power of Print* to give students examples in *Habitat Scramble.*

In *Every Species for Itself* introduce new color squares to represent a disease, exotic species invasion or poison.

Long term extension - find two similar examples of the same plant in different places on the school yard and point one out to the students as an example and suggest they take care of it as an endangered species. Don't tell them about the other plant. Much later compare the success of the one the students are caring for with the one you have not showed them (control).

89 Trees for Many Reasons - Select and plant a school or class tree. Involve the language arts class in writing fables about it.

Cedar was stripped from the prairies to make pencils.

Mississippi citizens' reaction to the clear cutting of virgin forest was to encourage the creation of the Mississippi Forestry Commission.
Samples to use in lesson

Firewood: oak (good heat value), lighter pine (excellent to start fires - will even light when wet), Osage orange (firewood that sparks), inner bark of juniper makes good tinder. Learn to recognize their bark.
Shelter: cedar shingles and a piece of 2 X 4 pine used for studs in a house. Hickory **tool handles** and rabbit sticks a **weapon** Choctaw used for hunting.
Baseball bats are made from ash.

90 Native Ways - Suggest teachers plant a three sisters garden (corn, beans and squash). Research the plants used by the Native Americans, or indigenous people in your area, and plant these in the outdoor classroom. Balanced treatment requires students have an accurate portrayal of Native American's impact on the environment. Sometime fair treatment is not politically correct. Squanto, for example, famous for teaching the Pilgrims to plant and fertilize corn with fish learned the technique of fertilizing plants while

in Europe. The Native American tradition was to move their gardens to new land as the soil wore out.

Study Erodes Image of Pre-Columbian Farmers

Traditional farming in central Mexico, first implemented around 3,500 years ago, caused at least as much soil erosion as plows, livestock raising, and other techniques introduced by the Spanish in the 16th century A. D., according to a new study.

And a return to traditional farming methods in order to make more efficient use of agricultural land, now under consideration in Mexico, probably will not produce the desired results, geographer Sarah L. O'Hara of the University of Sheffield in England and her colleagues assert in the March 4 Nature. "[The researchers] have provided a landmark study which shatters the myth of pre-Columbian America as an Eden in which people were "transparent in the landscape'," writes Karl W. Butzer, a geographer at the University of Texas at Austin, in a commentary accompanying the new report.

O'Hara and her co-workers obtained 21 sediment cores, ranging in length from about 4 feet to more than 8 feet, from the floor of Lake Patzcuaro, which lies more than a mile above sea level in central Mexico. Archaeological evidence for human settlements in the highlands surrounding Lake Patzcuaro dates back about 4,000 years.

Soil erosion into the lake, indicated by a predominance of clay and minerals associated with nearby agricultural land rather than natural lake sediments, first appears in core segments carbon-14 dated from around 3,600 to 2,900 years age, the scientists say. These dates correspond to the rise of maize cultivation in central Mexico, they maintain.

A more intensive period of soil erosion extended from about 2,500 to 1,200 years ago, O'Hara group reports. Sediment built up most rapidly in the lake's north basin, they note. The region's inhabitants, whose identity remains uncertain, apparently preferred to settle just north of Lake Patzcuaro and farm the steep slopes jutting down to its waters, the investigators say.

Comparable soil erosion occurred again between 850 and 350 years ago, reflecting extensive forest clearing by the Trascan people, who dominated the

region at the time of the Spanish conquest in 1521 A. D., O'Hara's group holds.

Soil erosion into Lake Patzcuaro following the introduction of Spanish agricultural methods falls at or below previous levels, they point out.

The environmental damage produced by pre-Columbian agriculture around Lake Patzcuaro equals that generated by ancient Maya "slash and burn" farming techniques in Central American forests more than 1,000 years ago, according to the scientists.

Native Americans exploited the land and other natural resources to support their large population centers, Butzer notes. O'Hara's study indicates that they did not operate "in harmony with nature" and possessed no panaceas that would improve modern land use, he contends.

Some rural areas may reap benefits by incorporating small-scale traditional farming methods into an overall subsistence strategy that includes livestock raising, Butzer asserts.
-B. Bower Published in Science News March 6, 1993, Vol. 143, No 10 page 149

Excerpts from <u>The Science of Good and Evil</u> by Michael Shermer

When it comes to how humans treat other humans and the environment, the Beautiful People have never existed except in myth. Humans are neither Beautiful People nor Ugly People, in the same way that we are neither moral nor immoral in some absolute categorical sense. Humans are only doing what every species does to survive: but we do it with a twist (and a vengeance)- instead of our environment shaping us through natural selection, we are shaping our environment through artificial selection. In a fascinating 1996 study, for example, University of Michigan ecologist Bobbi Low used the data from the Standard Cross-Cultural Sample to test the hypothesis that we can solve our ecological problems by returning to the mythical Beautiful People's attitudes of reverence for (rather than exploitation of) the natural world, and by opting for long-term group orientated values (rather than short-term individual values). Her analysis of 186 hunting-fishing-gathering (HFG) societies around the world showed that their use of the environment is driven by ecological constraints and not by attitudes, such as sacred prohibitions, and that their relatively low environmental impact is the result of low population density, inefficient technology, and the lack of profitable markets, not from conscious efforts at conservation. Low also showed that in 32 percent of HFG's societies, not only were they practicing conservation environmental degradation was severe; again, it was limited by the time and technology to finish the job of destruction and extinction.

UCLA anthropologist Robert Edgarton surveyed the anthropological record and

found clear evidence of drug addition, abuse of children and women, bodily mutilation, economic exploitation by the group of political leaders, suicide, and mental illness in indigenous preindustrial peoples, groups not contaminated by Western values (allegedly the source of such "sick").

Anthropologist Shepard Krech analyzed a number of Native American communities, such as the Hohokam of southern Arizona, and discovered a large scale irrigation project led to the salinization and exhaustion of the Gila and Salt River valleys, ultimately triggering the collapse of their society.

The most poignant example of big game exploitation was the famous Head-Smashed-In buffalo kill sight in southern Alberta, Canada.

The evidence is now overwhelming that woolly mammoths, giant mastodons, ground sloths, one-ton armadillo-like glyptodonts, bear-sized beavers, and beefy saber-toothed cats not to mention American lions, cheetahs, camels, horses, and many other large mammals, all went extinct at the same time that Native Americans first populated the continent in the mass migration from Asia some 15,000 to 20000 years ago. The best theory to date as to what happened to these mammoths is that they were hunted into extinction.

91 In the Good Old Days – It is very important to remember that hunters were among the first conservationists or environmentalists and were the ones to observe our first problems with wildlife. The hunter sponsored Lacey Act (1900) outlawed market hunting and prohibited the interstate transportation of game that had been illegally harvested. Species were being critically depleted to meet market demand.

As early as 1937 they were sufficiently involved and organized to figure out how to fund wildlife conservation. The Pittman-Robertson Act placed a 10% tax on firearms and ammunition to fund wildlife conservation.

The Migratory Bird Hunting and Conservation Stamp, that all waterfowl hunters over 16 are required to purchase, has enables the US Fish and Wildlife Service to preserve millions of acres of waterfowl habitat.

92 A Look At Lifestyles – Where do the things you need come from? Homework for this activity may be to monitor where everything you purchase for a week comes from, food included. Wonder how much of its cost is transportation. Would we rather have that huge carbon footprint or find a locally produced or more sensible product.
Hunting has been a lifestyle common to all cultures since the very beginning. Hunting is still an important tradition and one of the most successful game

management practices. And, hunters will be quick to point out that game management is habitat management. Hunters are in the environment observing trends, seasonal variations and problems long before they become obvious to others. Turkey hunters see the sun rise, deer hunters spend off seasons walking the woods noting its condition for wildlife and monitoring wildlife behavior, trends and problems. Hunters are the group that started modern conservation as well as forest and wildlife management programs and practices.

In 1929, Aldo Leopold submitted his report on a Game Survey Conducted in Mississippi. Amongst his findings, he states: "There is no state game department and only the beginnings of a conservation movement. There is no refuge system and little law enforcement... the one offset to all of these defects; a widespread interest and intense popular interest in game and hunting. In this respect, Mississippi excels any other state so far surveyed."

93 Paper Civilizations - use a hand lens to compare the paper of a paper wasp nest to the thinnest recycled paper you can make. Take a half dozen unsharpened hexagonal pencils and lightly cover about 3/4 inch with recycled paper pulp and secure the pencils in a bunch with rubber bands. Allow to dry and examine your paper wasp nest. If you watch you will notice wasp chew wood mixing it with saliva to make paper.

Experiment with small additions of tinsel, thread, lint, cloth or other materials when making paper.

Study currency from different countries to get an idea where the state of the art is in paper making! Banks can help you convert some currency but to find out which bank notes have interesting technology will only require a few minutes n the internet. We keep a few notes from each trip we make to another country.

94 By the Rivers of Babylon

For an excellent background for this activity read the short USDA book, *Conquest of the Land through 7,000 Years*. You can find it on the internet at http://www.nrcs.usda.gov/technical/ecs/agecol/conquest.html

By W. C. Lowdermilk formerly Assistant Chief, Soil Conservation Service, who describes land forms as a record of what men or nations write on it. “It is easy to read by those who understand the simple language of the land.” He describes the westward course of civilization from the Holy Lands of the Near East to the Pacific coast of the US through a period of 7,000 years. “...soil erosion,

deforestation, overgrazing, neglect, and conflicts between cultivators and herdsman have helped topple empires and wipe out entire civilizations. At the same time, he learned that careful stewardship of the earth's resources, through terracing, crop rotation, and other soil conservation measures, has enabled other societies to flourish for centuries."

95 Did You Notice? – Pick out a group of stars in the eastern sky as soon as it is dark enough to see several bright ones. Sketch a picture noting their height above the horizon. Hold your fist at arms length to estimate the height (in fist) of one star in *your constellation*. Record the time. Each hour repeat your observations.

Pick a favorite tree, preferably a deciduous tree, and sketch a picture of it during each season. Carefully save your pictures - your mother will want to frame them.

96 Improve Your Place – Consider planting fruit trees on your school property. Your Extension Horticulture Agent can assist you in making a decision on which trees and how to plant and care for them. Be sure to consider they will not receive much care during the summer...

Contact your state chapter of Keep America Beautiful and see if they have brochures or if they can assist in teaching you how to lead litter free events.

PLT Workshop/Classroom Snacks – Snacks that can be tied to trees or forest products are a nice supplement to a workshop. During breaks challenge the participants to identify as many connections to the forest as possible from the snack table. This is only a beginning. As you become aware of others add them.

Bark
Cinnamon, sassafras (chew twigs, root bark flavoring for drinks)
Fruit
Apples, pears, peaches, mulberries, plums, oranges, elderberry, persimmons, breadfruit, mango, pawpaw, cherries and chocolate
Apple cider, Sumac berry lemonade, carob chocolate substitute, juniper berries as a spice for meat
Nuts
Walnuts, beechnuts, hazelnuts, pine nuts, pistachios, hickory nuts, almonds, pecans, Brazil nuts, cashews, white oak acorns, acacia pods, maple seeds, chestnuts, coconuts, hackberry,
Almond M&Ms, Dates stuffed with an almond or pecan, Mixed nuts without peanuts,

Flowers
Fresh figs or fig preserves, acacia, elderberry, apple, orange, lime,
Cloves (gum, breath freshener, or flavoring for ham or apples)
Roots
Manioc (tapioca), sassafras tea,
Saps
Maple or Birch syrup
Gum – Beechnut and Chicklet gum, Sweetgum or *Liquidamber* sap
Sugar pine sap *John Muir preferred sugar pine sap to maple*
Leaves
Beech *(Fagus grandifolia*), wax myrtle (*Myrica cerifera*), Oregon myrtle (*Umbellularia californica*), red bay (*Persea borbonia*), young maple leaves and acacia (*Acacia farnesiana*). Sassafras (*Sassafras albidum*) leaves can be brewed into a tea with the roots or root bark.

Getting Your Guide Ready for a Lifetime of Use

I learned this technique from a PLT facilitator in Kentucky many years ago and it is worth passing on. After writing your name and year on the side (or the bottom) of your new PLT Resource Guide open it to about the center being careful to push on the center of the back spine keeping it against the pages. This will form a "V" as you open the book. Flatten the manual open, then open it to halfway to the front and then the back each time making sure the spine is remaining in contact with where the pages are attached and flattening the open manual. This will insure the pages do not begin to come out through decades of heavy use.

Notes