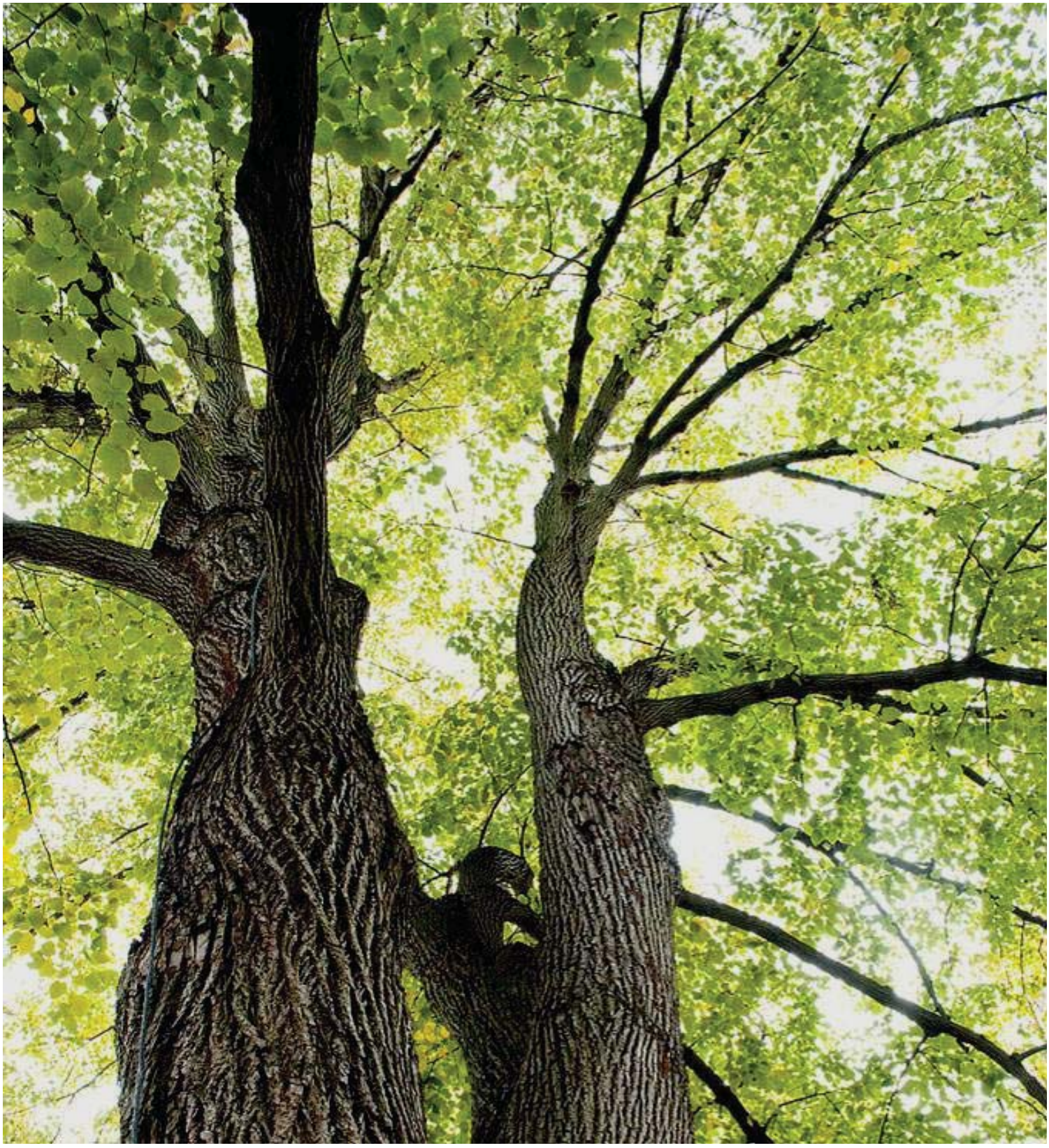
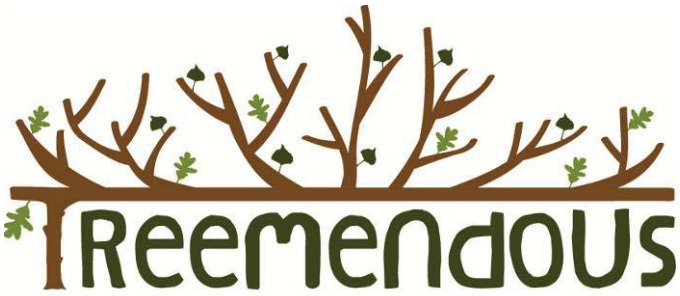


A TREEmendous Educator Guide

MISSOURI BOTANICAL GARDEN

P.O. Box 299 • St. Louis, MO • 63166-0299 USA • +1 (314) 577–5100 • www.mobot.org

Throughout 2011, we invite you to join us in shining a deserving spotlight on some of Earth's most important, iconic, and heroic organisms: trees.



To strengthen efforts to conserve and sustainably manage trees and forests worldwide, the United Nations has declared 2011 as the International Year of Forests. Their declaration provides an excellent platform to increase awareness of the connections between healthy forests, ecosystems, people, and economies and provides us all with an opportunity to become more aware, more inspired, and more committed to act.

Today, more than 8,000 tree species—about 10 percent of the world's total—are threatened with extinction, mostly driven by habitat destruction or overharvesting. Global climate change will certainly cause this number to increase significantly in the years to come.

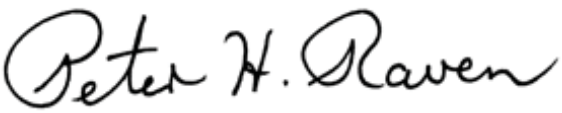
Here at the Garden, we care for many individual at-risk trees (representing 48 species) within our diverse, global collection. Many of these species come from areas of the world where the Garden is working to restore forest ecosystems and the trees in them. Overall, we have nearly 6,000 individual trees in our main Garden, some dating from the time of founder Henry Shaw. Thousands more trees thrive at nearby Shaw Nature Reserve, as part of the Garden's commitment to native habitat preservation, conservation, and restoration.

Regardless of where endangered trees are found—close to home or around the world—their survival requires action by all of us. The Great St. Louis Tree Hunt of 2011 is one such action, encouraging as many people as possible to get out and get connected with the spectacular trees of our region.

What else can you do? Take a tree census of your neighborhood. Brush up on your tree I.D. skills. Share your newfound knowledge with others. Plant at least one tree. Relax under the canopy of a favorite tree…

In recognition of the International Year of Forests, join us and others around the world in celebrating these extraordinary organisms and ecosystems, learn about the critical ecological and economic roles they play in our world, and help us protect them for generations to come.

Dr. Peter Wyse Jackson
President
Missouri Botanical Garden



Dr. Peter H. Raven
President Emeritus
Missouri Botanical Garden

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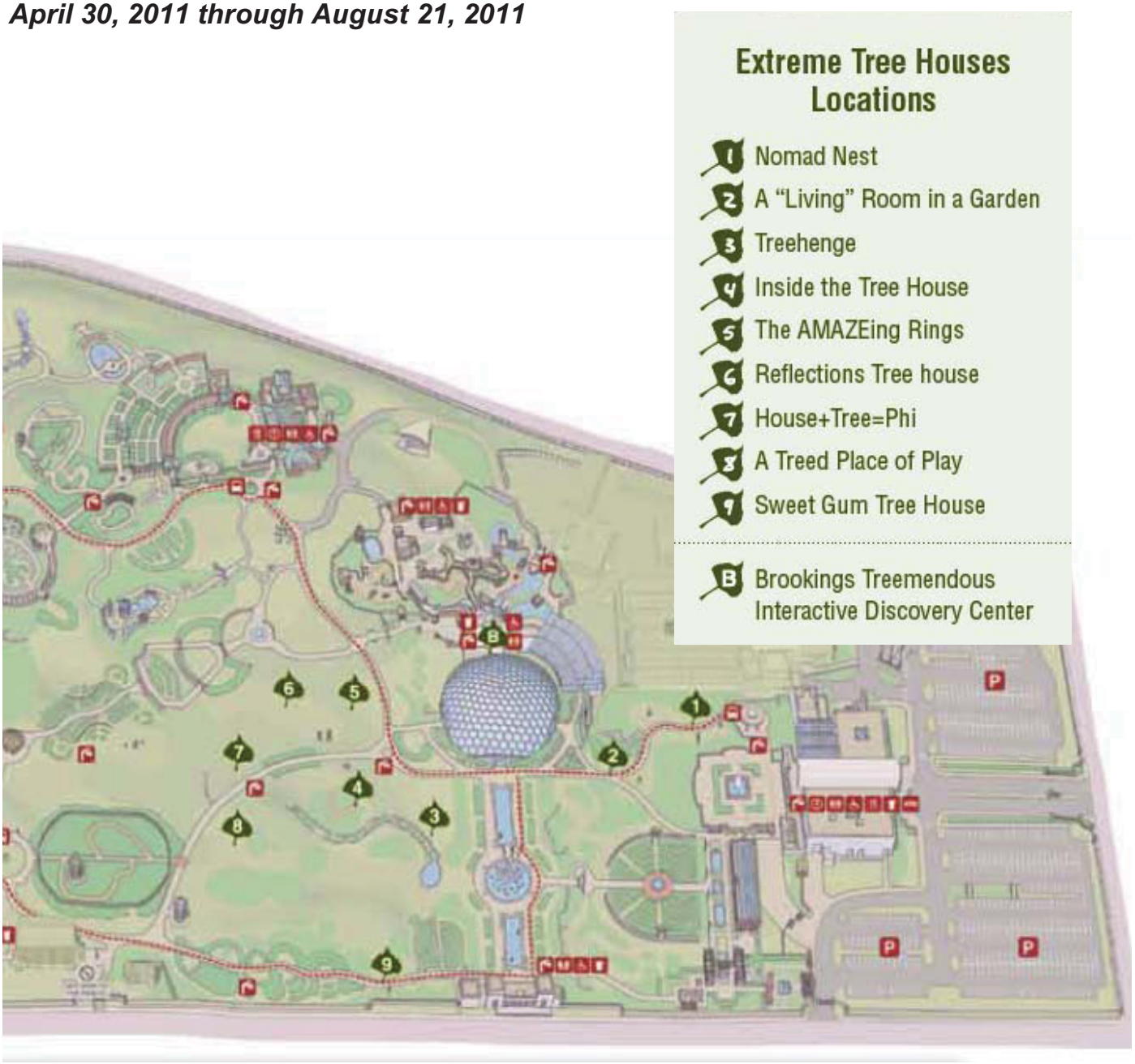
International Year of Forests
www.un.org/forests

EXTREME Tree houses

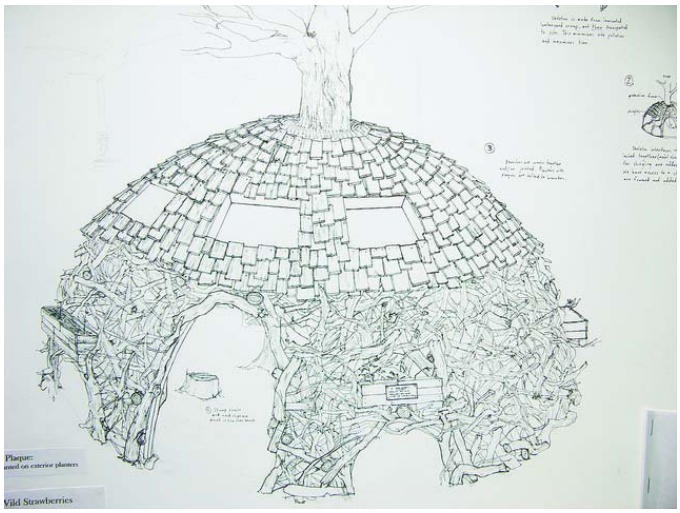
Branch out from the ordinary notion of tree houses with an imaginative and creative display of non-traditional structures. View the winning works of a juried competition among local designers, architects, schools, studios and individuals.

Enjoy a close, ground-level look at each Extreme Tree House displayed beneath the canopy of the Garden's oak, elm, ginkgo and other trees.

April 30, 2011 through August 21, 2011



1. Nomad Nest



The Nomad Nest is the result of (and venue for) sustainably using urban flora every day. The design's main feature is salvaged branches and saplings woven and joined together to create a strong and durable dome structure around the tree. Kids crawl spaces and a large main entrance lead to unconventional furniture inside, while planters containing wild edibles are mounted to the outside. By using exclusively recycled and salvaged materials, the Nomad Nest demonstrates that resourceful gathering can create grounds for a functional, alternative economy.

Location

Sycamore Tree, *Platanus occidentalis*

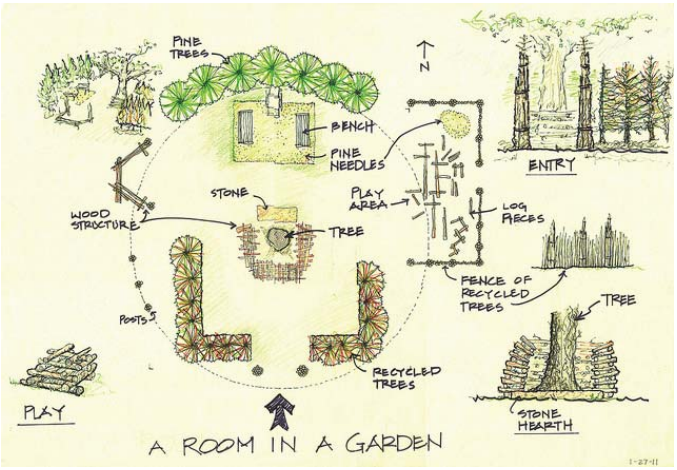
Designers & Collaborators

Kansas City Art Institute

Justin A. Rulo-Sabe

Theresa Joy Hitchcock

2. A "Living" Room in a Garden



This scheme is fashioned as a typical "living room" with the focus on a grand tree instead of a hearth/fireplace. The room is defined by recycled Christmas trees salvaged from and with the cooperation of the St. Louis City Forestry Recycling Program. The recycled Christmas trees become the construction material and fabric which defines the extent of the room within the Garden. The grand tree is highlighted by the construction of a wooded log enclosure surrounding two sides of the tree like a fireplace with a stone hearth in front. The grand tree's canopy is the overhead structure and ceiling/covering for this room. In front of the Tree, an accessible seating area is created by the crafting of a "rug-like" area made from the recycling of fir and pine needles and small branches.

Location

Amur Cork, *Phellodendron amurense*

Designers & Collaborators

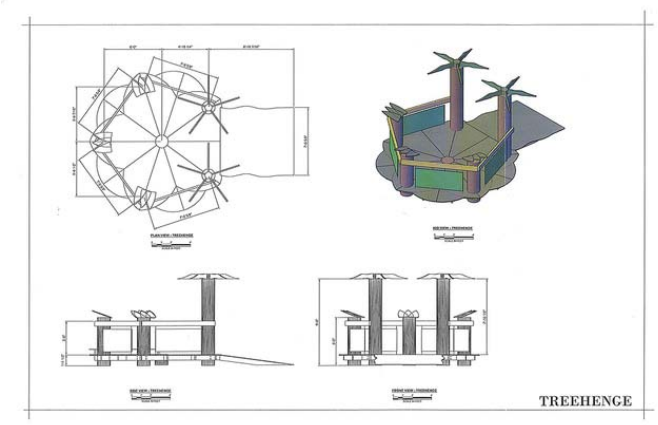
Christner Inc.

Rick Wimmer-Brown
Mick Schaefer
Ken Hoernschemeyer
Denise Buehrer

Waldbart Nursery

Jay Behle

3. Treehenge



Treehenge—the tree interpretive center—is where The Great St. Louis Tree Hunt begins. The design is constructed with a bamboo base and frame, creating a space surrounded by constructed trees. Within the space there are pictures, maps, and GPS coordinates to aid in the search for 30 marked trees throughout the Metro region. Treehenge features sustainable building materials such as bamboo as well as donated items like the re-used utility poles donated by Ameren. After the competition, the structure will be moved to a local business where it will be used as a picnic area.

Location

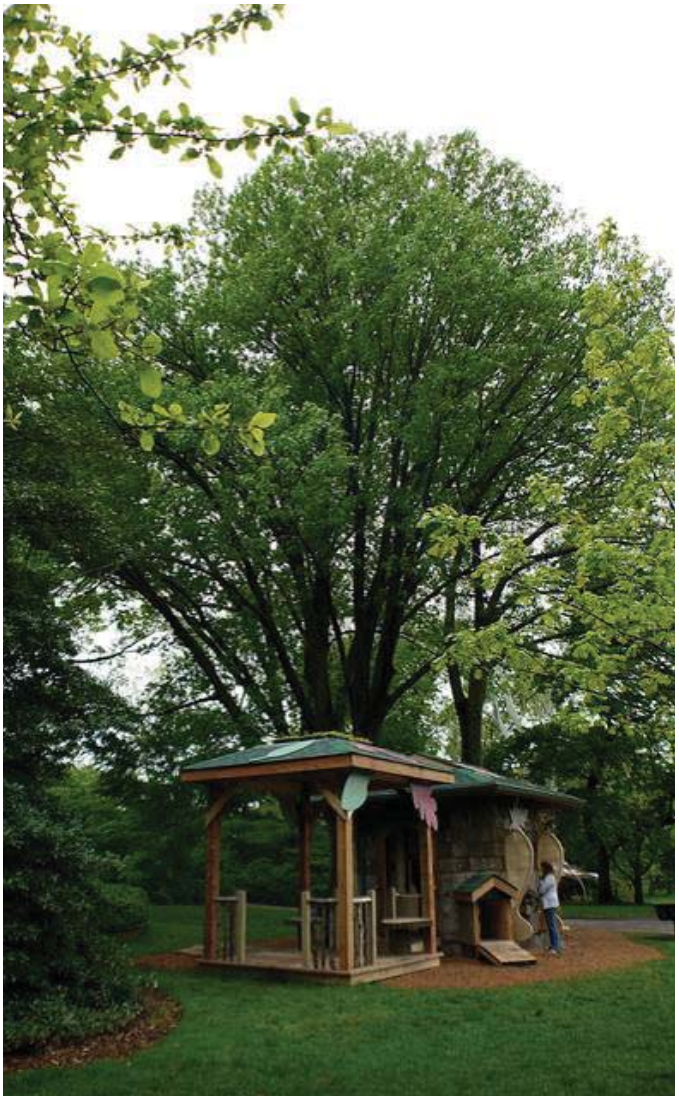
Silver Linden, *Tilia tomentosa*
Western Soapberry, *Sapindus drummondii*

Designers & Collaborators

Burns & McDonnell

- Tom Wagner
- John Enslin
- Barb Engler
- Steve DeFrancesco
- Robyn Coan,
- Tom Todd
- Nathan Newman
- Meghan Roberts
- Li Wang
- David Krumm
- Jeff Binz
- Tyson Heidmann
- Adam Young
- Ben Clement
- Diane Saftic (Ameren)

4. Inside the Tree House



Sprouting from a giant seed pod (helicopter) of the maple tree, the hexagonal house incorporates repurposed wood, green roof technology, solar power, and a recycled rain water system. In showcasing these aspects of sustainability, this tree house is able to educate, entertain, and enchant through root tunnels, leaf shutters, and models of forest inhabitants.

Location

Red Oak Tree, *Quercus rubra*

Designers & Collaborators

Carol Pearlstone

Ann Florsek Architect LLC
Ann Florsek

Villinger Construction Company
Milt Villinger

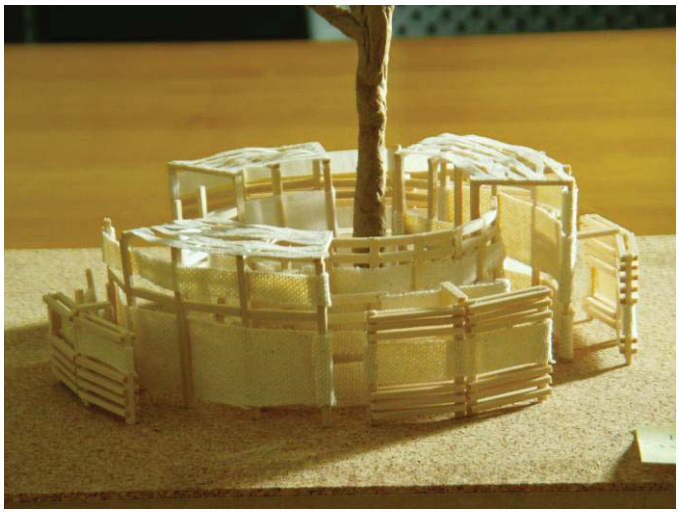
Teiber Construction Company
Dean Teiber

Thies Farm and Greenhouses
Fran Thies and Dave Thies

Contributors

Luaders Construction
Henson Construction
Dealers Service & Supply Co.
Pacific Lumber
Earthminded
Industrial Springs

5. The AMAZE-ing Rings



This tree house has been designed to represent an expanded tree ring structure, constructed out of wood for the outer layers and fabric for core rings. These rings, which radiate from around the tree, represent some of the different biological structures of the tree, such as the outer bark, the cambium cell layer, and the heartwood. A two-way traffic path runs throughout the rings, lined with educational panels explaining the functions of different parts of the tree, and at the center there is a sitting area surrounding the central tree. The design utilizes fabric and recycled wood in an effort to minimize waste and create an environmentally friendly structure, and following the exhibit, the wood used will be donated to education and community outreach programs.

Location

Ginkgo Tree, *Ginkgo biloba*

Designers & Collaborators

Washington University

Meghan Lewis
Catherine C. Pyle
Alvin Kong
David M. Adkin

6. Reflections Tree House

The concept of the Reflections Tree House was inspired largely by the aerial and buttress roots cast by some tropical trees found throughout the world. Perhaps one of the most important design considerations was in making the structure seem as if it were part of the tree or even growing from it, all while avoiding any physical contact with the tree itself. The name “Reflections” is derived from the way the structure complements and even mimics the canopy of a tree. It has been constructed with a very minimalistic approach, using easily repurposed lumber and fabric. It creates a perfect environment for visitors of the Garden to relax and “reflect” on the day.

Location

Sycamore Tree, *Platanus occidentalis*

Designers & Collaborators

Ranken Technical College

Jacob Amador
Aaron Becker
Shaun Black
Andrew T. Hustedde

7. house + tree = Phi

Tree houses are special places. They are classic examples of how people (typically children) dream, play, and contemplate life. They express one's most inner personalities: organic structures, built from found objects and adorned to assist the creative imagination. Our tree house is a formal abstraction of how Humans connect themselves with Trees, Nature, and the Universe through one of the most classic expressions in Western culture. Phi and the Fibonacci Sequence are two of the most well-known expressions Humans have created that formulate an order to Nature and the Universe. In that way we have used these expressions to make better order of our physical world and have used this expression in Art, Architecture, Music, and common, everyday objects. Through its form, illustrative panels, and elements of found objects, our tree house uses the classical principles of Phi and the whimsical construction of traditional tree houses. The culmination of these elements will illustrate to the viewers at the Garden how Humans attempt to better connect with Nature.

Location

Chinese Elm Tree, *Ulmus parvifolia*

Designers & Collaborators

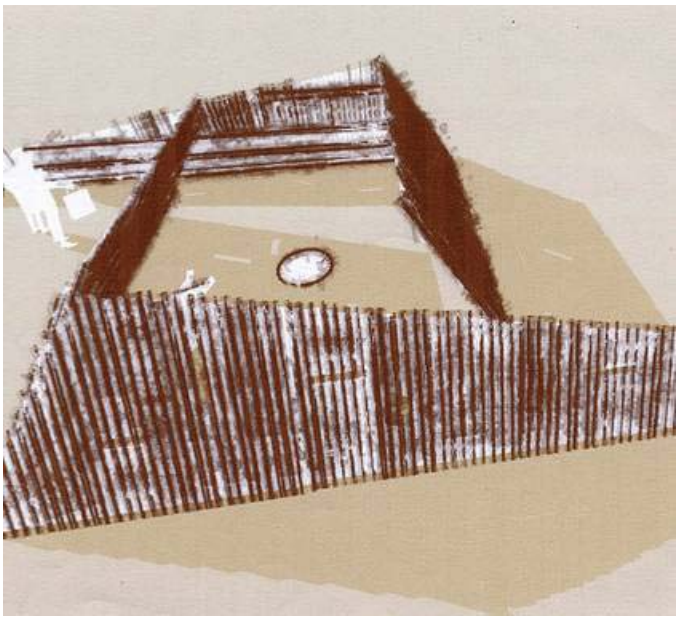
Christner Inc.

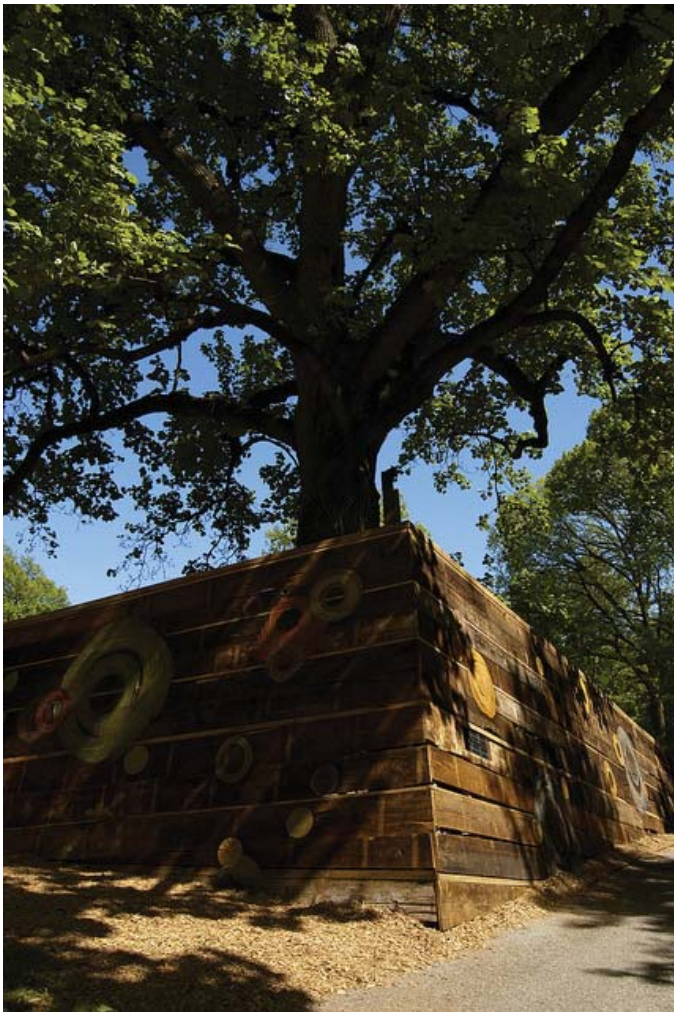
Michael Antkowiak
Grace Corbin
Christopher Montroy
Robin Ringwald
Marilyn Sander
Dan Rosenberg

Engraphix, Inc.

Ed Brimer

8. A Treed Place of Play





Two canted L-shaped structures surround the tree producing an enclosed play space so that visitors of any age can play while appreciating the beauty of the tree and the ceiling enclosure it provides. Working in collaboration with printmaker Elizabeth Foley, large colorful circles will be wheat-pasted along the walls echoing the color of the surrounding Garden. The Treed Place of Play is constructed out of 100% recycled scrap construction material and includes solar lighting for nighttime illumination.

Location

Tulip Tree, *Liriodendron tulipifera*

Designers & Collaborators:

Manzo Architects

Christopher Manzo
Rocco Manzo
Marie Manzo
Derek Maschek
Elizabeth Foley

Contributors

American Timber Salvage
Microgrid Energy

9. Sweet Gum Tree House

The concept for this tree house was to create a structural pathway allowing the Missouri Botanical Garden visitor to view the cedar trees, lily garden, and sculpture pond from a new perspective. The design acts as a "Gateway to the Garden," framing the new perspective while also receding slightly so visitors may use the level nearest the sweet gum tree as a bench. The entire structure is constructed out of re-purposed or pre-purposed materials, such as shipping pallets and conventional lumber, which will be reused after the tree house is disassembled and donated to the St. Louis Chapter of Habitat for Humanity.

Location

Sweet Gum Tree, *Liquidambar styraciflua*

Designers & Collaborators

Roost Design Studio

Terry Parnell
Levi Hausman
Chris Malone
Chuck Long

Contributors

Madison County Wood Products
Pallet Logistics Management, Inc.

The Garden's TREEmendous Trees

Although the trees of the Missouri Botanical Garden might seem to be an anonymous backdrop for the luscious plants nearby, they are in reality a garden unto themselves. They do not appear where they are by happenstance. They were planted with the same scrupulous attention to design and botanical diversity as the Garden's myriad flowers and shrubs, and are an integral part of the Garden. Some of the trees are commonplace; others rare. Many carry a historical message. Others burst into eye-catching bloom at certain times of the year. Together, they form a garden within a garden, and each tree has its own story to tell of its botanical or historical interest, as noted on the interpretative sign it bears noting its history.

The Garden was virtually treeless when Henry Shaw began it in 1859 on the Missouri prairie. Now there are trees everywhere. There are 4,873 trees on Garden grounds, representing 1,096 unique taxa and 624 unique species.

There are remnants or descendants of trees planted by Shaw himself or his staff a century ago. Shaw planted Osage orange trees (*Maclura pomifera*) in the 1860s to line the carriage trail leading to his country home, Tower Grove House. Some of those trees or their offspring still stand near the Climatron® conservatory and within the Doris I. Schnuck Children's Garden, which opened in 2006. Although much of the original route is gone, with imagination you can trace the trail followed by Shaw and his guests.

No one knows which Garden tree is the oldest because of the lack of written records. The Garden has completed a project to draw a core of wood from representative trees and count the rings to determine its age. The coring project indicates that among the oldest are three bald cypress trees (*Taxodium distichum*) in the northwest corner of the Garden along Alfred Avenue, near the maintenance area gate. Tall and stately, they were part of Shaw's arboretum, which he personally began in 1861 in a project that marked one of the earliest tree-planting efforts in the Garden. The three are most likely offspring of the originals, but "there isn't any question about their being among the oldest trees in the Garden," said Chip Tynan of the Horticulture Answer Service. The coring project indicated that the three were planted in approximately 1883.

More bald cypress are scattered throughout the Garden, with two rows by the lily pools between the Climatron and Spink Pavilion. Another bald cypress near the Shoenberg Fountain dates back to 1874. Their characteristic of dropping leaves each winter—unusual among conifers, which generally are evergreens—may have saved the large trees. Leafless in the winter, they escaped the pollution during St. Louis's coal-burning days when coal smoke killed nearly all the evergreen conifers on the Garden grounds.

Other historic trees include a ginkgo by the Cleveland Avenue Gate House which dates back to 1884 and a black gum in the Japanese Garden that is from 1885.

We also do not know which is the tallest tree, although a contender might be the white basswood *(Tilia heterophylla)* by the Museum Building near the Tower Grove House. It is one of three trees in the Garden declared by the Missouri Department of Conservation in 2008 as a "Missouri State Champion Tree," a designation marking the largest of the species in the state. According to the state, the basswood is 103 feet tall and 12.4 feet or 149 inches in circumference. In 2009, the basswood received National Champion status.

Another Missouri champion is nearby in the Garden: a possumhaw (*Ilex decidua).*

There are trees captivating for their showy blossoms, like the cherry trees near the Japanese Garden. Some trees are noteworthy because they are simply striking to behold. One such tree is a huge Scotch elm (*Ulmus glabra*) just west of Tower Grove House. Based on the coring project, this elm dates to 1913. The huge tree, with its gnarled trunk, has branches so large and heavy that some have to be supported by cables.

Another is a very stout ginkgo *(Ginkgo biloba)* by the Gate House. The species represents an evolutionary line that originated perhaps 280 million years ago, long before the earliest-known mammals and birds. This ginkgo was possibly purchased by Henry Shaw in 1861. Ginkgoes were popular in America for their beauty, novelty, biological and historical interest and tolerance of unfavorable conditions, despite the foul odor of its seeds.

To view a "living fossil," see the Shaw's Legacy® Dawn Redwood *(Metasequoia glyptostroboides, 'Raven')* trees near the Lehmann Building to the west of Tower Grove House. A particularly attractive specimen, it was vegetatively propagated to retain unique characteristics including its extremely uniform pyramidal form with a low branching habit; deeply furrowed, convoluted, buttressed bark; and fast growth rate. This tree was unknown except through fossil records until 1941, when it was discovered growing in Asia by scientists who noticed a curious conifer. But Japan and China were at war, and the scientists who independently discovered the tree had to wait until the end of World War II before sharing information that led them to conclude the fossil did indeed live. The Missouri Botanical Garden's specimens came from seeds received 1947, which led to their planting by the Lehmann Building. An example of an unusual tree is the golden larch *(Pseudolarix amabilis)* by the Museum Building. It is the offspring of two trees that were in front of the Chinese Pavilion at the 1904 World's Fair. The trees, long forgotten, were re-discovered in 1953 when a woman wore a sprig from a tree in her yard in a corsage to a social event at the Garden. Her corsage created quite a stir, with the sprig identified as the rare golden larch. It was further learned that a previous owner of the woman's home had been a hostess at the World's Fair, and had handed out sprigs of the larches to visitors. The fact that the larches are "one generation from the 1904 World's Fair makes it very significant," said Tynan.

TREEmendous Interactive Discovery Center

April 1, 2011–January 1, 2012

Inviting visitors of all ages to immerse themselves in the world of trees, the TREEmendous Interactive Discovery Center has been transformed into a forest of fun, discovery and learning—filled with hands-on, interactive experiences.

Visitors will be able to create artwork out of tree parts, dress up as a tree, test their tree I.Q. and experience what life is like in a forest canopy. Curl up with a book under the canopy of our story tree, take in a forest film on our big screen and even share your favorite tree stories and memories in the Tree Tales community journal.

Whether stopping by for a few minutes or a few hours, visitors are invited to learn about the extraordinary trees among us, discover the many roles trees and forests play in our lives and get inspired to take action!

Scope of Activities

Tree Tales: If you were a tree what kind would you be? Visitors will share their thoughts on this as well as their favorite tree story through the Garden's TREEmendous Tree Tales journal.

Branch Out: Use the Garden's TREEmendous TREE HUNT area guide, clue map and photo journal to explore the region in search of trees. Don't forget to pick up "My Guide to the Garden's Trees" for self-guided tour experience of the Garden's more significant trees.

Stump Station: Why do leaves change color? What is the tallest tree? How many trees are there on the Garden grounds? Here, visitors have an opportunity to test their tree IQ by stumping TREEmendous staff with TREErific questions.

Forest Friends: The forest is home to many friends. Through puppets and costumes, our young visitors explore the animals that live in temperate and tropical forests.

Forest Layers: Explore the many layers of forests through an interactive magnet panel and discover what plants and animals live in each of the layers.

Be a Tree: From bark, branch, leaf and root, to skin, limbs, fingers, hands and feet - young visitors discover through interactions and props the similarities between humans and trees.

Tree Treasures: There is no doubt that trees of all shapes, sizes and varieties enhance communities. Visitors will add their own personalized leaf to our "Leave a Leaf" wall. On each leaf, visitors share what they treasure and appreciate most about trees.

Creativity Corner: What can you make from trees? Design your own forest and leave your masterpieces to inspire other visitors. Got bark? Trees do and they are great for textural rubbings too. Assemble your own miniature tree house from wood blocks.

Lessons for K–8 Sorted by Grade Level

K–2nd Grade	3rd–5th Grade	6th–8th Grade
The Forester's Job		
Treemendous Leaves		
What is a Tree?	What is a Tree?	
The Parts of a Tree	The Parts of a Tree	
The Needs of Trees	The Needs of Trees	
	Feast in the Forest	
	Tree Measurement	Tree Measurement
	Nature's Treasure Chest	Nature's Treasure Chest
	Forest Families	Forest Families
Adopt a Tree	Adopt a Tree	Adopt a Tree

To find more activities about trees, please check out our website:

http://www.mobot.org/education/strc

If you are interested in checking out one of our videos or kits, please call the Stupp Teacher Resource Center at 314-577-9501 to reserve your kit today.

The Forester's Job

Activity for Grades K–2

Objective

In this activity, students will learn about the job of a forester and about the different tools a forester uses to do their job.

Materials

- Set of forester tool cards (found at end of this lesson)
- Set of forester tool clue cards (found at the end of this lesson)

Background Information

Overview of Being a Forester

Forestry experts, called foresters manage the forests for many uses. A forest is a complex natural community that supports many types of plant and animal life.

Foresters balance the management of the forest to produce products that people use with the need to conserve forest areas for wildlife and recreational use. Foresters are problem-solvers. Their job responsibilities include promoting the health and well-being of the forest by helping protect it from the harmful effects of fire, disease and insects. Foresters also decide when to harvest trees, when to plant new trees and how to help the forest grow better.

To be a forester, it's important to enjoy working outdoors. But the forester must also study a lot of different subjects in college. They need to understand sciences like botany, zoology and chemistry. They also need to be good in math and know how to use computers. Of course, writing and communications skills are very important, too.

How Foresters Manage a Forest

How do foresters even start to understand how to manage the forest? First, they must know about the trees in their forest before they can decide how best to manage the forest.

To begin, foresters use maps and aerial photos (a photo taken from an airplane) to get an overall view of the forest. They can use maps and photos to locate roads, rivers and creeks, property boundaries and tree stands that are different ages. After studying maps and photos, the forester needs to get a closer look from the ground at areas of the forest and take a timber inventory, just like a storekeeper takes inventory of his or her shop. This is called a timber cruise.

A forester will plant anywhere from 300 to 1,000 trees per acre depending on the particular area and tree species. Based on experience, the forester knows that there will be a certain number of trees that will not survive. Usually, nine out of 10 trees survive during the first five years after planting. Foresters use research and historical information to estimate the number of trees that will grow per acre in a forest that grows back naturally.

Sometimes the forest gets too crowded and the trees do not grow well. It can happen when the trees are first planted, and grass and weeds crowd the new trees. It can happen when the trees get larger and compete with each other for

water and nutrients from the soil. Foresters may decide to plow the ground before planting just as a farmer does for crops to help the trees grow better.

They also may decide to thin the trees. When you plant flower or vegetable seeds, you often get more sprouts than will be able to survive, so you weed them out and keep the healthiest looking plants. The same is true of trees, but it usually takes several years for them to start competing with each other. Foresters remove a portion of the trees so the remaining trees will grow faster. Usually the trees that are removed are not wasted, but are used to make paper.

For an older stand of trees, a forester will need to know how well the trees are growing and how healthy they are. They will measure the diameter and height of the trees and check the age of the trees. They also look to see how closely the crowns or tops are growing together.

The forester then may decide that this stand is ready to be harvested to make paper and wood products.

Procedure

Have the students sit in a circle on the floor. Begin the lesson by completing a K-W-L chart about the job of a forester. Once students have had ample time to share what they think a forester is and what a forester does, give a brief overview exactly what a forester actually does. Use the background information provided above to help you.

Explain to the students that foresters use many different kinds of tools to help measure trees. Invite the students to come up with a list of possible tools they think a forester might need to have. Write down the students' responses.

Then, place forester tool cards into the center of the circle. Ask the students to take turns trying to name the items.

Next, explain to the students that you are going to read a clue about a particular forester tool. Instruct the students to listen very carefully to see if they can match the tool's description with one of the picture cards on the floor.

Once all of the items have been matched to their clue, allow time for the students to discuss and brainstorm a list of characteristics that each person might need in order to have in order to be good forester. Write down the students' responses.

Extension

Set up a special learning station in your classroom and invite your students to role-play the job of a forester.

Forester Tool Cards

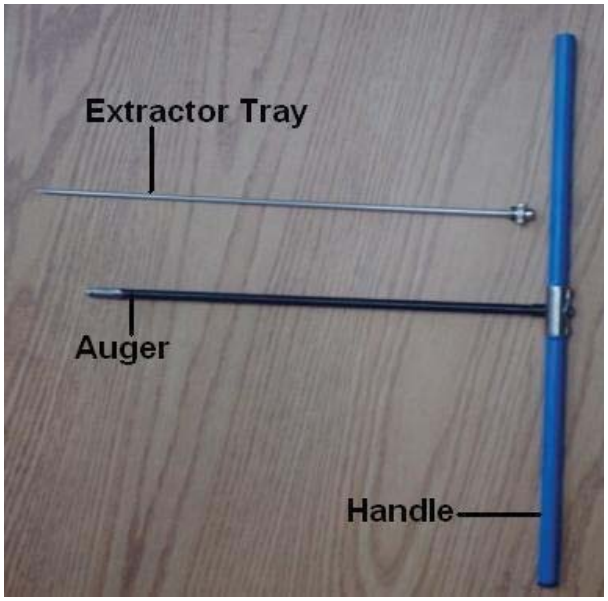
cruising vest

compass

data recorder

soil sampler

tape measure



increment borer

clinometer

dibble

Forester Tool Clue Cards

Cruising Vest Clue
Foresters wear a cruising vest when working in the woods. It has many pockets to hold the forester's tools and is bright orange so that the forester can be easily seen by others, especially hunters, who may be in the forest.

Compass Clue
When the forester is in the woods, he or she needs to know how to get around. Using a compass, foresters determine their location in a forest.

Data Recorder Clue
After collecting information about the forest, the forester uses a computer to summarize it. New hand-held computers called data recorders.

Soil Sampler Clue
The quality of the soil tells the forester how well the tree will grow. A forester may use a soil sampler to pull up soil samples and send them to a laboratory where they are analyzed.

Tape Measure Clue
Foresters use tapes to measure the diameter of a tree. They always measure the diameter at 4.5 feet above the ground. This measurement is called "Diameter at Breast Height."

Increment Borer Clue
It’s easy to look at rings after a tree has been cut, but how do you check growth while a tree is still standing? Using an increment borer, the forester can pull out a piece of the tree that looks like a pencil. They can then count the rings and see how old the tree is, how fast it’s growing and how healthy it is.

The study of tree time is called dendrochronology. Scientists have found that they can learn about past climates by studying tree ring patterns of very old trees.

Clinometer Clue
Foresters need to know the height of the tree to understand the volume of wood in the tree. There are many different types of instruments that a forester can use to gauge the height of the tree. One of these tools is a clinometer. It uses geometry to help a forester quickly measure height. Tree diameter and height are used to determine how much usable wood is in a tree.

Dibble Clue
When planting seedlings, foresters use a dibble to dig a hole in the ground.

Treemendous Leaves

Activity for Grades K–2

Objective

In this activity, students will explore the nature of leaves using science, math, writing, and dramatic play.

Materials

Nature Walk

- Brown paper bags (one per student)
- Magnifying glasses (one per student)

All About A Leaf Report

- Copies of "All About A Leaf Report"(one per student)
- Books about trees (from local library)
- Internet access (from the classroom)
- Pencils (one per student)

Graphing Leaves

- Assortment of Leaves
- Butcher Paper for Graphing
- Permanent Marker (used to create graphs)
- Scotch Tape (one per group)

The Story of a Maple Leaf—Dramatic Play

- Open space (so that students can move freely)
- Copy of "The Story of a Maple Leaf"

Experimenting with Leaves

- Green Leaf (one per student)
- Popsicle Stick (one per student)
- Bottle of Rubbing Alcohol
- Plastic Cups (one per student)

Background Information

Why do leaves change color?

While you were playing in the hot sun during summer vacation, the trees on the streets, in the parks and in the forests were working hard to keep you cool. To feed the shiny green leaves that make shade, trees use sunlight to convert water and carbon dioxide into sugar. This is called photosynthesis.

Now it's autumn, and you're ready—okay, almost ready—to go back to school. Those hardworking trees, on the other hand, need to take a break from all that photosynthesizing. When leaves change color, from green to yellow, bright orange or red, you'll know trees are beginning their long winter's rest.

Where do leaf colors come from?

Leaf color comes from pigments. **Pigments** are natural substances produced by leaf cells. The three pigments that color leaves are: chlorophyll (green), carotenoid (yellow, orange, and brown), and anthocyanins (red).

Chlorophyll is the most important of the three. Without the chlorophyll in leaves, trees wouldn't be able to use sunlight to produce food.

Carotenoid create bright yellows and oranges in familiar fruits and vegetables. Corn, carrots, and bananas are just a few of the many plants colored by carotenoid.

Anthocyanins add the color red to plants, including cranberries, red apples, cherries, strawberries and others.

Chlorophyll and carotenoid are in leaf cells all the time during the growing season. But the chlorophyll covers the carotenoid—that's why summer leaves are green, not yellow or orange. Most anthocyanins are produced only in autumn, and only under certain conditions. Not all trees can make anthocyanins.

Why do leaves change color?

As the Earth makes its 365-day journey around the sun, some parts of the planet will get fewer hours of sunlight at certain times of the year. In those regions, the days become shorter and the nights grow longer. The temperature slowly drops. Autumn comes, and then winter.

Trees respond to the decreasing amount of sunlight by producing less and less chlorophyll. Eventually, a tree stops producing chlorophyll. When that happens, the carotenoid already in the leaves can finally show through. The leaves become a bright rainbow of glowing yellows, sparkling oranges and warm browns. What about red leaves? Read on.

Do leaves change color because of the weather?

Perhaps you've noticed that in some years, the red fall colors seem brighter and more spectacular than in other years. The temperature and cloud cover can make a big difference in a tree's red colors from year to year.

When a number of warm, sunny autumn days and cool but not freezing nights come one after the other, it's going to be a good year for reds. In the daytime, the leaves can produce lots of sugar, but the cool night temperatures prevent the sugar sap from flowing through the leaf veins and down into the branches and trunk. Anthocyanins to the rescue! Researchers have found out that anthocyanins are produced as a form of protection. They allow the plant to recover nutrients in the leaves before they fall off. This helps make sure that the tree will be ready for the next growing season.

Anthocyanins give leaves the bright, brilliant shades of red, purple and crimson.

The yellow, gold and orange colors created by carotenoid remain fairly constant from year to year. That's because carotenoid are always present in leaves, and the amount does not change in response to weather.

The amount of rain in a year also affects autumn leaf color. A severe drought can delay the arrival of fall colors by a few weeks. A warm, wet period during fall will lower the intensity, or brightness, of autumn colors. A severe frost will kill the leaves, turning them brown and causing them to drop early. The best autumn colors come when there's been: a warm, wet spring, a summer that's not too hot or dry, and a fall with plenty of warm sunny days and cool nights.

Why do leaves fall?

A tree's roots, branches and twigs can endure freezing temperatures, but most leaves are not so tough. On a broadleaf tree—say a maple or a birch—the tender thin leaves, made up of cells filled with water sap, will freeze in winter. Any plant tissue unable to live through the winter

must be sealed off and shed to ensure the tree's survival.

As sunlight decreases in autumn, the veins that carry sap into and out of a leaf gradually close. A layer of cells, called the separation layer, forms at the base of the leaf stem. When this layer is complete, the leaf is separated from the tissue that connected it to the branch, and it falls. Oak leaves are the exception. The separation layer never fully detaches the dead oak leaves, and they remain on the tree through winter.

Evergreen trees—pines, spruces, cedars and firs—don't lose their leaves, or needles, in winter. The needles are covered with a heavy wax coating and the fluids inside the cells contain substances that resist freezing. Evergreen leaves can live for several years before they fall and are replaced by new growth.

On the ground, fallen leaves are broken down by bacteria, fungi, earthworms and other organisms. The decomposed leaves restock the soil with nutrients, and become part of the spongy humus layer on the forest floor that absorb and hold rainfall. In nature, nothing goes to waste!

Procedure

Nature Walk

1. Explain to the students that you are going to take them on a nature walk through the school neighborhood. Invite them to carefully listen to the sounds that they hear during their walk and to pay close attention to the smells that they encounter on their journey.
2. Give each student a brown paper bag. Explain to the students that they may only collect what has already fallen to the ground. There should be no picking directly from any plant on the walk. Encourage the students to try and collect as many different leaves as they can.
3. After returning to the classroom, have students sit at their desk and empty out their brown paper bag. Distribute a magnifying glass to each student and allow time for the students to investigate what they collected.
4. Once ample time has been given for observation, invite the students to share what they saw, what they heard, what they smelled, and what they collected during their nature walk. Write down the students' responses on the board. Explain to the students that they will be doing different activities with the leaves that they collected and ask the students to put all of their items back into the brown paper bag for now. Collect the students' bags and put them in a safe place until they will be used again.

All About A Leaf Report

1. Return the paper bags of leaves back

to the students.

2. Ask the students to choose a favorite leaf from their collection bag and have them create a leaf report using their favorite leaf.
3. Encourage the students to try and find out more about the tree their favorite leaf came from by using tree guides, resources from the library, and/or the internet. The students will use their gathered information to complete a leaf report (Leaf report can be found at the end of this document).
4. Once all of the students have completed their leaf reports, invite each student to read and share their report with the class.

Experimenting with Leaves

1. Invite the students to choose a green leaf to use for an experiment.
2. Give each student a coffee filter strip and a popsicle stick.
3. Have the students use the popsicle stick to rub some of the green color (chlorophyll) from their green left onto the coffee filter strip.
4. The teacher will place each student's strip into a plastic cup of rubbing alcohol for a half an hour. Be sure to keep the rubbing alcohol away from the students. This part of the experiment should only be done by the teacher.
5. Once a half hour has passed, take out the coffee strips and let them dry.
6. Once all of the coffee strips have had ample time to dry, have the students make observations on what they see. The students should see a small band of color that has separated from the green. Discuss with the students that the true colors of leaves are "hidden" by the chlorophyll that covers them up. In the fall, the tree stops making chlorophyll and the true colors of the leaves are allowed to show through.

Graphing Leaves

1. Divide the students into small groups.
2. Instruct each group to empty their leaf bags and to group their group's leaves. The students may decide to sort their leaves according to type, color, size, shape, texture, etc…
3. Once the students have finished sorting, the teacher should encourage the students to put their information into a graph. The students can tape their leaves onto graph paper (provided by the teacher), and then they can share with their class how they decided to sort their leaves.

The Story of a Maple Leaf—Dramatic Play

1. Explain to the students they you are going to read them a story about a leaf.
2. Encourage the students to act out or pantomime what is happening as you read the story. The children can pretend they are leaves, keeping a stiff body. This story easily allows exploration of movement and imagination.

"The Story of a Maple Leaf"

A yellow maple leaf was hanging onto a

branch, stretching on its tiptoes and reaching up, holding on with its hands together. The chilly autumn breeze sailed through the tree, shaking the branches and leaves, bending them in the middle, turning them in all directions. The next breeze was strong enough to make the leaves turn in circles and back again in the opposite direction. The yellow maple leaf twisted its top half, bending at the middle, moving in all directions as the wind shook the branch. Suddenly, the leaf lost its hold on the branch and floated down, down, down…..

The wind tossed it about in the air. It appeared to be dancing, leaping, and skipping in the air. Another puff pushed it higher, as it stretched to grab its old branch. Suddenly the breeze changed direction and turned the leaf around, again pushing it up, leaping up, crouching down, twirling down, flying down. It stopped.

The wind moved on to other trees and dropped the leaf to the ground. The leaf sat still. It rolled up against a stick. It wiggled its toes, feet, legs, arms, hands, and neck. The leaf was fine. A rake came toward it and rolled the leaf into a pile with other leaves from different kinds of trees. Was it going to be burned?

The maple leaf shook with fear. It felt a human hand move to push the leaves into a basket and carry them to a garden. The leaves were spread on top of the garden plants and roses. The leaf sat still, warming itself in the sun. It was lying over a delicate rose. As the days passed, its color changed to brown and it became dry. But it smiled and relaxed, for it was protecting the rose from the cold weather and the snow to come.

Extension

Math

Allow students to use cubes to measure the length and the width of their leaves.

Have students drop their leaves and record how high they can count before their leaf reaches the floor.

Have students measure the area of their leaf by covering it with pennies.

Take students outside to the playground with a list of plant and/or tree “items” they will find there (tree trunks, branches, leaves, seeds, flowers, etc.) and a measurement tool (ruler, yardstick, tape measure, etc.). Once outside, ask students to take measurements of the items on their list. Students could be asked to measure length, width, and circumference. As a class, compare measurements. Who located a needle with the longest length? Who found a branch with the greatest circumference? Tailor the discussion to the ability of your students and the “items” available on your site. Note: If measurement tools are not available for all students, string or yarn may be cut to standard lengths and used.

Games

Play a listening game in which clues are given to find the "secret leaf". Lay down all of the leaves. Say, "This leaf is not yellow." "This leaf is not large." "This leaf has smooth edges." Continue until all but one leaf is eliminated. After the children understand the "secret leaf" game, have them ask you questions to discover the secret leaf. "Is the secret leaf red?"

Art

Leaf rubbings: Ask each student to bring in a leaf (or provide a leaf for each student). Place the leaf under newsprint. Using the side of a crayon, have the students rub the crayon over the paper. They can see the outline of the leaf and veins come through on the paper. Use the rubbings to create covers or illustrations for books about leaves, mount them on heavier paper and create a mobile, or enjoy them on a bulletin board.

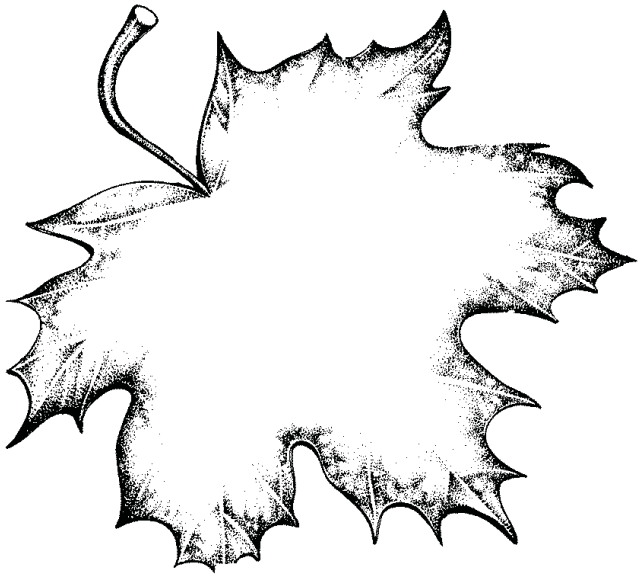
Leaf placemats: Provide each student with a rectangular piece of clear contact paper the size of a placemat and leaves or needles. Invite students to place their leaves wherever they choose on the sticky side of the contact paper. When finished, place another sheet of clear contact paper over the leaves. Print each child’s name on the placemat in permanent marker and use during snack or lunch time for easy cleanup.

Language Arts

Me? A Tree?: Ask students to imagine themselves as a tree. What would their day be like? What would they see? What would they hear? Invite them to write a story from their chosen point of view!

Creative writing: Introduce students to the idiom “Money doesn’t grow on trees.” Explain that it’s a saying that people use to mean that unlike leaves—which seem to be in abundance—money is harder to come by. Then, ask them to imagine what it would be like if money could grow on trees! Invite them to think about other items that might be fun to be able to grow on trees! Invite students to draw a picture of their special tree and write about it. Why do they like their tree? How does it grow? What do they do with the item it grows? Would they share their tree with others?

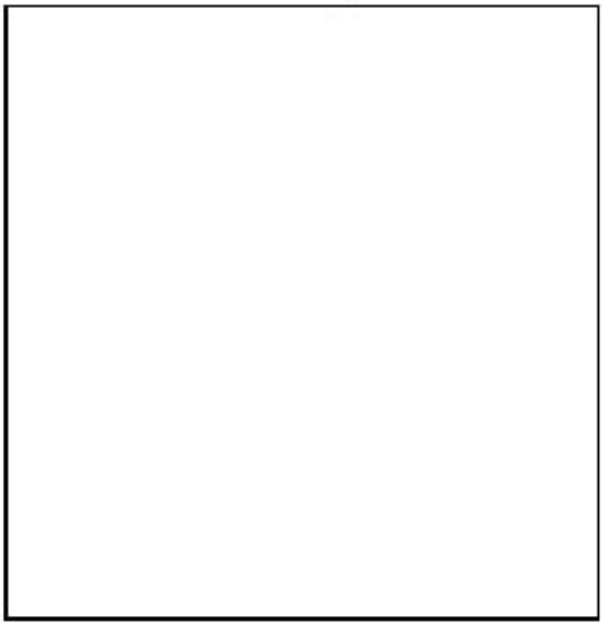
Poet-tree: Create a classroom poet-tree. Find a bare tree branch about 3 feet long with lots of smaller branches. Place the branch in a pail or large coffee can and anchor the branch with sand or gravel. Cut out large paper leaves from green construction paper. Have each child write a short poem about trees on a paper leaf. Attach the leaves to the “poet-tree” with thread, paper clips, or clothespins.



All About A Leaf

Name _____

This is my leaf.



The size of my leaf is:

large

medium

small

The color of my leaf is:

red	orange	yellow
brown	green	purple

What did you learn about your leaf?

_____

_____

_____

_____

What is a Tree?

Activity for Grades K–2 and 3–5

Objective

Students will understand that living organisms grow and change and that trees belong to families (species) and related trees look similar to their parent trees. The students will be able to show how the nonliving environment (abiotic factors) can affect a tree and will be able to use measurements to describe the characteristics of a tree and compare to one or more additional trees. The students will use adjectives to describe and compare trees, recognize that trees have specific shared characteristics and differences, and identify parts of a tree.

Materials

- Chart paper
- Markers
- Paper (one for each student)
- Pencil (one for each student)
- String (one per student group)
- Meter stick (one per student group)
- Magnifying glasses (one per student group)
- Venn Diagram (one per student group)

Background Information

Biotic and abiotic factors are interrelated. If one factor is changed or removed, it impacts the availability of other resources within the system. Biotic, meaning of or related to life, are living factors. Plants, animals, fungi, protist and bacteria are all biotic or living factors. Abiotic, meaning not alive, are nonliving factors that affect living organisms. Environmental factors such habitat (pond, lake, ocean, desert, mountain) or weather such as temperature, cloud cover, rain, snow, hurricanes, etc. are abiotic factors.

Biotic and abiotic factors combine to create a system or more precisely, an ecosystem. An ecosystem is a community of living and nonliving things considered as a unit. If a single factor is changed, perhaps by pollution or natural phenomenon, the whole system could be altered. While we usually cannot see what we are doing to various ecosystems, the impact is being felt all over.

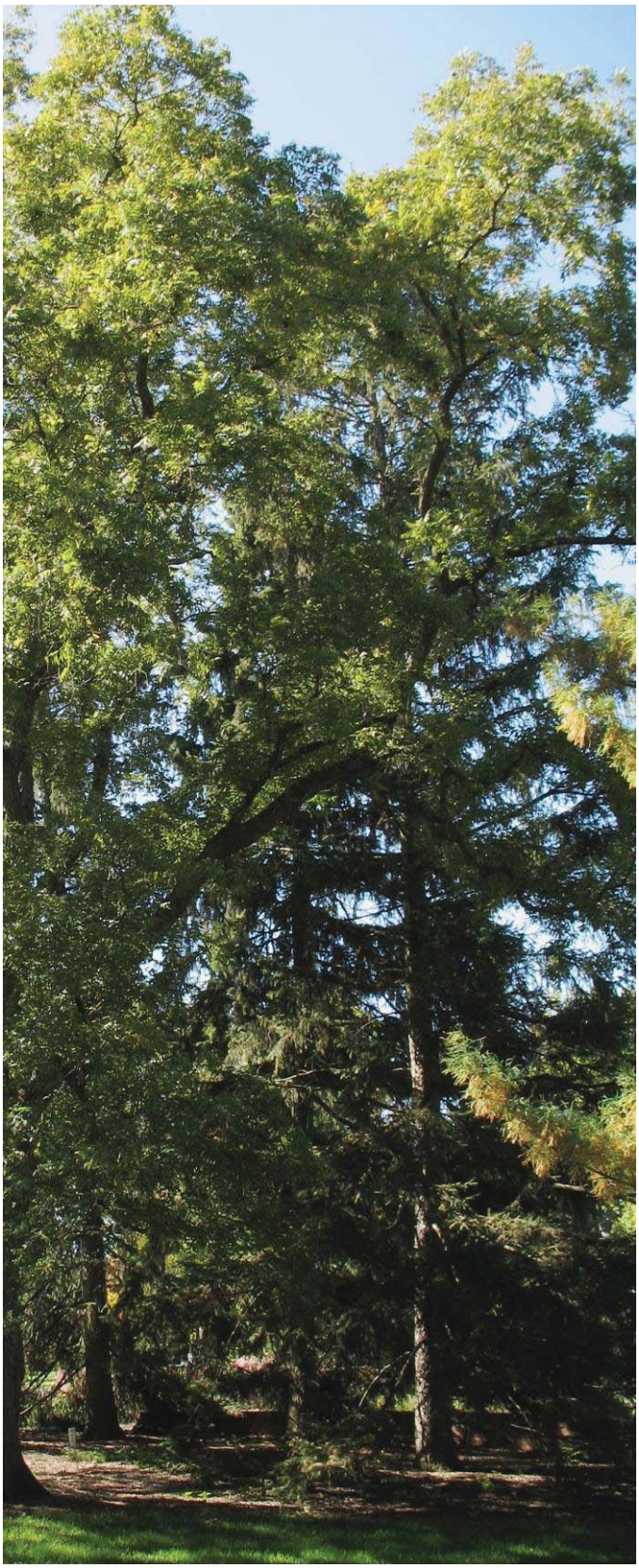
Procedure

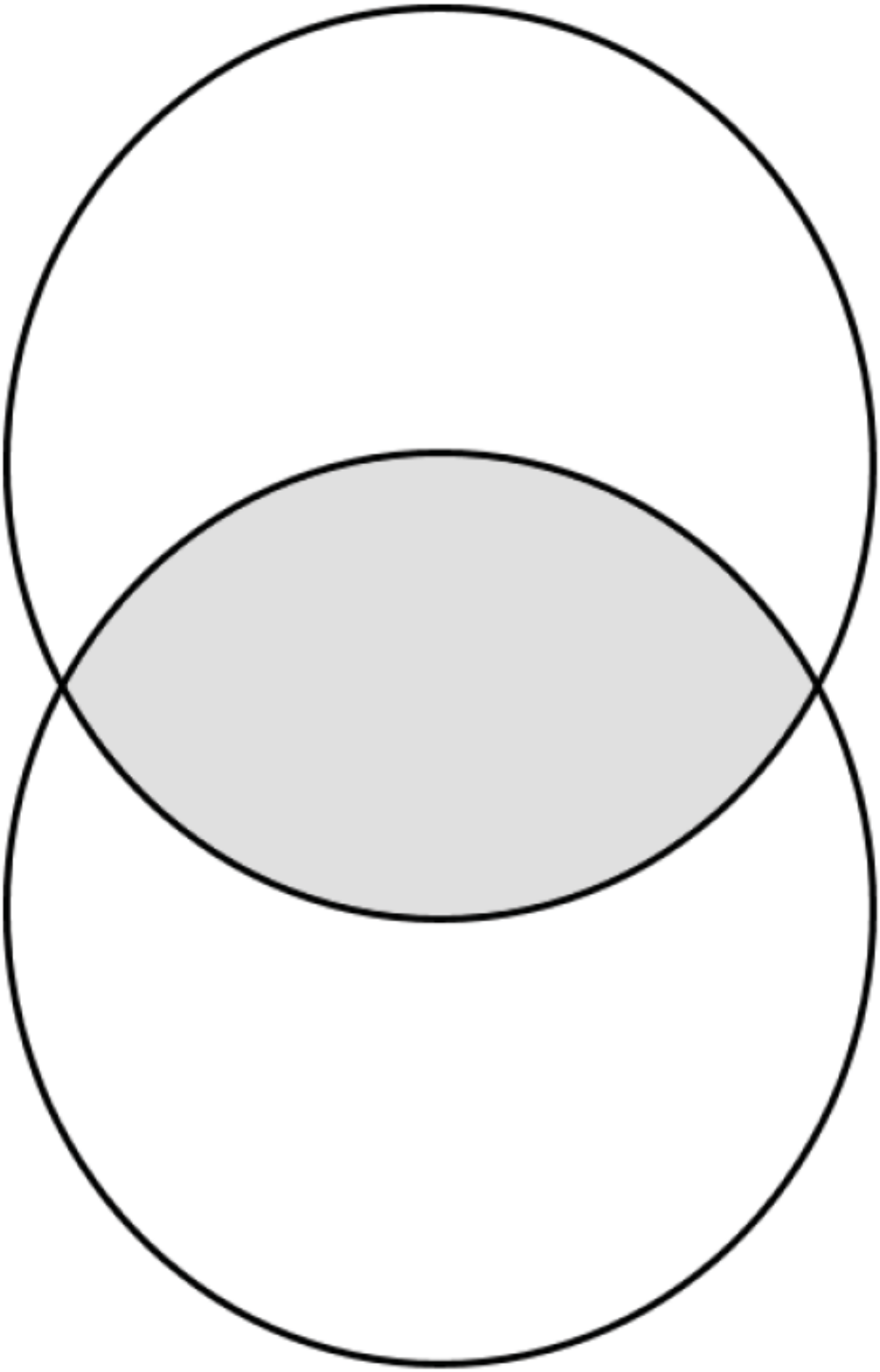
Activity 1: Tree Characteristics

1. The teacher will tell the students that they are visiting the schoolyard to find a living thing or organism. The teacher will ask the following questions: Are we living organisms? How can we tell?
2. The teacher will explain that all living things share these characteristics:
   - May breathe (Exchange gases: take a deep breath—we draw in O_2 even though we do not see it; blow out....we blow out another gas called CO_2 even though we do not see it)
   - May move (Not all organisms move, but they react—see this on playground)
   - Grow (All organisms grow)
   - Have offspring (All living things reproduce)
   - Eat
   - Take in water
3. Next, the teacher will take the students go into the schoolyard. Have the students stop at the first tree.
4. The teacher will ask the student measurers use string to measure around the tree and to mark the string. Similar to measuring our waist, the students measured the waist or the circumference of the tree. The teacher put the string on a yardstick to measure the tree circumference. The teacher will record the number onto the chart paper with a marker.
5. Then, the teacher will invite the students to feel the bark and use magnifiers to examine the bark. They use a word to describe how it feels. The teacher will record their observations onto the chart paper with a marker.
6. The teacher will ask the students to share what else they notice about the tree. The teacher will record the students' answers onto the chart paper with a marker. Next, the teacher will identify the tree and tell the students some more information about the tree.
7. The teacher will invite everyone to sit down and draw the parts of the tree that they see. The teacher will help to identify the basic tree parts: the trunk, branches, leaves, seeds or buds....
8. Finally, the students will visit a second tree in the schoolyard and will repeat the above steps for their second tree.

Activity 2: Trees tell their story (Inside or outside)

1. Have the students look at the chart paper of information that they gathered about the two trees.
2. The teacher will give each student group a Venn Diagram and instruct their students to work together to write down what the trees have in common and to explain how their trees are different.
3. Once ample time has been given, the teacher will allow time for each student group to share their Venn diagrams and to explain how the two trees were alike and different.
4. The teacher will wrap up the lesson by asking the following questions: What did you learn about trees today? Do you think the schoolyard is the best place for the tree to live? What else would you like to learn about trees?





The Parts of a Tree

Activity
for Grades K–2 and 3–5

Objective

In this lesson, students will learn the role of the deciduous tree, throughout its life cycle. Students will connect this lesson to the previous lesson by recalling how the tree is affected by its environment, and how it affects its environment, particularly as it relates to the abiotic factor, water. They will garner an understanding of how trees use water and how much water is needed.

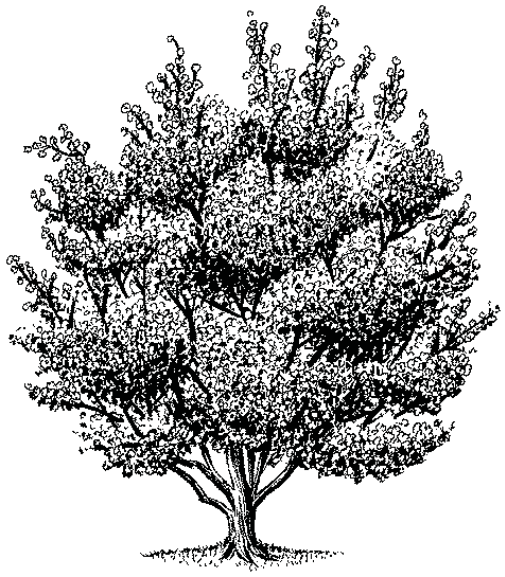
Materials

- Paper plates, one for each student
- Crayons or pencils, one for each student
- Tree cookie rings, one for each student

Background Information

The most significant part of this lesson is not the learning of the terms used for the parts of the tree, but rather how the tree reacts to or uses or is affected by the nonliving parts of the environment: the nutrients, water and air temperature. The deciduous tree grows more in the spring when there is more moisture and sunlight, than in the summer when it is hot and dry and the trees compete with other plants for more moisture. For each year of its life, the tree has a wide part of the ring for spring and a narrow part for summer and fall, when it grows less. In the wintertime, the air temperature drops, and then the soil temperature drops, until it is so cold that the tree no longer takes water up through its roots, thus the deciduous tree does not grow in Missouri in the winter because it is too cold. Showing the age of the tree through the tree cookies is less important than showing how the seasonal weather affected the tree's life. For example, the dogwood, the Missouri state tree, is typically a small tree that prefers dappled shade and grows under the larger trees in a forest.

There are many different types of trees. Some grow best in the desert and their trunks look different than the trunks of trees in our schoolyard, because the tree can handle the very hot, dry weather. Some trees will even grow in water. In the swamps that are along the Mississippi River, the big cypress trees live in the water, but they have “knees” that stick out of the water so they can use the oxygen in the air. Trees respond to the weather, the wind, and the other nonliving conditions of their habitat.



Procedure

Activity 1

1. The teacher will ask the students what they need to live and grow (vitamins, nutrients, food, water). Discuss and explain that living things often have many parts that all work together to keep alive. The tree, just like our body, is made up of many parts that work together. Tell the students that today they are going to become a tree! Students will form a set of circles around each other in order to simulate a tree.
2. The teacher will choose one student to stand with her arms straight up to show the innermost part of the tree, the part that supports the rest of the tree and all of the branches.
3. The teacher will then choose two students to be the sapwood, the part of the tree that brings the water and the nutrients up from the roots; they place one hand down and one up to show how the nutrients and water travel.
4. Next, the teacher will choose four students to be the growing part of the tree trunk; they hold their hands together and up to signify growth.
5. Then, the teacher will choose five students as the phloem (flow-uhm); one hand is horizontal because they are the part of the tree that in the spring through the fall bring the food in from the leaves, and one hand down shows that in winter they can only bring the stored nutrients up from the roots.
6. The teacher will choose four students to be the leaves. The leaves get energy from the sun. When we eat, we become full of energy. The food is broken down and used by our body, the red blood moves through our whole body providing us with what we need to live and grow. Trees have something special that makes the leaves green and works like our blood does to change the sunlight into food for the tree. Put their hands up to get sunlight, but point the fingers down to send rain to the soil/roots.
7. Next, the teacher will choose six students to interlock arms around the others since they are the bark and protect the tree, just like a person's skin protects their insides.
8. Any additional students sit on the ground and represent the roots, so they must point up toward a student inside the bark.
9. Finally, after the simulation, the teacher will ask the students to return to their seats and answer the following questions. (expand on their answers):

   Roots: Where does the water come from that you send to the tree? (rain, snow melting, deep in the ground -well)

   Bark : You protect the tree. What could hurt the tree if you were not protecting it? (insects, bad weather, people, wind)

   Leaves: If a tree has no mouth, then it cannot eat. So, how does the tree get its food?

   Phloem: You bring food into the tree from the leaves. How do leaves get

their food? (Trees and other plants make their own food, using the sun's energy)

Cambium: You are the growing part of the tree. If an insect or an injury, such as lightening, got into this part of the tree? (probably die)

Sapwood: How is your part of the tree like straws in a glass? (carry the water through tubes to all of the tree).

Heartwood: What were you doing? Holding up the tree.

Summarize by explaining that a tree, just like your body, has different parts that help it take in and use food and water. Unlike us, trees make their own food by using the sunlight.

Activity 2: Making a personal tree cookie

1. The teacher will ask the students how old they are. Ask that if you did not know, how could I tell that you were (5, 6, 7, 8, 9) years old? Explain that we can tell how old a tree is by counting the rings inside of the tree trunk. Show the tree ring.
2. Give each student a paper plate. Ask the following questions: If you were a tree, how would you show your age? (By making rings). How would you show me your age on this plate? Demonstrate concentric rings.
3. Allow students time to make their name and the rings on their paper plate.
4. Then the teacher will ask students to think of something special that has happened to them, like the first day of school, and mark it on one of the rings to show when it happened. Sometimes special events, although not as exciting as the first day of school, can happen that will cause the tree ring to be narrow or damaged. The teacher may point this out on her own plate - one time if she broke a leg and it healed.....

Activity 3: Making a personal tree cookie

1. The teacher will give each student a tree ring and magnifying glass. What do they see?
2. The teacher will ask students if anyone sees any marks, other than rings, on their tree cookies. Explain that many factors in the tree's habitat or environment can affect its growth. Does anyone have wide rings on one side? If the tree in our schoolyard is up against the building or another tree, it might not get enough water because of the hard ground or because it has to share with the other tree, so it grows less on one side than the other (may use students to show this). A lot of thin rings together may tell us about some years when there was not enough water for the tree to grow very much.

   Every year, trees grow more in the springtime when it is wet and sunny than in the fall and winter, when there is usually less rain and sunlight each day. Show students the difference in the rings using a tree cookie. For each year a tree grows, it has two parts, a

wide part for the spring and a narrow ring for the late summer and fall when it grows very little because there is less rain in Missouri. What season are we missing? (Winter—it does not grow at all; it is asleep—or scientists call it dormant).

Some of the tree rings may contain a spot, showing an insect invasion or an insect that disturbed the tree at one point in its growth. This evidence would show how living organisms affect each other. The insect bores into the wood to lay eggs, so the tree is helping the insect, but the tree is harmed by the insect.

3. The teacher will ask students to count the rings on your tree cookie. Younger students may need to count together. Two rings, a thin and a narrow ring, equal one year. The tree rings may come from a number of different trees.

4. The teacher will conclude the lesson by saying: Trees, like people, grow and change. They need nutrients, food and water in order to grow and change. Each part of the tree has a job. The roots take in water from the soil. The leaves make food by using the sunlight. The parts of the trunk send the water and food (sap) through the tree. By looking at the rings on the trunk, we can tell how old the tree is. We can tell what the weather was like when the tree was growing, because the rings are bigger and lighter when it is wet and sunny, like in the springtime. The rings show us how changes around the tree, in the habitat, affected the tree. Trees, like people, grow and change. They need nutrients, food and water in order to grow and change. Each part of the tree has a job. The roots take in water from the soil. The leaves make food by using the sunlight. The parts of the trunk send the water and food (sap) through the tree. By looking at the rings on the trunk, we can tell how old the tree is. We can tell what the weather was like when the tree was growing, because the rings are bigger and lighter when it is wet and sunny, like in the springtime. The rings show us how changes around the tree, in the habitat, affected the tree.

The Needs of Trees

Activity
for Grades K–2 and 3–5

Objective

The students will be able to identify the needs of trees and understand that nonliving things are needed in order to help living things stay alive. Students will be able to explain how different environmental changes affect the living organisms within the environment.

Materials

- Soil thermometer
- Air thermometer
- Trowels and bucket
- Graph paper
- Pencils

Background Information

Ecosystems are defined by the interactions of organisms with each other and their abiotic environment. The examination of trees and their relationship to the abiotic (nonliving factors) and the living factors in its environment clearly relate to the study of ecology, which is the study of ecosystems.

Biotic and abiotic factors are interrelated. If one factor is changed or removed, it impacts the availability of other resources within the system. Biotic, meaning of or related to life, are living factors. Plants, animals, fungi, protist and bacteria are all biotic or living factors. Abiotic, meaning not alive, are nonliving factors that affect living organisms. Environmental factors such habitat (pond, lake, ocean, desert, mountain) or weather such as temperature, cloud cover, rain, snow, hurricanes, etc. are abiotic factors.

Biotic and abiotic factors combine to create a system or more precisely, an ecosystem. An ecosystem is a community of living and nonliving things considered as a unit. If a single factor is changed, perhaps by pollution or natural phenomenon, the whole system could be altered. While we usually cannot see what we are doing to various ecosystems, the impact is being felt all over.

Procedure

Activity 1—Class Discussion About Living and Non-living Things

1. The teacher will begin the activity by having the students go outside for a class discussion. The teacher will begin a discussion by saying the following: Trees in our town live and grow together in parks, schoolyards and near buildings. Wherever they live, they must share, water, air, and space with other trees and other living things. Are we alive? How do we stay alive? People need to drink water to stay alive. How do we drink water? (hands; mouth) Just like people, trees need water to stay alive. If they have no hands or mouth and there is no faucet nearby, then how do they get and drink water?
2. The teacher will encourage the students to look for signs of water near a tree.

3. Next, the teacher will show the students a few tree leaves. The teacher will say: Leaves do not take in water, but the leaves are shaped so the rainwater slides off. Tell students to look up. Are they standing under the leaves? Tell them that where the leaves are hanging shows where the ends of the roots go. Then where does the rain go? (On the ground, in the ground) The roots of the tree are under them! The roots spread out from the tree. Roots help the tree get more moisture *and* keep the tree from falling over in windy weather. The spreading tree roots also help the soil, because the roots loosen the soil, letting more air and water in the soil. All trees have roots, just like people have mouths or hands.
4. The teacher will ask the students what would happen if the tree could not get water. Students may say it would die, but before that would happen, the tree would try to grow its roots farther out to reach water. Explain that sometimes, trees (willows/birches) in the city may find water by pipes—sometimes roots will wrap around water pipes and break them. So, city workers often plant trees that can handle long periods without water. Also mention to the students that putting mulch over the soil helps the tree roots stay moist and encourage organisms like worms to move in the soil which makes it easier for the tree to get the water it needs.
5. The teacher will say the following: Trees and people need water to live. Ask the students if water is living or nonliving. Living things need nonliving things like water to stay alive. What else do we need to stay alive? (food) Trees need these nonliving things, like water and sunlight, to live, grow and reproduce. Some foods and drinks make us grow strong and healthy. Milk has calcium in it, a mineral that helps our bones. bones! We *eat* food, but trees *make their own food using sunlight*, their leaves and water from the roots. Trees get some minerals or nutrients from the soil, too, and the nutrients are sucked up through the roots just like we drink orange juice or milk from a straw and take in minerals like calcium from the orange juice. Living things like people need nonliving things like minerals and water to live and grow.
6. Next, the teacher will ask students if sunlight is living or nonliving. The teacher will say the following: How can sunlight affect a tree? The amount of sunlight and moisture (water) changes throughout the year, and the tree responds to these changes. The tree also affects the environment around it. Its roots open up new air passages in the soil. Its leaves give water back to the environment. Its leaves shade the soil, helping keep it at a temperature in which plants can grow. When dead, the trees' leaves give nutrients back to the soil and these leaves provide a habitat for insects and spiders.

Activity 2—Measurement of Air and Soil Temperature

1. Explain to the students that thermometers can be used to measure soil and air temperature. Have the students guess (hypothesize) which will be warmer, soil or air. (The soil will most likely be warmer than the air in the winter and early spring) Write the number of votes for each guess.
2. Next, the teacher will allow students to take temperatures at various areas near tree (both in the soil and in the air) and have them record their data. Explain to the students that plants in our schoolyard do not like it very hot or very cold, they like the soil to be just right—(Compare to hot chocolate, soup, dinner, Goldilocks). Today, it is ____ degrees. Compare this to the soil temperature in which most plants grow in this area. Plants in our schoolyard will/will not grow their best at this temperature. Record the temperatures.
3. The teacher will say the following: The tree helps the soil. The leaves on the tree give the soil protection from the sun and rain. The leaves shade the soil from the hot sun so plants that like shade can grow. Look at the recorded soil temperatures. Tell students that you will average these numbers, which means taking all of the temperatures and choosing the middle one. Trees, by shading the ground, help keep the soil at a temperature for other plants to grow. If there is time, ask students to describe the sunlight reaching the tree by using the terms: sunny, shady or dappled. Look at the trees in our schoolyard. Do they help keep the soil at the right temperature for other plants to grow? Do we use their shade to stay cool?
4. The teacher should lead a discussion on how trees get more light in the spring and summer (longer days) and less in the fall (shorter days) as well as to look for morning or afternoon shadows affecting tree. When a tree is too shaded then sunlight does not get to the leaves, and the tree cannot make enough food. Let's look at the trees in our schoolyard. Are they getting enough sun to make their own food? (If one tree is shaded by the building, then what will the tree do to get more sun? It will grow to one side more than another, or it will grow taller; otherwise it will die). Was the temperature of the ground warm enough for the tree to grow?

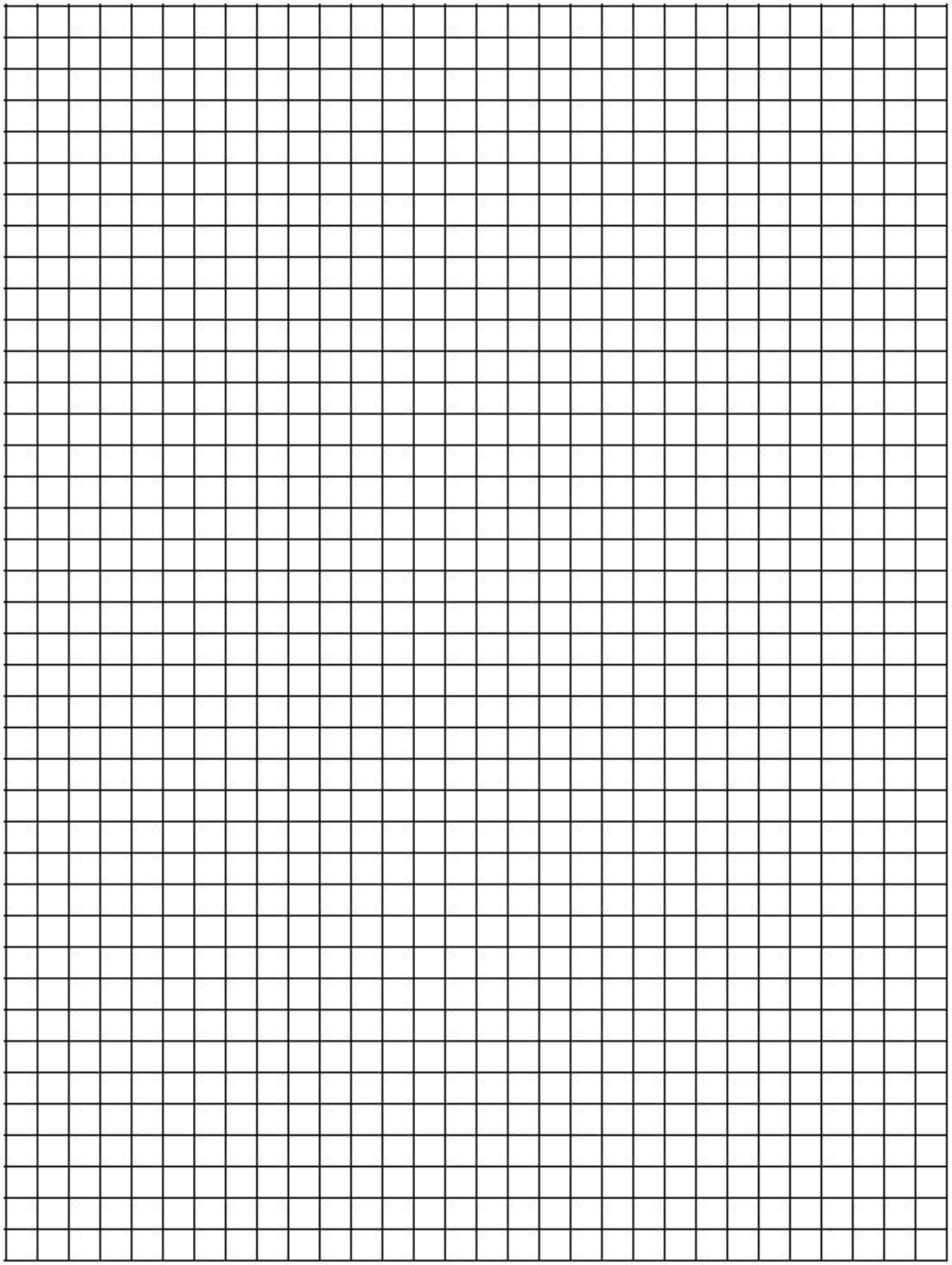
Activity 3—Graphing Data

1. Once all of the students have had ample opportunity to measure various temperatures of soil and air around the schoolyard, have the students return to the classroom.
2. Explain to the students that now they will put their recorded data into a graph. Give each group a piece of graph paper and allow time for each group to work on plotting their data.
3. Once all of the groups have finished graphing their soil and air temperature date, allow time for each group to share their findings.
4. Conclude the lesson by saying the following: Different types of trees live in different places. The trees in our schoolyard, if they have the right soil temperature, enough sunlight and water, can grow strong. Sometimes, a person who lives in a very hot climate with lots of beach sand, like Florida, may try to grow our tree, but it does not live. Why not? Our trees grow best with lots of spring rains - not salty ocean winds and little rain, and they need nutrients from clay soil, not sand. What temperatures did we find outside? The trees in our schoolyard have thick bark so they can live through cold winters. The trees in our schoolyard have (needles that stay on)/(leaves that fall off) the trees when it is cold. Needles help the heavy snow fall off the tree; trees with needles can live in cold weather and heavy snow. Leaves drop in fall because otherwise the trees would lose too much water and die. Trees, like people, grow and change. They need nutrients, food and water in order to grow and change. Each part of the tree has a job. The roots take in water from the soil. The leaves make food by using the sunlight. The parts of the trunk send the water and food (sap) through the rest of the tree. Sun shines, but is it alive? Water moves, but is it alive? The temperature of the air and soil changes, but are they alive? The tree does not walk, but is it alive? Living things need nonliving things to live and grow.

Extended Activities/Additional information

Make a bar graph of daily soil and air temperature and use it to discuss seasonal changes. (Older students could also use a chart of the length of sunlight in a day and rainfall.) Students may go view the tree as well and note any changes, possibly drawing the tree each day and writing down the changes, just like a scientist would do.

If schoolyard trees have any low branches, look at buds that are waiting for the abiotic conditions to be right for spring leaf or flower emergence. Have students make predictions about when leaves will emerge and write down dates in classroom and check every few days. Review that the buds are the tree's response to the warm sunlight.



Feast in the Forest

Activity for Grades 3–5

Objective

Students will be able to identify how animals use trees as shelter or food and to understand the tree as a habitat. Students will be able to recognize that different animals make use of different parts of the tree and to explain that animals use trees for different purposes at different times of the year. In addition, students will be able to make a food chain associated with the tree/forest and to understand that the forest ecosystem can become unbalanced.

Materials

Part One

- Chart—to be used in more than one session
- White sheet—optional
- Pictures of below-listed trees, with close-ups of their leaves,

Part Two

- Strips of construction paper
- Scissors
- Glue
- Pictures of the trees, sun, animals
- Animal cards
- Pictures of leaves, bark, berries, and other edible parts of the trees; pictures of gall, eaten parts of tree leaves, etc.

Background Information

Persimmon trees

Persimmon trees produce hard wood, so hard that it's too tough for use in furniture making. The bark is thick and dark gray. The trees are tall and thin. Thick square blocks are found on the 2 inch thick bark, looking like an alligator hide. Persimmons produce an edible fruit with several seeds, about the size and shape of a plum, eaten by Native Americans, explorers and pioneer children as well as by hikers today! Rumor has it that persimmons can be eaten after the first frost, but there are some earlier ripening varieties. When ripe, the persimmons are wrinkled and a bit mushy. Unripe ones taste bitter—they

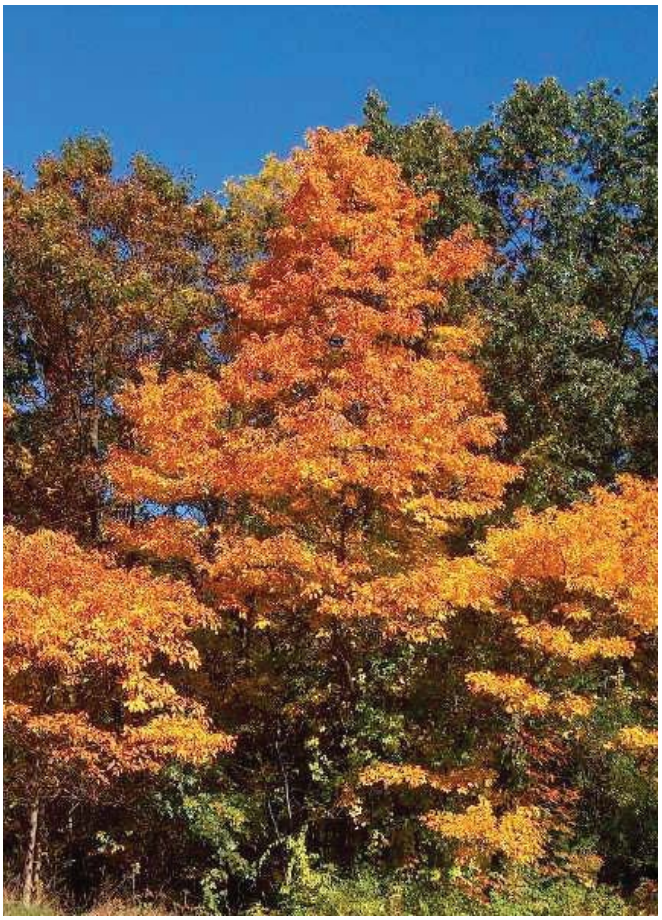
contain tannins and taste like the grounds in the bottom of a bottle of iced tea. All taste best after the cold weather begins to replace the warm weather. Persimmons give animals a final treat to fill them up before winter's cold sets in. It may be a food fight for that persimmon—mammals like deer, skunks, opossums, raccoons, and woodchucks, or rodents like squirrels and mice love to eat persimmon.

Sassafras trees

Sassafras trees are medium sized trees that have a small spread. Sassafras tree bark and leaves have a pleasing scent that can protect it from insects. The 4–6 inch leaves have three shapes, one like a mitten with just the thumb. The leaves turn brilliant oranges and reds in the Fall. However, scale insects, weevils and stem borers bother them. Sassafras trees are found in the understory of a forest. Sassafras trees are one of the first trees to emerge on disturbed farmland or deserted land. They are hard to transplant, but can grow in poor soils. The trees die if near roadways where salt is used in the winter.

Sassafras tree roots were used to make a tea. Sassafras may be an ingredient in root beer. Small yellow flowers appear before the leaves and have a pleasant fragrance. The fruits are bluish berries attached by single long bright red stalks.

Where can you find sassafras at MBG? The sassafras are located along the driveway at Tower Grove House.



Oak Trees

Oak and hickory trees are majestic primary food sources found in most Missouri forests. Some grow in wet lowlands and others prefer dry hills. Insects, deer, turkey, opossum, raccoons, squirrels, mice and even a starving carnivore like the coyote, will eat their acorns/nuts. Oak trees are about 30 years old before they produce acorns.

White oak trees have 5+ inch long leaves with rounded lobes. They turn a purple brown color in the fall. The flowers are catkins that hang down, with a yellow color. The bark is flaky and light gray. The tree is tall and rounded. It is drought resistant and likes well-drained rich soil.

White oak trees have tylose in their cells which causes them to hold up against water. Thus, their wood was used in St. Louis for making barrels and could be used for making ship or canoe hulls although their wood is not as light as other trees. White oak acorns have less bitter taste than the red oaks, but they were often boiled by woodsmen and Native Americans before eating or making tea. Acorns are eaten by turkey, squirrels, chipmunks, raccoons, opossum, deer, insects, and sometimes even a very hungry coyote that can't find meat. Leaf gall wasps like to lay their eggs on oak leaves, and then the baby insect eats through the gall made by the tree itself.

Where are oaks at MBG? As soon as you enter the Garden, you can see bur oak trees on the plaza, with their round lobed leaves and their fuzzy-capped acorns. Just past the Climatron, a grove of red oak trees with pointed leaves are found on your left before you come to the Children's Garden.

Maple Trees

Many students, when asked about food for animals that comes from maple trees, reply "maple syrup." They do not realize that the syrup which comes from particular maple tree is not accessible to many forest animals. Insects, like ants, often like the sap. The sugar maple is native to the north central and northeastern US. It grows slowly and is sturdy; its shape is tall and oval. The leaves turn yellow, orange and red in Fall and are wide with 3-5 lobes. They provide such dense shade that grass or other plants cannot grow under them. They have shallow roots and are easily damaged by salt. All maples

are attacked by borers, scales, aphids, tent caterpillars and mites. Maple trees became popular for urban/suburban yards because of their shade, fast growth and beauty. They have created a dilemma in native forests, because after their seeds are carried through the forest, the new trees cast too much shade over the oak and hickory saplings, so that the saplings do not survive. Sadly, the maple trees do not provide the level of food for forest organisms like the oak and hickory trees.

Dogwood Trees

Many dogwood trees were imported from Asia, but there are native dogwood varieties, one of which is Missouri's state tree. It is *Cornus florida*. Dogwoods are understory trees that live on the edge of forests. Dogwoods need average drainage. Native dogwood trees have white blossoms with two purple tips in the springtime—the flower is the green middle part. The leaves turn a deep red in the fall.

In the fall, they have red berries that are eaten by birds before the onset of winter. Dogwood berries are quite healthy for the birds, unlike honeysuckle berries which are less nutritious (but honeysuckles have invaded Missouri woods). Dogwood tree bark was historically used to heal scrapes.

Where are dogwoods at MBG? One is found just inside the fence area by Shaw's mausoleum.

Organisms that rely on these trees for food

Photo: James Solomon, USDA Forest Service, Bugwood.org.

▲ Leaf gall wasp

Gall wasp lays its egg on the leaf, and then the tree reacts, forming a gall of woody protective tissue around the invading insect larva. This gall is a "tree band aid" in that the tree makes its own band aid to protect itself from harm. However, the gall also shelters and feeds the insect larva until it breaks out. The galls usually do not harm the tree.

(Ttext adapted from: http://www.ehow.com/how_7153185_identify-oak-galls-texas.html#ixzz1l0a9w1AF.)

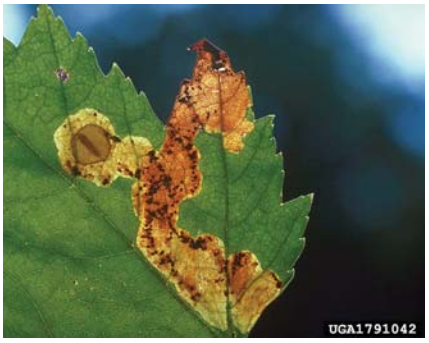


Photo: Lance S. Risley, William Paterson University, Bugwood.org.

◄ Leaf miner

Leaf miners live between the upper and lower skin of the leaf. They may leave trails, but usually leave big splotches on the top of the leaf. Leaf miners are the larval stage for some flies, butterflies or moths. They attack nearly all families of plants and trees.

Photo: Susan Ellis, Bugwood.org.

▲ Weevil

Long snouts act like a drill on tough plant parts like seeds, nuts, and stems to find the inside softer foods. Once the drill makes a hole, the weevil uses its chewing mouthparts to eat.

▼ **Geometrid Moth Larva** pretends to look like a twig on the tree it eats so it stays concealed from birds. You may see it and call it a cankerworm or an inchworm as it draws up its body to move forward. It loves to eat hard wood bark.

Photo: Connecticut Agricultural Experiment Station Archive, Connecticut Agricultural Experiment Station, Bugwood.org.

Photo: Robert Dzwonkowski, Bugwood.org.

▲ Bark beetle

Bark beetles live between the outside tree bark and the tree's sapwood and destroy lots of timber. Each species has unique tunnels and often leave small holes in dying bark when they exit. There are more types of beetles than any other species—250,000 kinds. Hard covers on the back wings protect their soft body. The mouth parts are designed for chewing.

► Stem Borer

The stem borers are larval stages of beetles, and as you can see in this young tree, they eat the insides of the tree.

Photo: James Solomon, USDA Forest Service, Bugwood.org.

► Leaf Roller

Leaf rollers look like wingless crickets that eat inside the leaf, protecting itself from predators until it emerges as a moth. It sews up the leaf blanket edges with silk thread made in its thorax and spun from its lower lip. It is fond of bur oak and maple leaves.

Photo: Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org.

See University of Illinois Extension—Selecting Trees for Your Home (*http://urbanext.illinois.edu/treeselector/problems.cfm*).

► Leaf cutter ants

Photo: Ronald F. Billings, Texas Forest Service, Bugwood.org.

These ants are small with spikes on their back.
They march single file from the nest to a large tree, and will cut off pieces of leaves or entire leaves to take back to the nest. They take the leaf piece to the nest, moisten them and grow fungus on them. Most of them live in South America and the warm southern states like Louisiana, but are moving north due to warmer climates.

Go to Science Nation (November 8, 2010) on the NSF website for great information about the food web with leaf cutter ants and fungi.

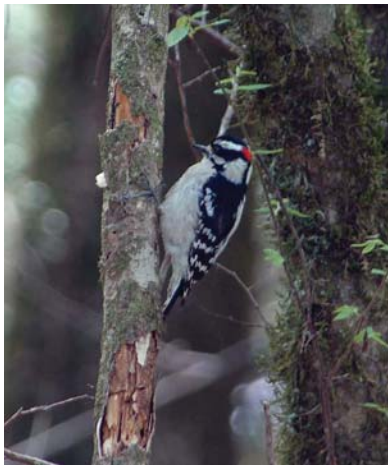
Birds

Birds will use the tree as a resting, nesting, and feeding place. Different species eat at different places on the tree, just like some students and their friends may each sit at the same place every day in the cafeteria. **Brown creepers** crawl up the tree, while **nuthatches** crawl head-down as they search for insects under the bark. **Downy woodpeckers** search for insects in the bark, wrapping their rough tongue around the insect hidden in the trunk. Ask students what sound might tell them that a woodpecker is in our tree. The small **chickadees** rest on the branch edges in the middle of the tree, while the **blue jay** sits in a fork in the middle. Besides resting and eating, why might birds decide to quietly sit in the branches of our tree? (Concealed; protected from daytime **hawks** looking for a meal or nighttime **owls** looking for food) The **barred owl** eats small rodents, reptiles, crayfish and birds. The owl hunts at night. Note that the owl eats aquatic and terrestrial creatures and it eats a wide variety of foods, thus making it easy for it to adapt to aquatic and terrestrial habitats in bottomland forest.

Even within the schoolyard, different species or types of birds may occupy different habitats—the grassy, open areas where they sometimes feed on worms or seeds (**robin, dove**) or the trunk of an old tree where they feed on insects (**brown creeper, downy woodpecker**). These birds may all use one part of the tree for shelter, nesting or eating at some time during the year. Some birds and animals will just use one part of the tree.

Brown Creeper

Photo: Donna Dewhurst, U.S. Fish and Wildlife Service.



Downy Woodpecker

Photo: Wendy VanDyk Evans, Bugwood.org.

White-breasted Nuthatch

Photo: David Brezinski, U.S. Fish and Wildlife Service.

Photo: Alfred Viola, Northeastern University, Bugwood.org.

Black capped chickadee

Photo: Wendy VanDyk Evans, Bugwood.org.

Barred Owl

Photo: U.S. Fish and Wildlife Service.

Bluejay

Photo: Rebekah D. Wallace, Bugwood.org.

Red-tailed hawk

Photo: Terry Spivey, USDA Forest Service, Bugwood.org.

Great Horned Owl

Other Forest Animals

Squirrels usually use the top part of the tree where they make their nests of leaves and eat their seeds. Chipmunks are also called ground squirrels because they seek the nuts on top of the ground around hickory and oak trees, and shelter in the ground under the tree. Squirrels eat nuts, fruits and buds of oak, walnut, hickory, pecan and elm trees in Missouri. When they forget where they stored their acorns and nuts in the ground, then a tree may have a chance to grow!

Photo: Michael Mengak, University of Georgia, Bugwood.org.

When squirrels are not eating acorns, the turkey and deer may cautiously approach—mice eat seeds and small fruits and acorns, then the mice are eaten by bigger meat-eaters. Deer have few predators left in Missouri. Deer and turkeys are too big for coyotes to eat, but a wildcat can eat them. The mice are eaten by many animals.

Photo credits, top to bottom: David Cappaert, Michigan State University; Gary M. Stolz, U.S. Fish and Wildlife Service; North Central Research Station Archive, USDA Forest Service; all via Bugwood.org.

Opossums and raccoons are omnivores—they eat both meat and plants.

Opossums are the only marsupial in North America and are agile enough to walk on a telephone wire, climb trees, emit a musty odor when they play dead to avoid predators, and like raccoons, can live in urban neighborhoods as easily as in forests. Opossums are usually active at night, eating insects and grubs or seeds and nuts.

Photo: Randy Cyr, Greentree, Bugwood.org.

Photo: Linda Haugen, USDA Forest Service, Bugwood.org.

Raccoons have sociable family groups and will make their homes in woodpiles, unused chimneys, sewers, or under porches. They can climb trees and will open garbage cans in neighborhoods to find food. They will eat birds, eggs, fish, rabbits, fruits and nuts.

	Fruit	Type of Nut or Seed	Shape of Canopy	Bark Design/ Texture/ Strength	Leaf Shape/ Texture	Height	Scent	Historic Uses	Food For/part	Shelter for
White Oak		acorn	Y- shaped/ tall	grey	Large Rectangular w/rounded lobes	T		Barrels Water-proof Canoes	Turkey Squirrel Chipmunk Deer Mice	Squirrels Birds opossum mice
Sassafras	x	Small yellow fruit	Tall/thin	Thin peeling, red under-neath	Three shapes: mitten, oval, and three-lobed	M	Sweet	Root beer, tea,		birds
Persimmon	x	Seeds contained in wrinkly light maroon/ white fruit	Tall/thin	Squared shapes, dark		T		food	People Birds Deer Raccoon opossum	Opossum Raccoon birds
Maple		Whirly-seed	All varie-ties	Smooth	Square shaped with 3-5 lobes	T	no	furniture	none	birds
Dogwood	x	Seeds in hard small red oval fruit	Umbrella/ short			S	Flr.	Bark is astringent	birds	birds

Food Chains

Food chains show more than simply who eats whom; they represent the flow of energy in an ecosystem. Food chains begin with the sun's energy. The students should place the sun first in their food chains. Sunlight energy enters the food chain through the process of photosynthesis used by producers (plant like the tree). Photosynthesis occurs when a producer transfers energy from the sun to make food to live and grow. A photosynthetic organism or producer (plant) is always the next step in any food chain. That food is then stored in the tissues of the plant. When an animal eats the plant, it consumes some of this stored food and uses it for energy in its own body. As energy transfers from one organism to another, it forms a food chain. In a visual picture of a food chain, the arrows always point to where the energy is going, for example, the arrow points from the sun to the plant to the mouse to the owl. Most food chains contain 3–5 links.

Sample food chains

sun → oak acorn → mouse →owl

sun → tree leaf → moth larva → opossum

sun → dogwood fruit → mouse → owl

sun → persimmon→ raccoon

sun → persimmon → deer → mountain lion

sun → maple leaf → leaf cutter ant → opossum

sun → maple leaf → leaf borer → woodpecker →hawk

sun → weevil → opossum

sun → sassafras bark → bark beetle → woodpecker → raccoon

sun → sassafras bud → squirrel → hawk

sun → oak tree → oak tree gall wasp → nuthatch → raccoon

Photo: David Cappaert, Michigan State University, Bugwood.org.

Procedure

Pre-lesson in the schoolyard

1. The teacher will go outside to a set of trees. Pull a branch down and shake the branch over a white cloth—ask the students if they see anything? In the early Fall and Spring, insects may drop into the white cloth.
2. Have students examine a tree at recess, looking for organisms.
    - For what reasons would these organisms be in the tree? [Food, shelter, shade, moisture]
    - What signs of other organisms can we see? [insect egg sac, holes in leaves or tree bark, ants going up or down the tree, insects in the tree litter underneath the tree, webworms, bird or squirrel nests]

Part One

1. Provide pictures or the MBG Leaf/Tree Identification Kit's bark and leaf samples. Put out the pictures of the four native Missouri trees and the one non-native Missouri tree.
2. Create a chart that compares the trees.
3. The teacher will assign students to groups to explore the trees in the books or on the web. Each student team will write a small paragraph and fill in their sections of the chart. The students will compare the trees—their seed, fruit or nut, their leaves and their canopy size, height, location. The teacher will ask the students to share a unique use of the tree: third graders could discuss the economic value of trees and how they are used in the US; fourth graders could share use by historic peoples in America.

How do organisms use these trees?

1. Explain to the students that most of the trees listed have been important to people as well as to organisms in the forest. Tell the students that their teams will talk about how animals use the trees.
2. The teacher will show a few of the Animal Cards. Ask the students: For what reasons would these animals visit the tree? [Food, shelter, to eat other organisms.] Explain that the tree is a habitat for many organisms—by itself it can provide food, shelter, space. After a rainfall, in its sap or on the leaf tips,

	Fruit	Type of Nut or Seed	Shape of Canopy	Bark Design/ Texture/ Strength	Leaf Shape/ Texture	Height	Scent	Historic Uses	Food For/part	Shelter for
White Oak										
Sassafras										
Persimmon										
Maple										
Dogwood										

water may exist on the tree for organisms. The tree and all of the other plants and organisms within the forest make up an ecosystem.

3. The teacher will explain that sometimes we can identify what part of the tree is eaten by these organisms by examining the organisms' mouth parts or teeth. Some of these organisms visit the tree not to eat the tree parts, but to eat other organisms visiting the tree!
4. Divide the class into teams. Each team has one tree and a number of animal cards. The team's job is to categorize their organisms by
   - how they could use the tree
   - if they eat the tree—can they guess which part?
   - if they eat another organism—can they guess which one?
5. Students may research their animals and the tree to find out how the animals use the tree as shelter, food or for finding other organisms in the tree to eat. They may use the pictures to help them determine what the organisms eat.
6. Allow time for the students to finish filling in the chart with the section related to their tree from Part One.

Part Two

Food Chain tree

1. The teacher will remind the students that organisms interact with the tree and with each other as a source of food. The sunlight gives energy to the tree—it uses the sun and its own water to make food. The food is stored inside the tree. When an animal eats the tree, it eats some of this stored food and uses its energy—to fly, run, eat more, etc. This movement of food, and energy, between the organisms is called a food chain. We use arrows to point to where the energy is going.
2. Explain that the pattern of eating and being eaten is called a food chain. Food chains *always* begin with the sun. The energy that we get begins with a nonliving thing in our world, the sun. Animals depend on each other and on plants to share the energy in a food chain. Every living organism needs food in order to have the energy to live, grow, and reproduce. Plants make their own food (producers). Some animals eat plants (herbivores) and some animals eat other animals (carnivores) and others eat both (omnivores) to get their energy. As organisms, such as leaves, break down or decompose, they recycle nutrients making them available for plant growth. The heat energy from that process is not returned to the forest ecosystem. Just think—there must be many acorns and seeds to feed mice and other small animals, and many mice or squirrels must be needed to satisfy the hunger of a big hawk or coyote. So, there are usually fewer predators at the top of the food chain than organisms at the bottom of the food chain.

Food chain activity

1. Students will be given a set of animal

pictures and arrows [or the teacher can laminate the pictures in this lesson and attach them to cards, one student per card, and then have the students make their own group food chain.]
    - Remind them that each food chain will contain a picture of the sun.
    - Remind them that plants make their own food (producers).
2. Students will cut out the pictures of organisms, place them on, in, or under the tree, then use the arrows to point who eats what/whom…..showing the flow of energy through the food chain
    - Students will connect the animals and sun in the correct order to show the movement of energy through the chain.
    - Once completed, the students are asked to explain their chain to a partner.
3. Discussion. The teacher will ask students if they believe the same food chain could be in the schoolyard.
    - What part of the food chain would stay the same?
    - What part of the food chain may be different?
    - Was the tree a part of the food chain? (Yes- its parts were eaten)

    Help the students see the pattern in the food chains—the tree, as a plant, makes food, and needs the sun to do this. The sun, a nonliving thing, gives energy that flows through every food chain as the food is consumed. The rest of the food chain relies on the sun and plants (in this case, trees).
4. Explain to the students that trees protect themselves from insects just as people do when we use insect repellant or dress in long sleeve shirts. How did the trees that we learned about try to protect themselves from insects and other animals eating them? (thick bark, particular smell or tough textured leaves). How did the animals that you learned about protect themselves from the animals that would eat them (predators)?

Ecosystem Dilemma (Refer to background information about the maple trees)

1. Explain to the students that a forest ecosystem needs a wide range of species of plants and animals in order for the balance of energy to benefit the plants and animals. Sometimes, a native species can start to take over,

but then another species seems to bring it under control.

2. The teacher will pose this dilemma to their students: In Missouri, so many maple trees are planted in cities because of their beauty and shade, and varieties that are fast-growing are popular. Many seeds have escaped to the forests (how?) and now these fast-growing maple trees are taking over some forests. When oak and hickory saplings try to grow, the dense shade of the young maples kills them.
    - What if the Missouri forests were full of maple trees instead of oak and hickory trees?
    - What food would the maple trees provide?
    - What would happen to the organisms in the forest? [See below for answers]
    - What solutions, if any, do we have?

Conclusion

1. Invite the students turn to a partner. Share the answers. The teacher will ask for a few partners to share their answers.
    - Give reasons for why the tree is a habitat for so many different animals.
    - How do trees interact with other living things?
    - What role does the [deciduous] tree play in the [forest/schoolyard] ecosystem?

2. The teacher will explain that the relationship between the tree and the living organisms can vary. For example, the tree may be helped by the animals, such as squirrels and opossums to spread their seed/ acorns. Some birds need to eat the berries to store fat before a long migration (dogwood tree). Relationships between the organism and the tree can also harm the tree itself—the ants may eat all the leaves, so it can no longer make food. Trees play an important role in the food chain. As plants, they make food. They provide shelter and nesting sites for animals that depend on each other to survive.

Website, MBG Kit and Book Resources

Missouri Department of Conservation Posters:

- MDC Missouri Owls poster
- MDC Show Me Trees poster
- MDC Winter Birds

Rocca, J.P., Starkey, D., & Heflin, E. (1979). *MDC Trees of Urban Missouri.*

Jackson, J. (1992). *Ecology of Missouri Forests*. MO Dept. of Conservation, 3rd printing

Ranger Rick's Naturescope, Trees are Terrific.

Yolen, J. *Owl Moon*.

Bastian, L. (2000). *Chipmunk Family*. Wildlife Conservation Society.

Himmelman, J. (2000). *A Mouse's Life*. Children's Press

Plants along the Trail with Lewis and Clark

MBG Kits (Call 314-577- 5150): Seed Identification Kit, Leaf Identification Kit, Tree Identification Kit

Tree Measurement

Activity for Grades 3–5 and 6–8

Objective

In this activity, students will demonstrate the measurement of the trunk, crown, and height using vertical and horizontal measurement, compare results with other groups, create a graph of their findings for the trunk, crown, and height of the tree, and define horizontal, vertical, circumference.

Materials

- String
- Ruler
- Paper
- Pencil
- Meter Stick
- Tree

Background Information

Is it possible to estimate the age of a tree by measuring the circumference of the trunk?

For precise age definitions, circumference doesn't give you the information you need because the amount of growth each year will not be consistent. Each species of a tree grows at a different rate each year. That growth depends primarily on rainfall. So, getting the age of a tree by measuring the circumference alone would not be very accurate. Experienced observers may be able to make estimates that are not too far off the mark. For example, they may be able to tell the age of a maple is between 20 and 25 years or between 125 to 175 years old. But it's likely they won't get much closer than that.

If you are looking for an estimate based on circumference, you could look for a tree of the same species that has fallen or been cut near to the tree you are observing. If you can get the age of this fallen/cut tree by counting its rings, you can then estimate the age of the tree you are interested in by comparing the circumferences. All in all, circumference alone will likely not provide a good estimate of age.

How long does it take for most trees to grow to their full size?

The time it takes for trees to grow to their full size depends on many things. In some tropical areas, trees may reach their full size in 30 years. In other areas, where it is colder, it can take hundreds of years. Different species grow at different rates. When trees are planted as a crop for harvest, "full size" is the size that is pleasing to customers. So, the answer to this question is ... it depends!

How long do most trees live?

The length of life for a tree depends upon so many things. The climate conditions (water, temperature, sunlight, etc.), fire dangers, the type of tree, and the condition of the soil are all things that help determine how long a tree will live. So, the true answer is ... it depends! I can tell you that the oldest living tree is a bristlecone pine tree called "Methuselah". It is currently 4,767 years old!

How can you tell how old a tree is?

There are actually a couple of answers for this question. The procedure used to find the age of a tree will depend on whether the tree is living or dead.

If the tree is no longer living, you can cut it down. In the place where you made the cut, look for the rings in the trunk. Each ring equals one year. Look closely because some of the rings may be difficult to see. Some of the rings may be smaller than others. That's okay. Each ring, no matter how big or small, equals a year.

The age of a living tree is difficult to discover unless you have an increment borer. This is a small tool that drills (bores) a small hole into the tree and pulls out a core of the wood. Once you have the core, you can count the rings on it and determine how old the tree is. Some trees have rings you can easily see. To count the rings for some species, you may need magnification and/or staining with an ink dye to be able to count the rings.

Increment borers cut only a small hole (about the diameter of a pencil) and do not harm the tree. They are most often used by arborists and foresters. If your tree is a pine tree, you can estimate its age by counting the whorls (places where branches have grown out each year). The number of whorls will give you the age of the tree. However, this only works with pine trees ... fir and spruce trees don't work the same way.

The only real way to know the age of a tree is to count the rings ... other methods will give you only an estimate.

How long does it take to grow an evergreen?

Evergreen trees (conifers) grow at different rates. The trees on REAL TREE operations are harvested somewhere between 7 and 12 years. That's when they have reached the right size and shape for you, the customer.

In the wild though, some evergreens (conifers) can be mature at 50 years and some may live to be thousands of years old. The oldest known evergreens (conifers) are the bristlecone pines that grow in the southwestern United States ... some of them are over 4,000 years old!

When is an evergreen tree an adult? What are the different characteristics of a evergreen adult?

REAL TREE growers consider trees to be adults when they produce cones with viable seeds ... seeds that will grow when they are planted. For some types, a 6 year old tree can be considered an adult. For others, it takes much longer - maybe over 20 years.

One characteristic difference between a young evergreen and an adult is that the bark of a mature tree is much rougher than a young tree. Size is another clue. Usually, older trees will have larger trunks and be taller than younger trees ... but not always. Remember that there are many different factors that play into the growth of a tree

What is the difference between conifers and deciduous trees with respect to the filtering of light through

their canopies? Do conifers allow more light to penetrate the canopy, thus producing less shade on its own needles when compared to a broad-leaved species? How does this change throughout the day?

Conifers don't allow more light to filter through the canopy than their deciduous counterparts. There are some conifer stands that are very dense and allow no light to penetrate the forest floor. Hardwoods have one adaptation allowing them to grab light even in shaded areas ... their broad, large leaves. Conifers don't share this adaptation. Typically, you wouldn't expect to see much change during the day.

Do all evergreens have pinecones on them?

Not all evergreen trees are conifers (cone bearing trees). Some trees that are evergreen don't have cones.

Not all conifers are pine trees. Fir trees or spruce trees, for example, would not have pinecones on them ... but they would have cones.

So, the answer to your question is "No." Not all evergreen trees have cones. Conifer trees, however, do all have cones! To figure out if your tree will have cones, you'll need to figure out if it is a conifer!

Why is it that evergreen needles are able to stay on the tree all year long? How do the needles catch sunlight?

Actually, evergreen trees aren't really EVER GREEN. The needles of conifer trees actually do fall off and are replaced by new needles. Instead of losing all of their needles at once, most evergreens lose needles little by little all year long. Because they are always being lost and replaced, the trees look like they never lose their leaves!

The long, thin needles don't look like they would be able to catch enough sunlight for photosynthesis, but they do! The sunlight is one of the things that a conifer has to have to live. That's because as the sun shines on the tree, the needles, gather the sunlight in special places inside the needle cells. These are called chloroplasts. The job of the chloroplast is to change the sunlight into energy the plant can use to grow. It takes sunlight, water, and a chemical called carbon dioxide to make this energy! Scientists call this process photosynthesis. Of course there is much more to it than that, but that's a good start!

Why do the leaves of deciduous trees change color?

You may know that the green of deciduous leaves comes from the chlorophyll that is needed to make food for the tree. What you may not know is that there are other colors "hidden" in the leaves. They are hidden in the spring and summer because the chlorophyll is busy doing its job and the green color sort of takes over.

In the fall, when days get shorter and cooler, the food production slows to a stop. When this happens, the green color of the chlorophyll disappears and the other leaf colors are allowed to show through!

Evergreens don't lose their needles. How does that adaptation help them?

Evergreen trees do lose their needles. They just have a special way of doing it. Instead of losing them all at once, they lose them a little at a time. In fact, you could almost say that they shed their needles. As the old fall away, new needles take their place.

Because they have green "leaves" all the time, they are able to start their food factories back up quickly ... without taking the extra energy to grow leaves. That is one of the reasons that evergreen trees are better able to survive in places where there is not as much water available or where it is colder.

Does the fact that evergreens (conifers) keep their needles make them able to survive the winter?

The truth is that even trees that lose their leaves actually "survive" the winter. They just do it in a different way. Deciduous trees lose their leaves during colder months. It's an adaptation they have made to their environments.

Any tree species (evergreen or deciduous) that doesn't adapt to its surroundings will not survive. Evergreen trees have several adaptations that allow them to survive in areas where other trees have not been able to. The way they lose their needles is one of those adaptations.

The adaptation of a species is why we see different types of trees in different areas of the country (and the world). Since "winter" is different in different areas, many species have had to adjust. For example, trees that are successfully grown in Texas or Louisiana, for example, would not do so well in Wisconsin or Michigan.

How does an evergreen adapt to the shorter days in winter other than by holding water better/longer?

Evergreen trees living in cold climates become dormant for the winter. When the weather gets cold, everything inside them slows down. They don't do much growing, if any. In other words, they are inactive. It's almost as if they go to sleep.

How does the triangle shape of conifers protect them?

The name of the game is sunlight! Conifer needles need to be exposed to as much sunlight as possible so that the tree can produce food (photosynthesis). The triangle shape helps the tree by allowing more needles to "see" the sun. As a tree grows older and taller less sunlight reaches the needles on the lower part of the tree. When this happens, these lower areas shed their needles and, eventually, the branches.

As an added benefit, the triangle shape also allows the tree to gather less snow weight ... the snow tends to slide right off! Trees that lose their leaves (deciduous trees) do not have this problem because when it snows all their leaves are gone and there's not much left to hold snow.

Can you clear up for me, in a simple way, the difference between deciduous and evergreen trees?

Deciduous trees shed their leaves at a certain time each year. The leaves are grown again at later time. Evergreens are trees that grow new leaves before the old ones fall off. It's important to know that not all evergreens are conifers. The trees we talk about on this web site are both evergreens AND conifers!

How many types of trees are there? How do they grow so fast?

There are about 750 types of trees in North America and about 100,000 in the world. Many of those are endangered. Those numbers count both conifer (cone bearing) trees and deciduous trees. Conifer trees that are grown on farms for the holidays take 7 to 14 years to grow. The trees that you can buy at Christmas have actually been growing for quite a while!!!!

What information can you give me on replanting in the tree industry?

Tree farmers and foresters learned some time ago that in order to sustain their business, they needed to plant trees to replace the ones that were cut. As long as the number of trees planted replaces those that are cut, there will be little long-term effect on the environment. In fact, the amount of growing timber in the United States has steadily increased since the 1920s! In addition to planting more trees, there are also many laws and practices that help make sure that the environment is well cared for.

The ratio of trees harvested to those planted is usually given per tree. Trees harvested for the pulp and paper industry are planted in a 1:1 ratio … for every tree that is harvested; another is planted in its place. In the Christmas tree industry, the ratio depends on where the farm is located and what type of tree is being grown. The ratio varies from 2:1 up to 20:1. In addition to this replanting, it's helpful to remember that a REAL TREE crop is in the field for 7 to 12 years before it is harvested!

What would be a reasonable cost estimate to raise a tree from seedling to full tree, (per harvested tree)? Based on the four acres, 1000 trees and maturing in say 8 years.

There are many, many variables involved here. The type of trees, soil condition, and other growing issues cover some of them. Then there are planting issues, for example, are you considering rotating the crop or doing a single planting? Are the 4 acres completely usable or are you actually only able to plant on part of it? The list goes on ... so, giving you an actual cost per tree is pretty difficult without chatting with you. That being said, one of our team members estimates that it would cost you between 15 and 20 dollars per tree ... this is a VERY ROUGH estimate!!!

Procedure

1. Explain to the students that you are going to take them out to the schoolyard. The goal is for each student group to pick a tree to measure.

Trunk

2. Have the students measure from the ground to 4 ½ feet high on the trunk. At this height, ask the students to measure the trunk's circumference by wrapping a string around the tree. The students will mark the string and then measure the length of the string using a meter stick. Tell the students to round the number to the nearest centimeter and to record the number and to label it as the circumference.

Crown

3. Ask the students to examine their tree and to find the tree's five longest branches.
4. Tell the students to place markers on the ground beneath the tip of the longest branch. Then, tell the students to find a branch that is opposite of the longest branch and to mark its tip on the ground.
5. Next, have the students measure along the ground from the first marker to the second marker. Explain to the students that they will need to record this number and label it as the crown.

Height

6. Explain to the students that in order to measure the height of your tree, they will need to have one person stand at the base of their tree.
7. Then, have the other students back away from the tree, holding their ruler in front of them in a vertical position. Be sure to keep the arm straight. When the ruler appears to be the same size as the tree, tell the students to stop. (The students may need to close one eye to help them line it up.)
8. Next, tell the student to turn their wrist so that the ruler looks level to the ground and is in a horizontal position. Be sure to keep the arm straight.
9. Now, have the other student who has been standing at the base of the tree walk to the spot that you see as the top of the ruler. (Be sure the base of the ruler is kept at the base of the tree.)
10. Finally, have the students measure how many feet they walked. Ask the students to round the number to the nearest meter and to record their answer as the height of the tree.
11. Once all of the groups have had ample time to calculate their findings, invite the students to compare answers and re-measure as needed. Once finished, have students come back into the classroom to create bar graphs using the information gathered outside. Have the students identify the biggest and smallest tree of the same species using the data that was collected.

Nature's Treasure Chest

Activity
for Grades 3–5 and 6–8

Objective

The students will be able to understand and appreciate the variety of forest products that we all use in our everyday live and to appreciate wood as one of earth's renewable, recyclable, and biodegradable resources.

Materials

- Copy of "Nature's Treasure Chest" (one for each student)
- Copy of "Nature's Treasure Chest Answer Key" (one for teacher)
- Copy of "Nature's Treasure Chest In-Depth Information" (one for each student)

Background Information

Since the beginning of time, people have found many uses for trees. They have used them to build shelter, as a source of food, to provide heat and for recreation. An increase in the earth's population has created more and more demand for products that come from trees. Fortunately, trees are a renewable resource. But even though we have many trees, they are a valuable resource, and we don't want to waste them. That's why it's important to use every part of a tree that is harvested.

Procedure

1. The teacher will explain the concept of the word "paper" by identifying the Latin word "papyrus" named after the Egyptian reed from which paper was first made. The teacher will ask the students if they can guess how paper is made today. Then, the teacher will ask the students to think of some of the things that they know are made from wood. The teacher will make a list of the student answers on the board.
2. The teacher will explain the value and variety of forest products by having the students read the story, "Nature's Treasure Chest." After the students have finished reading it, the students will draw a circle around all of the wood products that they can find the story.
3. The teacher will review with the class the answers and explanations of the many surprising products derived from wood.

NATURE'S TREASURE CHEST

NAME _____

Read the story below then circle the items in it that you think are made from a tree.

"Hurry, Randy, or you'll be late for school," Mrs. Carter called out from the kitchen. Randy's hand slid over the smooth handrail as he raced down the stairs. He skipped the last three steps and landed with a thud.

"Coming, Mom," he mumbled through the thick sweatshirt that he put on over his new rayon shirt. He walked down the corridor, his shoelaces tapping on the shiny wood floor.

"What's for breakfast? I'm starved," he said. Randy slid across the bench to his place next to his father's chair at the head of the table. The smell of vanilla coming from the stack of steaming pancakes made his mouth water. The aroma of the spicy sausage on his plate made his stomach grumble. "Pass me the maple syrup, please." Randy reached for the carton of icy cold milk.

"And good morning to you, too," Mr. Carter said, folding the newspaper and setting it down beside him. "Did you finish that report you were working on last night? I've got two tickets to the basketball game this evening and lots of film in the camera. I'd hate to go by myself."

"No problem, Dad. It's done." Randy drank the last drop of milk then wiped his mouth with his napkin and slid off the bench. "See you tonight."

Mrs. Carter opened the cabinet door and pulled out a box of apple juice and a box of chocolate chip cookies. She added them to the cellophane wrapped sandwich and orange already in the brown lunch sack.

"Brush your teeth before you leave, Randy," she said.

"No time. Besides, I can't find my toothbrush, and I'm out of toothpaste," Randy answered. He picked up his books and pencils, his football helmet, and his lunch sack then headed for the front door. "Bye, Mom."

As Randy closed the door, he saw the school bus round the corner, its shiny, black tires gleaming in the morning sun. He hopped over his mom's planter boxes and ran across the lawn. Down the street he raced—past four houses, three picket fences, two signs, and a telephone pole. He reached the corner just as the bus came to a halt in front of the bus-stop bench. All of his friends were already lined up to get on.

Beth Parker, the funniest girl in his class, was the last in line. Beth wore lavender glasses, bright yellow polish on her nails, and always smelled like hairspray, strawberry lip gloss, and peppermint candy. She turned around and smiled at Randy.

"You were lucky today," Beth said.

"That wasn't luck. That was perfect timing."

"Well, someday you're not going to make it to the bus in time," she said.

"Never," he answered, as he stuck a piece of gum in his mouth. Randy climbed the steps, then walked along the black rubber matting to the wide seat at the back of the bus.

The doors closed with a hiss as the bus rumbled down Hudson Street.

NATURE'S TREASURE CHEST
Answer Key

"Hurry, Randy, or you'll be late for school," Mrs. Carter called out from the kitchen.

Randy's hand slid over the smooth **handrail** as he raced down the **stairs**. He skipped the last three **steps** and landed with a thud.

"Coming, Mom," he mumbled through the thick sweatshirt that he put on over his new **rayon** shirt. He walked down the corridor, his shoelaces tapping on the shiny wood **floor**.

"What's for breakfast? I'm starved," he said. Randy slid across the **bench** to his place next to his father's **chair** at the head of the **table**. The smell of **vanilla** coming from the stack of steaming **pancakes** made his mouth water. The aroma of the spicy **sausage** on his plate made his stomach grumble. "Pass me the **maple syrup**, please." Randy reached for the **carton** of icy cold milk.

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"No problem, Dad. It's done." Randy drank the last drop of milk then wiped his mouth with his **napkin** and slid off the **bench**. "See you tonight."

Mrs. Carter opened the **cabinet door** and pulled out a **box** of **apple** juice and a **box** of chocolate chip **cookies**. She added them to the **cellophane** wrapped sandwich and **orange** already in the brown **lunch sack**.

"Brush your teeth before you leave, Randy," she said.

"No time. Besides, I can't find my **toothbrush**, and I'm out of **toothpaste**," Randy answered. He picked up his **books** and **pencils**, his **football helmet**, and his **lunch sack** then headed for the front **door**. "Bye, Mom."

As Randy closed the **door**, he saw the school bus round the corner, its shiny, black **tires** gleaming in the morning sun. He hopped over his mom's **planter boxes** and ran across the lawn. Down the street he raced—past four **houses**, three **picket fences**, two **signs**, and a **telephone pole**. He reached the corner just as the bus came to a halt in front of the **bus-stop bench**. All of his friends were already lined up to get on.

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"Never," he answered, as he stuck a piece of **gum** in his mouth. Randy climbed the steps, then walked along the black **rubber matting** to the wide seat at the back of the bus.

The doors closed with a hiss as the bus rumbled down Hudson Street.

In-depth Information

Many people know that furniture, lumber for building houses, paper, and books are wood products. But did you know that over 5,000 different products come from trees? Some of them are pretty surprising. Through the magic of modern science, man has learned how to take the fiber from trees and create wonderful items that make our everyday lives better and more enjoyable. How do they do it?

A tree is like any other plant, only bigger. It is built of plant CELLS made of CELLULOSE that are held together by LIGNIN. The lignin acts as a type of glue holding all the cells together in bundles of fibers. If the wood is cut into chips and then cooked into PULP, the lignin dissolves. The cellulose can now be separated out and cooked again. Soon it is a stew of fibers and a liquid called CELLULOSE ACETATE.

Some wood products come directly from the tree. Some come from the cellulose pulp, the lignin, or the cellulose acetate. Many medicines, clothing, foods, cosmetics, paints, even some “plastics” are wood products. So the next time you use a bowling ball, put on your new rayon dress, rinse with mouthwash, eat a cookie, or play your drums—THANK A TREE—and thank the foresters who keep our forests healthy and growing for all of us to enjoy.

Below are the items made from trees that were included in the story you read about Randy. How many of them did you find? If you got them all, you are…….TREE-RRRR-FIC!

HANDRAIL, STAIRS, STEPS, FLOOR, DOOR, CUPBOARDS: Many homes have stair parts and floors made of oak, pine, or fir because these woods are sturdy and attractive. Do you have a staircase in your home? What kind of wood was used to make it? Sometimes maple is used for a highly polished wood floor. Doors are most often made of pine and fir, but sometimes they are made of oak or even redwood. Many kitchen cabinets are made of pine or oak. Some are made of cherry. Make a tour of your house. Do you have a wood floor, or does carpet cover it? What kind of front door do you have? Are your cupboards wood? Are they painted or are they natural colored?

RAYON: This fabric is very popular because it is light and comfortable and can be made into clothes used for fancy occasions or clothes made for fun. Rayon is produced from cellulose acetate. Check the closets and drawers in your house. How many things do you and your family use that are made from rayon?

BENCH, CHAIR, TABLE: Furniture comes in all shapes and sizes and is made from many different materials. Today, it is often made from pine, oak, and teak. Makers of fine wood furniture like using walnut, cherry, and mahogany. These woods do not splinter easily and look beautiful when they are sanded smooth and polished.

VANILLA: Artificial vanilla is used in many baked goods that are found in the stores or are baked at home and is sometimes called vanillin. It is made from lignin. Lignin is used in some baby foods, pet

foods, and deodorants to help hold the ingredients of these products together. Some medicines that help with high blood pressure and Parkinson's disease also come from lignin.

PANCAKES, COOKIES: Baked goods sometimes contain an ingredient called torula yeast. It comes from the wood sugars that are produced when pulp is made. Torula contains lots of protein. It has five times more iron in it than Popeye's spinach. Torula yeast is also found in baby foods, cereals, imitation bacon, beverages, and many diet foods. Torula even seems to make bees and lobsters grow faster! What products in your kitchen have torula yeast or artificial vanilla in them?

SAUSAGES: No. meat inside the sausage is not made from wood! But the casings that hold the meat in links usually are cellulose, a wood product. Cellulose is tasteless and comes in several varieties. Sausage casings are made from ethyl cellulose. So are hard hats, combs, brushes, luggage, and fishing floats.

MAPLE SYRUP: The ingredient that soaks into our hot pancakes and shines on top of our puddings is the forest product we call maple syrup. It is the sap that flows through the cells of the sugar maple tree. This wonderful treat is tapped from the tree in early spring when the sap begins to move through the tree again after a winter rest.

CARTON, NEWSPAPER, REPORT, TICKETS, NAPKIN, BOX, BOOKS, SACK: Ordinary paper is most often made from soft woods such as pine and fir. In paper mills, wood chips are cooked in order to break down and soften the fibers. Next, they are washed clean and put into a beater. Beating makes the fibers fluffy so that they will hold together better. The mixture is now called wood pulp. At this point, dyes are often added to the pulp to give it color. Then it is spread out very thinly on a wide, wire screen. The pulp moves along a conveyor belt where most of the water drains out through the mesh. The rest is squeezed out by a series of rollers. As the fibers dry, they bind themselves together and become paper. Many paper products that are manufactured today are made from recycled paper. What does recycled mean? The next time you buy greeting cards, toilet paper, paper towels, facial tissues, cereal and other grocery boxes, check to see if they are made from recycled paper. What is printed on your paper grocery store bags? Does it show how much of the paper used to produce this bag is recycled? Making recycled paper is easy and fun.

APPLE JUICE, ORANGES: Most of the fruit we eat comes from a tree. We squeeze fruits into juice, cook them to make jams, jellies, and syrups, use them to help flavor other foods such as pies, and eat them fresh. What is your favorite way to enjoy fruit? What job does the fruit do for the tree? Here is a hint: What do we find hidden inside the fruit?

FOOTBALL HELMETS: Though they don't look like it, plastics are sometimes made by using wood. Wood flour is mixed together with other ingredients to form the plastic parts to many household

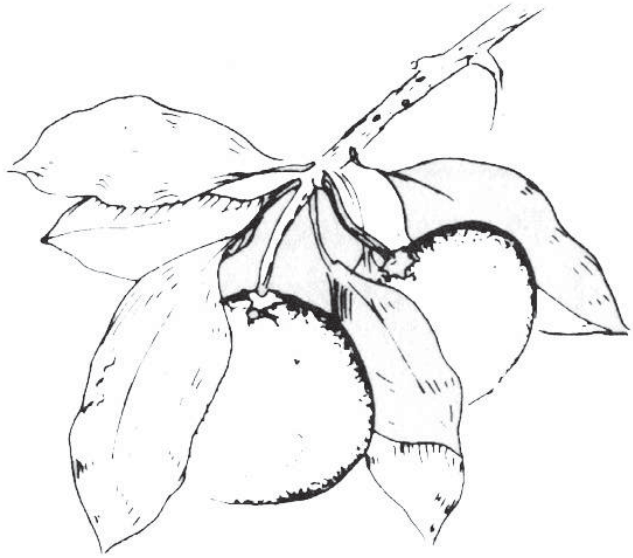
appliances, like coffee makers, and sports equipment, like hockey helmets and baseball hard hats. Scientists believe that using wood fiber strengthens the plastic.

TIRES, RUBBER MATS: Rubber trees originally came from South America, but now large rubber tree plantations are also found in the tropical areas of Africa and Asia. Workers make a cut into the bark of the tree and set a cup beneath it to catch the sap called latex. The latex is then made into rubber. What other items can you think of that are made from latex rubber? Can you think of another wood product that comes from tapping into the bark of the tree to catch its sap?

PHOTOGRAPHIC FILM, CELLOPHANE, TOOTHBRUSH, EYEGLASSES: These everyday items are made from cellulose. VCR tapes, sponges, and cellophane tape are also made from cellulose. Look at the knives and tools in your kitchen and workshop. Many of the handles are made from regular wood or from the wood product, cellulose.

NAIL POLISH, HAIRSPRAY, LIPSTICK, PEPPERMINT CANDY, GUM: The cosmetic and food industries make use of wood oils to give their products scent and flavor. Sandalwood is used in many perfumes and incense sticks. Eucalyptus is the smell we recognize in ointments, cough drops and syrups. Chewing gum uses both of these oils for fragrance along with chicle, an ingredient that is found in the forests of Central America. The drops of chicle that ooze out of the tree are what we find so much fun to chew!

PLANTER BOXES, HOUSES, FENCES, SIGNS, TELEPHONE POLES, BUS STOP BENCHES: The strong smelling oils in the wood are what makes redwood and cedar ideal for outdoor furniture, decks, planter boxes, and fences. These oils help protect redwood and cedar products from insects and also from damage by the rain, sun, and wet soil. Carpenters love to build with redwood and cedar because they have no knots in them. Their grain is straight and smooth. Some houses are made entirely out of wood. In other houses, the framework, the outside covering, and the shingles on the roof are made of wood. Douglas fir, white fir, and ponderosa pine are most often used to build houses. Douglas fir is also used to make telephone poles and bus-stop benches, while ponderosa pine is used to make most wood signs. Does your house have wood siding? Do you have shutters on your windows or decks around your house? Is there a gazebo or a birdhouse in your backyard? Does one of your neighbors have a wooden mailbox or



Forest Families

Activity for Grades 3–5 and 6–8

Objective

In this activity, students will be able to participate in a game that allows enrichment and a deeper understanding of the forest and its many moving parts.

Materials

- Forest Families Playing Cards (make enough decks so that students can play in groups of four per deck—for lasting durability be sure to laminate the cards)
- Master Copy of all of the Forest Family Playing Cards (one for each group to use to ask questions—at least until they have played the game enough that they know all possible 36 cards)

Background Information

Playing games is an easy and excellent way to spend unhurried, enjoyable time together. As an added bonus, games are also rich in learning opportunities. They satisfy your student's competitive urges and the desire to master new skills and concepts.

Just by virtue of playing them, games can teach important social skills, such as communicating verbally, sharing, waiting, taking turns, and enjoying interaction with others. Games can foster the ability to focus, and lengthen your student's attention span by encouraging the completion of an exciting, enjoyable game.

Games have distinct boundaries. Living in a complex society, students need clear limits to feel safe. By circumscribing the playing field — much as tennis courts and football fields will do later — games can help your student weave their wild and erratic side into a more organized, mature, and socially acceptable personality. After all, staying within the boundaries (not intruding on others' space, for example) is crucial to leading a successful social and academic life.

Procedure

1. Explain to the students that they are going to play a game called Forest Families. There are 36 cards in each deck (6 Forest Families with 6 members in each family).
2. Divide your students into groups of four.
3. Distribute a deck of Forest Family cards to each group.

4. Explain to the students how to play the game. The rules are as follows:
    a. The dealer shuffles the cards and passes them all out, face down, to all of the players.
    b. Players will take a moment to organize all of their cards into sets of Forest Families.
    c. The player to the right of the dealer begins the play. This "lead" player will choose a "target" player to question in order to collect more cards to add to the partial sets they already have in their hand.
    d. The first question on every player's turn is always to find out whether the target player has cards in a particular forest family that the lead player wishes to collect. For example: "Susie, do you have Parts of a Tree family? If Susie doesn't have one of the cards in that set, she answers, "No." The first player then loses their turn. However, if Susie does have one or more of the chosen category, they will answer the lead player, "Yes, I do." They should not tell which card or cards that they have. The lead player then can ask a question about a particular member of that family. (If this is the first time your class is playing the game, it is a good idea to supply each group with a master copy of all of the cards so that they will know what is in each Forest Family.) For example: "Susie, do you have the Sapwood?" If Susie doesn't have that particular card, the first player loses their turn. If Susie does have the card, then she must hand over the card and the first player gets to continue with their turn. The lead player can now ask Susie or another player about a forest family of their choice.
    e. Players take turns asking questions as they try to collect all the cards in a particular family. The game is over when all of the cards in the deck are collected in sets by the different players in the group. The person with the most sets of Forest Families wins.

Forest Safeguards

Forest Safeguards **TIMBER HARVEST PLAN** 1. Before a landowner can harvest timber, a timber forest plan must be approved. 2. A timber harvest plan describes how the harvest will be done, how the area will be replanted, and what will be done to prevent erosion, keep water pure, and protect habitat.	**Forest Safeguards** **CLEAN WATER ACT** 1. The Clean Water Act protects against watershed erosion that might clog rivers and streams. 2. The CWA regulates areas around city and county water supplies to maintain water quality.	**Forest Safeguards** **FOREST PRACTICES ACT** 1. Controls all harvest-related activities on private lands in the state. 2. It encourages private forest landowners to do whatever is necessary to protect and improve forest health.
Forest Safeguards **CONTROLLED BURNS** 1. Controlled burns are usually set during the rainy season, when they can be more easily regulated. 2. Controlled burns reduce the amount of brush and debris on the ground.	**Forest Safeguards** **MANAGED THINNING** 1. Thinning protects the forest by preventing overcrowding. 2. Thinned trees can be chipped for use by pulp and paper mills. 3. Thinned trees can be used as fuel to produce electricity at biomass power plants.	**Forest Safeguards** **SUSTAINED YIELD HARVESTING** 1. Sustained yield means never harvesting more wood than the forest is currently growing. 2. Sustained yield harvesting provides the forest products we need and also makes sure that our forests will be here today, tomorrow, and forever.

Workers of the Forest

Workers of the Forest GEOLOGIST	Workers of the Forest HYDROLOGIST	Workers of the Forest BOTANIST
1. A geologist is an earth scientist. 2. Geologists make certain that when trees are harvested there won't be landslides or erosion problems. 3. Geologists work with RPF to produce a timber harvest plan.	1. A hydrologist is a water scientist. 2. Hydrologists protect rivers, streams, and other bodies of water during harvesting. 3. Hydrologists work with a RPF on timber harvest plans.	1. A botanist is a plant scientist. 2. Botanists protect all forms of plant life as an area is harvested. 3. Botanists work with a RPF to plan for replanting after harvesting.
Workers of the Forest **R.P.F.**	**Workers of the Forest** **WILDLIFE BIOLOGIST**	**Workers of the Forest** **FISHERIES BIOLOGIST**
1. A registered professional forester writes up a timber harvest plan. 2. A RPF checks with other forest specialists about where trees can be harvested, how harvesting can be done, and what rules have to be followed to protect the forest. 3. Like a doctor or a lawyer, a RPF must firs pass a test in order to get a license.	1. Makes sure that when trees are harvested, animals that live in the forest are protected. 2. Checks to see that animals have plenty of places to find food, hide, and take care of their young. 3. Works with a RPF to produce a timber harvest plan.	1. Checks to see that during harvesting, water will be kept clean. 2. Checks to see that fish will have many places in which to live and reproduce. 3. Works with an RPF to produce a timber harvest plan.

Forest Products

Forest Products ENERGY	Forest Products PAPER PRODUCTS	Forest Products BUILDING MATERIALS
1. Wood is a natural resource that is renewable, recyclable, and biodegradable. 2. Wood scraps are burned at very high temperatures to provide the electricity needed to power our mills and our homes.	1. Machines at paper mills filter leftover paper-making ingredients to keep water clean. 2. Vacuums at paper mills filter our 99.9% of pollutants from the air. 3. Oxygen is added to the water around paper mills so that plants and fish stay healthy.	1. At the mill, lumber is stacked and left to dry out. This drying out is called "seasoning." 2. Fresh wood has a lot of moisture in it. If it is not "seasoned," it may warp later on. 3. If lumber is too dry, it may crack.
Forest Products **RECREATION**	**Forest Products** **ANIMAL HABITAT**	**Forest Product** **CLEAN AIR AND WATER**
1. Roads built by forest products companies make it easy to get to campsites, ski areas, and trailheads. 2. National forests offer miles of fishing rivers, miles of trials, thousands of lakes and reservoirs, and many major ski resorts.	1. Forests are home to hundreds of species of fish and wildlife. 2. Strict state and federal laws require that forest products companies protect not just wildlife but also their habitat.	1. Forests are oxygen factories. An acre of trees that grows 4,000 pounds of wood also produces 4,280 pounds of oxygen for us to breathe. 2. When forests get overcrowded, they quit growing. Trees then start to use oxygen instead of producing it. 3. Water that trees add to the air is important for rainfall patterns.

National Disasters of the Forest

National Disasters of the Forest VOLCANOES	National Disasters of the Forest WINDS	National Disasters of the Forest WILDFIRES
1. They cause forest fires when burning lava covers forests. 2. Mount St. Helens destroyed forests up to 20 miles from its mouth. 3. That wood destroyed could make a board that reaches to the moon and back and wraps around the earth ten more times.	1. Hurricanes are powerful enough to destroy a whole forest. 2. Large trees in overcrowded stands are often uprooted by severe storms because of their size and weak condition.	1. Wildfires often get so hot that they bake the soil and destroy all the biota in it. 2. Large wildfires can be prevented by reducing fuels through harvesting of trees and prescribed burns. 3. Controlled burns imitate Mother Nature by preventing the unhealthy effects of overcrowding.
National Disasters of the Forest INSECTS	**National Disasters of the Forest DISEASE**	**National Disasters of the Forest STRESS**
1. Bark beetles eat a circle around a tree and prevent nutrients and water from reaching all parts of the trees. 2. Insects can be more easily attack and destroy trees that are stressed from overcrowding. 3. Insects do more damage than forest fires and diseases put together.	1. A fungus takes nutrients away from the tree's cells. 2. Mistletoe and Dutch elm disease are examples of diseases. 3. Overcrowded trees are stressed and are more likely to be attacked by fungus and other diseases.	1. Competition for nutrients and water in overcrowded forests causes trees to become stressed. 2. Stressed trees are more likely to be killed or harmed by diseases, insects, drought, and violent acts of nature.

Types of Trees

Types of Trees **EASTERN COTTONWOOD** 1. Cottonwood is one of the largest and fastest growing of the eastern hardwoods. 2. The wood is used for boxes, crates, furniture, and pulpwood. 3. It can grow up to 90 feet tall.	**Types of Trees** **EASTERN REDCEDAR** 1. Redcedar trees quickly colonize old fields and fence rows and it is also found on dry limestone glades. 2. The fragrant wood is valuable for closet lining and novelties. 3. It is excellent for windbreaks and the berries are eaten by many kinds of wildlife.	**Types of Trees** **WARD'S WILLOW** 1. This attractive willow, with white lower leaf surfaces, is abundant along all of the Ozark streams. 2. It pioneers as one of the first woody species to occupy the outer edges of gravel bars and rocks in the stream. 3. It is a small tree and is important for streambank stabilization.
Types of Trees **SHAGBARK HICKORY** 1. Shagbark Hickory is the most common hickory north of the Missouri river. 2. The wood is used for the handles of axes, hammers, hatchets, and for smoking meat. 3. The Shagbark Hickory is a very summer habitat for bats.	**Types of Trees** **BLACK WALNUT** 1. Black Walnut is one of the scarcest and most valuable native hard-woods. 2. It is prized for its nuts and lumber. 3. A chemical in the leaves and nuts will kill some plants such as tomatoes and apples.	**Types of Trees** **RIVER BIRCH** 1. River Birch is the only native birch to Missouri. 2. The attractive bark and its resistance to borers make river birch the preferred birch for landscaping. 3. It can grow up to 60 feet high.

Parts of a Tree

Parts of a Tree ROOTS	Parts of a Tree LEAVES/NEEDLES	Parts of a Tree BARK
1. Most trees have very large root systems. 2. Roots draw water and nutrients from below the ground to cause growth above the ground. 3. Because of root growth, the tree may be almost as large below the ground as above it.	1. Once they sprout, trees make their own food in their leaves or needles. 2. Chlorophyll is the substance that gives needles and leaves their green color. 3. Needles and leaves convert energy from the sun, water drawn from their roots, and carbon dioxide from the air to produce the sugars they use for "food."	1. Outer bark protects the tree from weather, insects, disease, fire, and animals. 2. Inner bark (phloem) carries nutrients down from the leaves to the branches, the trunk, and the roots for growth. 3. Bark can be thick or thin; birch bark may be ¼ of an inch thick; giant sequoia bark may be 2 feet thick.
Parts of a Tree **CAMBIUM**	**Parts of a Tree** **SAPWOOD**	**Parts of a Tree** **SEED**
1. Cambium is made up of layers of cells that divide and grow, producing new layers of wood. 2. These layers of cells allows us to "read the rings" to tell a tree's age. 3. A dark ring and a light ring are produced each spring and summer. We count the dark rings to tell a tree's age.	1. Sapwood (xylem) transports minerals and water from the roots to the crown of the tree. 2. Chemicals in the sap determine the color the leaves turn in the fall.	1. Seeds carry the beginnings of life fro a tree and also its food supply. 2. Seeds can be found in cones, nuts, or fruits. 3. Seeds fall in the autumn and are covered by a blanket of needles and leaves fro the winter. Then, they sprout in the spring.

Adopt a Tree

Activity
for Grades K–2, 3–5, 6–8

Objective

In this activity, students will "adopt" a tree and throughout the year will record and examine its characteristics and the changes that it goes through.

Materials

- Schoolyard area with trees
- Student journal
- Pencil (one for each student)
- Magnifying glasses (one for each student)
- Crayon (one for each student)
- Measuring tape (one for each student)

Background Information

Benefits of Trees

Most trees and shrubs in cities and communities are planted to provide beauty and shade. These are two excellent reasons for their use. Woody plants also serve many other purposes, and it often is helpful to consider these other functions when selecting a tree or shrub for the landscape. The benefits of tree can be grouped into social, communal, environmental, and economic categories.

Social Benefits

We like trees around us because they make life more pleasant. Most of us respond to the presence of trees beyond simply observing their beauty. We feel serene, peaceful, restful, and tranquil in a grove of trees. We are "at home" there. Hospital patients have been shown to recover from surgery more quickly when their hospital room offered a view of trees. The strong ties between people and trees are most evident in the resistance of community residents to removing trees to widen streets. Or we note the heroic efforts of individuals and organizations to save particularly large or historic trees in a community.

The stature, strength, and endurance of trees give them a cathedral-like quality. Because of their potential for long life, trees frequently are planted as living memorials. We often become personally attached to trees that we or those we love have planted.

Communal Benefits

Even though trees may be private property, their size often makes them part of the community as well. Because trees occupy considerable space, planning is required if both you and your neighbors are to benefit. With proper selection and maintenance, trees can enhance and function on one property without infringing on the rights and privileges of neighbors.

City trees often serve several architectural and engineering functions. They provide privacy, emphasize views, or screen out objectionable views. They reduce glare and reflection. They direct pedestrian traffic. They provide background to and soften, complement, or enhance architecture.

Environmental Benefits

Trees alter the environment in which we live by moderating climate, improving air quality, conserving water, and harboring wildlife. Climate control is obtained by moderating the effects of sun, wind, and rain. Radiant energy from the sun is absorbed or deflected by leaves on deciduous trees in the summer and is only filtered by branches of deciduous trees in winter. We are cooler when we stand in the shade of trees and are not exposed to direct sunlight. In winter, we value the sun's radiant energy. Therefore, we should plant only small or deciduous trees on the south side of homes.

Wind speed and direction can be affected by trees. The more compact the foliage on the tree or group of trees, the greater the influence of the windbreak. The downward fall of rain, sleet, and hail is initially absorbed or deflected by trees, which provides some protection for people, pets, and buildings. Trees intercept water, store some of it, and reduce storm runoff and the possibility of flooding.

Dew and frost are less common under trees because less radiant energy is released from the soil in those areas at night.

Temperature in the vicinity of trees is cooler than that away from trees. The larger the tree, the more cooling it provides. By using trees in the cities, we are able to moderate the heat-island effect caused by pavement and buildings in commercial areas.

Air quality can be improved through the use of trees, shrubs, and turf. Leaves filter the air we breathe by removing dust and other particulates. Rain then washes the pollutants to the ground. Leaves absorb carbon dioxide from the air to form carbohydrates that are used in the plant's structure and function. In this process, leaves also absorb other air pollutants—such as ozone, carbon monoxide, and sulfur dioxide—and give off oxygen.

By planting trees and shrubs, we return to a more natural, less artificial environment. Birds and other wildlife are attracted to the area. The natural cycles of plant growth, reproduction, and decomposition are again present, both above and below ground. Natural harmony is restored to the urban environment.

Economic Benefits

Individual trees and shrubs have value, but the variability of species, size, condition, and function makes determining their economic value difficult. The economic benefits of trees can be both direct and indirect. Direct economic benefits are usually associated with energy costs. Air-conditioning costs are lower in a tree-shaded home. Heating costs are reduced when a home has a windbreak. Trees increase in value from the time they are planted until they mature. Trees are a wise investment of funds because landscaped homes are more valuable than non-landscaped homes. The savings in energy costs and the increase in property value directly benefit each home owner.

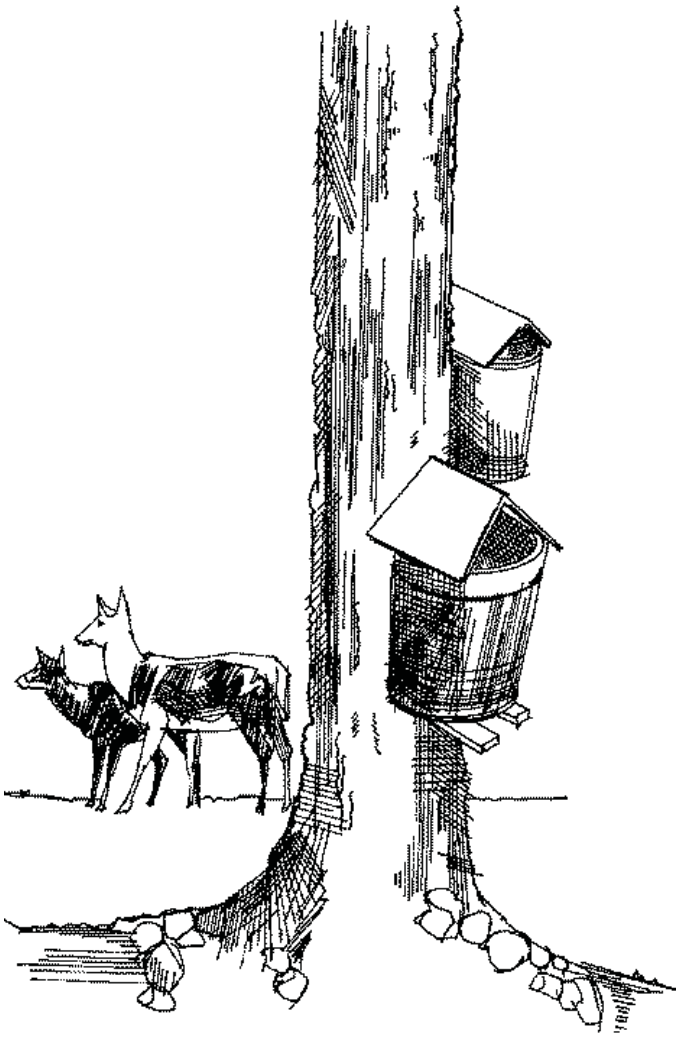
The indirect economic benefits of trees are even greater. These benefits are available to the community or region. Lowered electricity bills are paid by customers when power companies are able to use less water in their cooling towers, build fewer new facilities to meet peak demands, use reduced amounts of fossil fuel in their furnaces, and use fewer measures to control air pollution. Communities also can save money if fewer facilities must be built to control storm water in the region. To the individual, these savings are small, but to the community, reductions in these expenses are often in the thousands of dollars.

Procedure

Nature Walk

1. Explain to the students that you are going to take them out to the schoolyard. The goal is for each student to pick a tree that they like.
2. Give each student a blank journal, a pencil, a crayon, a magnifying glass, and a measuring tape. Remind the students to write down the date so that they can keep track of the their tree changes throughout the year.
3. Ask the students to look very closely at their tree and its surroundings. Invite the students to write down what they see, hear, feel, and smell into their journal. Have them answer questions like: Are there squirrels? Spiders? Birds? Ask the students to draw some of the animals that they see.
4. Have the students sit by their tree and listen. Tell the students to write down what they hear in or near the tree. Can they hear the branches moving? Are birds singing? Is a squirrel chattering to you from one of the branches? Students should write down what they hear.
5. Invite the students to feel the bark of the tree and describe how it feels. Make a rubbing of the bark. (Hold a piece of paper against the bark. Scribble over most of the paper with the side of a crayon. Be sure to leave some space to write a few words about the rubbing.)

6. Tell the students to smell a piece of bark, a leaf, or any flowers on the tree. Have the students write down what these things smell like. Do they smell like anything they have smelled before?
7. Have the students make a tracing of a leaf from their tree. Invite the students to look for other trees with the same kind of leaves and draw a map to show where these trees are.
8. Next, invite the students to wrap a tape measure around the tree and record its width. Then, have the students measure the width of another tree that looks that same as yours. Ask the students which tree do they think is the oldest? The youngest? Explain how you know.
9. Ask the student to use a magnifying glass to look more closely at their tree. Have them explain how the tree and its leaves look different.
10. Invite the students to sum up their experience by writing down at least four things that they learned about their tree by looking closely at it. Then, back at school, have the students do some research to find out what kind of tree they have adopted. Next, ask the students to write down more things that they learned about their tree after reading about it. Be sure that the student find out the tree name, learn about other areas that it grows in, detail what animals rely on it for life, etc. Have the students include all of the facts into their journal.
11. Choose other days to make recordings (maybe once a month) to return to the schoolyard and to make additional observations and notes about each student's tree. Allow time for student to share the changes that they are noticing throughout the school year.



TREEmendous Words to Know

agronomist: a person who studies the science of land cultivation and management

autotroph: an organism that uses energy to produce the food they need biodegradable

bark: the protective outside covering of a woody stem or root.

biodegradable: being able to be broken down or decomposed by natural means

biologist: a scientist who studies living things

biome: large geographical region biosphere: the part of the earth's crust, water, and atmosphere that supports life

botanist: a scientist who studies plants and plant life characterized by distinctive types of plants and animals and a specific

botany: the study of plants

cambium: thin layer of living cells that produce a new layer of wood each year, forming tree rings, which we can count to tell the age of a tree. The cambium lies between the xylem and phloem layers.

carbon dioxide: a colorless, odorless gas that is formed during respiration, combustion, and organic decomposition.

carnivore: animal that eats other animals

carrying capacity: the point when the organisms in a community are using the resources of that community to the fullest extent

canopy: the uppermost spreading, branchy layer of a forest

cellular respiration: the chemical breakdown of glucose to produce energy. This process is the opposite of photosynthesis.

cellulose: the material that makes up plant cell walls; wood fiber

chlorophyll: the green substance found in leaves and needles that capture's the sun's energy

climate: tundra, tropical forest, desert, savanna, coniferous forest, deciduous forest, and temperate grassland, for example.

clinometer: a tool that helps foresters measure tree height

community: a group of animals and plants that live together in the same environment

cone: the cone-shaped fruit of a conifer tree (pine, fir, spruce, etc.)

conifer: A conifer is a needle-leaved or scale-leaved tree or shrub that produces cones. Conifers are a type of plant called a gymnosperm.

coniferous: coniferous trees are trees that are mostly evergreen, have needle-like or scalelike leaves, and produce cones. Conifers are a type of plant called a gymnosperm.

crown: the distance the tree's branches spread away from its trunk

cultivate: to grow or take care of a plant or crop ... to help grow

cycle: a repeated event or sequence of events over time

data recorder: hand-held computer used for the storage, retrieval and analysis of forest information

deciduous: falling off at a particular time or season

decomposer: organism that absorbs nutrients from non-living material such as dead plants and animals and wastes of living organisms that recycles those nutrients so they can be used again by plants

diameter: the length of a line through the center of a circular object, such as a tree dibble: a tool used to plant seedlings

fiber: thin threads that bind together to form animal and plant matter.

food chain: pathway along which food is transferred from one feeding level of organisms to another

food web: interconnected food chains of an ecosystem

ecological succession: series of slow, generally predictable changes in the number and kinds of organisms in an area

ecology: study of how plants and animals interact with each other and the environment

ecosystem: a system formed by the interaction of a community of organisms with its environment

environment: external factors and forces surrounding and affecting an organism

evaporation: to take moisture from leaving the dry portion; to change into a vapor

evergreen: a tree or shrub that remains green throughout the year

forester: trained professional who manages the forest for many uses

habitat: the natural environment of a plant or organism; the place an organism is usually found

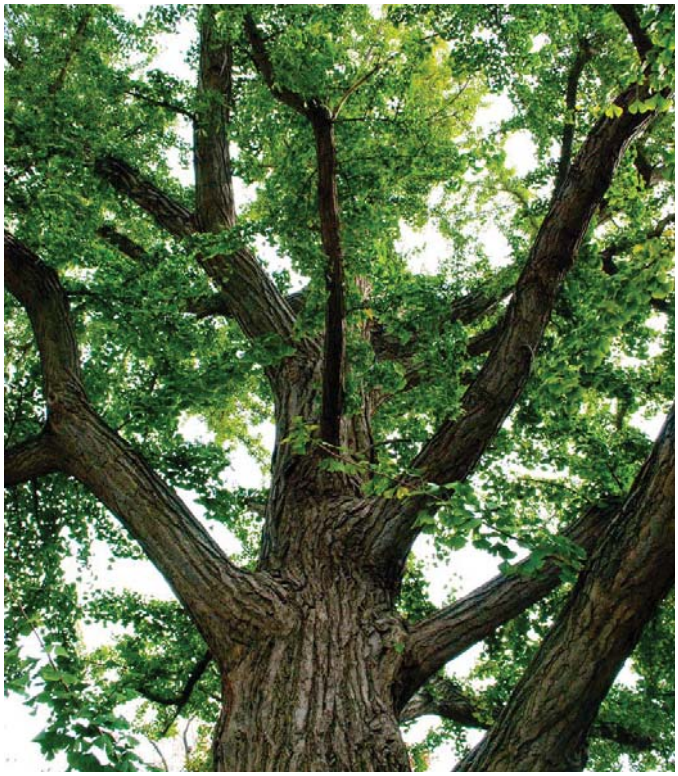
hardwood: the hard, inactive wood at the center of the tree

herbivore: animal that eats plants

hereditary: passing genetically from parent to offspring

heterotroph: an organism that gets energy from the foods they eat

humus: dark organic material in soils produced by decomposition of plant and animal matter



increment borer: a forester's tool used to check the growth, age and health of a tree

lathe: machine that holds a log in place while it is peeled for veneer

life cycle: the progression through a series of different stages of development

lignin: a glue-like chemical that holds a tree's wood fibers together

limiting factor: factors in an ecosystem that help determine the size of a population (i.e., food supply, predators, climate, and disease)

microhabitat: an extremely localized, small-scale environment, as a tree stump or a dead animal

mulch: a protective covering spread on the ground especially to reduce evaporation and control weeds

natural resource: material we use from our environment for housing, clothing, food energy, etc. Natural resources can be classified as renewable or non-renewable.

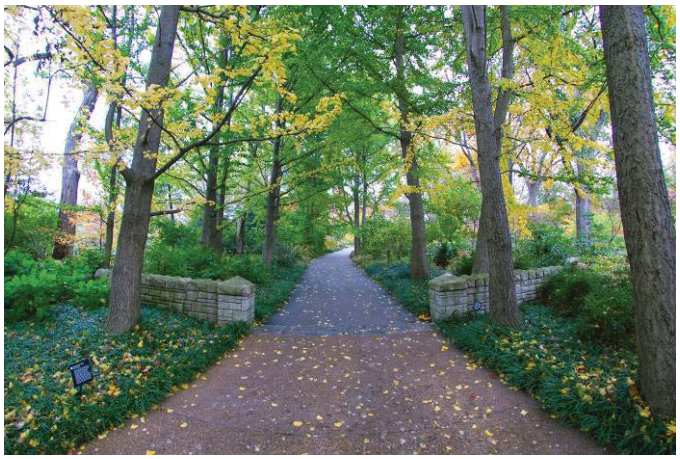
niche: the position of a particular population in an ecological community

non-renewable resource: exists in a limited amount that takes thousands of years to replenish. Examples are fossil fuels like coal, oil and natural gas.

nutrients: a substance necessary for a plant or animal to grow; any substance that can be used by an organism to give energy or build tissue

omnivore: animal that eats both plants and other animals

organic: of, or made from, living organisms



oxygen: an element found freely in nature that is needed for humans and animals to be able to breathe and is necessary for nearly all combustion to occur

peat moss: dark brown, partly decayed plant matter

phloem: layer of inner bark cells that transport food made by photosynthesis in the leaves to the rest of the plant

photosynthesis: the production of carbohydrates from carbon dioxide and water using sunlight as the source of energy with the aid of chlorophyll

pigment: a substance that makes color in the tissues of organisms

pollen: the part of a plant that allows for fertilization (the ability to create a seed)

pollination: when pollen from the male cone comes in contact with the ovule of a female cone

population: a group of the same species of organism living in one area at the same time

precipitation: any form of water that falls to the earth's surface; rain, sleet, snow, or hail

prescribed burn: to deliberately burn forest fuels under specific environmental conditions that allow the intensity and rate of fire spread to be controlled to achieve specific management objecives

producers: someone who makes or manufactures

propagation: multiplication or increase as by natural reproduction

pruning: cutting off undesired twigs, branches, or roots

pulp: soft, wet mass of wood fibers used to make paper

rayon: fabric made from cellulose, which comes from trees

recyclable: being able to be utilized again, often by being restructured into something else.

regeneration: the planting and growing of new trees

renewable resource: has the capability of replenishing itself in a human lifetime. For example, if a tree is harvested, it will regenerate from a seed that was dropped from a cone or planted by a human

resin: chemical used to glue wood veneer or wood chips and shavings together

roots: the network below ground that anchors the tree in the soil. Root hairs push their way through the soil and absorb moisture and minerals from the soil.

sapling: a young tree

sapwood: newly formed wood cells that lie just inside the cambium. It acts as a major conductor of water and minerals for the tree; also known as xylem

scales: small, thin, usually dry, parts of a plant

seed coat: the outer protective covering of a seed

seedlings: a plant or tree grown from a seed; any young plant

shear: to cut or remove by cutting

softwood tree: a coniferous tree such as a pine or fir whose long, flexible wood fibers are used to make products like bags and boxes

soil: the top layer of the earth's surface consisting of rock and mineral particles mixed with organic matter

soil profile: shows and describes the layers of the soil just below the surface of the earth

species: a kind, variety, or type of organism

tally: to add up for a total sum

timber cruise: taking measurements of a sample of the trees in a stand

tree ring: a new layer of wood added to the outside edge of a tree during each growth season

tree stand: a group of trees that have similar characteristics

veneer: thin sheets of wood

web of life: network of relationships that interconnects all members of an ecological community

wood volume: the amount of usable wood in a tree is determined by measuring a tree’s height and diameter

TREEmendous Resources

Aliki. *The Story of Johnny Appleseed.* Simon & Schuster, 1971.

Barron, T.A. *Tree Girl.* Paw Prints, 2008.

Cassie, Brian. *National Audubon Society First Field Guide: Trees.* Scholastic, 1999.

Cherry, Lynne. *The Great Kapok Tree.* Harcourt, 1990.

Chessen, Betsey. *Rainforest.* Scholastic, 1998.

Coombes, Allen J. *Trees.* Dorling Kindersley, 2002.

Dorros, Arthur. *A Tree is Growing.* Scholastic Press, 1997.

Ehlert, Lois. *Red Leaf, Yellow Leaf.* Harcourt, 1991.

Gibbons, Gail. *Tell Me, Tree: All About Trees for Kids.* Little, Brown and Compnay, 2002.

Gibbons, Gail. *The Seasons of Arnold's Apple Tree.* Harcourt, 1988.

Hall, Zoe. *The Apple Pie Tree.* Blue Sky Press, 1996.

Hunt, Angela and Tim Jonke. *The Tale of Three Trees.* David C. Cook, 2001.

Ingoglia, Gina. *The Tree Book for Kids and Their Grown-ups.* Brooklyn Botanic Garden, 2008.

Julivert, Maria. *Trees.* Enchanted Lion Books, 2007.

Klise, Kate. *Regarding the Trees.* Harcourt, 2007.

Kottke, Jan. *From Acorn to Oak Tree.* Scholastic, 2001.

Lauber, Patricia. *Be a Friend to Trees.* Harper Collins, 1993.

Levin, Ellen. *The Tree That Would Not Die.* Scholastic, 1995.

National Wildlife Federation. *Trees Are Terrific.* McGraw-Hill, 1998.

Pakenham, Thomas. *Remarkable Trees of the World.* W. W. Norton & Company, 2003.

Plotnik, Arthur. *The Urban Tree Book: An Uncommon Field Guide for City and Town.* Three Rivers Press, 2000.

Rex, Adam. *Tree Ring Circus.* Houghton Mifflin Harcourt, 2006.

Roemer, Heidi. *What Kinds of Seeds Are These?* Northwood Books for Young Readers, 2006.

Rosenberry, Vera. *The Growing-up Tree.* Holiday House, 2003.

Silverstein, Shel. *The Giving Tree.* Cape, 1987.

Tagliaferro, Linda. *The Life Cycle of an Oak Tree.* Capstone Press, 2007.

Thomas, Peter. *Trees: Their Natural History.* Cambridge University Press, 2000.

Tudge, Colin. *The Tree: A Natural History of What Trees Are, How They Live, and Why They Matter.* Random House Digital, Inc., 2007.

Udry, Janice May. *A Tree is Nice.* HarperCollins, 1997.

Wallace, Nancy. *Seeds! Seeds! Seeds!* Marshall Cavendish Corp, 2007.

Internet Resources

www.mobot.org

TREEmendous!
Great St. Louis Tree Hunt

Through September 30, 2011

Search the great outdoors for 15 of 30 marked TREEmendous trees throughout the Missouri and Illinois metro St. Louis region.

Ways to participate

Visit www.mobot.org/treemendous or visit the Garden.

Download or pick up an area tree hunt guide, clue map, and photo journal or view the Google map to find clues about locations of the trees.

At each tree location, you'll find a TREEmendous sign that identifies the tree. Write down the information included on the sign, or take a photo of the sign with your smartphone.

On each sign, a scannable QR (Quick Response) code will also enable smartphone users to visit a web page and learn more about its surroundings. Many reliable (and FREE!) QR code scanners are available to download from your phone's app store or marketplace.

Offset Your Carbon Footprint

For every Tree Hunt web page that's visited, 10 lbs. of carbon dioxide will be offset by 3Degrees, Ameren Missouri Pure Power's partner for renewable energy and carbon balancing services.

Collect Your Prize!

Document your findings and bring the completed guide (or an image of each tree) to the *TREEmendous Interactive Discovery Center* at the Missouri Botanical Garden to receive a special tree-themed reward.

Notes

Missouri Botanical Garden