A TEACHERS' GUIDE TO ARBOR MONTH

Activities on Trees and the Natural World for Grades K–8

Minnesota Arbor
Month Partnership

Revised 2002

Introduction

Dear Teacher,

Arbor Day is the last Friday in April each year in Minnesota. Arbor Month is May. Both offer wonderful learning opportunities for your students during Arbor celebrations and throughout the school year.

A *Teachers' Guide to Arbor Month* makes it easier than ever to integrate knowledge about trees, shrubs, plants, and the natural world into your regular school curriculum. This cross-curricular thematic guide offers dozens of student-appealing lessons to supplement your daily lessons in: language arts, people and cultures, science and the environment, math, the arts, games and physical activities. It is an ideal enhancement to your environmental education program, and can help you meet Minnesota graduation standards.

You'll want to page through the subject areas, choosing activities that are appropriate for your group. Grade levels are suggested, but you are encouraged to check out the other grade materials, too, and adapt any activities to fit your group. Many of the activities include ready-to-reproduce student pages. You'll recognize them by the "Kid's Copy" design at the top right corner of the page.

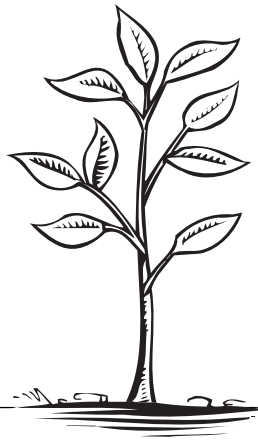
Take a look through the Resources section. It's a valuable collection of reference material on many topics about trees. Most of these pages are also designed as ready-to-reproduce resources for your students and are ideally suited for independent learning projects in the upper elementary and junior high grades.

If you're using literature-based units with your students, be sure to look through the Books and More section.

Keep your *Teachers' Guide to Arbor Month* handy throughout the school year. It's a great reference for tree information any time, and offers a treasury of learning opportunities that integrate into your curriculum any time of the year.

This *Teachers' Guide to Arbor Month* has been especially prepared for you by the Minnesota Arbor Month Partnership in collaboration with Minnesota teachers. Please feel free to reproduce any of these materials and share them with others.

Happy Arbor Day!



Setting the Stage

Trees: A Cross-Curricular Thematic Unit

1. Develop a reading corner, a quiet place for treasuring books. Make it an inviting, enjoyable nook by including carpeting, pillows, rugs, comfortable chairs, and a bookshelf. Stock your reading corner with many fiction and nonfiction books about trees, forests, and related topics. Invite students to share their own favorite tree books, too.
2. Create a science station and an art gallery for displaying tree- and forest-related items.
3. Provide computer access and website addresses to a number of tree and environmental sites. Create opportunities for students to share what they discover in their Internet searches.
4. Invite students to create tree bulletin boards, posters, models, and murals to go with the lessons in these units.
5. Contact your local community, county extension, or Department of Natural Resources forester for tree seeds, seedlings, and saplings. Grow tree seedlings in the classroom and saplings on the school grounds. If possible, send a seedling home with each child to plant along with the tree planting instructions found on page 119 in the Resources section of this guide.

A Teachers' Guide to Arbor Month
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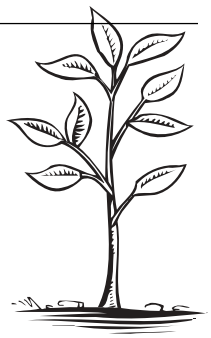
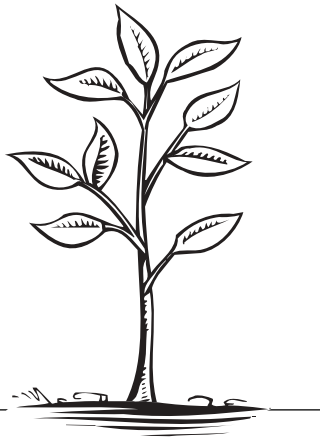


As you launch into the exciting activities in this book, you're doing so with the support and encouragement of the Minnesota Arbor Month Partnership. The agencies, organizations, and individuals comprising the partnership are deeply committed to building understanding and respect for Minnesota's trees and forest resources. Their mission is to educate Minnesota's youth and build public awareness about the importance of trees, community forestry, and the environment by getting children and adults involved with planning for, planting, and maintaining trees.

Contact the Minnesota Arbor Month Partnership at 500 Lafayette Road, St. Paul, Minnesota 55155-4044; 651-296-4491; http://www.dnr.state.mn.us/forestry/arborday

Arbor Day



Celebrate Trees!

Objectives

- To motivate young people to value, conserve, and plant trees for a better environment.
- To provide a plan for conducting Arbor Day/Month ceremonies or tree-planting campaigns.

Tree planting is what a Minnesota Arbor Celebration is all about. Just one tree planted on Arbor Day does more than shade the spot where it's planted. It gives root to the love of trees and the stewardship of renewable resources.

This *Teachers' Guide to Arbor Month* is a collection of activities, bulletin board ideas, tips, facts, and reproducible pages designed to make your observance an exciting and meaningful tradition ... and to help young people become tree-conscious all year long. Through Arbor Day celebrations and teaching students about trees, you help them plant the future for themselves and for generations of Minnesotans to come!

Arbor Day

To everyone concerned with protecting and conserving tree resources, Arbor Day is a day to celebrate! It's a special day when people learn about, plant, and care for trees. *Minnesotans celebrate Arbor Day the last Friday in April,* along with most other states in the region. Since 1978, *May* has been Arbor Month in Minnesota. The ground has thawed by May to allow planting and the weather is warm enough to get young trees off to a good start.

Arbor Day is an American tradition. Arbor celebrations began in Nebraska in 1872. Nebraska, along with other Great Plains states, had almost no trees. Still, the region grew flourishing agricultural crops and the climate was suitable for growing trees. A man named J. Sterling Morton believed the state needed more trees. He sponsored a campaign for tree planting in Nebraska, setting aside April 10 for just that purpose. The idea spread. In 1876, Minnesota became the fourth state to adopt the tradition. Today all 50 states observe Arbor Day on various dates, and all plant trees on their Arbor Days.

The following information will help you plan your Arbor Day/Month celebrations. Keep a good thing growing!

Arbor Day Ceremony

Page 2 offers a framework of events you can adapt to fit your school or community. Your ceremony should include the reading of an Arbor Celebration proclamation and the planting of one or more trees. It can be much more, however. Singing, reading poems, entertainment by musicians and other performers, and refreshments all lend a festive air to your program and encourage widespread participation.

Your city forester, county extension people, Department of Natural Resources forestry personnel, greenhouse and landscape business owners, and other local environment-related people may be great resources and collaborators in the event. Check out your community resources!

Here is a typical order of events for an Arbor Ceremony:

1. **Welcome** by mayor or other local dignitary.
2. **Brief history of Arbor Month** read by the program coordinator, a student, or a business leader. (Use the "Arbor Day" paragraphs from the previous page or choose a summary from a library book or encyclopedia.)
3. **Reading and signing of Arbor Day/ Month Proclamation** by mayor or other local dignitary.
4. **Music, poems, or selected readings.** Have students write or choose some. See "Tree Poems" and "Tree Tunes," Resources, pages 130 and 131.
5. **Ceremonial tree planting.**
6. **Refreshments** and other entertainment.
7. Many classes follow up (or precede) their ceremonies with special classroom activities such as how to plant a tree (see Resources, page 119).

Details to Remember

1. Foul weather contingency plans.
2. Make arrangements. Schedule a public address system, tents, portable lavatories, trash cans, chairs, or other items you think you'll need as soon as possible.
3. Invite everyone! Don't forget parents, school volunteers, community leaders, senior citizen and civic groups, local business people, and city public works and parks people.
4. Media coverage. Announce your event everywhere you can. Invite the media four to six weeks ahead of the event. Follow with a brief press release one to two weeks ahead of the event describing what will happen, who will be participating, and why the event is important. Include the date and specific time schedule, along with helpful directions, parking information, etc. Give a contact number for more information. Provide write-ups summarizing the event for the media at the ceremony. Be available for questions. Plan a creative or unique photo opportunity for television or newspaper photographers.
5. Printed programs. They hold events together.
6. Prepared-in-advance planting sites. Dig the holes in advance and provide mulch for each tree. Order appropriate tree species for your site. Make sure you have permission or the proper authorization to plant on the site.
7. Rehearse the details. A "dry run" the day before the ceremony helps you relax. Be sure projectors, public address systems, and other equipment aids are working perfectly. Post signs and appoint guides to help visitors.
8. Shovels. Have enough shovels for dignitaries ... and remind them to wear sturdy shoes!
9. Refreshments. April and May are often cool; you may want to move indoors after the planting for hot drinks and the program.
10. Follow-up tree care. Make sure someone comes back after the ceremony to water the tree(s) on a regular basis. Arrange to have one person or a group of people provide continued regular tree care.

Kindergarten

Getting to Know Trees

Objectives

Students will:

- tell what a tree is (the worlds largest plant);
- describe in simple terms the value and beauty of trees;
- observe trees and identify roots, crowns, trunks, and bark;
- describe seasonal changes in trees.

Vocabulary Words

air	bark
seeds	inner wood
roots	adults
trunks	branches
crowns	leaves
fluids	

Background Information

What would the world be like without trees? We would certainly miss their beauty. Think about the changes in colors from season to season, the rustle of leaves under our feet, the beautiful green of the evergreen trees standing in the white winter snow. What are some other beautiful things about trees?

A summer without trees would be much hotter. Trees give us shade and help cool the air. Trees "drink" huge amounts of water each day through their roots. Some of that water passes through the leaves into the **air** to give us moisture. Trees also help clean our air by taking the part of it we can't breathe (carbon dioxide) to make their own food. As they do this, they make oxygen, which is the air we breathe.

Many animals would be without homes and food if there were no trees. Birds, squirrels, bugs, and mice are just a few of the animals that live in and around trees. These animals and others get much of their food from trees. Bark, nuts, leaves, and fruit are tasty treats for many animals—and for people, too.

Trees cover about one-third of the earth and are the largest plants in our world. They can live for a very long time. One bristlecone pine tree in California is 4,600 years old!

Like other plants, trees grow from **seeds.** Trees have three main parts: **roots, trunks,** and **crowns.** As they grow tall above the ground, exciting things are happening underground, too. Below the soil where we can't see them, roots are spreading far out from the tree in all directions. The roots are creeping through the soil looking for water and nutrients (food). They're also helping hold the tree in place so it doesn't blow over.

The tree's main stem—called the trunk—keeps growing from year to year. The trunk keeps the tree standing strong and tall. It holds up the top part of the tree (the crown), and is a passageway for water and other **fluids** to move up and down the tree. The rough outer skin of the trunk is called **bark.** The woody center inside the trunk is called **inner wood.** Humans stop growing bigger when they become **adults,** but trees grow all their lives.

The crown of the tree is the **branches** and **leaves.** It has the important job of making food for the tree. The leaves are tiny "factories" that make food. To do this, they need water, air, minerals from the soil, and energy from the sun.

First Steps … A Nature Hike!

Capitalize on children's natural enthusiasm and curiosity and a nature hike becomes a delightful tree discovery learning experience. See "Tips for Safe and Successful Nature Hikes," Resources, page 91. A first trip for kindergartners might be the schoolyard or a close-by neighborhood.

For better focus and direction on a nature hike with young children, have an older student or adult accompany each group of three to four children. Give each group leader a written list of things to look for and a few questions to spark discussion. Throughout the hike, encourage children's observation skills and their sense of beauty: Ask and discuss questions such as the following to reinforce the objectives in this lesson.

What do you like best about trees?

What do you think is beautiful about trees?

Why do people like to have trees in their yards and parks?

How are the trees we see here alike? How are they different?

There are many different kinds of trees. How do people know the difference between one kind and another? (Leaves are a main clue.) How can we find out what kinds of trees we have in our schoolyard?

Which tree is the largest? The smallest?

Which trees seem to be older? Younger? How can we tell?

Where are the roots of a tree? The trunk? The branches? The crown?

Where is the bark on the tree? Does the bark look alike from one tree to another? What is different?

How do we know what is inside a tree?

Are there any signs that animals live in or near these trees? How is a tree a friend to animals?

What season of the year are we in?

How will these trees look different in other seasons?

Encourage students to ask their own questions and to compare and discuss their ideas with others. The questions and activities you choose and the amount of guidance you give depends on the attention span, interests, and "personality" of the group.

A Special Friend

Invite students to get to know at least one tree near the school as a special friend. Take a photograph of the tree to post in the classroom. Help students learn what kind it is, what kinds of life go on around it, and how it changes from season to season. Are there ways people can help the tree stay healthy? (Watering, protecting against damage from bicycles and lawn mowers, carving, breaking branches, etc.) Visit the tree periodically and watch for changes.

Seasonal Enhancements

See "Trees through the Seasons," Resources, page 123, for a variety of questions and activities for each season.

Language Arts

Literature and Folklore

Book Nook. See "Book Nook," Resources, page 135, for tree-related books to enjoy with young children. Choose books about forest wildlife, flowers, etc., too.

The Giving Tree. Read *The Giving Tree* by Shel Silverstein. This classic is available in most libraries and book stores. In what ways did people hurt the tree? How did the tree keep "loving back" anyway? In what ways could people have helped the tree and kept it safe? What could the young man have done to make sure his children and grandchildren had "giving trees" of their own?

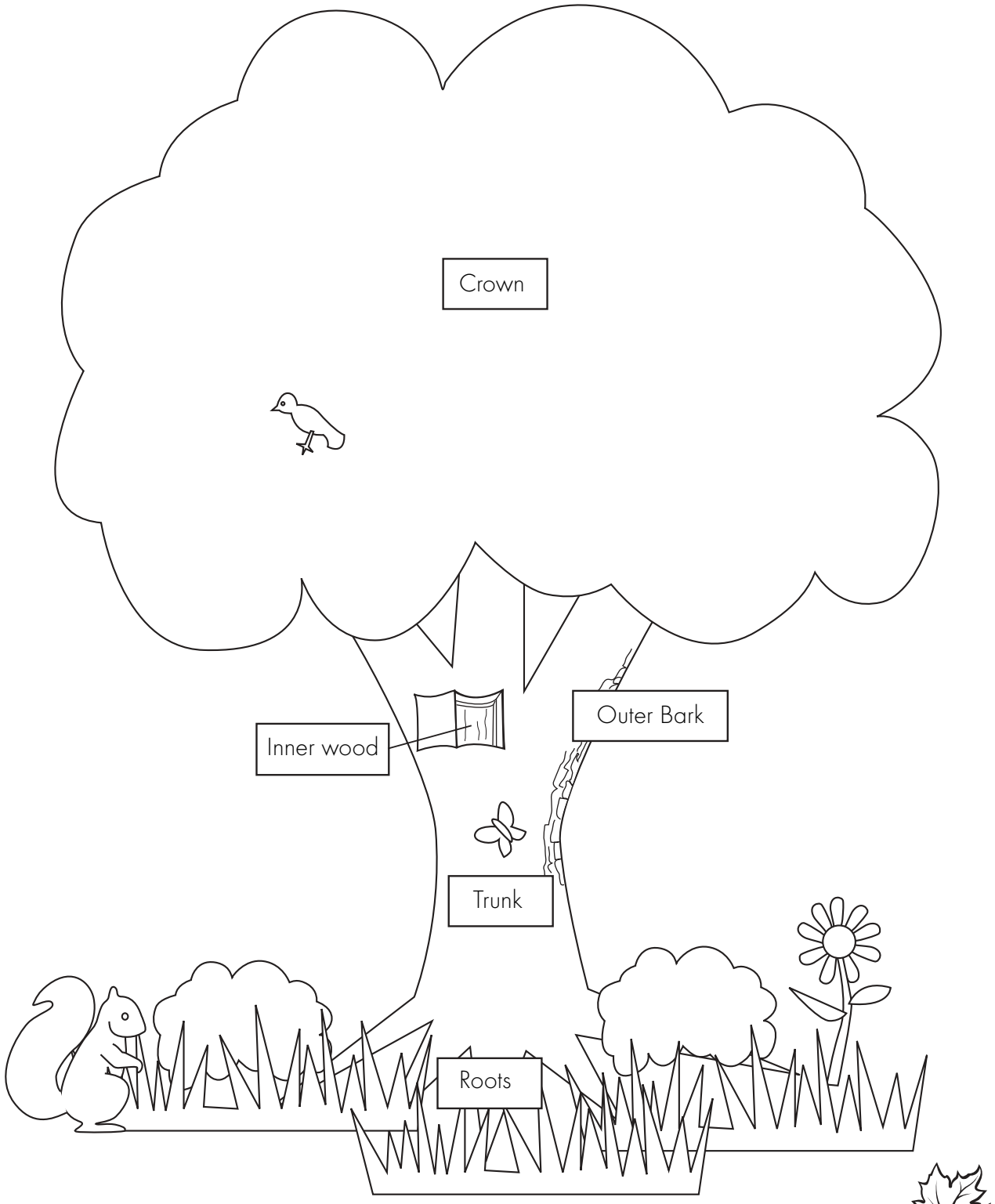
Trees … Friends to Many

Talk about some of the many creatures that call a tree a friend and how they use it. How many can you think of? Birds build their nests in trees. Many birds eat bugs that live on trees or in the bark. A tree gives shade for people, animals, and buildings. Some trees give nuts and fruit to eat. Trees are a fun place for children to play. Squirrels have their homes in trees, eat nuts, and jump from branch to branch, safe from animals that might catch them on the ground.

What Is a Tree?

Create a large paper tree on the bulletin board. Have students paint or color the tree. Label the roots, trunk, crown, outer bark, and inner wood.

Students participate by adding other things that share a tree's living space: grass, squirrels, birds, mice, woodpeckers, flowers, shrubs, etc.



My Favorite Tree

You'll need: Drawing paper and crayons or a camera with film.

Encourage students to choose a favorite tree, draw or take a picture of it, and tell why it's special.

People and Cultures

Tree Things

You'll need: Drawing paper, crayons, scissors, and magazines (optional).

Look around the room and name all the things made from wood. Invite students to bring things from home made of wood or to cut photographs from magazines of things made of wood. Ask: How would our lives change if we did not have some of these things? Why do you think wood is used to make these things rather than some other material?

Give each student a sheet of paper. They fold the sheets into quarters (to have four boxes). In each box or window, they draw something they use that is made from wood.

Totems

You'll need: Pictures of totem poles made by American Indians of the Northwest, drawing paper, and crayons.

American Indians living in the northwestern United States carved tall wooden poles into symbols that told stories, scared away enemies, and stood for good luck. Show students the pictures of the totem poles, then invite them to draw a totem pole of their own with faces, animals, and other symbols they think will bring good luck.

Science and the Environment

Eye Spy

Look for: Robins returning. Why do they search among the tree roots near the ground? How do trees help robins?

Look for: Lilac bushes and apple trees blooming, pussy willows, and dandelions.

Look for: Birds nesting. Why do birds often rest and sleep in trees instead of on the ground? Why do birds build nests?

Seasons of Life

You'll need: Photographs of trees in different seasons.

Show pictures of trees in each season of the year. Ask students to identify the season and choose words to describe each: bare, blossoming, budding, colorful, green, etc. What else is going on in nature during each of these tree changes? (Colder or warmer temperatures, snow, grass greening out or turning brown, etc.) What makes the tree change? (Simply, trees change with temperature changes, amounts of moisture, and the length of days—long summer days with lots of sunshine help trees produce food for themselves so they can grow; the shorter, colder days of fall and winter cause the tree to stop making food and go into a resting time.)

Is It a Tree?

You'll need: "Is It a Tree?" Activity Sheet, page 10 and crayons or markers.

A tree is the largest of all plants and differs from other plants in four ways:

1. Most trees grow at least 15-20 feet tall. That's about twice as high as our classroom ceiling (if 10-foot ceiling).
2. They have one woody stem that is called a trunk.
3. The trunk grows at least 3 to 4 inches thick.
4. A tree's trunk (stem) can stand by itself.

All other plants are different from trees in at least one of these ways.

Look at the activity sheet. Ask: Is the tree in Box A really a tree? Why or why not? Color it if it is a tree. If it is not a tree, don't color it. Continue in the same way with the rest of the boxes.

Mix and Match Leaves

You'll need: A collection of leaves or good photographs of leaves.

Classify leaves according to:

1. shape
2. size
3. smoothness or roughness
4. smooth edges or toothy edges
5. smell
6. color
7. kind

Healthy Snacks

Brainstorm a list of things people eat that come from trees. Why do we *never* eat tree or plant parts unless adults have said it is safe to do so?

Rodney the Root Says …

Finish my tree! See "Rodney the Root Says" Activity Sheet, page 11.

Enhancements

Math

Nature Math

On a visit to a park (or in the schoolyard) involve all the members of your group in number activities by using directions such as:

Take three steps forward, take five steps to the left.

From things already on the ground, pick up three very small twigs or leaves, and two large twigs or leaves. See how you can arrange them in different sets or groups.

Arrange your twigs or leaves in order of size with the largest one first and the smallest one last.

Arrange your twigs or leaves in sets according to the number called out. (Call out numbers, students match with same number of objects.)

Return the objects used to where they were found and discuss why this is important. (Removing things from their natural settings takes away from the environment. See "Tips for Safe and Successful Nature Hikes," Resources, page 91.)

Variation: Small groups of students stake out various sections of the area. Older students might help the younger ones to prepare a guided tour of the objects they find in the area, beginning with the largest and ending with the smallest. Encourage students to use the math terms "greater than" and "less than" when describing their finds. For example, "First we have a tree. It is greater (in size) than this pebble."

Explore Tree Shapes

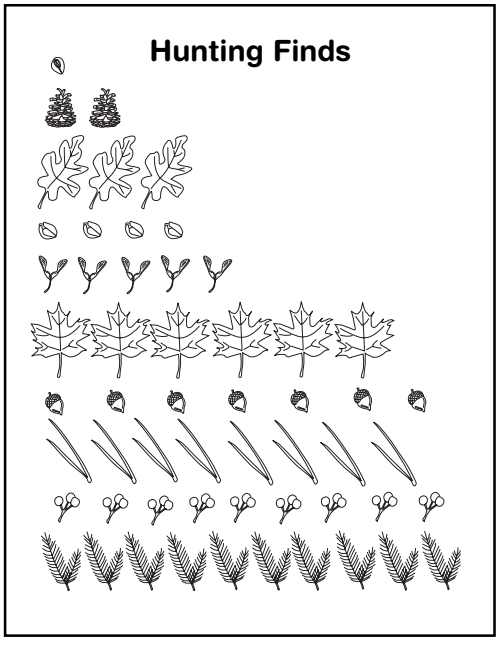
You'll need: "Explore Tree Shapes" Activity Sheet, page 12.

Ask: What shapes do you see on the bottom of your paper? Cut out the shapes and paste each one onto the tree it matches.

Scavenger Hunt

Go on a scavenger hunt outside or inside. In a paper bag, collect one of some object, two of a different object, three of yet another object, and continue until you have collected 10 different items, in 1-10 quantities. Collect only things that can be taken without hurting the environment and other living things.

Make a graph of these objects using the objects themselves, prints, or pictures of the objects.



The Arts

Dance of the Forest

Play tapes of forest or "nature" sounds. Children dance and move about, feeling the music with their bodies.

Leaf Melties

You'll need: Leaves, heavy books, waxed paper, old color crayons, potato peeler or grater, a towel or newspaper, iron, string, and adult assistance.

Besides enjoying their shade, look what you can do with leaves! Have each student collect two or three well-shaped leaves and press them flat under a stack of heavy books for several days. Arrange pressed leaves on a piece of waxed paper about the size of a notebook page. Using old color crayons and a potato peeler or grater, make crayon shavings to sprinkle over the leaves. Use favorite colors. Cover the leaves and crayon shavings with a second piece of waxed paper. Put a towel or a few sheets of newspaper on top to protect the design. With the help of an adult, press carefully with a hot iron to melt the crayon shavings. When you take away the towel or newspaper, you have a beautiful leaf meltie. Trim to a shape you like, thread a string through the top, and hang in the window to "light up" and dazzle!

Leaf Figures

You'll need: Leaves, heavy books, glue or staples, drawing paper, and crayons, paints, or markers.

Press leaves under a stack of heavy books for several days. Then glue or staple them to drawing paper. Students use crayons, paints, or markers to add features to the leaf to make it something else (a leaf person, leaf car, leaf fish, etc.).

Beautiful Trees

You'll need: Drawing paper and crayons, paints, or markers.

Invite students to close their eyes and think about things they think are beautiful about trees. Ask: What would the most beautiful tree in the world look like? Where would it be? What would you do with it? What would you say to it? Each student describes and draws a picture of his or her "dream tree."

Draw or paint beautiful flowering trees.

Games and Physical Activities

Game Time

Forests and the Great Outdoors offer a bonanza of opportunities for fun and creative physical education activities.

Play familiar games such as hopscotch, jacks, marbles, or pick-up sticks, substituting natural materials—cones, twigs, or rocks—for manufactured counterparts. Invent new games using other natural materials you find, but don't change or damage the environment of the area from which they are taken.

Bear in the Forest

One player, the bear, crawls around the playing area on his or her hands and knees. The other players weave in and out and around the bear in a clockwise rotation, some coming within a few inches of the bear and others staying farther away. When ready to surprise the players, the bear yells "Bear in the Forest!" and leaps up to tag the other players. They scatter as quickly as possible in all directions. Any player tagged becomes a bear and the game is repeated until all are bears.

Touch and Feel Fun

You'll need: Bags or containers and objects to feel.

Place several items in a bag that are things from a tree. Students take turns putting their hands in the bag and trying to identify items by touch only. When they have things in their hands, they describe each item and tell what they think it is. Then they take out the item to check their guesses.

Performance Assessment

Task Statement

Give each student a large sheet of drawing paper. They fold their papers into fourths. Students then draw what they think their trees look like in each of the four seasons. Start with spring, the growing and new-birth season. Go next to summer, then fall and winter.

Kindergarten Standard

Illustrate the seasonal changes that occur in trees. Include a trunk and crown on each tree.

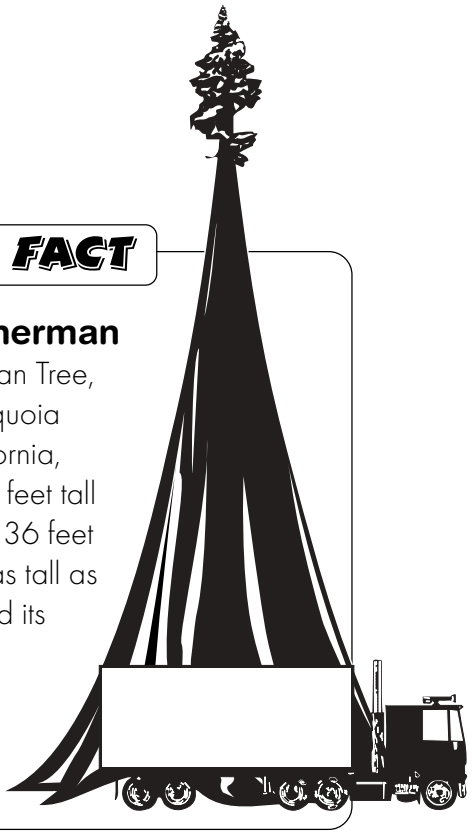
Rubric—Quality of Performance

4 Exceeds performance standard
3 Meets performance standard
2 Developing toward performance standard
1 Attempt made but many serious errors

FUN FACT

Meet General Sherman

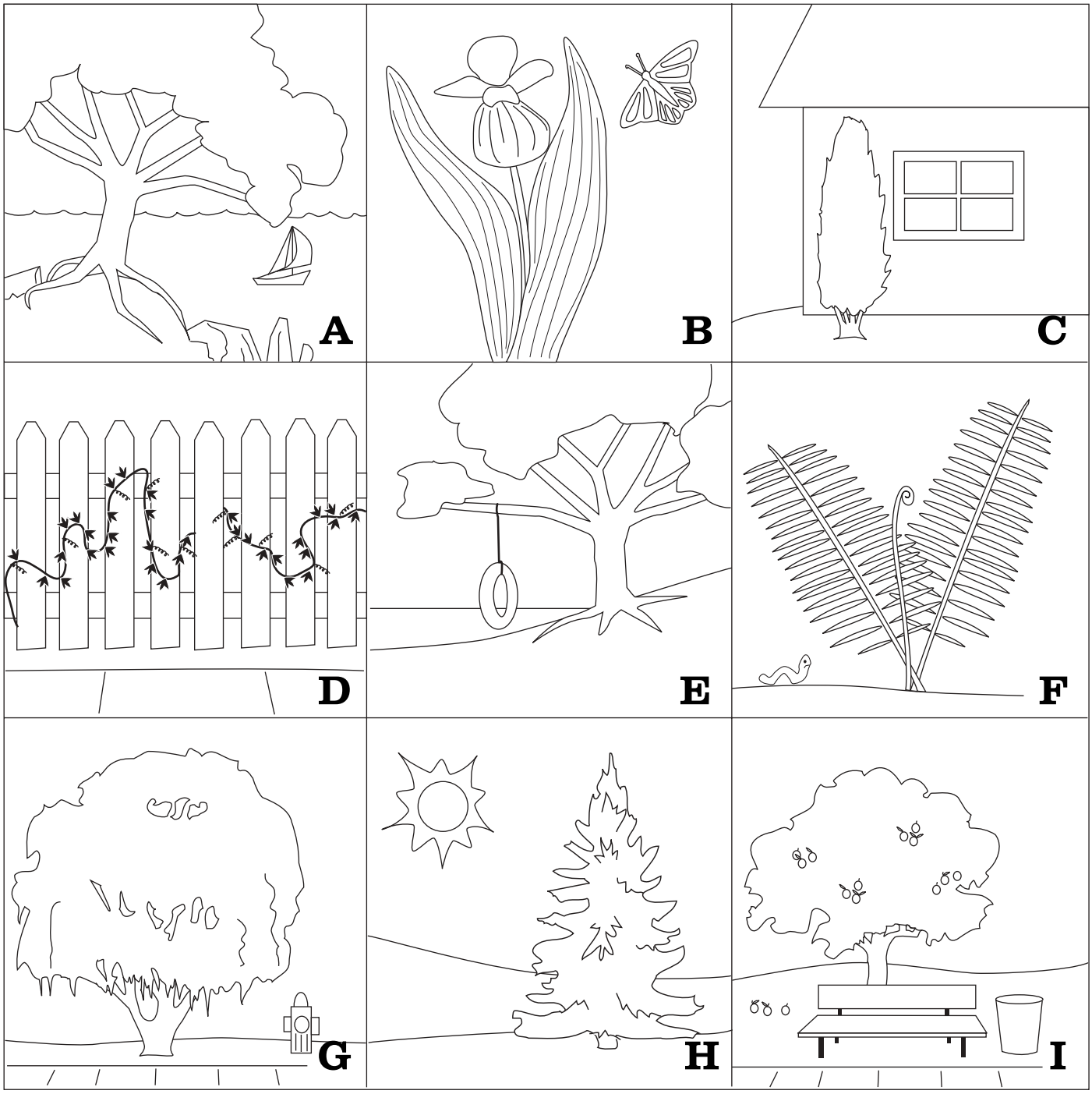
The General Sherman Tree, a giant sequoia in Sequoia National Park in California, towers more than 272 feet tall and has a trunk about 36 feet wide. That means it's as tall as a 20-story building and its trunk is as wide as a semitrailer is long. It's probably almost 3,000 years old.



Is It a Tree?

KID'S COPY

NAME: _____

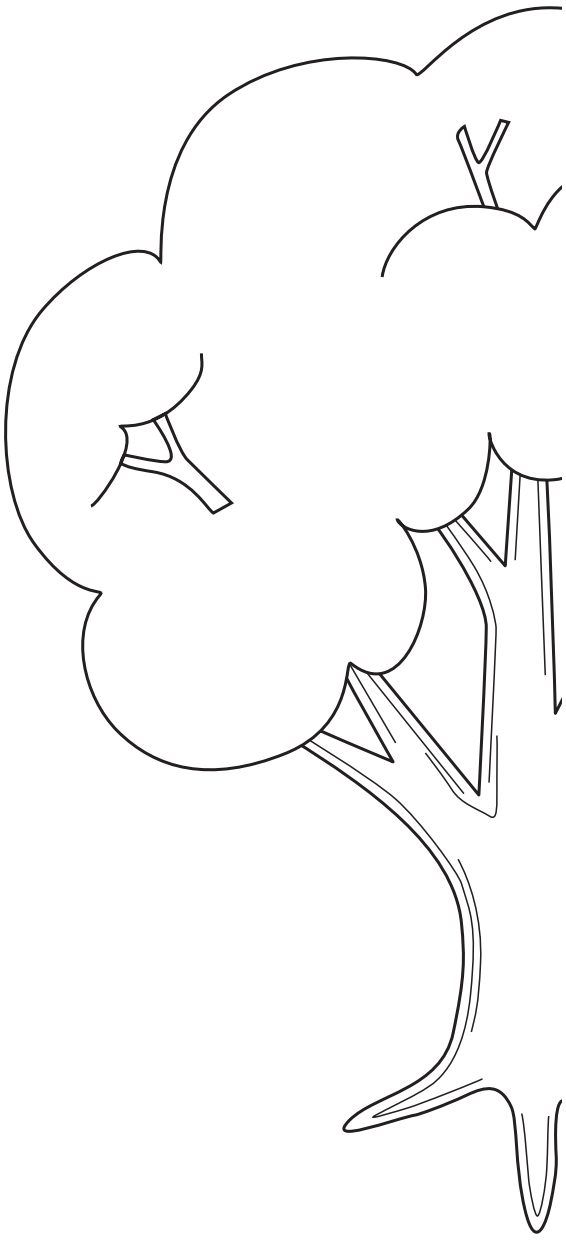


Rodney the Root Says…

KID'S COPY

NAME: _____

Finish my tree!



Explore Tree Shapes

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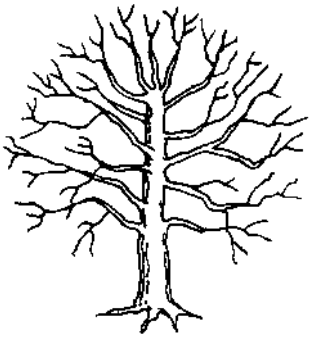
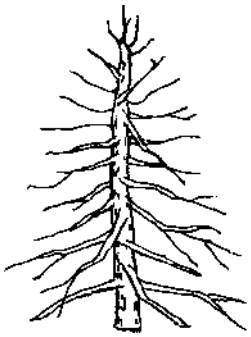
Cut out the shapes below and paste them on a tree that matches each shape.

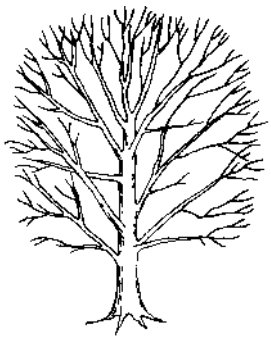
NAME: _____



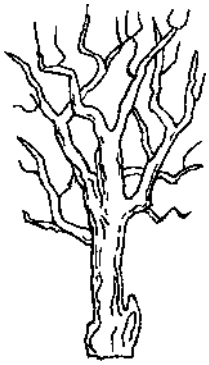
oak



spruce

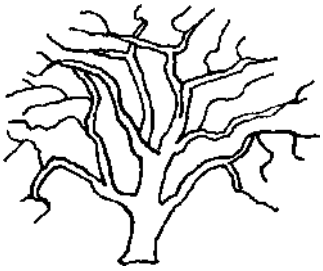


maple

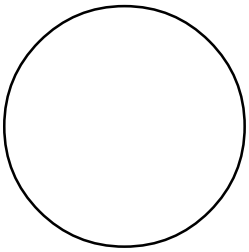


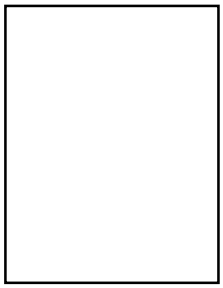
cypress

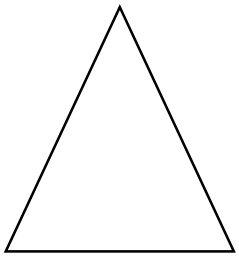
cedar

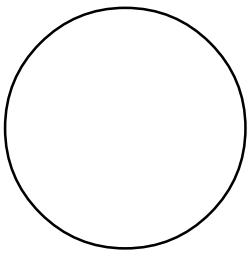


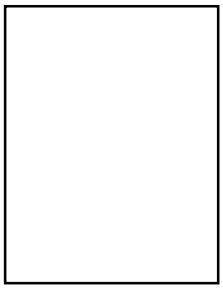
crab apple

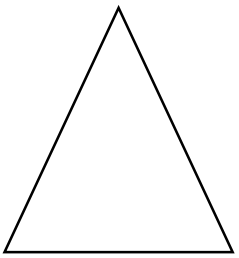




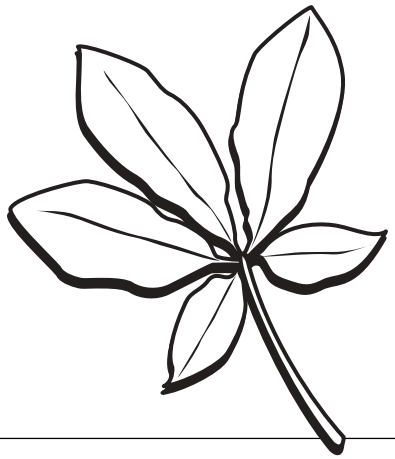








Grade 1



Parts of a Tree

Objectives

Students will:

- identify the main parts of trees and the function of each;
- describe some of the ways trees and wood are used;
- tell why it is important to protect and respect trees.

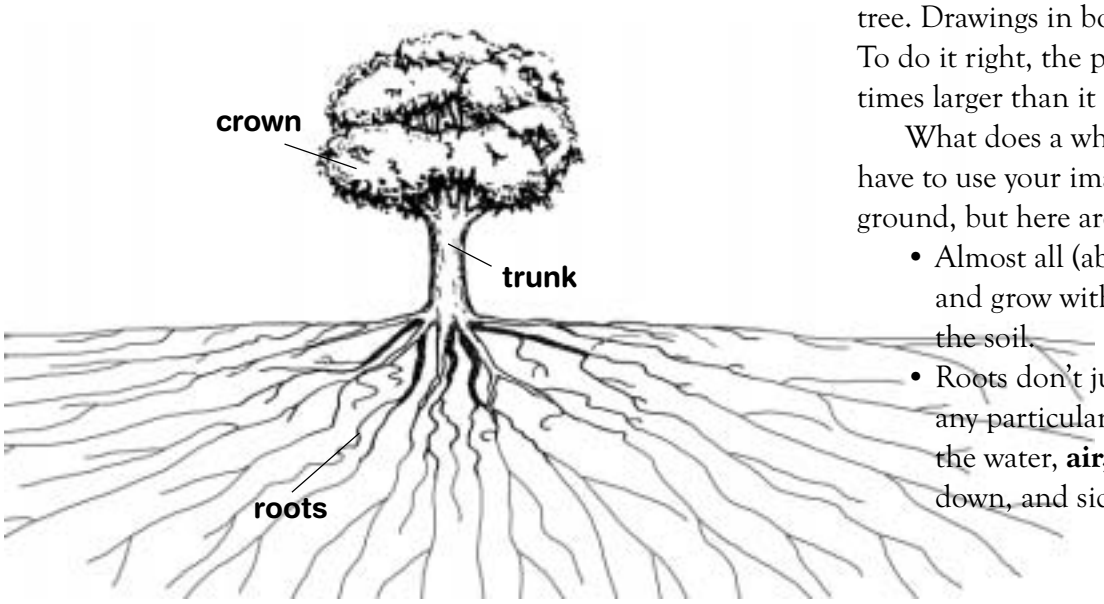
Vocabulary Words

roots	broadleaf
trunks	inner wood
crowns	xylem
air	cambium
minerals	phloem
absorb	sap
evergreen	outer bark
needleleaf	photosynthesis

Background Information

Everywhere we go in our communities, we see trees. Do you ever stop to really think about trees and how they grow so big and tall? Trees have different parts, all with important jobs to do to keep the tree healthy and growing. This unit will help you learn about parts of trees and some of the amazing things they do.

Trees have three main parts—**roots, trunks,** and **crowns.** Each part has a special job to do.



Roots

Explore roots and you'll discover a fascinating underground world. People who study trees are learning more each year about tree roots. They tell us the root system is probably the least understood part of a tree.

We've all seen sturdy trunks and leafy crowns of trees. Maybe you've tripped over the above-ground roots. But no human has ever seen a whole adult tree. Drawings in books are only part of the picture. To do it right, the page would have to be over 300 times larger than it is now.

What does a whole tree really look like? You'll have to use your imagination for what's underground, but here are some of the facts:

- Almost all (about 99 percent) of the roots live and grow within three feet of the surface of the soil.
- Roots don't just grow downward or toward any particular thing, but wherever they can get the water, **air,** and **minerals** they need ... up, down, and sideways.

- There's a connection between the root system and the rest of the tree. If part of the roots die, a part of the crown may die, too.
- Tree roots come in many different sizes. Some are so tiny you can only see them with a microscope. Others may be up to 12 inches or more across.

Large, woody roots grow horizontally (side to side), mainly in the top 12 inches of the soil and usually no deeper than 3 to 7 feet. Smaller roots stretch out from the large roots to take up a space four to seven times larger than the crown! These roots spread across an area that can be twice the height of the tree.

Why are roots important? To grow, all parts of the tree need to be healthy. Roots hold the tree in the ground so it can stand straight. They help the tree make food for itself. Roots **absorb** (soak up) water and minerals that move up through the trunk and are used by the tree to make food. They store energy (food) too.

By understanding roots better and not damaging them, we can help keep trees safe and healthy.

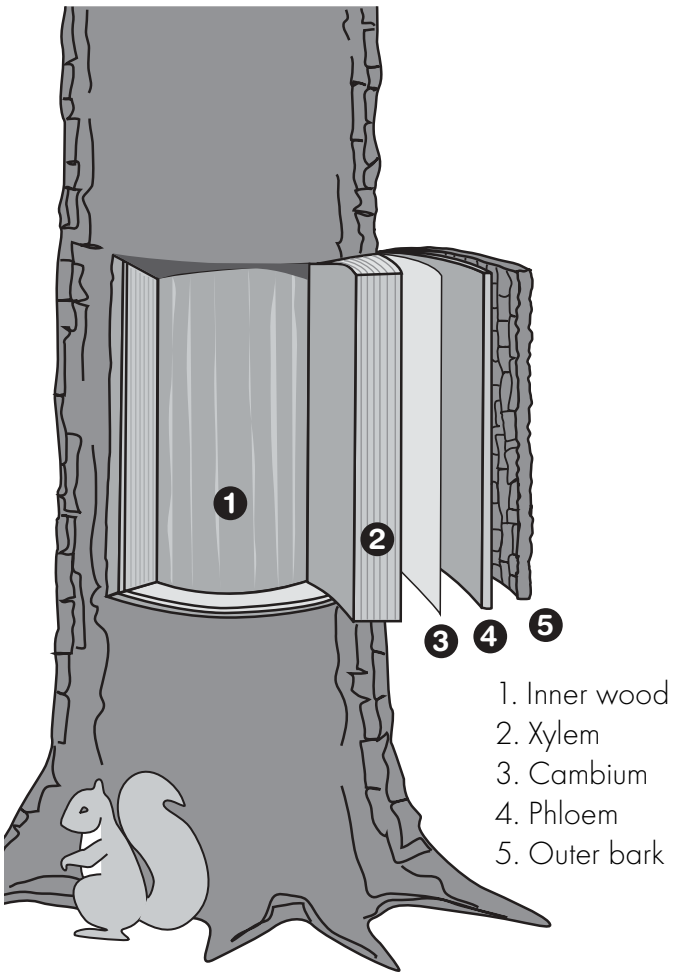
Trunks

Trunks and branches give a tree its shape. The trunks of most **evergreen (needleleaf)** trees grow straight up to the top of the tree. All the branches grow out from the trunk. The branches near the top are shorter than those farther down, giving the trees a shape of a triangle. The trunks of most **broadleaf** trees (such as an oak or maple tree) do not reach to the top of the tree. Instead, the trunk divides into spreading branches, giving the crown a rounded shape.

The trunks of most trees are made up of five layers. Most young children will not remember the names of these layers; the important concept is that there are different layers in the trunk. Information is provided here for teacher background in case questions arise. From inner to outer, trunk layers are:

1. **Inner wood:** This is the woody tissue in the center of the tree. Inner wood has two main jobs: to store growing compounds and sugars (tree food) and to help hold the tree up.
2. **Xylem:** This is a band of cells at the outside edge of the inner wood. It has tiny pipelines that carry water and small amounts of dissolved minerals from the roots to the leaves.
3. **Cambium:** This is a thin layer of growing tissue on the outside of the xylem. Its job is to make the trunk, branches, and roots grow thicker. The trunks and branches of most trees grow thicker as long as the tree lives. It uses the sugar manufactured by the leaves to make new plant tissue. On its outside, the cambium makes phloem. On its inside, it makes new xylem, which eventually becomes inner wood.
4. **Phloem:** This layer also has tiny pipelines. The food made by the leaves moves through the phloem to the other parts of the tree. This food is called **sap.**
5. **Outer bark:** This is the "skin" of hard, dead tissue that protects the living inner parts of the tree from injury. The outer bark stretches to let the trunk and branches grow thicker. The bark of a few kinds of trees, such as beeches and birches, is smooth because it stretches easily. But the bark of most other trees does not stretch so well. As the trunk and branches grow thicker, they push against the bark. It finally cracks, dries, and becomes rough with large ridges. Most trees lose old bark from time to time and replace it with new layers.

Remember: Bark needs our protection! A tree's outside bark protects it from insects, fungus, and disease. The phloem, which is on the inside of the outer bark and is often referred to as the tree's inner bark, moves food from the leaves to the roots. Peeling, carving, or damaging a tree's bark will injur the tree and may cause the tree to die.



Crown

The crown is the branches and leaves of the tree. It has the important job of making food for the tree. The leaves (the leaves of a pine tree are its needles) are tiny "factories" that make food, using water absorbed by the roots and carbon taken from the carbon dioxide in the air. These leaf "factories" get their energy, or fuel, for the work of making food from the sun. Putting the sun's energy to work to make food in this way is called **photosynthesis.**

Other important parts of a tree include the flowers and fruits. This is where seeds are found that will grow into new trees. Trees have many kinds of flowers. Some trees have very showy flowers and others have small, plain flowers that are hardly noticeable.

The fruits of some broadleaf trees, such as apples and cherries, have tasty outer coverings we can eat. The fruits of other broadleaf trees, like acorns and walnuts, are hard nuts. Ashes, elms, and maples have thin, winged fruits. Most needleleaf trees grow their seeds inside cones.

Language Arts

Literature and Folklore

Book Nook. See "Book Nook," Resources, page 135, for tree-related books.

Treelore. Literature is packed with fascinating folklore and legends about plants and trees. Your librarian will direct you to good sources.

It's Arbor Day!

See "Tree Poems" and "Tree Tunes" for Arbor Day Ceremonies, Resources, pages 130 and 131.

Fantasy Journey

If there's room, have the students lie down on the floor. (Alternate sites: If you have a woods or park available, go there for this project; beneath a large, old tree also works.)

Tell students: Close your eyes. Imagine you are resting on your back in a large forest. What are you feeling? What does it smell like? What sounds do you hear? How do the trees look from this angle? What words would you use to describe the sky?

Life of a Leaf

You'll need: Writing paper and pencils.

You are a leaf. What happens to you each season? When there is a big windstorm? When there is pollution in the air? When a hungry caterpillar decides you would make a tasty lunch? When you are chosen the most beautiful leaf in the school leaf collection? Write a story about yourself and your life as a leaf. Use plenty of details and describing words!

Bulletin Board Idea

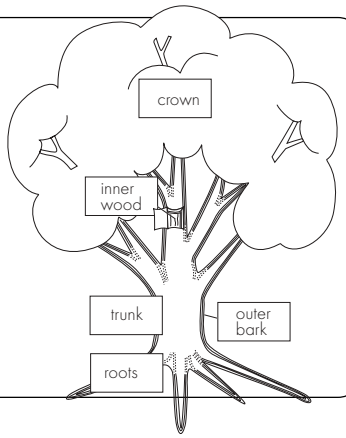
Parts of a Tree

Write the name of each tree part on the line that shows where it is. Use the words in the Word Bank.

Color your tree. Draw bugs, birds, and animals that might live in or by your tree.

Teacher's note:

Photocopy the page below for each student. Make a forest on the bulletin board with all the trees. (Cover this "Teacher's note" with paper before copying so it will not appear on students' copies.)



Word Bank

inner wood
outer bark
crown
trunk
roots

People and Cultures

Pollution Patrol

You'll need: Large drawing paper (12" x 18") and markers or crayons.

Do you know trees help clean the air, making it safer for humans and animals to breathe? When we breathe in, our lungs use oxygen from the air. We breathe out carbon dioxide. Tree leaves do just the opposite. They absorb (take in) carbon dioxide in the air around them and give off the oxygen we need. As they take in air, they also absorb some of the pollution in the air.

Take a walk around the school neighborhood and notice things that are polluting the air. Ask students: Are there factories with large smokestacks? How about cars, motorcycles, lawn mowers, and highway construction machines? What else do you see? What can you smell? Draw things you find on a problems/solutions chart. This chart can easily be made by having children fold their paper lengthwise and drawing the problems on the left side of the fold, solutions on the right.

Who can you tell about the problems you see? Are there any ways trees might be used to solve a pollution problem in your community? Who might be able to help do something about the problems you've listed?

Thanks, Wood!

People can do many different things with wood. What have people done with wood because:

It floats? (Made boats, pontoons, docks, rafts, diving platforms.)

It is super strong? (Made houses and buildings, bridges, ships and ship masts, posts and poles.)

It burns? (Used it for cooking food, heating buildings, making campfires.)

It can be cut to different sizes? (Made buildings, furniture, fences, poles.)

It can be bent? (Made rocking chairs, bows, boat hulls, rounded doors and windows, American Indian dwellings.)

It can be carved? (Made sculptures, spoons, bowls, totem poles, carved art.)

It can glide on snow? (Made sleds, toboggans, skis, sleigh runners.)

Which part of the tree is used for boards and building materials, log homes, and large posts? (The trunk.)

Which part of the tree is used for firewood? (The trunk can be split for firewood, but branches are more easily handled and often used.)

Forests Then and Now

For the Dakota and Ojibwe American Indians who lived in Minnesota before the first European settlers arrived, the forest was much more than just trees. The forest gave them shelter from the snow, wind, and rain. It gave building materials for tepees and lodges. It produced materials for making transportation easier as they made papoose carriers, canoes, rafts, sleds, and snowshoes. The forest was a steady source of food, with meat, berries, nuts, maple sugar, and green plants. Skins from forest animals were used for clothing, sleeping mats, blankets, and tent coverings. Some medicines even came from the forest. The American Indians showed great respect for the forest and tried to live in cooperation with the land.

Today, Minnesota's forests are used for many different things: camping, hiking, growing lumber, snowmobiling, cross-country skiing, snowshoeing, birdwatching, fishing, hunting, growing Christmas trees, and much more. Ask students: How can today's visitors to wooded areas show their respect for trees and forests? (They can protect every part of trees against damage from fire, carving, chopping, damage from machines like cars, snowmobiles, and all-terrain vehicles; pick up and carry out litter; control and thoroughly put out campfires; stay on trails and roads; leave forest plants and animals alone, etc.) What else can students suggest? How should the respect we show forests also be shown to trees that live in towns and cities? (Protect trees against damage from carving, weed whips, and lawn mowers; water and mulch trees; plant more trees, etc.)

Science and the Environment

Root Power

You'll need: A package of small seeds, two eggshells broken in half, an egg carton, and potting soil.

Put some potting soil in each of the four eggshells; sprinkle seeds in two of them. Cover according to the directions on the seed package. Set the four half-shells in the carton so they will stay upright. Water very lightly and place in the sunlight. After a few weeks, watch what happens. The shells with the seeds will start to crack from the roots. Discuss how roots cause damage to sidewalks or basements.

The Role of Root Hairs

You'll need: Two seedlings, potting soil, two jars, and paper and markers for graphing.

Show how root hairs have a vital role in absorbing water and minerals from the soil by using two nearly identical seedlings. (Be sure the root systems of seedlings are kept moist; seedlings can die in as little as 20 minutes if allowed to dry out!) From one seedling, remove all of the tiny hairlike roots, leaving the main roots intact. Plant both seedlings in identical soil in two jars, and water daily.

Compare growth and vigor of the two seedlings. Graph heights.

Is growth good or poor? Is foliage wilted or healthy? What color are the leaves? The seedling without root hairs may survive, but growth will be poor and foliage will likely be wilted from the first day on.

After the root lesson above, care for your healthy seedling until it becomes well established. Then students can plant it in an area they decide is well suited to the tree's survival needs.

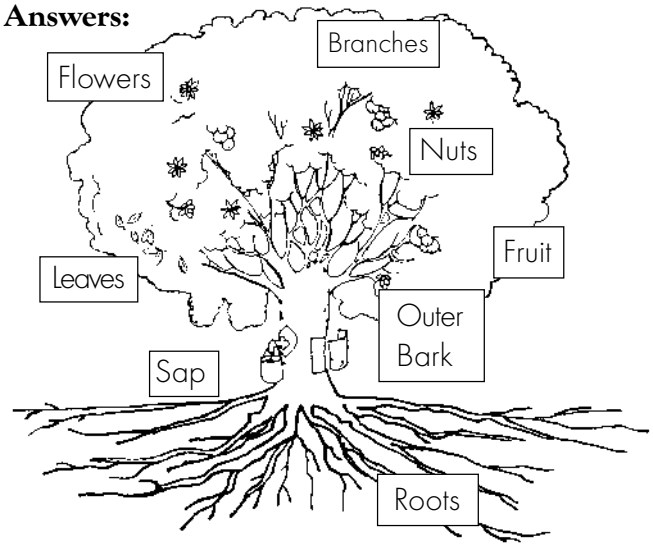
New or Old?

Look for partially opened leaves, twigs, etc., and partially decayed ones. What season of the year do we see the most new leaves? The most decayed leaves? Why?

Rodney the Root Says …

Label the parts of a tree. See "Rodney the Root Says" Activity Sheet, page 21. For science or evaluation have students complete the activity.

Answers:



Enhancements

Math

How Many Kinds?

You'll need: A large sheet of drawing paper or one-inch-squared graph paper, crayons or markers, and leaves.

Have students count all the trees in the schoolyard and make a graph showing how many there are of each kind. If they don't know the species, group by type of leaf (needleleaf or broadleaf).

Ask students: How can we find out what kinds of trees we have? (Guidebooks, encyclopedia, ask a city forester or someone who knows, etc.) Post a labeled leaf from each tree where all can see them and begin to learn the names of the trees.

Measure Up

You'll need: "Measure Up!" Activity Sheet, page 22.

Tell students: We are going to do some measuring today. On the bottom of your sheet is a ruler. Cut it off the sheet. Then use it to measure the parts of trees on the rest of the paper. (Depending on your group, you may need to do this activity together or have extra aides available to help students who have difficulty.)

Where Are the Roots?

Choose two or three trees of different sizes. Estimate their heights. Have students stand in a circle around each tree and take one big step back from the trunk for each foot of height. Stop and look at the size of your circle. Now make the circle twice as big by taking the same number of big steps back again. This new circle (twice the height of the tree) begins to show how far roots spread out from the tree. Amazing!

Ask: What does this big space mean when we try to protect tree roots?

The Arts

Forest Sounds

You'll need: Rhythm band instruments and a cassette recorder.

Gather rhythm band and other instruments and create your own forest music. Ask students: How do you think a forest sounds? Have you ever really heard one? Which instrument(s) would you use to make the sounds of soft breezes through the leaves? Strong wind through the needles or leaves? How about squirrels leaping from branch to branch, birds calling, a tree being chopped down or falling? How about feet shuffling through the fall leaves, a deer running through the bushes, a woodpecker pecking, a sleepy owl hooting? Would a forest sound different at night than during the day? (Owls hooting, bats swooping, coyotes crying, etc., are usually night sounds. Birds are usually quiet at night.)

Create your forest sounds with the instruments, tape recording your best efforts. Invite others to listen to the tape. Do they "hear" the forest the same way you do?

Look and listen for songs about trees and sing or play your favorites. For possible songs and recording artists, see Resources, page 131.

Bark Rubbings

You'll need: Light-weight drawing or copy paper and crayons.

Take a tour of a woods or neighborhood (get permission if going on private property) and make rubbings of various tree barks. Enjoy the different textures and patterns you find. Are your rubbings from old trees or young trees? What are some clues? (Older trees are usually larger and generally have rougher, thicker bark with deeper grooves. Younger trees are usually smoother with smaller and shallower breaks. Species of tree makes a difference, too, however, so bark isn't a foolproof clue to age.)

Seasonal Life of a Leaf

You'll need: Classical tape, record, or CD.

Put on a soothing classical recording and act out or dance a leaf's life during different seasons.

Spring—small, then budding and unfurling.

Summer—growing, turning, rustling in the wind.

Fall—changing colors, falling to the ground, being raked into a pile and hauled away.

Winter—resting in a compost pile.

FUN FACT

From the Top Down

Most trees grow from the ground up, but not the banyan tree of Southeast Asia. The banyan usually sprouts above the ground and grows down. Banyans are planted when birds, bats, or squirrels drop seeds into cracks in the branches of other trees, called hosts. When a banyan sprouts, its roots grow down from the host branches and into the ground, forming trunks. The banyan kills the host tree by preventing its trunk from growing. After the host dies, the banyan continues to grow and eventually, one tree appears to be an entire forest. Try to find and share a picture of a banyan tree.

X-ray Vision

You'll need: Drawing paper and crayons or markers.

Think about roots after sharing the information from this lesson. Review what students know about them. Then, using fine lines and "x-ray" vision, they each sketch their idea of what an entire tree looks like, tree top to root tips. Which part of the tree will take up the most drawing space?

3-D Trees!

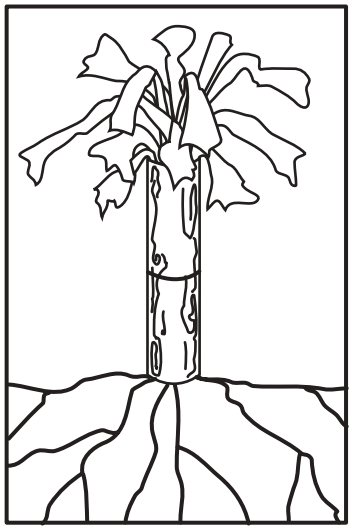
You'll need: A large piece of construction paper, toilet paper tubes, scissors, markers or crayons, yarn, glue, and tape.

Your trunk: Cut your tube in half. Make both halves the same size.

Use markers or crayons to make bark and knot holes. Tape your halves end-to-end on your paper. Leave room for your crowns and roots!

Make paper leaves and yarn roots. Glue in place. Add grass, flowers, and animals that might live in or near your tree.

Sample Tree



Adapted from *Ranger Rick's Naturescope "Trees are Terrific."* Used with permission.

Watercolor Magic

You'll need: Watercolor paints, brushes, and a large piece of paper.

Use watercolors and large paper divided into fourths to show seasonal changes in a favorite broadleaf tree.

Games and Physical Activities

Invent-A-Game

Gather some stones, a stick, or other natural objects. How might American Indians or early settler children have used these objects? What games can your group invent to play with them? After you have made some suggestions—complete with rules for playing—go to a park, playground, or wooded area to play the games you have invented.

Performance Assessment

Task Statement

Students will demonstrate their understanding of the main parts of a tree by illustrating and labeling eight of these parts. (See "Rodney the Root Says" Activity Sheet, page 21.)

Grade 1 Standard

Demonstrate an understanding of the main parts of a tree: crown, trunk, roots, branches, bark, leaves, sap, fruit, flowers, nuts.

Rubric—Quality of Performance

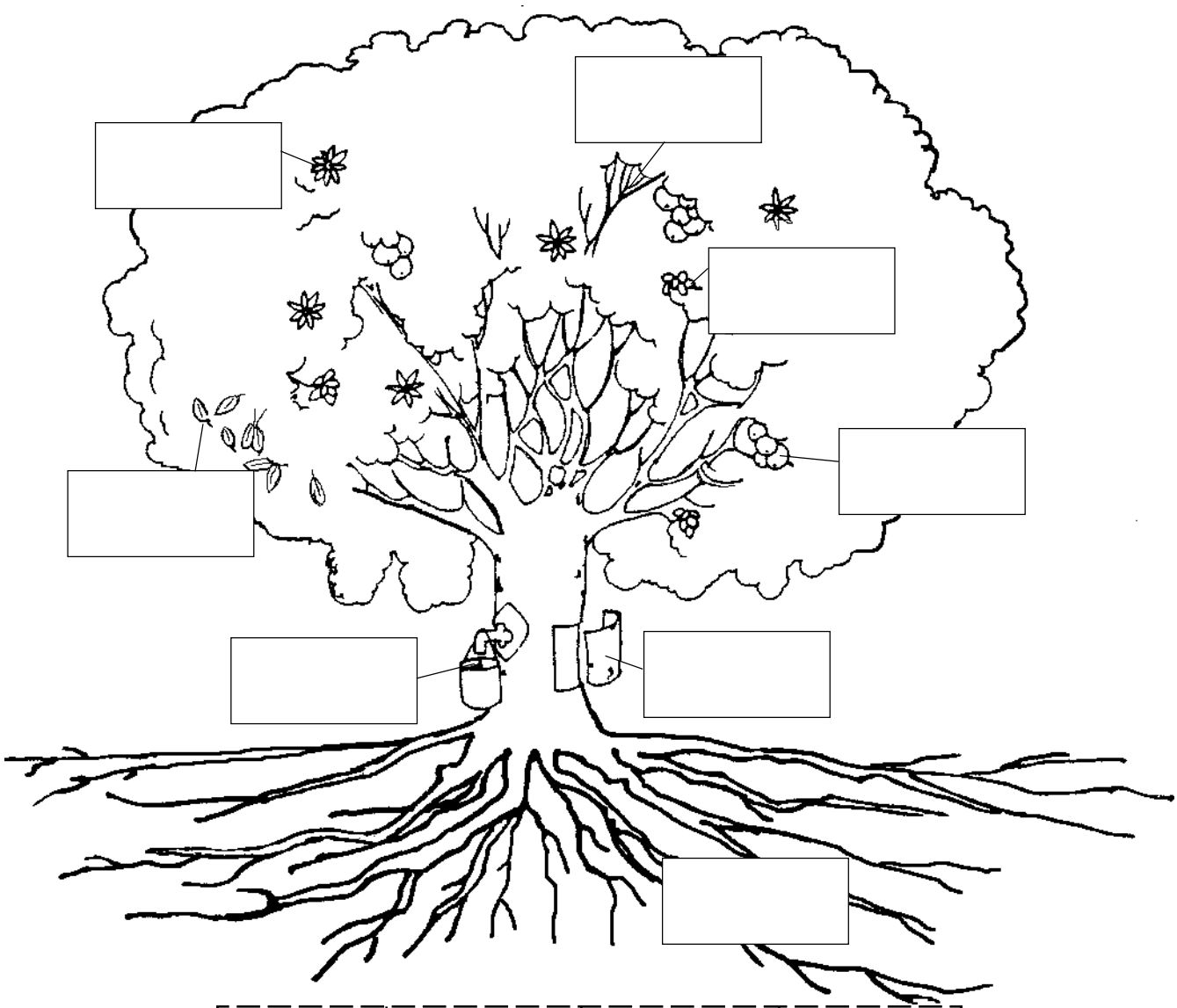
4 Exceeds performance standard
3 Meets performance standard
2 Developing toward performance standard
1 Attempt made but many serious errors

Rodney the Root Says …

KID'S COPY

NAME: _____

Label the parts of a tree.



branches	outer bark	flowers	nuts
roots	leaves	fruit	sap

Answers on page 18.

Measure Up!

KID'S COPY

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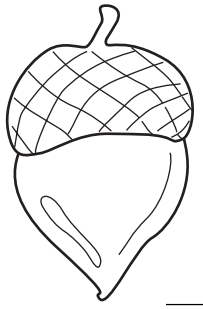
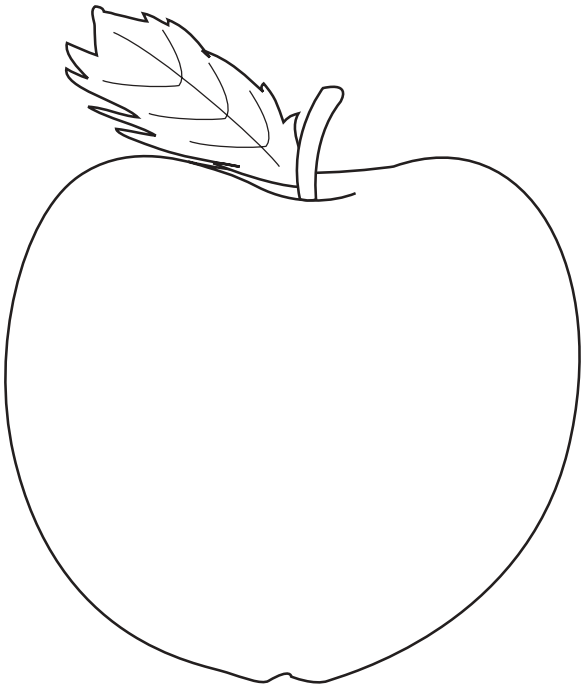
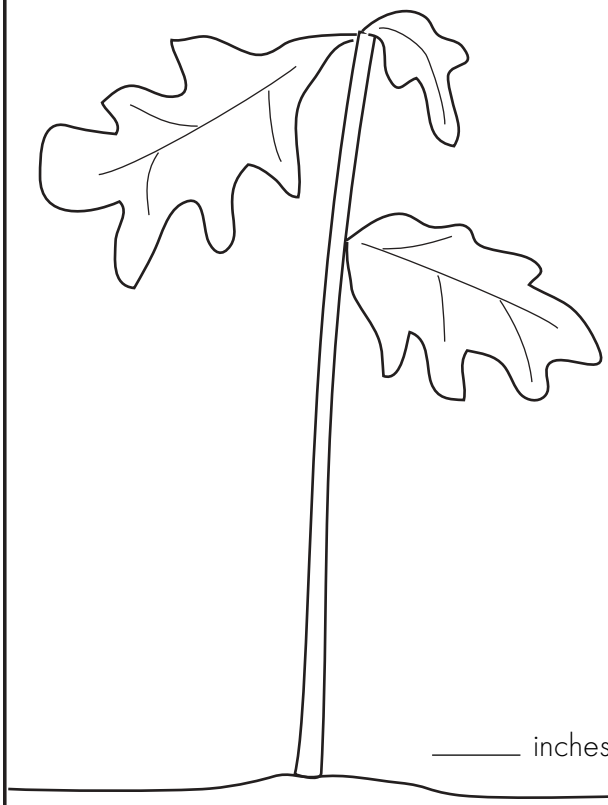


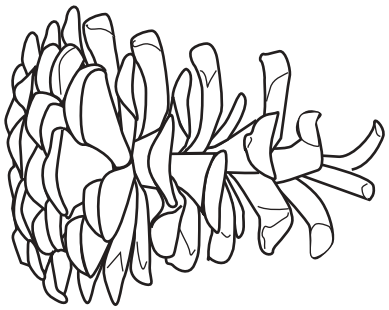
_____ inches wide



_____ inches wide



_____ inches tall



_____ inches long

_____ inches long

1 2 3 4 5 6 7

Grade 2

Tree Life

Objectives

Students will:

- explain in simple terms how a tree grows from seed through maturity and finally decays and returns to the soil;
- identify and count annual rings;
- describe seasonal changes in wildlife and in broadleaf trees.

Vocabulary Words

seeds	root tips
roots	cambium
stems	outer bark
buds	sap
dormant	annual ring
life cycle	inner wood
chlorophyll	broadleaf
photosynthesis	needleleaf
seedling	decay
sapling	recycling

Background Information

Minnesota, like many parts of the world, has very cold winters. During this time, the ground is hard and seems lifeless under layers of snow and frost. But under all this cold lie the **seeds, roots,** and **stems** that will be next summer's plants. Each seed holds a tiny plant and some food that will feed the new plant. Roots and stems have tiny **buds** that will begin to grow when the weather warms. The cold earth is far from lifeless. Winter is simply a time of rest.

As spring arrives, the rays of the sun begin to warm the earth. Snow and frost melt. The moisture soaks the seeds and makes them swell. The tiny plants begin to grow. Buds and roots also begin to grow and soon we see new plants.

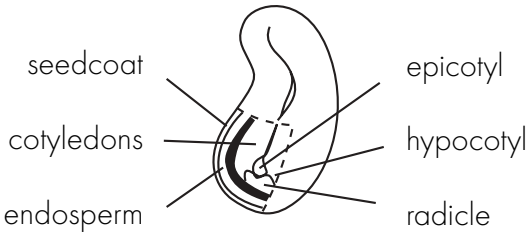
Through the hot summer months, plants grow strong and sturdy. But at the end of the season, a plant's work is usually done. For some plants, it's the end of their lives. For others, it means going into a long rest as the autumn ground freezes and there is no more water. They will "sleep" (lie **dormant**) again until spring, when the **life cycle** will start all over again.

It Starts With Seeds

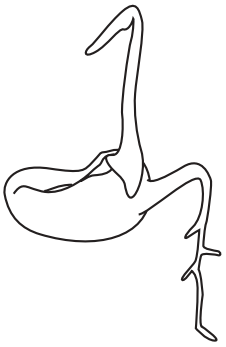
They can be as large as a baseball or as small as the head of a pin. Some are flat, some are round: others are long and thin. Most travel ... some by air, some by water, some by hitching a ride with a passing person or animal. Touch them with a bit of warmth and moisture, and the miracle of growth begins. What are they? Seeds, wonderful seeds!

Seeds look and feel very different from each other, but they're all alike in important ways. Each of them is a baby plant with its own food supply, all put together in one handy, self-sealed package. The cross section on page 24 shows the parts of a tree seed.

All seeds have the same needs for growth—moisture, warmth, sunlight, food, and air. And they all begin to grow in much the same way. Moisture soaks the outer shell of the seed until it becomes soft. The food inside expands as the water enters the seed. If warmth is also present, the shell breaks open and growth begins.



A small root pushes out of the seed and down into the earth to search for water. A tiny stem pushes up through the soil reaching toward the sunlight.



As the plant grows underground, it uses the food stored in the seed. As soon as it pushes out of the ground into the sunlight, it begins to make its own food. Food is made by the leaves and the stem. The green material in the leaves' tissues—**chlorophyll**—acts together with water, air, and sunlight through the process called **photosynthesis** to make a kind of sugar that is food for the plant. Some tree species have unusual seed "containers." Think about bananas, apples, and pine cones.

The young tree that grows from a seed is called a **seedling.** After a tree reaches a height of 6 feet or more and its trunk is 1 to 2 inches thick, it is called a **sapling.** The tree grows taller and its trunk grows thicker every year. The tree continues to grow as long as it lives.

Where Growth Takes Place

Trees have three different growing parts: the **root tips,** the **cambium,** and the buds. The root tips cause the roots to grow longer and spread out in search of more water and minerals. The cambium is inside the tree, under the **outer bark.** You'll find cambium in the trunk and limbs. The buds on the limbs grow longer, making the tree taller and wider. This also makes it possible for the limbs to spread out to receive more sunlight.

Teacher note: See Resources, page 115, for more detailed information on the structure of a tree.

Wood is not solid material. It is made up of a lot of tiny tubes that can be seen only under a microscope or very strong magnifying glass. These tiny tubes carry plant foods up and down the trunk of the tree and through the branches as liquid called **sap.** A piece of wood even as small as a pencil contains millions of tiny tubes.

By looking at the cross section of a tree trunk, you can see tree growth from the center toward the outside. Look closely at the top of a stump or the end of a log, and you can see rings in the wood. These rings are made by growing layers of wood; a new layer is added each year. Each layer is made up of a band of lighter-colored wood called spring wood and a band of darker wood called summer wood. The spring wood band is usually wider than the summer wood band. One spring wood band and one summer wood band together are called an **annual ring.**

The tree's age can be figured out by counting the annual rings on the stump. Remember, one light band and one dark band is one year's growth.

Notice the darker wood in the center of a stump or log. It is called **inner wood.** It gives support and strength to the tree, and stores food the tree can use later. For more information about annual rings, see Resources, page 113.

Seasons Come, Seasons Go

Seasons bring a lot of changes to a forest. During spring, forest life is renewed. The flowering plants, including many trees and shrubs, display their showy flowers. The **broadleaf** trees and shrubs bud out, then begin to cover themselves with new leaves. The **needleleaf** trees develop new shoots that later flare out into the new stems and needles.

While all the forest plants are springing to life, fur-bearing mammals are giving birth to their young. Songbirds (cardinals, robins), game birds (ruffed

grouse, wild turkeys), predatory birds (hawks, owls), and scavengers (vultures, gulls, crows) are hatching their offspring. Along nearby ponds and lakes, waterfowl hatch their young. All this new plant and animal life is a wonderful form of beauty for people to enjoy.

During late spring and summer, the new life that began in the spring is "growing up." Many flowers turn into showy fruits; young birds grow feathers and begin flight training; ducklings start to swim; young fur-bearing animals romp around and learn the serious business of hunting for food and hiding from their predators. While all this activity is going on, the trees in the forest have full sets of leaves. They are adding a new layer of wood around their trunks and spreading their branches wider and higher.

In the autumn, the forest changes into a new kind of beauty. The leaves of broadleaf trees, shrubs, and other plants change to brilliant colors of red, yellow, and orange. Many people think frost causes this change. Actually, frost can reduce the brightness of autumn colors. The green color in leaves comes from a green material called chlorophyll. In the fall, when temperatures begin to lower (not yet freezing) and the hours of daylight shorten, the production of the green chlorophyll stops. The chlorophyll that is already in the leaves gradually breaks down until it is completely gone. Other colors in the leaves that have been there all along then show through. These colors are now seen in various shades of reds and yellow. After showing their beauty for several days or weeks, the colorful leaves fall to the ground.

During the autumn, some birds and waterfowl migrate to warmer climates. Squirrels and chipmunks finish storing acorns, pine cones, and seeds of other plants to feed on through the long winter months. Hibernating animals prepare to "hole up" for much of the winter. Most of the trees and other plant life shed their seeds before the snow flies so the seeds will be ready to sprout into new plants when the snow melts the next spring.

Once the cold of winter sets in, some animals hibernate until spring. Many birds have flown south to warmer climates. Those that don't spend many hours each day looking for food. Fur-bearing animals such as rabbits, squirrels, fox, wolves, and deer snuggle up in sheltered spots to stay warm, but also spend time each day searching for food. Trees move into their dormant (resting) time.

Decay of a Tree

You already know trees start out as seeds. Over many years—sometimes hundreds of years—trees grow up and stand as strong, healthy "adults." Over time, though, trees get old. They may be attacked by insects or diseases. They may be weakened by years with little rain. Finally, they begin to die and **decay.** Their places, in turn, are taken by other plants and trees. As each tree decays and returns to the soil, it affects the area around it and it changes the environment. New space is opened up for other plants. More sunlight can reach the forest floor, and plants that need the sunlight to grow sprout up. Downed trunks and branches make great homes for rabbits, skunks, and other forest animals. Decaying bits of the old tree add nutrients and organic matter to soil, making it a richer food for other plants.

In most forests, old, weak, and sick trees are dying and decaying all the time. It is a normal part of nature's plan.

Language Arts

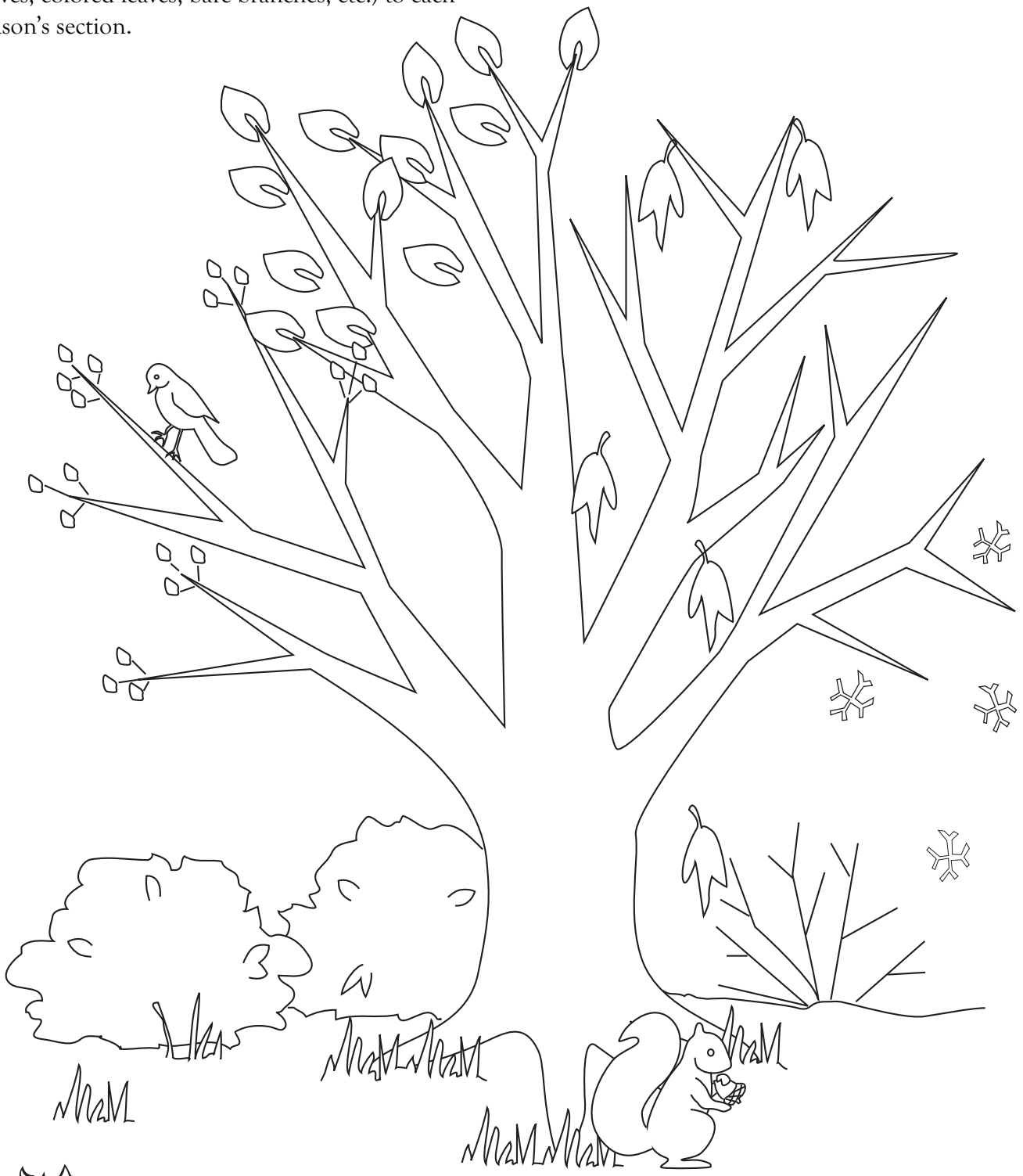
Literature and Folklore

Book Nook. See "Book Nook," Resources, page 135, for tree-related books to enjoy.

Treelore. Literature is packed with fascinating folklore and legends about plants and trees. Ask your media specialist or librarian to help you find good sources. For example: It's said that Ojibwe Indians seldom took down a living tree because they believed a tree could feel pain. Their medicine men told of trees wailing as they were being chopped down. Many other tribes around the world have also been especially respectful of trees. Stories of Scandinavian elves and trolls living in and around trees have been told for years.

A Tree for All Seasons

Make a basic tree trunk with branches. Divide the crown according to the four seasons. Students participate by adding appropriate parts (buds, green leaves, colored leaves, bare branches, etc.) to each season's section.

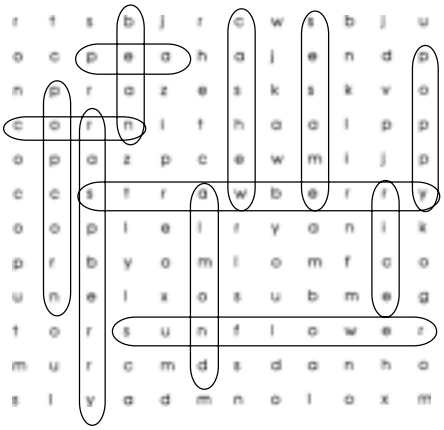


Seed Search (Vocabulary)

You'll need: "Rodney the Root's Seed Search" Activity Sheet, page 32.

Discuss the activity sheet and do the word search.

Answers:



Be a Poet

You'll need: Writing paper and pencils.

Write a poem about why trees are so special in our lives. As a group, brainstorm words that can be used. Then let the creative juices flow! Write about what trees and forests do for you ... how they make you feel. Or imagine you are a tree. Talk about how things look from your point of view, or how you feel about things that happen to you as a tree. What are some other ideas?

People and Cultures

Trees Then and Now

Have students interview older members of the community to learn what the area looked like 25 or more years ago. Borrow or copy old photographs from your county Historical Society to help. How have the trees changed? Are there more trees or less trees than there were then? How have people's needs affected the trees in the community? Have the senior citizens relate a favorite memory or story about a tree from their youth. Is the tree still alive? If not, why not? Talk about planting trees as a legacy to future generations.

Treat a Tree Like a Best Friend

You'll need: Writing paper and pencils.

Someone once said, "We should treat a tree like it is our best friend." Ask students: Why do you think someone might say this? Is it a good idea? Why or why not? What are some things you could do to show trees you are their friend? What could your whole city or neighborhood do to show friendship and respect for trees? Pair up with a partner and make a list. Share your lists with the whole class, and make it a habit to do at least two of your best ideas.

Become Recycling Sleuths

You'll need: Wastebaskets filled as they normally are at the end of a school day and a custodian or person who empties the baskets to visit the classroom.

What do school wastebaskets have to do with trees? Have students make hands-on connections.

Arrange a day for a custodian or maintenance person to visit the room for the purpose of telling about his or her job and talking with students about ways they can help care for the school. Tell students about the visit ahead of time and have them prepare questions to ask of the guest. Then, more specifically, ask the visitor to discuss what happens to things that are thrown in school wastebaskets.

What does the word **recycling** mean to students? Why do they think people do it? Do they know how recycling can help save trees? (Because paper is made from wood pulp, recycling and using less paper is one way to reduce the number of trees being cut down. Recycling also reduces the amount of waste hauled to landfills.)

Ask students: What things does your family recycle? What do we recycle at school? Schools and homes use a lot of paper. Think about the things that are thrown away in garbage cans and wastebaskets. How much of it is paper? Look in the classroom wastebaskets at the end of the day for several days. What do you see? How many wastebaskets full of paper does your class throw away in one week? In one month? Keep a count! Where does the paper go? What can you do to use less paper?

Tips: Recycle paper products, save newspapers for recycling, use both sides of drawing and writing paper, use discarded mail for scrap paper, cut out magazine pictures and make your own greeting cards, use gift wrap more than once, use a regular cup instead of a paper drinking cup, use rags made from old clothing instead of paper towels, etc. Try for one day to use no new sheets of paper! You'll discover all sorts of other paper to write on.

Where is the nearest recycling center? What things do they recycle? What do they do with the things they collect? What new things are made from the recycled products they handle? Why might some people choose not to recycle? If we don't know about the recycling in our community, how can we find out? Can wood be recycled? Are there any wood recycling centers in your city?

For more information on recycling, check out this site: http://www.moea.state.mn.us/reduce

Science and the Environment

Growing Buds

You'll need: 12-inch (approximately) twigs from several kinds of trees, a jar, and water.

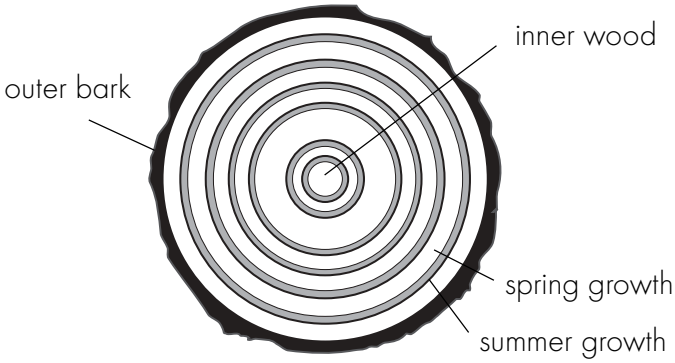
In early spring, when the buds are still tightly closed, have an adult cut about a 12-inch twig from several kinds of trees (cut at an angle). Take only what you need. Put the twigs in a jar filled with water and set in a warm, sunny place. Change the water once a week. Notice the changes that take place. In May, can your group find the kinds of trees that match the twigs?

Learn Those Layers

You'll need: "Learn Those Layers" Activity Sheet, page 33.

One spring growth ring (light-colored wood) and one summer growth ring (dark-colored wood) together are called an annual ring. To find out the age of a tree through counting its rings, start at the outer (newest) ring just inside the bark and count in toward the center of the tree. This tree is in its sixth year of growth.

Answers:



Reading the Rings

You'll need: Cross section of a branch, small trunk, or freshly cut stump.

Use actual tree parts to study and count the rings. Are there differences in the width of the annual rings? In good growing conditions (warm spring weather, plenty of moisture and sunlight) trees grow more rapidly and have wider rings. In chilly, cloudy conditions and not enough moisture, they grow more slowly and have narrower rings.

Rotting Treasures

You'll need: A rotten log or decaying stump and magnifying glasses.

One of the best ways to learn about the ecology of an area is to study a rotten log or decaying stump. Here's a community life cycle at work. What forms of new life can you see around the log or stump? What larger growing things are there? What is happening to the log or stump as it decays? Are there clues about what is helping the wood decay (moisture, insects, etc.)? What new discoveries do you make when you study the rotting wood with a magnifying glass?

Leaf Skeletons

You'll need: Partially decomposed leaves.

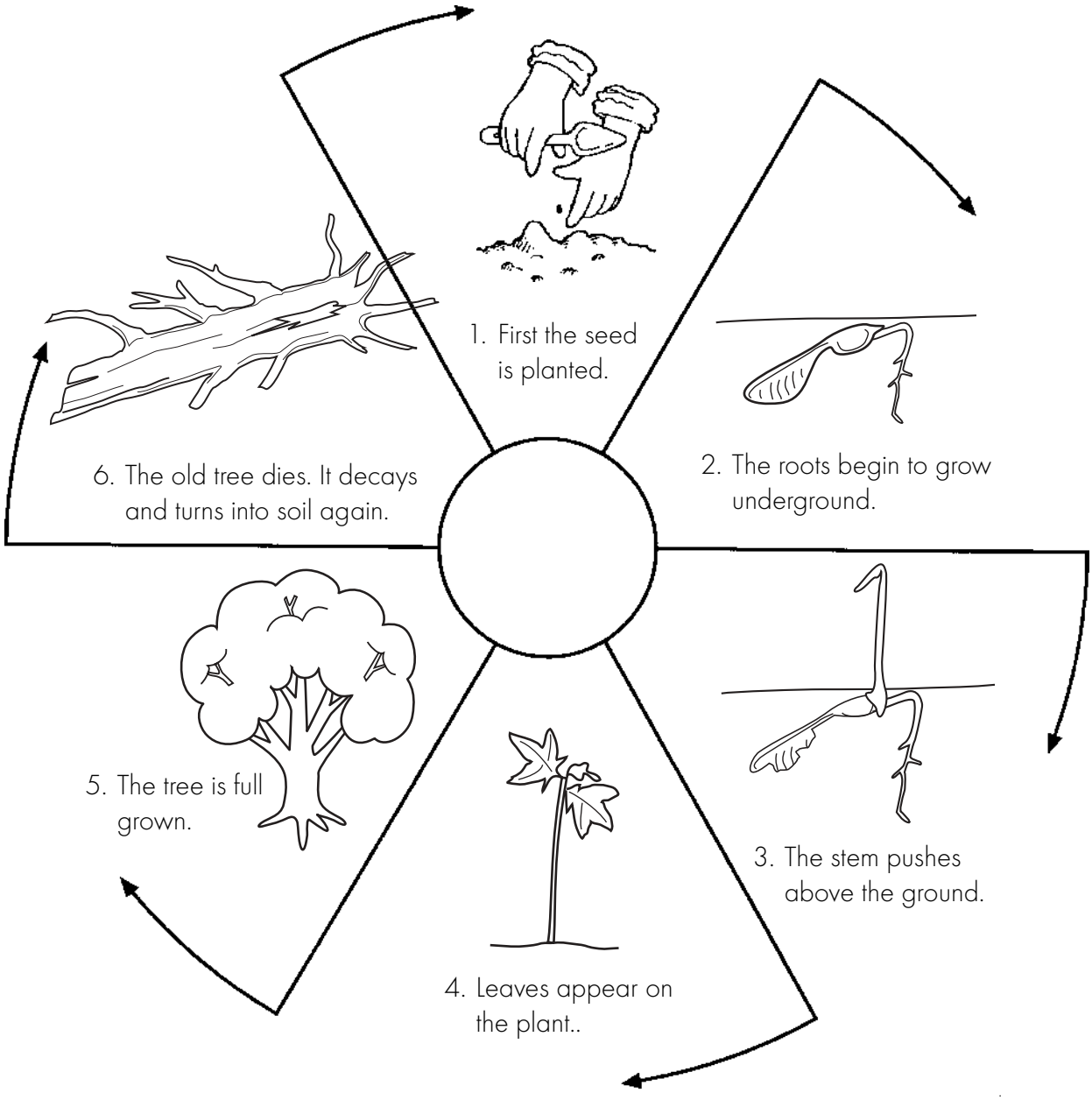
You can find leaves late in the winter or early in the spring that have not fully rotted into rich soil. Look under bushes, in tall grass, or all over the ground in the woods. Search through the layers of rotting leaves. You might find a leaf "skeleton" with just the harder veins left. Dig down and look for leaves on the bottom that have almost turned to soil and you may find insects hiding from the cold. Your leaf skeletons show the first steps in how leaves decay.

Cycles of Life

You'll need: "Cycles of Life" Activity Sheet, page 34.

Discuss the cycle of life of a tree and then have students complete the activity sheet. Their work will be easier to check if you guide them to paste their first picture (planting the seed) at the top of their circle.

Answers:



Enhancements

Math

Tree Shadows

You'll need: String, sticks, or tape measures.

Use string, sticks, or tape measures to show and measure how the shadow of a tree changes at several different times of the day. Why does it change? At what time of day is it shortest? Longest? When is your own shadow longest and shortest?

Stump Rubbings

You'll need: Stumps, light-weight paper, and soft-lead pencils or dark crayons.

Find the stump of a large tree. (Dutch elm and oak wilt diseases have affected many trees. Diseased trees have been removed, and their stumps are a good learning source.) Do a stump rubbing, using a strip of paper and a soft-lead pencil or dark crayon. Figure out how old the tree was when it was cut. (See "Nature's Timeline: Read the Rings!" in Resources, page 113.) It might be fun to see who in the class can find the oldest tree stump.

The Arts

Leaf Prints

You'll need: Leaves, tempera paint, and paper.

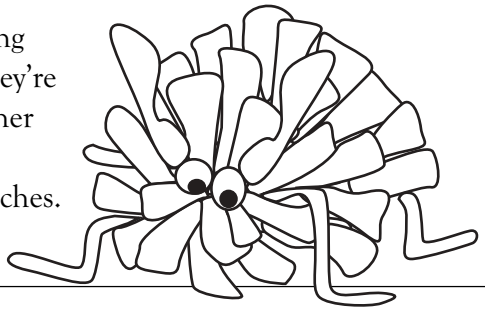
Make a leaf print by covering a pressed leaf with tempera paint. Place leaf, paint side down, on a piece of paper. Carefully rub the leaf and then peel it off. You're left with a nice leaf impression.

Make prints of many different kinds of leaves and post on a bulletin board for a colorful and interesting display.

Pine Cone Critters

You'll need: Pine cones, glue, pipe cleaners, construction paper, and scissors.

Have students collect pine cones and bring them to class. Look for a variety of sizes ... they're out there somewhere! Glue pine cones together to make animal critters. Use pipe cleaners, construction paper, etc., to add finishing touches.



Health

Nutrition—Who Needs It?

Is good nutrition important only for humans? No way! All living things need some kind of nutrition in order to survive and that includes trees. Brainstorm a list of the things you need for good nutrition and healthy living (vitamins, minerals, proteins, carbohydrates, water, fresh air). Now list the things trees need: rich soil (minerals and other nutrients), fresh air, sunshine/light, water, etc. Most of our nutrition comes through our mouths, although Vitamin D can be absorbed through our skins from the sun. Research how a tree gets its nutrients. (Moisture and nutrients are absorbed from the soil through the roots. Energy—food for growth— is created through photosynthesis, the leaves, and the sun.) Tree leaves absorb carbon dioxide from the air; but roots absorb oxygen from air pockets in the soil.

Games and Physical Activities

Run and Seek

You'll need: Bags and a list of, and access to, tree-related items.

Give students bags and a list of things to find. Go outdoors to a safe and specific area in which to hunt. Space "contrived" tree-related items far apart so there's plenty of space for active movement. Set a time limit, and they're off! The list of items to find might include pine cones, acorns, maple tree seeds, a feather, fallen twigs, etc. You may want to do a "dry run" in the hunt area first to find things to add to the list. Make sure the list contains only nonliving or on-the-ground items.

Tree Tag

Players are divided into two teams—"squirrels" and "rabbits." Squirrels are on one end of the playing area, rabbits on the other. For plenty of exercise, teams should be 40 or more feet apart and have side boundary limits. One player, the fox, stands in the center. The fox calls either "squirrels" or "rabbits." When their team is named, those players try to run to the opposite end of the playing area to visit their forest friends (the other team). If the "fox" tags them before they reach the other end, they immediately stop in place, become trees, and are rooted in place. They can move their arms, though, and now help the fox by tagging other players as they run past. The fox continues to call out teams and tag players until everyone has become a tree. The fox then chooses one of the trees to become the new fox and play continues.

Growing Up

Show how a seedling grows by having students form their bodies into "a ball" on the floor. Have them lift an arm above their heads to represent the stem breaking from the seed and reaching upward toward the light. Next, each student stretches a leg straight down to represent roots growing from the seed. Students stand up to become a sapling. They show by stretching arms and hands how they grow taller and wider until they're mature trees. Then they act out growing old, falling down, and decaying.

Try a relay: Divide students into four groups. Beginning at the same time, have one student in each group act out the life cycle of a tree as previously described. When the first student is done, the second one in each group "sprouts" up from the decaying tree to begin the life cycle again. Each student in the group takes a turn acting out the life of a tree until everyone has had a turn. The first group to "grow" all its trees, wins.

Performance Assessment

Task Statement

Go on a walk and have students differentiate between the different stages of a tree's growth. After returning to the classroom, have students diagram and label these stages (seed, seedling, sapling, mature tree, dead tree, decaying tree).

Alternate: If a walking tour won't yield these differences, use photographs or the "Cycle of Life" pictures on page 34.

Grade 2 Standard

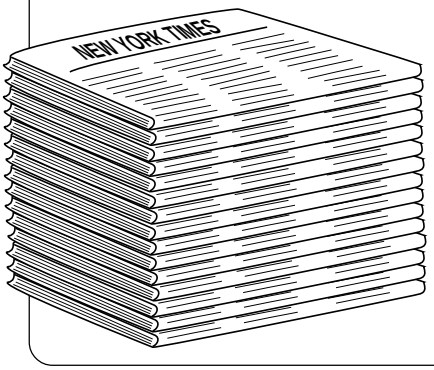
Differentiate between the different stages of a tree's growth.

Rubric—Quality of Performance

4 Exceeds performance standard
3 Meets performance standard
2 Developing toward performance standard
1 Attempt made but many serious errors

FUN FACT

Paper, Paper Everywhere!

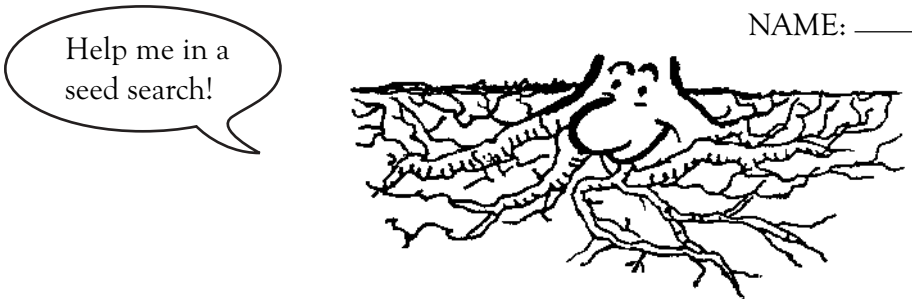


An average of over 600 pounds of paper is used each year by every man, woman, and child in the United States!

Rodney the Root Says…

KID'S COPY

NAME: _____



How many plants can you name whose seeds are often eaten by humans? Check out the puzzle below. Names are up and down and across. Did you find all 12?

r	t	s	b	j	r	c	w	s	b	j	u
o	c	p	e	a	h	a	j	e	n	d	p
n	p	r	a	z	e	s	k	s	k	v	o
c	o	r	n	i	t	h	a	a	l	p	p
o	p	a	z	p	c	e	w	m	i	j	p
c	c	s	t	r	a	w	b	e	r	r	y
o	o	p	l	e	l	r	y	a	n	i	k
p	r	b	y	o	m	l	o	m	f	c	o
u	n	e	l	x	o	s	u	b	m	e	g
t	o	r	s	u	n	f	l	o	w	e	r
m	u	r	c	m	d	s	d	a	n	h	o
s	l	y	a	d	m	n	o	l	o	x	m

Look for these seeds:

corn	cashew	popcorn	sesame	raspberry	poppy
bean	sunflower	pea	almond	strawberry	rice

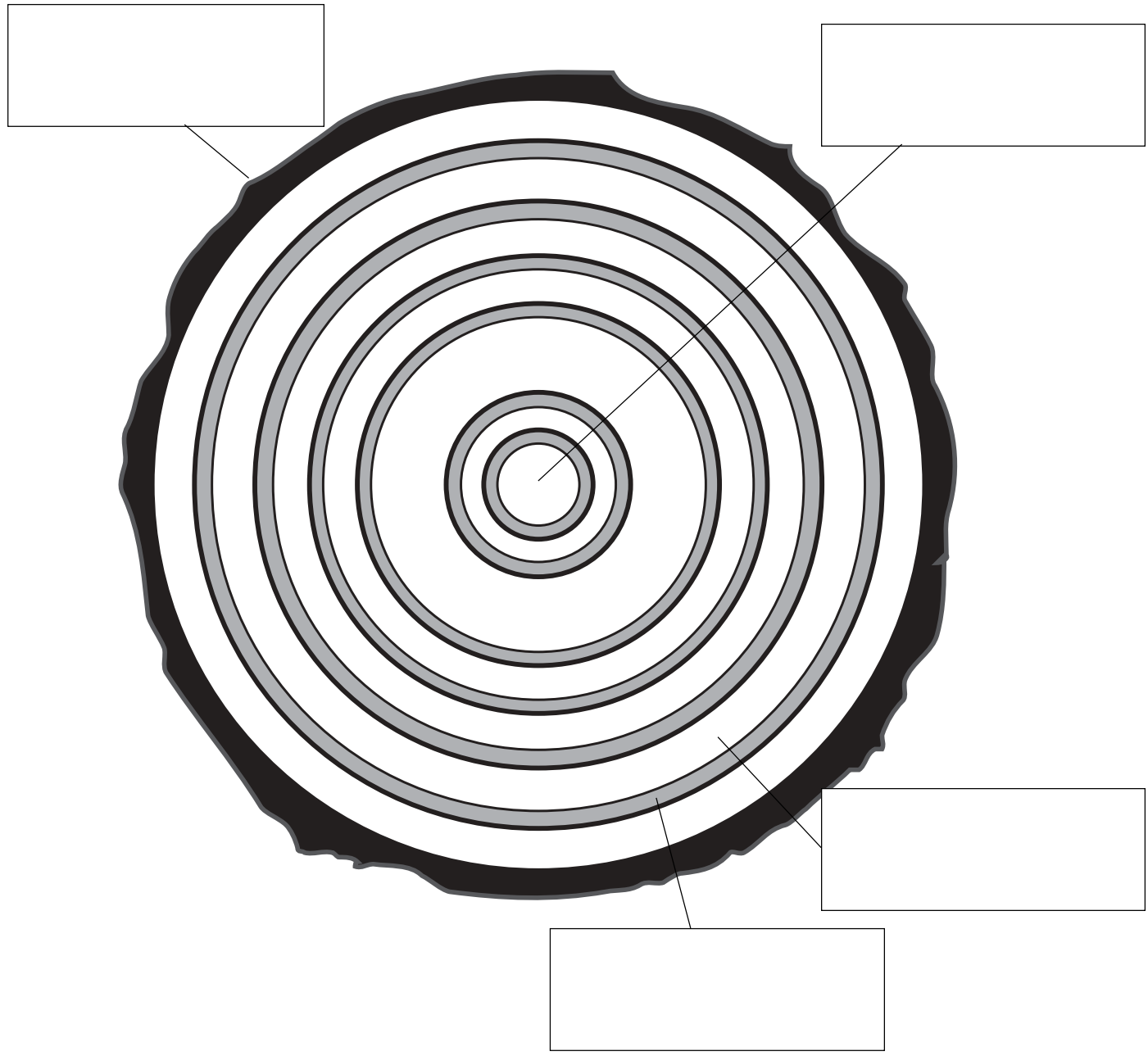
Answers on page 27.

Learn Those Layers

NAME: _____

Can you label each layer? The layers you're looking for are:

inner wood	summer growth
spring growth	outer bark



One spring growth ring and summer growth ring together are called_____.

This tree is in its_____year of growth.

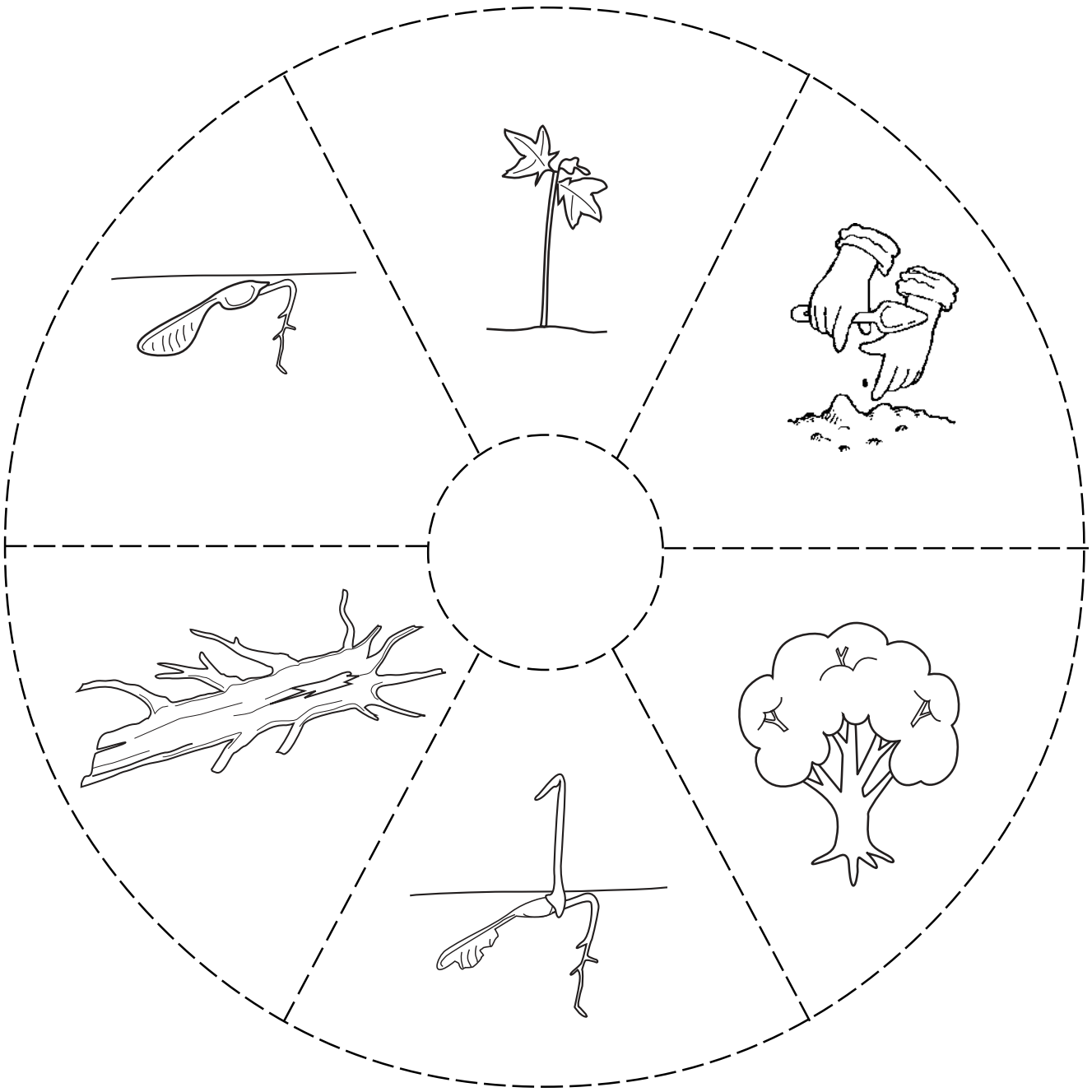
Answers on page 28.

Cycles of Life

KID'S COPY

The pictures show stages of a tree's life. Cut out the pictures by cutting along the broken lines. On another piece of paper, paste the pictures in the order in which the plant grows. Below each picture, write a sentence telling about it.

NAME: _____



Answers on page 29.

Grade 3

Tree Enemies

Objective

Students will:

- identify some of the causes of damage to trees and what they can do to help prevent harm to trees.

Vocabulary Words

renewable resources	elm bark beetles
carbon dioxide	oak wilt disease
oxygen	chemicals
conserve	environment
soil erosion	urban
watersheds	girdling
fungus	humus
Dutch elm disease	kindling

Background Information

Our friends, the trees, have many enemies. Fire, wind, ice, lightning, pollution, disease, insects, machines and vehicles, animals, and abuse from people all hurt trees. Some of these, such as weather damage, we can't always prevent. Others we can do much about. With good care and management, trees can continue to be **renewable resources.**

Trees give us many things. This includes fuel for fires and heating, lumber, wood pulp for paper making, and food for humans and animals in the form of fruits, nuts, bark, and leaves. Trees are an important part of the earth's environment because they absorb **carbon dioxide,** give off **oxygen,** hold water and soil in place, and return nutrients to the soil.

Forests can be resilient, but if they are continually or drastically disturbed, they can be destroyed. It is our job to protect, **conserve,** and manage the forests of the world rather than simply cut them for our uses today. Good management of a forest includes planting, growing, protecting, and reproducing trees in places where we cut them for lumber, fuel, or paper. At the same time, forest managers must control **soil erosion,** guard **watersheds,** protect animals, allow for agriculture, and provide for recreation. Each of us has a responsibility to do what we can to save and protect trees, too.

In these lessons, we will learn about some of the natural causes of damage to trees, as well as damage caused by people and machines.

Natural Causes of Damage

Did you know that trees, just like people and animals, can get diseases? They can ... and it can be serious.

A **fungus** is an organism that may be deadly to certain trees. Two diseases caused by fungus that have had huge effects on the trees in Minnesota are **Dutch elm disease** and oak wilt.

Dutch Elm Disease

Dutch elm disease was first described in the Netherlands in 1919. It spread quickly in Europe and by 1934 was found in most European countries and the British Isles.

European **elm bark beetles,** which carry the disease, were reported in the United States, in Massachusetts, as early as 1909. The fungus that causes the disease came into this country in logs shipped from Europe. The logs contained both the fungus and the European elm bark beetles. The logs were shipped to factories in New York, Ohio, and

Indiana. The bark beetles escaped from the logs as they traveled and carried the fungus to at least seven states.

Once in this country, Dutch elm disease spread rapidly. It is now in more than 40 states and is the most destructive shade tree disease in North America.

Minnesota's first case of Dutch elm disease was found in St. Paul in 1961. Now the disease is in nearly every one of Minnesota's counties. It has infected large portions of the elm population in many areas.

To learn more about Dutch elm disease, see Resources, page 120.

Oak Wilt Disease

Oak wilt disease has probably been in the North Central states for many years. As early as 1912, records describe oak tree deaths in Minnesota and Wisconsin that were more than likely caused by oak wilt. Oak wilt had not been identified at this time, however, so other causes, such as drought, were blamed for the oak death. It was not until 1940 that a fungus was found to cause wilting and eventually death of oak trees.

Oak wilt is a concern in all of Minnesota. It is a serious problem in east-central and southeastern Minnesota. To learn more about oak wilt, turn to Resources, page 121.

Insects

Insects can be good or bad for trees. Some are truly plant enemies. They are hungry little creatures that chew away day and night. If they eat all the buds or young leaves on a tree, or the water-conducting tissue under the bark, the tree can die.

It is difficult to know how to control insects. Some people use **chemicals** that kill the bugs, but these chemicals can also cause other damage to the **environment.** Other folks try to combat some bugs with other bugs that like to eat them. This is more difficult, but better for the environment if we are sure the bug-eating bugs don't cause other problems. Getting rid of harmful insect enemies is important, but it has to be done with care. The best protection for trees is to keep them healthy in the first place.

Fire

Fire is another great enemy to trees. When a forest is very dry, thousands of acres can burn in a short time. Raging forest fires destroy valuable timber and threaten lives and property. They can also harm the soil and destroy the forest as a home for wildlife. Once they start, forest fires are hard to fight. Firefighters battle large fires with water dropped from planes or helicopters. They might also chop down trees and dig up the ground to form firebreaks, which keep the fire from spreading. Some fires are caused by lightning, but most are caused by careless people.

Unusual as it may seem, fires are sometimes helpful to the forest. They can release nutrients trapped in the soil. These nutrients enrich the environment for new plants to start growing. Fires remove leaf litter to expose bare soil for new and dormant seeds to grow. They make growing conditions better for trees such as the jack pine that need fire to help open their cones, and for others that are not able to grow in the shade of a tall, dense forest. Frequent small fires can prevent a buildup of brush that can lead to a disastrous large fire.

Pollution

Imagine a world that is plain, even ugly—a world without beauty. Imagine a world in which most of the trees are dead. It wouldn't be a very pleasant place to live. But many scientists fear that's what our world will be like if we don't do something about pollution. Both air and water pollution are tough on trees. Pollution can poison a tree's system, slow its growth, and even kill it. Pollution happens when human-made and natural wastes dirty the air or water. Human-made wastes are the main sources of pollution. The greatest air pollution comes from the burning of fuel to run motor vehicles, heat or cool buildings, and run industry. Water pollution is caused by wastes from industry, farmlands, and homes. In the Mississippi River and parts of the Minnesota River, **urban** runoff from yard waste and lawn chemicals (fertilizers and pesticides) is a major pollutant.

Other Human Actions

People can be a tree's best friend; they often are its worst enemy, too. Plants and trees need land to grow on. But people need roads, houses, factories, mines, fields, shopping centers, and parking lots. So trees are chopped down, and land is cleared and paved. Little by little, the world's forests are disappearing.

Left alone, nature often renews itself. If we change too much land without renewing what we're taking away from it, we can upset or change the environment. Then all plant, animal, and even human life is affected.

Sometimes we might think people who are cutting down forests and clearing land are the only problem. Not true. People are wounding trees every day right in our own neighborhoods!

Trees can be wounded through damage to roots, to bark, and to the tree itself (limbs, trunk, leaves). Serious damage to any of these parts of the tree can threaten its health or even kill it.

Tree roots are injured when they're cut into or cut off, poisoned, or blocked from needed moisture, air, or nutrients. Lawn mowers, digging or grading equipment, and even shovels can cause serious root-cutting problems. Packing the soil above the roots or adding a layer of new soil limits air and moisture flow and can damage delicate roots. Dumping chemicals and other strong substances near the root system of a tree can cause poisons to enter the conducting vessels of the tree, damaging and killing tissue. Since the root of the tree is the first step in its food system, damage to roots can close down the tree's ability to get water and nutrients. Without water and nutrients, the tree will die.

Damage to bark happens through cutting or carving, ramming, fire, animal activity, people chaining or attaching things to the tree. Lawn mowers and weed eaters do their share, too. Bark has an outer dead layer and an inner living layer. The outer layer is the "skin" of the tree, protecting the soft inner parts of the tree from damage. The inner layer of bark carries food made by the leaves to other parts of the tree. Bark damage makes the tree more open to disease, rot, animal and insect invasion. It also destroys some of the food- and water-conducting tissues.

Bark damage that goes most of the way or all around the tree is called **girdling.** Girdling usually kills the tree. Tree guards or mesh shields can help protect young saplings against girdling damage from animals and careless humans.

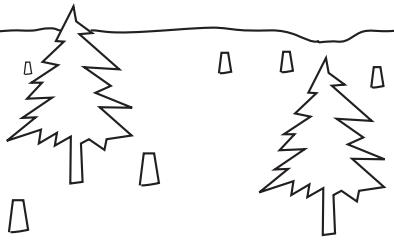
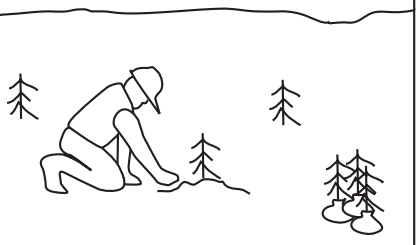
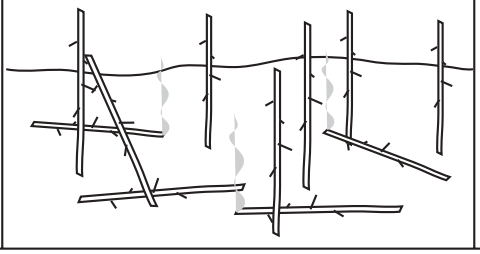
Damage to the structure of the tree comes through cutting, carving, breaking off, improper pruning, climbing, etc. This type of damage ruins the beauty of the tree. If there are bark injuries or open cuts, the tree faces the same health threats it did in the "Damage to bark" section.

What can we do to help protect trees? A lot! Here are just a few suggestions:

- Replace the grass around the base of a tree with mulch made from wood chips or composted leaves. As the tree gets bigger, the mulch bed should get larger. This will improve growing conditions for tree roots and protect the trunk from lawn mowers.
- If you have a lawn, help your family rake the leaves that fall on it in autumn. Don't burn them—that pollutes the air (in fact, leaf and debris burning is prohibited in most cities unless they choose to issue permits specifically regulating leaf and debris burning). Instead, rake them into an out-of-the-way pile. Flatten the top of the pile and leave it where rain can soak into the pile. (See "Compost Anyone?," Resources, page 101.) The leaves will rot and turn into dark, muddy-looking **humus** (soil). Spread the humus on your lawn and it will make the soil richer for the grass and other plants. In some communities, you can also take leaves and lawn clippings to a compost site.
- Don't carve on trees or peel the bark. The outside bark protects a tree from insects and fungi. The inner bark moves food from the leaves to the roots. Peeling off a tree's bark is like taking off its skin. It may cause the tree to die.

Tree Enemies

Create a cause and effect chart that includes both natural and human hazards for trees. Students participate by finding or drawing pictures to match each category. If possible, students might also draw or find pictures that offer solutions to the problems.

Cause	Effect	Solution
Insects 		
Fungi		
Humans 		
Pollution		
Fire		

Language Arts

Literature and Folklore

Book Nook. See "Book Nook," Resources, page 135, for tree-related books.

Trees. Read the familiar tree poem, "Trees," by Joyce Kilmer. What does it mean to students? What other tree stories and poems do you know? Find some to share with the group. For some suggestions, see Resources, page 130.

How Do People Wound Trees?

You'll need: "How Do People Wound Trees?" Activity Sheet, page 45.

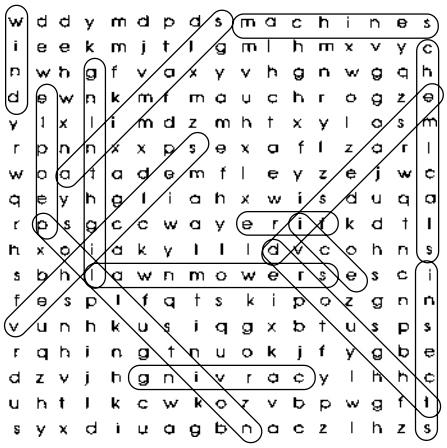
Do the activity sheet and learn more about how trees can be hurt.

Trees Have Many Enemies (Vocabulary)

You'll need: "Trees Have Many Enemies" Activity Sheet, page 46.

Do the activity sheet and discover some enemies of trees.

Answers:



Write a Rap

You'll need: Writing paper and pencils.

Write raps about saving, protecting, and respecting trees. Brainstorm words that might be used and list them on the white board.

My Side of the Story

Imagine city life from a tree's point of view. As a group, brainstorm ideas about how a tree might act, or what it might say or feel when it is wounded or hurt in some way. What might it say when it is helped and thoughtfully cared for? Jot down your group's ideas. These discussion-starters may help, too.

What would a tree say or do if:

- a 10-year-old locks his bicycle to it?
- a teenager carelessly rams into it with the lawn mower every week during the summer?
- a person from a lawn service sprays weed killer on the grass around it?
- a parks worker structurally prunes it and places mulch around it?
- cars slap against the branches hanging over the street?
- people having a garage sale nail their signs to it?
- someone gives it water on a hot, dry day?
- children playing in the schoolyard all use the same tree as "base," and the many feet pack down the dirt around it?
- gophers dig tunnels in and around its roots?
- a new curb in the street causes the rain to collect around it in a pool of water?
- junior high kids think it's cool to carve their initials on it?
- the children in the neighborhood climb it, going all the way to the small branches near the top?
- a teenager puts a fence around it when it is small so no rabbits can nibble on it?
- construction crews drive bulldozers and other heavy machines over its roots?
- city workers remove branches broken by strong winds?
- people volunteer to keep watch for insect and disease problems?

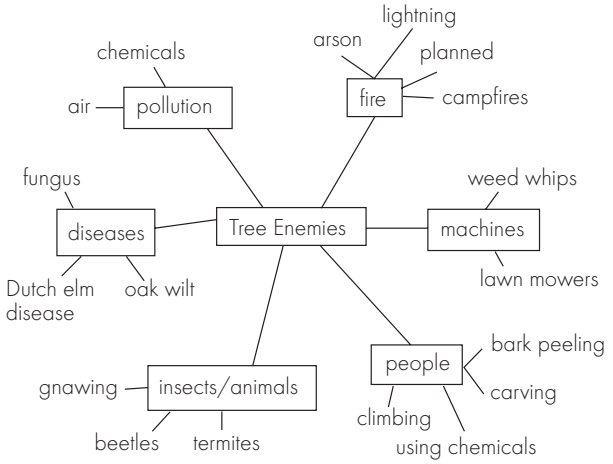
Arbor Month Spelling

For Arbor Day (last Friday in April) or Arbor Month (May), choose tree- and forest-related words in spelling.

Word Webs

Write the word "tree enemies" on the white board. Brainstorm together and write in random spaces all the words you can think of that could represent damage to trees. Draw lines to join things that go together. Circle all the words on your word web that people can help prevent.

Example:



People and Cultures

Visit City Hall

Arrange to have your class visit your community's local government offices (city hall, county courthouse) to ask their own questions and to learn answers to these questions:

1. What department is in charge of the trees in the community?
2. How much money does this department spend each year on tree care? What are the main expenses?
3. Has the community planted any trees? How many? Where? Where did they get their planting stock (trees)? What species of trees were planted? Why were these species selected? Have the plantings been successful? Who cares for the trees? Did the trees survive?
4. What kinds of "tree enemies" do the trees in our community have?
5. What can people do to help our trees stay healthy?
6. Where can citizens get help and advice about their own trees?
7. Where can citizens get seedlings to plant new trees?
8. Does the city/county have any laws that protect trees?

Conservation Connections

Get to know conservation groups! What are some organizations that work for conservation and protecting the environment? (American Forests, Izaak Walton League, National Arbor Day Foundation, National Wildlife Federation, Sierra Club, Society of American Foresters, the Wilderness Society, nature conservatories, and state conservation agencies are some.) Contact one of the organizations in your community. Can someone come out to talk to the students about their work? Do they have brochures and educational materials for young people? Some organizations are already geared to youth—Boy and Girl Scouts, 4-H, FFA, Camp Fire, Incorporated, etc.

Necessary or Just Nice?

Brainstorm a list of forest products people use in these areas of home living:

1. Kitchen (cutting board, knife handles, cupboards, shelves, counters...)
2. Interior (furniture, walls, doors...)
3. Cleaning and repair (broom handle, vacuum cleaner bags...)
4. Food (vanilla, nuts, wild game...)
5. Exterior (fence post, picnic table, shutters...)

Divide the class into small groups. Students use the list for discussion to answer these questions:

1. Which of the items listed are necessary for human survival?
2. Which of the items are not necessary or maybe even wasteful of forest products? Why? Which of the unnecessary products are you willing to eliminate or find a substitute for? What would be the environmental effect if everyone avoided the unnecessary products?
3. Look at the items you decided were necessary. Are there materials available that could be substituted for the forest products used? Do you think the substitute material would serve as well as the forest product?

Check Out the Wraps

You'll need: Writing paper and pens or pencils.

One way humans damage forests is through too much cutting and not enough replanting. One way to try to influence food businesses to save trees is to check out containers.

Contact a local fast-food business and find out what their food trays and containers are made from. Are they recyclable? Write letters and perhaps draw pictures expressing your concern and encouraging them to help save our trees. If they aren't using recyclable containers, suggest that they do so!

Trees Get "Sick" Too!

Note: Can be integrated into "Visit City Hall," page 40. Discuss the "Dutch Elm Disease" and "Oak Wilt Disease" sections of this unit and in Resources, page 120. Then assign students to one or more of these activities.

1. Contact your local tree inspector or city forestry department. How serious is Dutch elm or oak wilt disease in your community or neighborhood? How are they being managed? What is being done with trees that are cut down and removed?
2. Is there an area in the community where diseased trees are standing? Visit that area and look for symptoms of Dutch elm disease or oak wilt disease on the trees. If trees have been recently removed from the area, inspect the stumps. What disease symptoms do you see? (Other than a staining under the bark of a recently removed elm, there won't be visible signs.)
3. Find out from your community forester or extension office ways in which your community tries to prevent a problem like Dutch elm disease or oak wilt disease in the future. (For example, a variety of trees could be planted so a disease affecting one particular species would not spread so quickly.) Are any new tree diseases or problems being discovered? If so, how is your community guarding against them?

Wood Around the World

What are some main ways people around the world use wood? How can you find out? (Your librarian or media specialist can help you find resources.)

Why are there so many differences in how people use wood? What things are being done in different countries to protect trees and use wood wisely? (Some examples: Timber volume in the temperate climates is increasing rapidly, including in the former Soviet Union and Canada. This is happening through lots of planting and better forest management. In the United States, more timber is grown each year than is cut.)

Science and the Environment

Damage Detective Tour

Take a walk around the neighborhood and look for different forms of damage to trees. Scars, broken branches, misshapen trees are clues. Discuss:

a. What caused the damage?
b. Is this an old injury? A new one? How can you tell the differences between old and new injuries?
c. What causes tree "bleeding" (sap running out of the tree)? Is it harmful to the tree? (Probably not.)
d. Why are trees pruned and trimmed? How can pruning help a tree? Hurt a tree? (Pruning helps trees when it's done by people who know how to do it correctly. Pruning is done to cut off damaged, weak, or poorly attached tree parts. This leaves the rest of the tree strong and ready to face storms, diseases, and other threats. Pruning is also done to improve the appearance of a tree. Cutting large parts off a tree may create an opening for wood decay.)

Fire: Friend and Foe

Think and discuss: Is there such a thing as a good forest fire? Intense fire is usually an enemy to a forest, but sometimes fire can be helpful. For example, there was a great fire in Yellowstone National Park in the summer of 1988. At this time, there were great amounts of dry wood lying around like piles of **kindling.** Why would a fire have an easy time taking off during a dry summer? How might this fire have been helpful? (The fire cleaned out old forest and opened space for new growth and meadows. It encouraged growth of different types of vegetation. This in turn brings in animal life.) Once in a while, Minnesota forest managers decide it would be best to start a small, controlled fire to burn dry wood and underbrush that could start a big, out of control fire. What do foresters have to do to make sure their fires are safe and the right thing to do? (Safety plans must be made and in place before the fire is set. Houses and other property must be protected. Firefighting people and equipment must be available and ready for any emergencies. The weather must be right—no strong winds or dry conditions in the forest. Areas to be burned are usually done in small patches so wildlife can escape.)

What's Inside?

You'll need: A stethoscope (the school nurse may be able to provide one).

Borrow a stethoscope and have students listen to a tree in spring. Choose a healthy, medium or large broadleaf tree. What do they hear? (You should hear water— sap—moving from the roots to the leaves. Try a few different spots on the tree to find the best listening.) What do they think they would hear if the tree were diseased so its waterways were clogged?

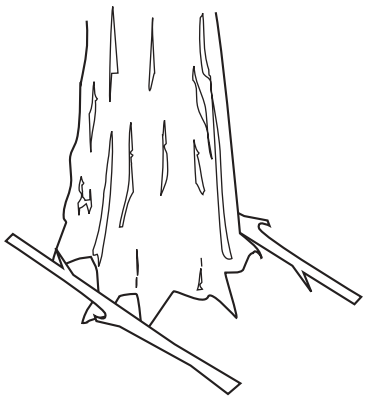
Enhancements

Math

Guess What?

You'll need: A tape measure and two sticks.

Have students estimate the diameter of a tree trunk. How can they check the estimates to see how close they might be? (Lay sticks that extend beyond the tree on opposite sides of the trunk. Measure the distance between them.)



Let's Measure That Tree!

You'll need: Rulers.

Discuss the ways in which people in early times used their bodies (hand spans, step "paces," for instance) to measure. Measure various things in the classroom using different parts of bodies: foot, hand span, arm span, length of a finger, paces. Estimate the measurements in inches or feet. Then remeasure the same items using a ruler.

How accurate is each type of measurement? Why do different people get different measurements when they measure by body forms?

How Tall?

You'll need: A tape measure or yardstick.

How can we measure a tree's height? Try this:

On a sunny day, measure the height of a small tree, preferably one short enough so students can reach its top. Record the time of day when the length of the tree's shadow is the same as its height. Then at that same time the next day, look at a tall tree. By measuring the tall tree's shadow when the sun is in the same position as when the small tree's height and shadow matched, how can you figure out

the height of your tall tree? (Shadow and height will match.) What are some other ways you might be able to measure the height of the tall tree? How would a forester do it?

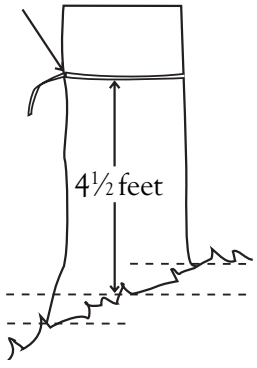
Students may wish to estimate how many "student lengths" the tree will be before beginning the measuring exercise. Was their estimate less than or greater than the tree's actual height?

How Big Around?

You'll need: A tape measure.

Measure the circumference of a tree by joining arms around a large tree or using hand spans on a small one. Estimate the circumference in inches or centimeters. Then use the tape measure to measure the distance around the trunk at a point 4½ feet above the ground to get an exact measurement.

If the tree is on a slope, measure from the ground at the mid-point of the slope and the tree base.



How close was your estimate?

The Arts

Another Point of View

You'll need: Drawing paper and crayons or markers.

After discussion, based on additional research if necessary, ask students to think about how each of these individuals might view a healthy and a decaying tree. Ask the students to choose one of the individuals listed, then draw pictures of healthy and decaying trees as they think this individual might see it—or might use it.

an artist	a homeowner	a tree inspector
a forester	a gypsy moth	an ecologist
a logger	a tree farmer	a bird that lives in the trees
	a rabbit	

Create a gallery of these drawings. Have students serve as guides for each other, pointing out the differences in the way the various people and animals might view healthy and decaying trees.

Boot It Up!

You'll need: Computer access and graphics software.

Use computer graphics to create tree art.

Bumper Notes

You'll need: Drawing paper, markers, clear adhesive contact paper, and scissors.

Design bumper stickers that encourage people to plant trees and to practice fire safety in the forest. If you are going to actually apply them to bumpers, cut adhesive paper larger than the bumper sticker; mount the sticker face down on the sticky side to seal the drawing. Clean the bumper; apply by pressing the adhesive paper in place.

Bookmarks

You'll need: Tagboard, clear adhesive contact paper, and small pressed leaves or evergreen needles.

Cut a strip 2 to 3 inches wide and 6 inches long from the tagboard. Cut a piece of contact paper large enough to cover both sides of the strip. Place leaves or evergreen needles on the strip to decorate it, then cover with contact paper. Press the contact paper and strip firmly together. Trim off any extra contact paper.

Games and Physical Activities

Jump Rope Jingles

You'll need: Jump ropes.

Make up your own jump rope jingles and raps about trees of the forest. Some idea starters:

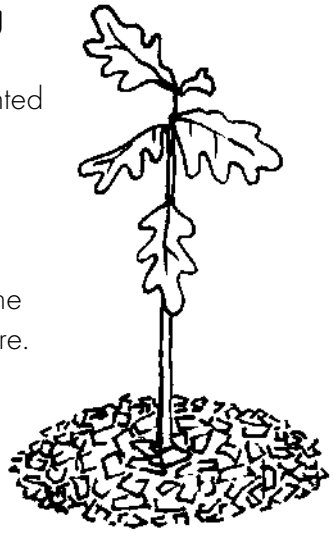
Ma-ple, ma-ple,
Grows so tall
Leaves are bright red
In the fall
or
How many apples on my ap-ple tree?
Count with me and we will see!
1-2-3-4-5-

(Count until the jumper misses; a new jumper hops in and the chant begins again.)

FUN FACT

We're a Planting State!

More trees are planted in Minnesota than are harvested each year. Forest managers are making sure there are plenty of trees for all the generations of the future.



Performance Assessment

Task Statement

Using the "How Do People Wound Trees?" Activity Sheet on page 45, students analyze what damage is happening and what they can do to prevent it.

Grade 3 Standard

Analyze damage to trees and how the damage can be prevented.

Rubric—Quality of Performance

4 Exceeds performance standard
3 Meets performance standard
2 Developing toward performance standard
1 Attempt made but many serious errors

How Do People Wound Trees?

KID'S COPY

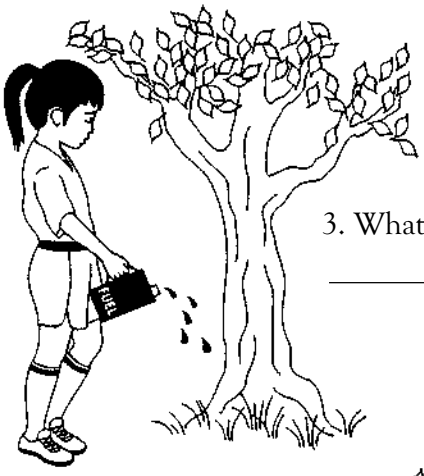
NAME: _____

1. What happens to the tree?

_____

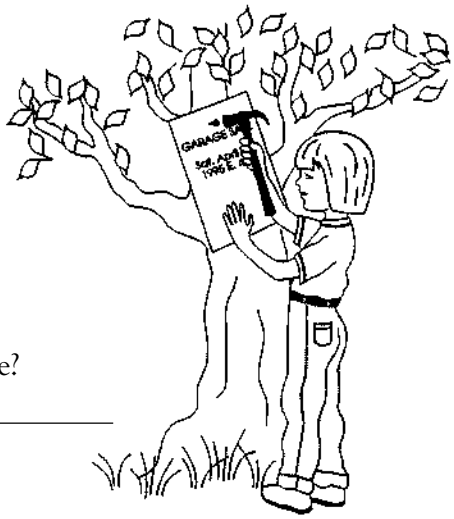
2. What happens to the tree?

_____



3. What happens to the tree?

_____



4. What happens to the tree?

_____

5. What happens to the tree?

_____

6. What happens to the tree?

_____

Trees Have Many Enemies

KID'S COPY

NAME: _____

w d d y m d p d s m a c h i n e s
i e e k m j t l g m l h m x v y c
n w h g f v a x y v h g n w g q h
d e w n k m f m a u c h r o g z e
y l x i i m d z m h t x y l o s m
r p n n x x p s e x a f l z a r i
w o a t a d e m f l e y z e j w c
q e y h g l i a h x w i s d u q a
r p s g c c w a y e r i f k d t l
h x o i a k y l l l d v c o h n s
s b h l a w n m o w e r s e s c i
f e s p l f q t s k i p o z g n n
v u n h k u s i q g x b t u s p s
r q h i n g t n u o k j f y g b e
d z v j h g n i v r a c y l h h c
u h t l k c w k o z v b p w g f t
s y x d i u a g b n a c z l h z s

Can you find these words? They go across, up, down, and diagonally. Sometimes they're even backward.

lawn mowers	machines	disease	chemicals	animals
people	pollution	carving	wind	lightning
drought	fire	vehicles	insects	ice

Answers on page 39.

Grade 4

Trees and People: Depending on Each Other

Objectives

Students will:

- list ways in which humans depend on forest products and forests depend on wise human decisions;
- describe how trees are a renewable resource.

Vocabulary Words

interdependent	renewable resource
products	seed orchards
economy	coniferous (needleleaf)
consumer demand	deciduous (broadleaf)

Background Information

Have you ever thought of yourself as **interdependent** with trees? Probably not. Yet, humans depend on trees in many ways—and trees depend on humans, too. The forest industry is much like every other industry based on a major natural resource. It gives us **products** and materials that are important to our country's **economy** and to the lives of our people. But how can we be sure we will always have a supply of those important things? We help the forest and the forest helps us. That's where wise management of the forest comes in.

People who manage forests must always keep in mind the **consumer demand** for products and services. Government studies say the demand for paper and wood products will double between the 1990s and 2030. Lucky for us, trees are a **renewable resource.** That means we can plant more trees to replace the trees we use.

The forest industry, the U.S. government, and our Minnesota state government are working together to protect and manage our trees. We're making steady progress in growing better trees—faster growing, straighter, more disease and pollution resistant. The goal is to grow more timber and make it the best quality we can. At the same time, we need to make sure there are more and better trees for future generations to use and enjoy.

Seed orchards, where improved seed is produced, are helping us grow more timber. Seed orchards in Minnesota are producing trees that will grow up to 15 percent faster than the seeds used now.

An example of industry and government working together to manage trees is Stora-Enso Industries (formerly Lake Superior Paper). Opened in 1988, this leader in nonpolluting papermaking is located on 92 acres in Duluth. In one year it produces 230,000 tons of paper. But that requires 45 truckloads of spruce and balsam trees each day. Before the plant was built, the company needed to know for sure there would always be enough balsam and spruce to make its paper. Through good forest management and planting, it is now able to depend on a steady flow of those trees in coming years. Trees are necessary not only to make the paper, but also to fuel the power that makes the plant's electricity. Each year, the plant uses the amount of wood equal to a woodpile 4 feet wide and 4 feet high running from International Falls south to the Iowa border!

In every grade level of this book, you'll find information about how people depend on trees. Former President George Bush, Sr., in a speech in Sioux Falls, South Dakota (September 1989), called trees "the oldest, cheapest, most efficient air purifi-

ers on Earth." They give us oxygen, shade, beauty, protection against wind and erosion, and food and homes for wildlife. They provide fuel, food, wood products, mulch for gardens, and chips for walking paths. They quiet a highway's noise with living snow fences, and much more.

Our job is to help trees grow healthy and strong, to protect them against disease, injury, and too much cutting. When we do our job well, we enjoy all the benefits of trees—and trees benefit too.

Minnesota Trees

Minnesota's rich soils and variety of climate provide an ideal home to many different kinds of trees and plants. (See "Minnesota Biomes Map," Resources, page 108.)

Minnesota tree types are either **coniferous (needleleaf)** or **deciduous (broadleaf).** Coniferous trees (also called conifers), bear their seeds in cones and have thin, needlelike leaves. They shed only a portion of their needles each year and people in the wood products industry often refer to them as softwoods. Our conifers include white pine, jack pine, red pine, balsam fir, black spruce, white spruce, red cedar, and white cedar.

Deciduous or broadleaf trees have covered seeds and drop their leaves each autumn. These trees are sometimes referred to as hardwoods, even though their wood is not necessarily harder than that of the softwoods. Our deciduous trees include elm, oak, aspen, cottonwood, birch, basswood, ash, and maple.

FUN FACT

Something Different

Minnesota has one obvious exception to the "rule" that conifers are evergreens. The tamarack, found in the sprawling peat bogs of the north, bears its seeds in cones but also turns golden and sheds all of its needles in the fall.

Both coniferous and deciduous trees are important for all the things they provide for humans, animals, and the environment.

Trees: A Renewable Resource

What does it mean to be a "renewable resource"? To renew means to begin again, to restore or revive. A resource is something that is a source of help or of value. Resources can give us things we need, or they can be sold to bring us money.

Trees are a renewable resource because we can use them and yet grow new ones to get more trees in the future. This is different than some of our other natural resources. Silver and gold, oil and gas, for example, are mined out of the ground. When they're gone, they're gone for good.

Renewable resources depend on people. We need to conserve and protect the trees we have now and plant a lot of new ones to keep the cycle going.

Language Arts

Literature and Folklore

Book Nook. See "Book Nook," Resources, page 135, for tree-related books.

Worth Noting

You'll need: Journals or notebooks and pencils.

Keep notes/a journal on what is learned about trees. At the end of the unit use these notes to write a story, picture book, poem, make a video or rap about trees.

Creative Writing: Haiku

You'll need: Writing paper and pencils.

Brainstorm words that can be used and list them on a white board. Then write haiku about why trees are so special in our lives. Write about what trees and forests do for you, or how they make you feel. Or, pretend you are a tree and tell about how things look from a stuck-in-one-place, tree-top point of view! What are some other ideas?

My Tree Story

Everyone has a favorite tree story. Invite students to write or tell their own favorites. Have them interview older adults and ask for favorite stories. What made these trees special? Are the trees still there? If not, why not?

Tree Pals

Choose a state in a different climate than your own. Make a contact with a school in that state. Perhaps someone has a cousin, a grandparent, a good friend who could put you in touch with a school, but if not, try telephone information or use the Internet to find "Tree Pals." Locate a class that would be willing to share "Tree Talk" with your group. Share your plans for celebrating Arbor Day. Tell about the trees in your community, and ask about the kinds of trees they have. Exchange photocopies of leaves common in each state. Discuss why different climates are needed by specific tree species.

Connecting With Business

Contact these sources. Ask what materials they can share with your class about their industries. Discuss how forest industries of tomorrow depend on replanting today.

- Minnesota Forest Industries
  903 Medical Arts Building
  324 West Superior Street
  Duluth, MN 55802
- Paper mills and lumber mills of Minnesota:

  Blandin Paper Company
  115 First Street Southwest
  Grand Rapids, MN 55744

  Boise Cascade Corporation
  Second Street & Third Avenue
  International Falls, MN 56649

  Hennepin Paper Company
  P.O. Box 90
  Little Falls, MN 56343

  Potlatch Corporation
  Northwest Paper Division
  P.O. Box 510
  Cloquet, MN 55720

Nifty Naturalists

You'll need: Resource sources, journals or notebooks, and pencils.

Sigurd Olson, John Muir, and Gifford Pinchot are names to remember when thinking about appreciating and preserving the outdoors. They knew trees and the environment need help from humans. Sigurd Olson, a Minnesotan, had a lot to do with creating our famous Boundary Waters Canoe Area Wilderness (BWCAW). John Muir's love of nature led him to persuade President Theodore Roosevelt to set aside 148 million acres of forest reserves. Muir also founded the Sierra Club, an organization that works hard to protect the environment. Gifford Pinchot was the nation's first professional forester and later, the Chief Forester of the United States. Like Muir, he too worked with President Theodore Roosevelt to bring the idea of conservation to the American people. Pinchot was one of the original founders of the Society of American Foresters.

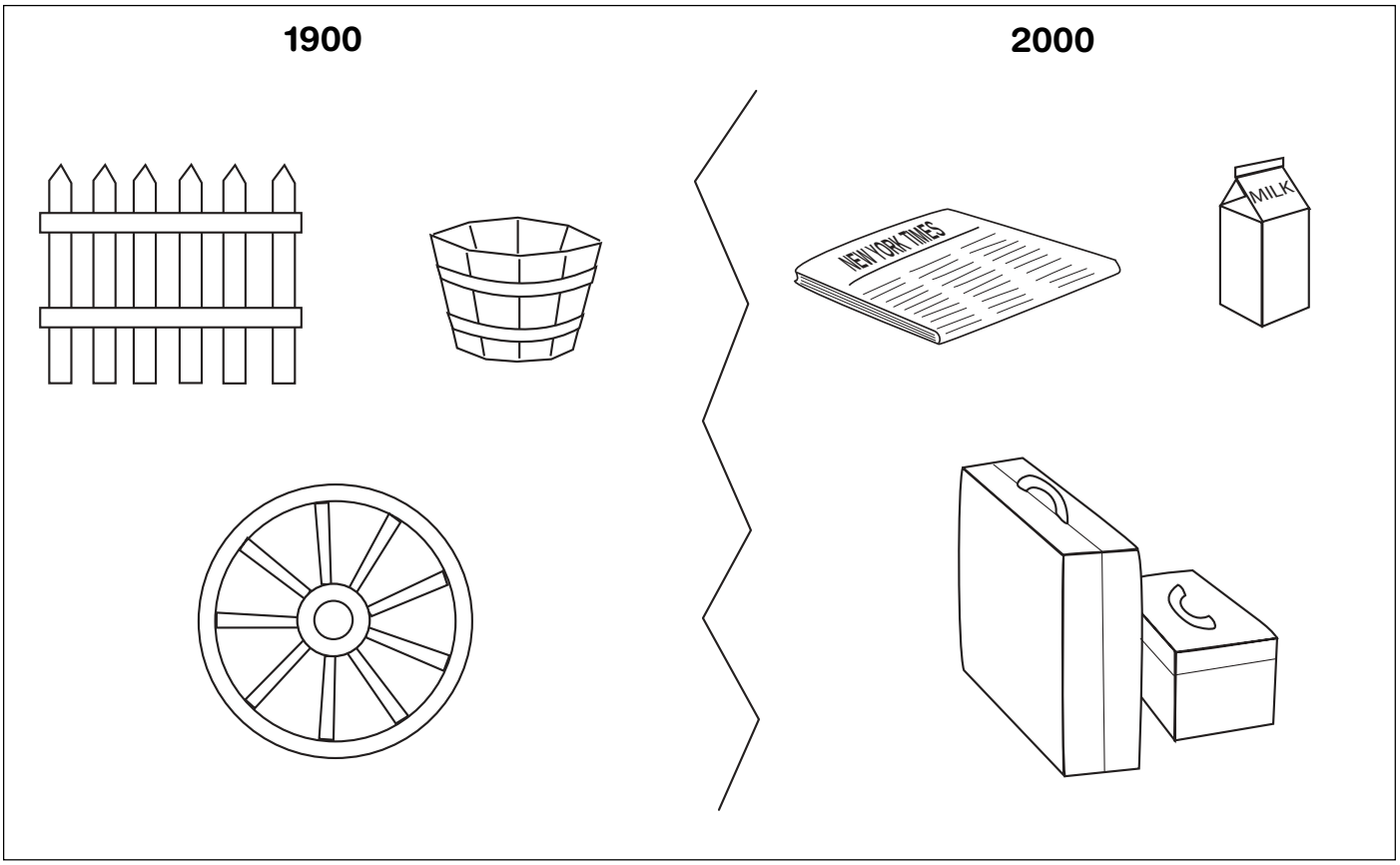
Research to learn more about these environmental pioneers. Bonus: Find out how J. Sterling Morton (the founder of Arbor Day), Rachel Carson, Aldo Leopold, and Teddy Roosevelt contributed to ecology. How does their work affect what we do today?

You and your students can be naturalists, too! Start a nature journal to write about things you would like to do to help the environment. You're sure to notice things when you take a walk, drive along the roads, or even stare out a window. What new habits or practices can you begin right away? Who can help you put your ideas into action? What things can you tell others about, encouraging them to be naturalists, too?

Use your journal to write about natural wonders you'd like to explore in your lifetime. Are they being cared for so you and future generations can enjoy them?

Things Made From Trees

Students participate by researching and bringing pictures or drawing pictures of things made of wood used in 1900 and in 2000 to show the differences in lifestyles and differences in wood uses. Discuss: How has wood helped people and changed lives since earliest times?



People and Cultures

Speak for the Trees

You'll need: The Lorax by Dr. Suess.

Read the book together and encourage each student to share the story with a younger child. Ask students: Would you like to change the end of the story? How would you do it and why? What are the main reasons people cut down trees? (For lumber, buildings, houses, fuel, to clear for roads and shopping malls, etc.) Will we ever stop cutting trees? (No, we need them for wood and other things.) How can we make sure trees are replanted to replace those cut down?

The Charter Oak

You'll need: Computer Internet access if using web sites and a Connecticut quarter (state series, issued in 1999).

Show the quarter first. Ask students: Do any of you know what the symbol on the back of the Connecticut quarter stands for? Share the following:

When the 169-year-old Charter Oak died in Hartford, Connecticut, the city bells tolled, a band played funeral songs, and the whole community grieved. The funeral happened on August 21, 1856. The treasured tree had been blown down in a windstorm.

The Charter Oak had been loved and respected for generations. American Indians had held meetings under it and used its new leaves each year to know when it was time to plant corn. Colonists gathered around it. The colony of Connecticut once hid their charter in the tree so they would not have to turn it over when King James II wanted to restrict their freedom. When the Charter Oak blew down, people wanted keepsakes made from its wood. Pianos, furniture, and many small items were made. A carved chair made from the Charter Oak is still used in the Senate Chamber in the State Capitol building in Hartford. You can also see the tree on the Connecticut quarter, issued in 1999 as part of the States of the Union quarter series.

Ask students: What trees are important to you? Can you think of any trees that are special to your whole school or to the whole community? What makes certain trees special? (Age, location, size, place in a historical event, trees planted to honor people or events, etc.) Is there a tree we should give special honor to? How could we do that? (Naming, create a celebration, etc.) To search out ideas, visit American Forests (the oldest U.S. nonprofit citizen's conservation organization) at http://www.historictrees.org to see all the famous trees it has in its historic tree nursery.

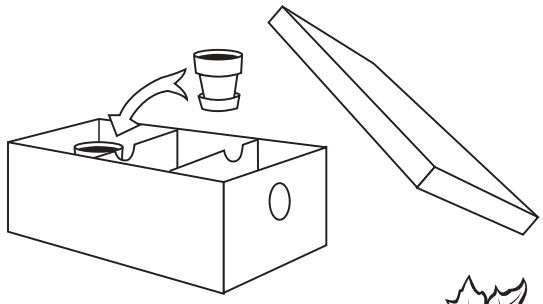
Some trees in Minnesota and across the nation have received special attention for their size. Visit the Minnesota Department of Natural Resources web site at http://www.dnr.state.mn.us/forestry/big_tree or American Forests web site at http://www.americanforests.org/resources/bigtrees to see the state and national registers of big trees.

Science and the Environment

How Important is Light?

You'll need: A large shoe box with the lid, a potato, a small clay pot, soil, pieces of cardboard, and scissors.

This gardening project shows students just how sensitive plants are to light. Cut the potato so there is a section with an "eye" on it. Plant this section in the clay pot. Water the soil in the pot and put the pot in a corner of the shoe box. Using your cardboard pieces, make two partitions to go across the width of the box. Cut a two-inch opening in each partition (stagger these openings). Make a two-inch opening in one end of the box and cover with the lid. Place in an area where the end hole receives good light. The potato will grow out through the holes in an effort to find light.



Discover Nuts

You'll need: An assortment of nuts in shells, a world map, and push pins or self-stick page flags.

Ask students to bring from home or the grocery store 10 to 12 whole nuts still in the shell. Suggest a variety such as: pine nuts, Brazil nuts, hazelnuts, hickory nuts, almonds, cashews, filberts, English walnuts, black walnuts, macadamia nuts, pecans, and pistachios. Examine and identify the nuts. Label each and create a display counter for them.

Divide into small groups to research where the following nuts are grown and an interesting fact or two about them. Each group reports its findings to the class and marks the growing areas on the map with push pins or page flags. As each nut's growing area is discovered, add the information to your display.

- Brazil nuts—Brazil and Venezuela.
- English and black walnuts—English walnuts: California, Oregon, China, Greece, Turkey, much of Europe. Black walnuts: eastern and southern U.S.—Massachusetts to Florida and west to Texas.
- Pine nuts—North America and Europe.
- Hickory nuts—southern and eastern U.S., eastern Canada, Mexico, China.
- Almonds—California, Spain, Italy, Iran, Portugal, Morocco.
- Cashews and filberts (also called hazelnuts)—Cashews: Florida, Central America, Brazil, India, Africa. Filberts: Oregon, Washington, northern California, Turkey, Italy, Spain.

What do you notice about the areas that produce nuts? What do the areas have in common? Where do nuts not grow? Why?

Tree Seed Tasting Party

With all the "nuts" that have gathered in your classroom, have a "tree seed" tasting party. Watch out for students with allergies!

FUN FACT

Seeds to Trees

It takes a bushel of pine cones to produce less than a pound of seeds, but each pound of seeds represents about 55,000 new trees. That's enough to plant over 73 acres of forest land.

Enhancements

Math

Scan the math activities in grades 3 through 5 of this *Teachers' Guide.* Since fourth grade is such a strong transition between lower and upper elementary grades, many of the activities for these grades work well with fourth graders. Try these ideas, too:

Pounds and Pounds of Paper!

You'll need: A scale, paper, and pencils.

How much paper do youngsters use in your school? Here's a survey with surprising results:

a. Each student weighs all the paper in his or her desk (books, notebooks, etc.) on a scale. Add each student's total for a grand total.
b. Divide to find the average weight of paper per student.
c. Multiply the average weight by number of students in the school. What's the grand total for your school?
d. A 16-inch diameter tree yields 700 pounds of paper. How many trees did your school consume?

Forest Math

Create your own story problems using content in this *Teachers' Guide* as a base. Some ideas to get you started:

1. Pretend you are the new owner of Hundred Acre Woods. (An acre is about the same size as a football field.) You decide to plant five new trees on each acre of your woods. How many new trees will you need in all?
2. You want to buy four new young trees to plant in your yard. Each tree costs $14. How much do you pay in all?
3. A Christmas tree farmer prunes one tree in five minutes. How long will it take her to prune 10 trees? 18 trees? How many trees will she be able to prune in one hour?
4. Imagine your schoolyard has three oak trees, five maples, two basswoods, three red (Norway) pines, and three birch. How many trees are there in all? How many are left if one blows over in a windstorm and two die after having their bark damaged by bike locks?
5. A careless camper leaves a fire burning and it starts a forest fire. It burns eight acres of campground. If there were 30 trees on each acre, how many trees were burned?

Answers to Forest Math Activity:

1. 500 trees
2. $56
3. 50 minutes; 90 minutes; 12 trees in one hour
4. 16 trees in all; 13 trees left
5. 240 trees

Super Sleuths

You'll need: Notebooks, pencils, and a 10-foot length of string for each pair of students.

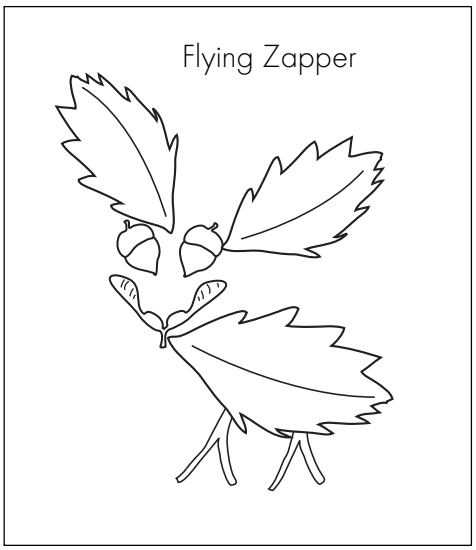
Students work in pairs. Take a neighborhood walk and find undisturbed places with interesting combinations of soil and plant life. Each pair makes a circle with their string, then become super sleuths to discover as many different things as they can in their circles. They observe, count, and jot down at least 15 or more different items in their circles. Back in the classroom, they share their findings with classmates. Did any pair discover 20 or more things? Amazing, but possible! (Examples: leaves, grass, rocks, ants, dirt, seeds, worms, clover, flowers, tracks, butterflies, etc.) Have students create a bar graph representing how many of each item they found. Compare graphs among the class.

The Arts

Tree Monsters

You'll need: Tree debris, construction paper, and crayons or markers.

Tree monsters are lurking in your classroom! Have students go outside and gather items from trees that they can make monsters from. (Remember to gather only those items that can be taken without harming the tree or look on the ground for items already fallen from the tree.) They glue these pieces onto pieces of construction paper and add crayon or paint features and details. What is the name of each monster?



Games and Physical Activities

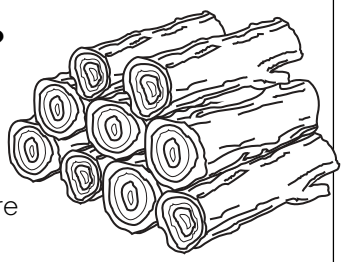
Over and Under Relay

You'll need: Playground ball.

Players line up in relay fashion (one behind another) in two teams. The first player in each team has a ball. At the signal to start, he or she says the name of something that can be found in a Minnesota forest. It can be an animal, tree or other plant, or even something human-related such as camper, logger, hiking trail, cabin. The player then passes the ball back over his/her head to the second player, who says the word and passes the ball between his/her legs to the third player, who in turn says the word and moves the ball over the head. The ball is passed over and under through the whole team. When the last player receives the ball, he/she races to the front of the line, says a new forest word, and starts the ball again. The game continues until one team is back in its original lineup with the player who started the game holding the ball.

FUN FACT

How Much Wood?



Did you know a U.S. citizen uses, in a lifetime, the wood produced by 300 mature trees? In one year, the average U.S. citizen uses 600 pounds of paper, 224 board feet of lumber, and hundreds of other forest products that all come from trees! Much of the timber harvest goes into homes and furniture, newspapers, books, writing paper, film, frozen food cartons, and corrugated boxes. It also goes to produce other valuable wood products like turpentine, alcohol, plastics, rayon, fuel wood, sugar and syrup, barrel staves, shingles, printing ink, baseball bats, chewing gum, musical instruments, dye, shatterproof glass, and shoe polish.

Performance Assessment

Task Statement

Using the "From Paper to Plastic" Activity Sheet, Resources, page 84, each small group tries to identify the more than 40 forest products located in the picture.

Grade 4 Standards

Identify and evaluate how people depend upon forest products.

Rubric—Quality of Performance

4 Exceeds performance standard
3 Meets performance standard
2 Developing toward performance standard
1 Attempt made but many serious errors

Grade 5

Forest Wildlife and Recreation

Objectives

Students will:

- describe at least three examples of the interdependence of forests and animal wildlife;
- identify at least 10 kinds of wildlife common in Minnesota forests;
- name and describe the general location of at least three Minnesota state forests;
- tell ways forests are used for recreation and well-being.

Vocabulary Words

predators	clear-cutting
prey	prescribed burning
vegetation	conifers
habitat	deciduous
cover	recreation
species	forest regions

Background Information

There is a close relationship among soil, water, plants, and animal wildlife. They all affect each other. Some animals, like fox and wolves, are **predators** that hunt and eat other animals (called **prey).** Deer, rabbits, and others eat plants. Birds, squirrels, chipmunks, and animals traveling through the forest help spread the seeds of plants so they can reproduce. Water gives life to all.

People can, and do, change or alter the environment. Through knowledge and care, humans can make things better. Through carelessness, not knowing the facts, or simply putting their own wants and desires before nature's needs, people disturb and destroy soil, water, and **vegetation.** This in turn destroys animal wildlife.

Wildlife Habitat

A wildlife **habitat** is a place or area where wildlife live, grow, and reproduce. Wildlife includes both plants and animals, but in this lesson we will focus on animal wildlife. Habitat includes both land and water areas.

Forests provide food, **cover** (protection from weather and enemies), and nesting places for wildlife. The number and the variety of wildlife **species** in an area depend on the amount and variety of plants (flowers, grasses, vines, shrubs, and trees) in the area. No two species of wild animals need exactly the same things.

Most animal species rely on a variety of plants. Pheasants and quail like to feed in the farmer's corn and grain fields and return to the forest borders near the farm crops to rest, nest, and hide. Fox venture out into these fields and meadows to catch the unwary quail, pheasant, rabbit, or field mouse and then return to their dens in the forest. Hawks soar over these same fields for the same food and return to their nests in the forest. The coyote might be seen ready to pounce on a rodent while its competitor, the badger, does the digging that chases the rodent out. The greater variety of vegetation and water areas, the greater the variety of wildlife species.

Swamp or marsh areas, often surrounded by forests, are necessary habitats for moose, muskrats, beavers, geese, ducks, and many birds. Many of these animals feed in or near the water, then return to their forest homes. The trees in forest land sur-

rounding marshes are helping soil and wildlife in another way. Their roots help hold soil in place, reducing erosion and keeping marsh waters clean for wildlife.

Animal Food

The greatest variety of animal wildlife is found along the shrubby edges of forest growth. Because there is more sunshine and moisture on edges, that's where the greatest variety of food plants grow. These edges are found along the outside forest borders, beside roads or logging roads, along stream banks, and in farm shelterbelts. Whether they're munching along the forest edges or moving further into the trees, everyone is looking for something different to eat.

Snowshoe and cottontail rabbits feed on bark and twigs of shrubs and small trees. Porcupine and beaver feed on bark as well as seeds and certain plants. Bears, raccoons, and many songbirds eat the berry-type fruits of wild plants such as strawberry, blueberry, highbush cranberry, raspberry, blackberry, cherry, and hawthorn. Ruffed grouse eat these berries as well as wild strawberry leaves, winter green, and rose hips. During winter, these grouse eat buds and catkins of birch, hazel, and aspen.

Deer prefer leaves and young twigs of northern white cedar, red-osier dogwood, white pine, and mountain maple. They also eat red maple, basswood, jack pine, willow, and aspen. When these plants are scarce, deer will feed on spruce, tamarack, and hazel. Deer need forest plants like these listed to digest their food properly; they can't exist on a diet that's entirely made up of grasses and forbs (broad-leaved plants).

Foresters can help deer and other plant eaters by creating small-scale forest openings by limited **clear-cutting** or by **prescribed burning.** Cutting or burning in a carefully planned way clears the area of old grass, bushes, trees, and tree litter, and makes room for new young plants. More sunlight reaches the forest floor when older trees are gone, and tender young shrubs and trees quickly spring up. This is like fresh "salad" to deer and other animals.

Foresters study each forest carefully before deciding to clear-cut or burn. They only do it when they know for sure these actions will create the best conditions for growing new tree species, make more forest edges for wildlife habitat, or create a healthier forest.

Animal Cover

Wild animals seek cover for many reasons including: a place to hide; shelter or protection from storms and wind; shade on hot, sunny days; a place to nest or rest; privacy during mating seasons; a place to build a nest or home; and a safe place to raise their young, where the youngsters can play, hunt for food, and learn to protect themselves.

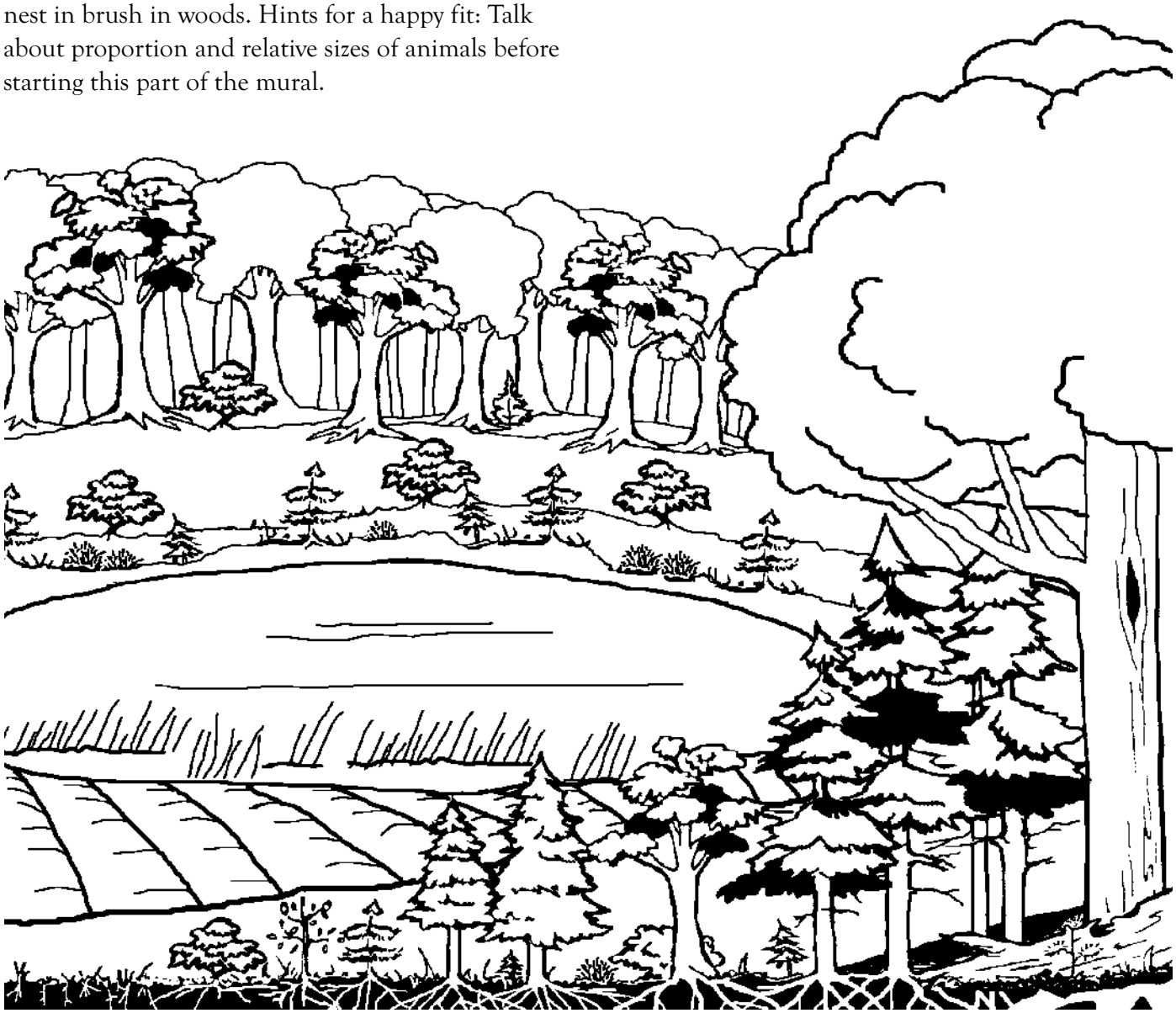
Hollow trees and logs, brush piles, and fallen branches offer wonderful cover for many animals. Raccoons, squirrels, and wood ducks are at home in hollow trees. Grouse, pheasants, quail, and rabbits use brush piles, downed tree branches, low shrubs, and tangled vines to hide and build their nests. Songbirds choose dense trees or shrubs as nesting sites. Trees and shrubs in a farm windbreak or shelterbelt are also excellent cover. They are animal roadways, too, making protected travel lanes for game birds, songbirds, fox, rabbit, deer, and skunks. Good cover is important to smaller animals because their enemies live in the same animal community. Hungry hawks, owls, wolves, and fox are waiting to nab animals that leave their cover.

Scavengers such as vultures and crows also live in the forest. They have a special role. They help keep the forest clean by clearing away and feeding on dead forest animals.

Are all trees good for cover? Not really. Usually, **conifers** provide good shelter and some foods, while **deciduous** trees provide good food and some shelter. A forest with a mixture of conifers and deciduous trees is ideal for wildlife animals. Each forest has its own type of soil, topography, and plant and animal wildlife species.

Places in a Forest

Students participate by drawing and painting a forest including forest edges. As part of the background scenery, include a corn or soybean field and water. After the painting is finished, students draw and paint animals to fit in the scene in the appropriate places on the mural. Include at least 12 animals. Some animals may appear in more than one place. Example: Pheasants feed in meadows or fields and nest in brush in woods. Hints for a happy fit: Talk about proportion and relative sizes of animals before starting this part of the mural.



Forest Beauty and Recreation

Throughout the ages, poets, writers, and painters have praised the forest as a place of great beauty. Trees have given strength, inspiration, hope, healing, and a sense of peace to people in all walks of life. The beauty of a forest, with its wonderful plant and animal life, is enjoyed by youngsters and adults alike. Towering pines, reaching for the clouds, make us stop in wonder. Seeing a moose with its nose under water, grazing on the bottom of a stream flowing through the forest, is a thrill of a lifetime.

Since forests are places of beauty and peace, it is only natural that people are drawn to them for **recreation.** Fishing, hunting, camping, canoeing, birdwatching, hiking, horseback riding, skiing, snowshoeing, snowmobiling, and photography are all part of forest fun.

Much of the heavy traffic leaving a city on a Friday afternoon is due to city folks heading for **forest regions.** Minnesota has 58 state forests specifically set aside for the public to enjoy. Two national forests—the Chippewa and the Superior—are also in Minnesota.

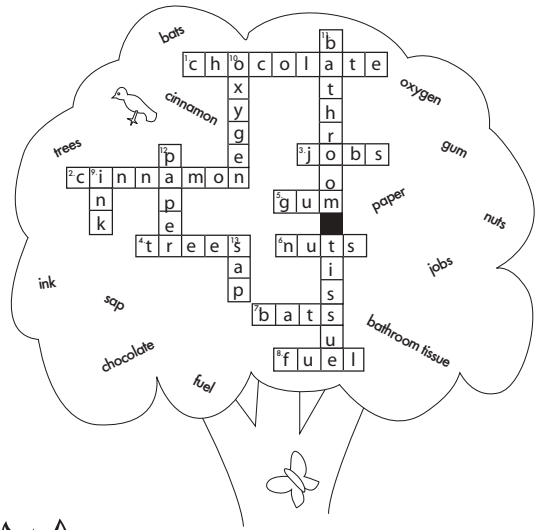
Language Arts

Tree-Mendous

You'll need: "Tree-Mendous" Activity Sheet, page 62.

Do the crossword puzzle on the activity sheet and learn more about what forests contribute to our lives.

Answers:



Forest Scramble

You'll need: "State Forest Scramble" Activity Sheet, page 63.

Do the game to learn more about our state forests.

Answers:

Minnesota has 58 state forests!

1. Northwest Angle
2. Sand Dunes
3. Richard J. Dorer Memorial Hardwood
4. Mississippi Headwaters
5. Paul Bunyan
6. Golden Anniversary
7. Emily
8. Land O' Lakes

What's Out There?

You'll need: Writing supplies and telephone or Internet access.

Write or call to get more information about Minnesota's forest recreation opportunities.

- State Forests: Contact the Minnesota Department of Natural Resources (DNR), Information Center, 500 Lafayette Road, St. Paul, MN 55155-4040; 651-296-6157 or toll free at 1-888-MINNDNR (646-6367). Check out the DNR's web site at http:/www.dnr.state.mn.us/forestry/state_forests/
- National Forests: Contact the Chippewa National Forest, 200 Ash Avenue Northwest, Cass Lake, MN 56633; 218-335-8600; http://www.fs.fed.us/r9/chippewa or the Superior National Forest, 8901 Grand Avenue Place, Duluth, MN 55808; 218-626-4300; http://www.fs.fed.us/r9/superior

People and Cultures

Trees and Celebrations

You'll need: Encyclopedias, access to library materials or optionally, the Internet, writing paper, and pencils.

Throughout history, trees and parts of trees have been at the center of celebrations and special occasions around the world. Have students research world celebrations and explore the significance of trees in them. Some idea starters: the Yule log, the Christmas tree, the maypole, ancient sacred trees, Northwest American Indian totem poles, the Buddhist Tree of Life.

The King's Forest

Versailles, France and Mexico were just two of many areas in past centuries that had royal forests. The king would enclose large areas of land with trees to save the acres for game and hunting. In some places, to trespass in the king's woods was punished with death. Paths cut through the forests to make it easier for the king's mounted hunting parties to pass through. These paths were so popular that they became a feature in designing the streets of Paris. Tree-lined streets crossed the city, often leading to a palace or an armory. Many places in Europe copied the idea, but the streets of Paris are the most dramatic because so many trees were carefully placed and planted.

Source: Porteous, Alexander. *Forest, Folklore, Mythology, and Romance,* 1928.

Think and discuss: How are trees used to mark special places in our communities today? (We still plant trees along our streets and boulevards. Trees are planted when babies are born and to honor people and events. Homeowners plant trees near their houses for shade and beauty, but also to make the houses look like they fit into the landscape. They make hedges for privacy and to mark their property lines. Trees, especially evergreens, grace our cemeteries and stand as tributes beside the graves of loved ones.)

Science and the Environment

Web of Life

You'll need: A ball of string and a card for each player with the name of a forest-related item. You may have some repeated cards; each of the items named on the cards is part of the web of life. For example, animals (deer, bear, fish, worm, wolf, rabbit); plants (grass, berries, tree buds, leaves); soil; sun.

Each student takes a card. Players sit in a circle with their cards on the floor in front of them. Starting with the *sun,* the first player holds onto the end of the string, then passes the ball to someone whose card names something that needs the sun in order to survive.

Have the student explain the connection. The next player does the same, moving the ball to something that needs his or her item to survive.

Continue to pass the string until all players are included and you can see a web. Discuss how all living things depend on each other. What happens in a forest when one part of the web is missing?

Option: If the group is large, you may want to break into smaller groups so players are closer together and cards are easier to see.

Forest Relationships

You'll need: The diagram on page 60 in a form students can see, acorns, and something to break open the acorns (optional).

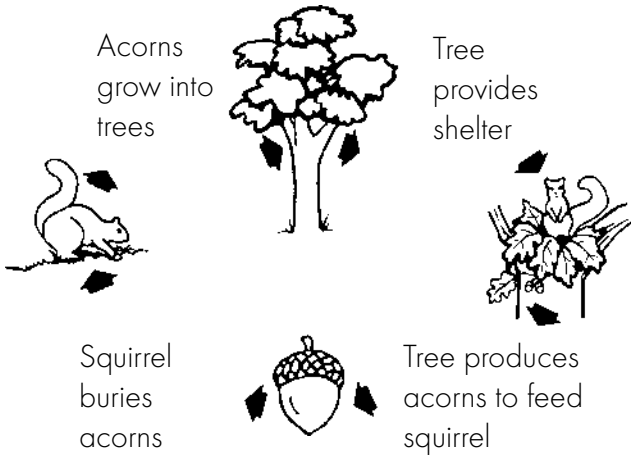
Draw the squirrel-nut-tree relationship cycle on the board or photocopy it for each student. Discuss what this diagram means. Ask the following questions; encourage students to ask questions, too!

a. How do most acorns get planted? Does every acorn grow into an oak tree? How do you know?
b. What happens to the acorns that do not grow into oak trees?
c. Does anything live in an acorn? How do you know?

List all the facts students know about acorns. Carefully cut several open and observe their insides.

What portion of the acorn will grow into the new tree? Which part is eaten by squirrels and other animals for food? Why don't humans eat acorns? (They are bitter.)

The Squirrel-Nut-Tree Relationship



—U.S. Department of Agriculture Forest Service

Places in the Forest

You'll need: Magazines to cut up, scissors, and materials for making a mural background.

If you didn't do this as a bulletin board activity, create a "Places in the Forest" mural now or talk through the various places of the forest with students.

Discuss: Which animals live in each part of the forest? Ask students to bring "wildlife" magazines to school that can be cut apart. Some titles to suggest are *Field and Stream, Outdoor Life, National Wildlife, Ranger Rick.* Attach wildlife where it would belong in the mural.

Enhancements

Math

Pine Tree Math

You'll need: "Pine Tree Math" Activity Sheet, page 64.

Have students do the activity sheet.

Answers:

1. 600' x 12" = 7,200"
   7,200" ÷ 2" = 3,600 seeds per row
2. 3,600 seeds/row x 8 rows = 28,800 seeds in all
3. 600' x 12" = 7,200"
   7,200" ÷ 4" = 1,800 seedlings per row
4. 1,800 seedlings/row x 5 rows = 9,000 seedlings

The Arts

The Living Forest

You'll need: Paper and pencils.

Write a short musical based on the life that goes on in a forest. Students take turns reading sections of the story and performing original songs or appropriate songs from other sources.

Recreational Fun

You'll need: Magazine clippings or photos of outdoor recreation and display space.

Have students find as many outdoor recreation pictures as possible in magazines or from family vacation snapshots. Each picture must include at least one tree. Make a recreational collage on a large bulletin board or length of butcher paper to display the pictures. How many of the students have done each of the recreational activities? Which are group favorites? Share tales of adventures in the forest.

Natural Works of Art

You'll need: Art materials and debris from the natural world.

Create forest landscapes using "natural treasures" collected on a hike. Students combine illustration, design, and bits of nature to create scenes. Consider dioramas or three-sided scenes constructed in boxes, too. Natural elements to choose from are nonliving specimens whose removal will not harm the environment in which they were found. Examples are stones and pebbles, twigs, bark debris, leaves, catkins, pine cones, and nuts.

Games and Physical Activities

Forest Call Ball

You'll need: Playground balls for each group of eight to 10 students.

Form circles of eight to 10 students. One player in each circle holds the ball to start. This first player tosses the ball to another player, calling out the name of a tree as he or she does so. The receiving player catches the ball, names another tree, and tosses it to someone else. The game continues until all players have had several chances to toss and receive the ball. Change the call category and continue on. Other call categories might be: animals that live in a forest, things people do for fun in a forest, and things made from wood.

Performance Assessment

Task Statement

Students replicate, on their own, a forest relationship cycle similar to the squirrel-nut-tree relationship cycle on page 60. They may choose another animal for a different plant-animal-soil, etc., example, but must show at least three steps of interrelationship between forest elements.

Grade 5 Standards

Identify the interdependence of forests and animal wildlife.

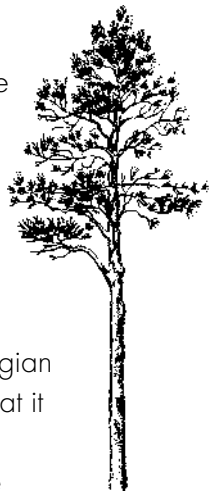
Evaluate the recreational contributions forests make to Minnesota.

Rubric—Quality of Performance

4 Exceeds performance standard
3 Meets performance standard
2 Developing toward performance standard
1 Attempts made but many serious errors

FUN FACT

Minnesota's state tree is the Norway pine, but we in the Lake States (Minnesota, Wisconsin, and Michigan) are the only ones who call it that. To most others, it is the red pine. The name "Norway" could have come from English settlers who thought it resembled the Norwegian scotch pine. Others speculate that it took its name from the town of Norway, Maine, another locale where red pine was observed by early settlers.



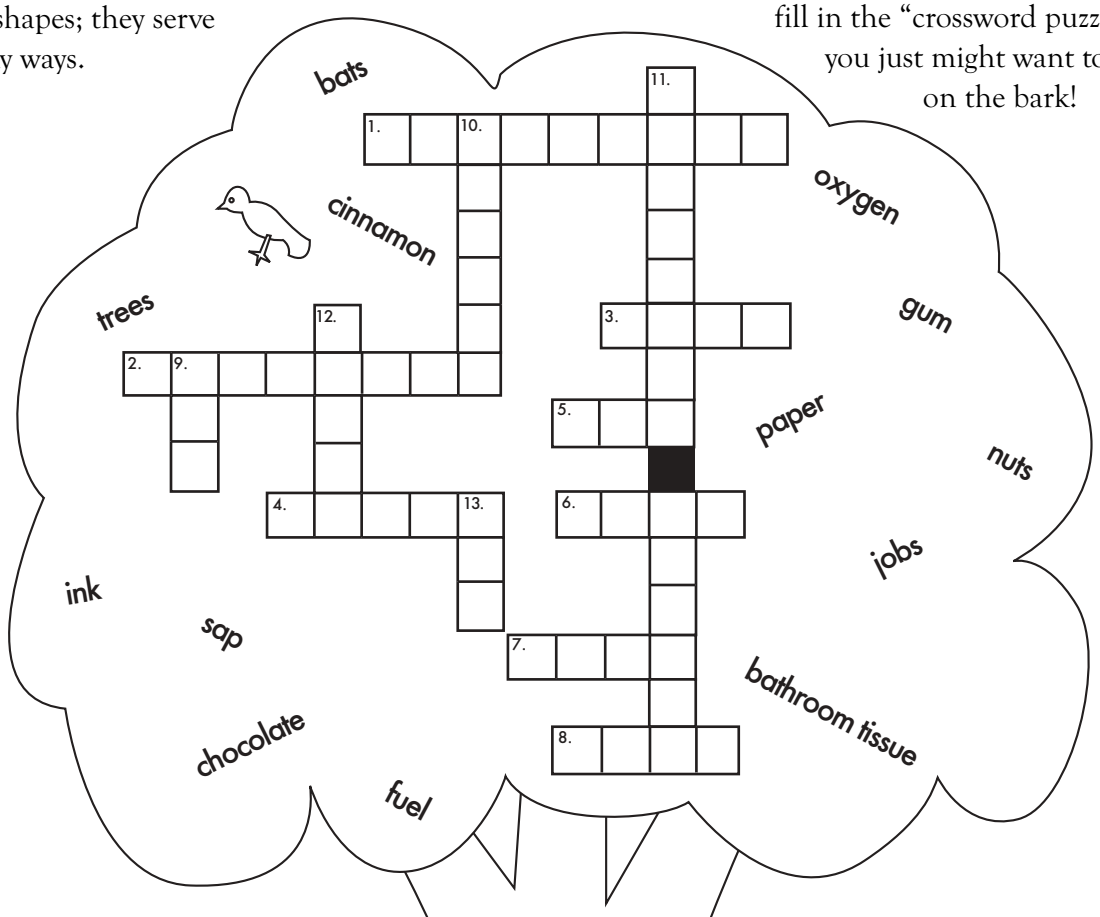
Tree-Mendous

KID'S COPY

Tree (tre)n. A woody plant that is at least 15 feet tall when fully grown; trees grow taller, live longer, and become more massive than nearly any other living thing; trees grow in many sizes and shapes; they serve us in many ways.

NAME: _____

You'll think trees are tree-mendous when you see some of the things they give us! Use these words to fill in the "crossword puzzle" ... then you just might want to pat a tree on the bark!



Across

1. Ground, roasted beans from the cocoa tree make _____.
2. _____ is a spice made from the bark of certain trees.
3. Trees give _____ to thousands of Minnesota workers who make these tree products for us!
4. Arbor Day is a special day when people learn about, plant, and care for _____.
5. Thank a tree for your chewing _____.
6. _____ are a type of food from trees.
7. The wood of ash trees makes great baseball _____.
8. Enough wood is burned for _____ each year in the U.S. to build a 100-foot-tall wall of wood that could stretch from New York to San Francisco.

Down

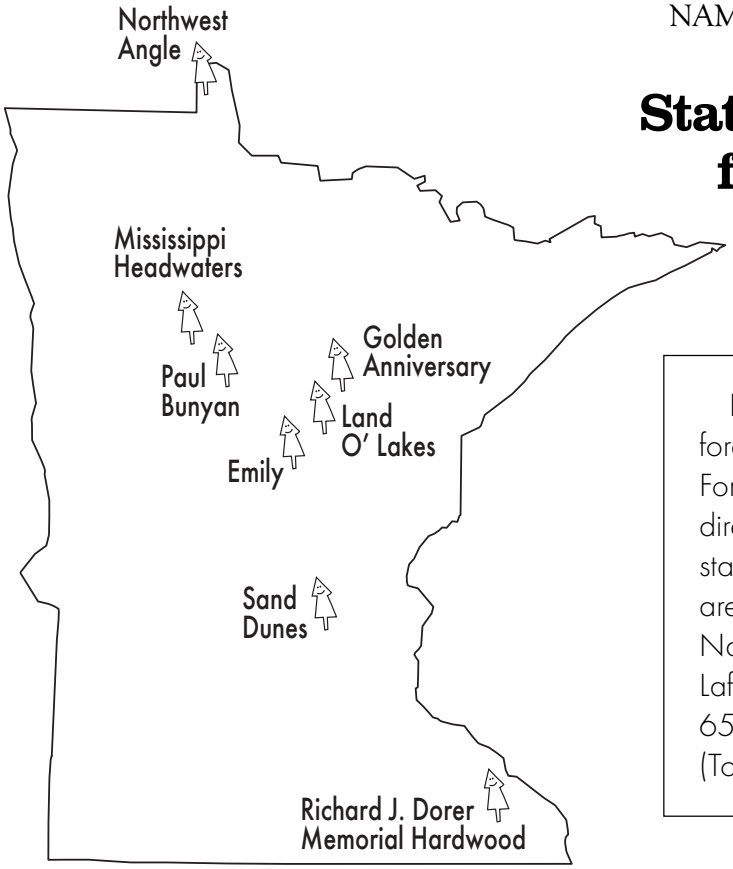
9. The _____ that is printed on this page starts with trees.
10. Trees supply _____ for the air we breathe.
11. Machines spin out 6,000 feet of this paper product every minute!
12. Each of us uses 600 lbs. of this tree product every year.
13. 30 to 40 gallons of _____ from a sugar maple tree boil down to one gallon of maple syrup.

Answers on page 58.

State Forest Scramble

KID'S COPY

NAME: _____



State forests are for everyone!

For more information on Minnesota's state forests, check out the brochure, "Minnesota State Forests—Outdoor Recreation Guide." It includes directions to state forest recreation areas and lists state forest trails, campgrounds, and day-use areas. Available through the Department of Natural Resources' Information Center, 500 Lafayette Road, St. Paul, MN 55155-4040; 651-296-6157 (Metro Area); 1-888-646-6367 (Toll Free).

How many state forests do you think Minnesota has? _____

In what ways can urban dwellers enjoy state forests? _____

_____

Eight of Minnesota's state forests are shown on this map.
Unscramble the names and tell which state forest is:

1. The farthest north? tsewthorN glenA _____
2. Named after landforms? nadS nDeus _____
3. East of Rochester? odroawdH mroiaelM orerD J chardiR _____
4. Where the Mississippi River begins? issiMppiiss sdwaHeater _____
5. Named after a logging legend? aulP yanBun _____
6. Named after 50 years of marriage? oldenG vnniAerarsy _____
7. A woman's name? miEly _____
8. Has the same name as a Minnesota foods company? naLd O keLas _____

Answers on page 58.

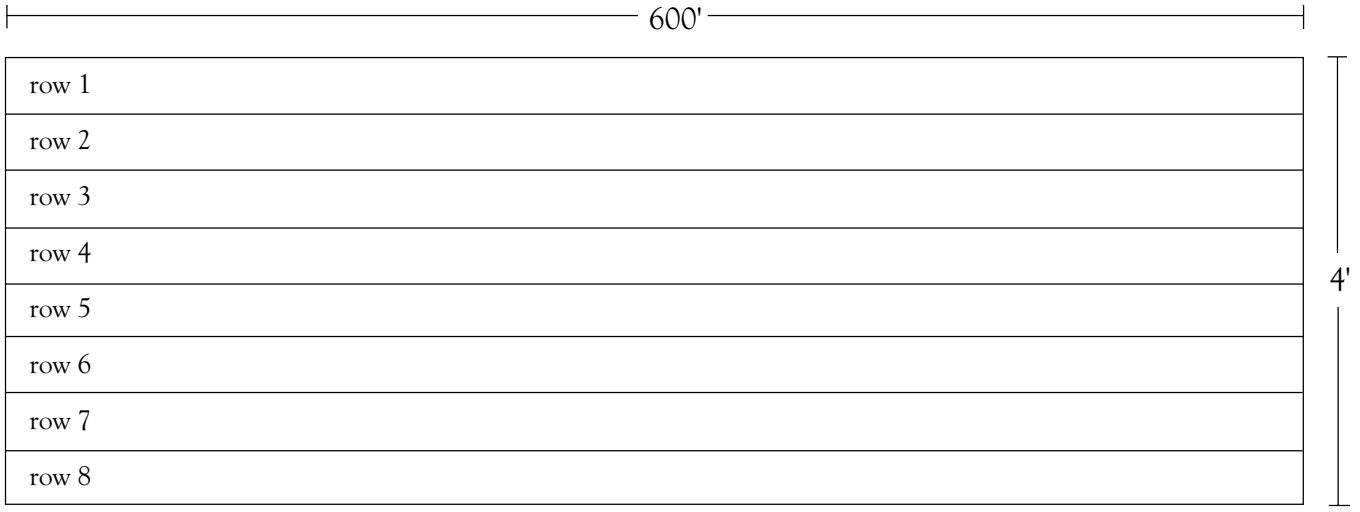
Pine Tree Math

NAME: _____

The red pine is an important tree to both wildlife and humans. It's an excellent cover, timber, windbreak, and Christmas tree. Long-lived, it can grow to a height of 60 to 80 feet. Although found on a wide variety of sites, the red pine grows best in areas with full sunlight and moist, well-drained soil. It grows quickly, has few major pests, and is Minnesota's state tree.

Shown below is the way a tree nursery plants seeds and seedlings in a planting bed beginning the life of red pine trees.

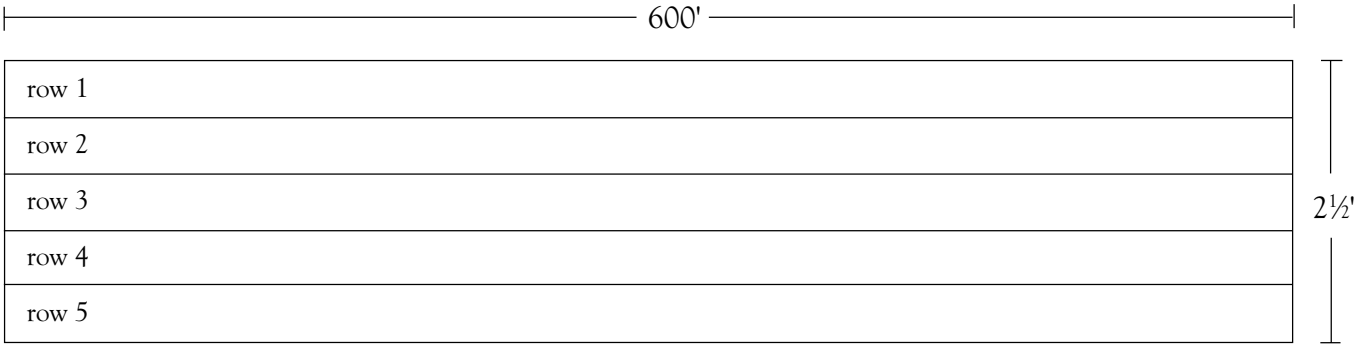
The planting bed is 600 feet long and 4 feet wide. It has 8 rows. Seeds are planted 2 inches apart in each row.



1. How many seeds are planted in each row? _____

2. How many seeds are planted in a planting bed? _____

After two years of growth, the seedlings are transplanted to another planting bed. This planting bed has 5 rows. Seedlings are planted 4 inches apart in each row.

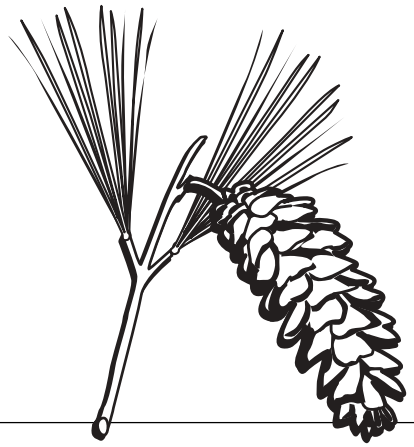


3. How many seedlings are planted in each row? _____

4. How many seedlings are planted in a 2-year-old seedling planting bed? _____

Answers on page 60.

Grades 6–8



Minnesota's Forests

Objectives

Students will:

- name and locate the three biomes of Minnesota and forest cover associated with each;
- describe shelterbelts, windbreaks, and living snow fences and their purposes;
- describe urban forests and their special needs;
- describe the importance of the forest industry to the state's economy.

Vocabulary Words

biomes
deciduous
coniferous
prairie grassland
shelterbelt
wind erosion
topsoil
windbreaks
snow fences
soil erosion
urban forest
community forest

Background Information

The history of natural stands of forests in Minnesota is much like that of forests throughout the United States. American Indians lived in the forest for thousands of years. They got all the necessities of life from their immediate surroundings. While they sometimes intentionally burned sections of forest to make open space to grow crops and attract game animals, the overall impact of native peoples on forests was small. They respected their woodland environment, knowing their survival depended on it. They used only what they needed, and did not deliberately harm their natural world.

European settlers arriving on the eastern coasts in the mid 1700s often found the lushly wooded lands to be a hindrance to the things they wanted to do. Clearing away trees to make way for homes and villages, roads, and fields was slow, backbreaking work with only animal power and simple tools. It wasn't until the late 1700s and early 1800s that many saw the value and money to be earned by harvesting what looked like an endless supply of timber. In a movement across the treed regions of the nation that lasted into the early 1900s, millions of acres of forest fell to the logger's saw. Forests were exploited; there was not much thought to the future. That's different today. Most wooded lands are now managed, planned, and planted so both our generation and those coming after us can enjoy things that only forests can bring to our lives.

Minnesota has three distinct **biomes.** These are biological communities of similar plants and their related animals that occur over large areas. The three biomes in Minnesota are the **deciduous** forest biome, **coniferous** forest biome, and **prairie grassland** biome. To see a map of Minnesota's biomes, turn to Resources, page 108.

For more information about Minnesota's forest regions, the history and uses of the forest, and special Minnesota trees, see Resources, page 105.

Human-Made Mini Forests

Farmstead Shelterbelts

As you drive through rural Minnesota, trees are a familiar sight around farm buildings and livestock feedlots. Trees give protection from Minnesota's strong, cold, winter winds and driving snowstorms.

In winter, prevailing winds in Minnesota are from the northwest. The ideal farmstead planting is

an L-shaped belt of trees and shrubs on the north and west sides of the farmstead area. The design of the planting depends on the number and location of buildings and feedlots on the farmstead.

For best protection, plantings are about 100 feet from buildings or feedlots. Trees planted too close to buildings or feedlots cause snow to pile up in winter and create hot air pockets (no air movement) on hot summer days.

A **shelterbelt's** main purpose is to stop the wind. Evergreens are especially good for this because they keep most of their needles all year long. Their branches also extend all the way to the ground.

Shelterbelt trees are planted close together in rows, with the rows also close together. The trees should not crowd each other, however. When this happens, sunlight is limited and limbs begin to die.

Field Windbreaks

All America awoke to the seriousness of soil losses through **wind erosion** (soil being carried away by the wind) when the first big dust storm hit the Great Plains in May 1934. The storm started in western Kansas, Texas, Oklahoma, and eastern Colorado. It carried an estimated 200 million tons of soil at a height of almost two miles eastward and northward across the country and for hundreds of miles out over the Atlantic Ocean. Dust settled in Canada, blocked out the sun over the nation's capitol, and sifted through screens of homes and offices all across the country. Some farms lost **topsoil** (the upper layer of soil, usually darker and richer than the subsoil) as deep as their plows reached. The blowing soil particles cut off crops at the soil line as cleanly as you could cut them with a knife.

After the dust storms, field **windbreaks** began to appear throughout the Great Plains and Midwestern states. In Minnesota, you'll see them primarily in the flat prairie region. The two main purposes of a windbreak are:

- to hold valuable topsoil in place, keeping it from blowing off the land
- to keep the winter snowfall on the cropland, which keeps more moisture in the topsoil.

An effective windbreak slows the wind, but is not so dense that it completely stops it. Instead, it should be open enough to let wind move slowly through—much like a screen in a window lets air through. This allows snow to sift through and spread over the protected cropland. When the snow melts, moisture increases over the entire protected area. Since deciduous trees lose their leaves in winter, they are a better choice for field windbreaks than evergreens. A single row correctly spaced can do the job.

Along with holding topsoil and keeping snowfall on fields, windbreaks offer food, cover, and travel lanes for wildlife. They also add beauty to the landscape.

Living Snow Fences

Living **snow fences** are plantings of trees, shrubs, native grasses, and sometimes standing rows of corn that trap blowing and drifting snow. These barriers are carefully placed near highways to help keep roadways clear and prevent big drifts that lead to stranded motorists.

According to the Federal Emergency Management Administration (FEMA), the natural disaster that claims the most lives in Minnesota is winter weather. Between 1990 and 2000, in the Mankato–Windom area alone, there were 1,411 vehicle crashes due to snow, 917 crashes due to blowing snow, and 86 crashes resulting from cross winds. With living snow fences, driver visibility is improved and these vehicle accidents are reduced.

Living snow fences have many other advantages. They save money when they help keep winter roads open. They absorb carbon dioxide, give off oxygen, and help reduce **soil erosion** (loss of soil) from wind and water. They add beauty to the landscape and provide wildlife habitat.

Urban and Community Forests

When many of us hear the word "forest," we think of the Boundary Waters Canoe Area Wilderness (BWCAW), the towering trees along the highways in northern Minnesota, or perhaps the wood lot on a farm. City dwellers tend to think forests are somewhere out in the country, perhaps a place where they hunt or hike or camp.

Bulletin Board Idea

Trees and Careers

Students participate by preparing the background and drawing or painting a large map of the biomes of Minnesota. (If you need help with this, check out the biomes map in Resources, page 108.) They research forest-related jobs in the 1860s and today, and add job information cards (and illustrations or pictures, if possible) to the bulletin board display.

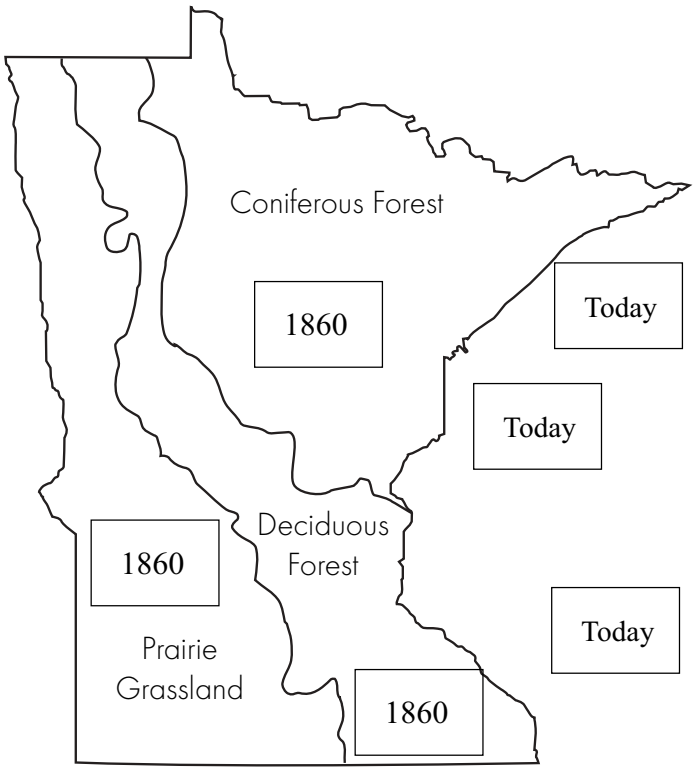
Job market of 1860. Illustrate cards showing past forest-related jobs. These go right on the map. For instance, horses and humans did much of the work with simple tools. There were loggers (lumberjacks), skidders, horse handlers and drivers, cooks and cook shanty helpers, saw sharpeners, and more in the forest itself. "River pigs" helped float logs down rivers to sawmills. From the mills, lumber traveled by horse-drawn wagons and sleds to meet local needs. Train cars and riverboats moved lumber longer distances.

A great collection of information on the history of logging in Minnesota can be found in "Early Loggers in Minnesota, Volumes I-IV" by J.C. Ryan. These four booklets can be ordered from the Minnesota Timber Producers Association, 903 Medical Arts Building, 324 West Superior Street, Duluth, MN 55802; 218-722-5013. Each booklet is $8.50.

The Forest History Center in Grand Rapids can also help with this project. If possible, try visiting the site and see how some of these forestry jobs were done in the past. Contact the Forest History Center at 2609 County Road 76, Grand Rapids, MN 55744; 218-327-4482; http://www.mnhs.org/foresthistory.

Job market today. Illustrate cards that show and tell about a forester, tree inspector, logger, large crane operator, trucker, etc. "Today's" cards go on the outside of the map, but on a parallel with the biomes they might apply to.

Forest products manufacturing is Minnesota's third largest industry surpassed only by machinery and computer services and electronic equipment and instruments. Many forest product-manufacturing jobs are located in the Twin cities metro area.



The truth is that cities and towns have forests, too. The trees in city parks and open spaces, the plantings along boulevards, the bushes on golf courses and in back yards, birds in the trees and the wildflowers at the edge of the schoolyard are all part of an ecosystem that is often called an **urban** or **community forest.**

The trees in urban forests are usually a combination of species that have sprouted naturally and plantings done by humans. Some of the trees grow in public places like parks, and belong to everyone in the community. Others grow on private property.

Trees that grow in areas where there is a lot of human activity have special challenges. Air pollution; damage from vehicles, weed whips, and human actions; root damage from construction and utility work; and soil compaction over the roots can all be hard on tree health. Many communities have city foresters or park employees who look out for the health and welfare of the trees, advise property owners how to care for their trees, and help plan and plant trees for now and for future generations.

Forests for Special Uses

Sometimes, trees are planted for very specific purposes. Examples of these forests are Christmas tree lots and fields of fast-growing aspen to be used for paper or construction fiberboards. Several acres are planted with the same species of trees, and the trees are cut when they reach the right size for their purpose.

Language Arts

Literature and Folklore

A Sand County Almanac. Introduce students to naturalist Aldo Leopold through selections from this classic journal of a family's experience on a southern Wisconsin farm.

Lumber-Camp Lore

You'll need: Library or media center access.

Have students research life in the lumber camps during the heavy logging periods of the 1800s and early 1900s. Along with getting a fascinating glimpse of history in their work and lives, enjoy lumber lore. Lumberjacks often invented fantastic stories and characters to entertain themselves during the long, cold winter months.

Forest Facts Crossword

You'll need: "Forest Facts Crossword" Activity Sheet, page 76 and Forest Facts Crossword Clues Sheet, page 77.

Have students do the crossword puzzle.

Answers to Forest Facts Puzzle: **Across**—3. acid rain, 8. redbacked, 11. erosion, 12. trees, 14. understory, 16. forest, 18. humus, 19. golden mouse, 21. fern, 22. porcupine, 24. recycle, 26. growth, 28. slug, 29. multiple use, 31. bark, 32. log, 34. needle, 35. canopy, 37. tropical, 38. cypress swamps, 40. broad, 41. polluted, 42. stork. **Down**—1. fir, 2. hiking, 4. deforestation, 5. nest, 6. water, 7. northern spotted owl, 9. mushroom, 10. wood, 13. pines, 15. resource, 16. fur, 17. ruffed grouse, 19. ground beetle, 20. earthworms, 23. climate, 25. conifers, 27. salmon eggs, 28. snag, 30. decomposers, 31. boreal, 33. deciduous, 36. paper, 39. mixed.

Spread the Word

You'll need: Writing supplies.

Three weeks before Arbor Day, have students write "press release" announcements to local newspapers, community leaders, business owners, and residents reminding them that Arbor Day is coming. In the announcements, encourage participation in this year's Arbor Day by planting trees and other plants. Invite readers to share their plans with students, telling how they will support Arbor Day and how students, in turn, might be involved in making it happen. (See "Arbor Day, Celebrate Trees!" on page 1 for activity ideas.)

Vocabulary Boosters

You'll need: Reference materials and a dictionary.

Have students research to define silviculture, bottle biology, arborist, botanist, landscape engineer, forester, hydrologist, horticulture.

People and Cultures

Trees in Any Language

Take a walk outdoors and have students sit quietly beside a tree, simply being with the tree in silence for five minutes. During this time, ask them to really focus on the tree, the look of its branches against the sky, the pattern on the bark, the spread of the canopy, the shadows on the ground. When we really spend time with a tree, what messages might we imagine it can say to us?

Ask students: What do trees "say" to people all around the world? Have them research what trees mean in cultures throughout the world. Why do the feelings and messages about trees move so easily from one culture to another?

Invite students to share times trees have been meaningful to them, or how a tree is important in their culture or community.

Think and Discuss

Discuss Minnesota's biomes (see Resources, page 108). How does the natural environment influence the way people live?

Research: The Hinckley Fire of 1894. If you need more information, write to the Fire Museum Curator, 106 Old Highway 61, Hinckley, MN 55037. What precautions do we have today that would help avoid a fire of such size in Minnesota today?

Guest speaker: Ask someone from the Minnesota Historical Society to speak to the class about the Forest History Center in Grand Rapids.

Home Forests

Have students research and discover the forests in their own community. Before beginning, ask: How can you find out this information?

For town and city dwellers, what does urban forest mean? Where is it? Who takes care of it?

Find out what portion of your county is forested, the kinds of trees that are generally cut, if any, and why, and the kinds of wood products made in your county. Learn how people use the forests in the local community.

Field Trip

Visit a lumberyard, sawmill, pulp mill, or other wood-processing industry. Call beforehand to arrange a tour. Here are some questions you can ask to help learn about this business:

How does this business get the raw materials to make its product?

How does it help ensure the raw product will be there for its use in the future?

Who buys the product? How and where does it get shipped?

How many employees are there? What are their jobs?

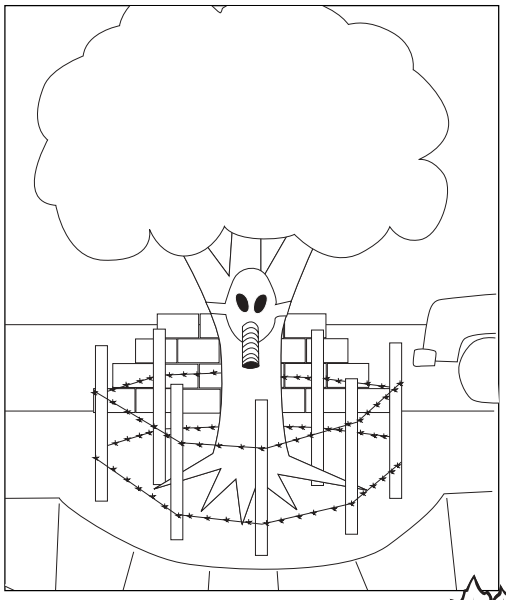
Option: If there are no businesses like this locally, contact companies by phone or letter in another area and ask the same questions.

Science and the Environment

Perfect Urban Trees

You'll need: Drawing materials and paper.

Let student's imaginations soar. Design a perfect urban tree. How would it deal with polluted air ... wear a thick gas mask perhaps? How would it protect itself against climbers? Would built-in ladders or an elevator work? Think about the challenges that affect urban trees, then draw the solutions.



Original Field Charts

You'll need: Cameras, poster board, pens or markers, ruler or measuring tape, staplers, treats such as cookies, and younger students (first to third graders).

This project may take several days. You might want to pair or group students to work with different trees.

Students will create large, single-tree charts that function as a field guide to many of the trees in the area. Students take photos of various trees and perhaps attach a leaf, pine cone, etc., from each tree to a chart. The chart also contains locations of the tree, species, approximate size, and any unusual characteristics. Each pair or group takes its completed chart and a group of younger students outside. The younger children are challenged to locate the tree that is featured on the chart. The chart makers then lead the younger children to that tree, invite children to explore it close up to really get to know the tree, and share the information on the chart. The group sits beneath the tree and enjoys a treat together.

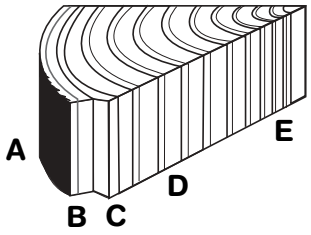
Discover How Trees Grow

You'll need: Materials students decide they need to complete the project.

Provide information about the cambium cells and how a tree grows (see the following information and Resources, page 115). Also, use references such as youth-friendly encyclopedias, most of which have good illustrations. Ask students: How could we make a model, drawing, or other demonstration to show how trees grow? What needs to be included?

Divide students into groups of three or four. Each group develops a way to visually show someone who does not understand the way the cambium cells divide—forming wood cells toward the center of the tree and bark cells toward the outside and causing the tree to grow. Students might produce a video, drawings that move, transparencies, and models to teach this fascinating concept.

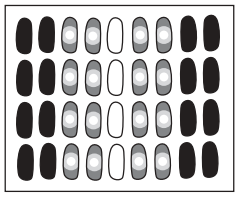
The trunks of most trees are made up of five layers. From outer to inner, these layers are:



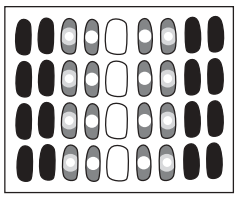
A. Outer Bark
B. Phloem
C. Cambium
D. Xylem
E. Inner Wood

Every layer performs a vital function in growth.

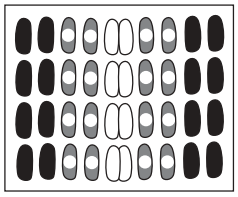
Trees grow from the inside out. Beginning in spring, the cells in the cambium layer divide to form new cells. The new cells toward the outside of the tree form the phloem that carries sugar-rich sap from the leaves throughout the tree. Phloem eventually becomes bark. New cells toward the inside of the tree form xylem, which carries water and minerals up the tree from the root system. Xylem eventually becomes wood. Growth that makes a tree larger in width takes place at the cambium layer. Growth that makes the limbs and roots longer and trees taller takes place at the branch tips (buds) and root tips.



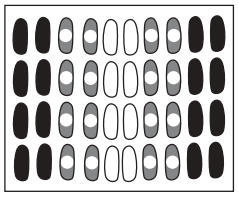
1. Cambium cells are found between the inner wood and xylem, and the phloem and outer bark (moving from inside the tree out). The cambium is visible with a magnifying glass.



2. Growth widens tree trunks, limbs, and roots.



3. Then cambium cells divide, forming xylem cells toward the center of the tree and phloem toward the outside.



4. The new cambium cells begin the growth process again.

Tree Growth

You'll need: Models, photos, or actual parts of a tree.

Show how a tree grows from seed to maturity. Use models or actual parts of trees that students have collected.

Show the relationship of various parts of the growing tree to its environment including cooperation and competition with other plants (flora) or animals (fauna).

Observe the differences in growth and form between a deciduous tree and a conifer or between different deciduous trees and conifers. Show how these occur in nature, and with the aid of books on trees, describe these differences in your project.

Design a Shelterbelt

You'll need: Construction paper, large paper or poster board, markers, and glue. This can be a group or an individual project.

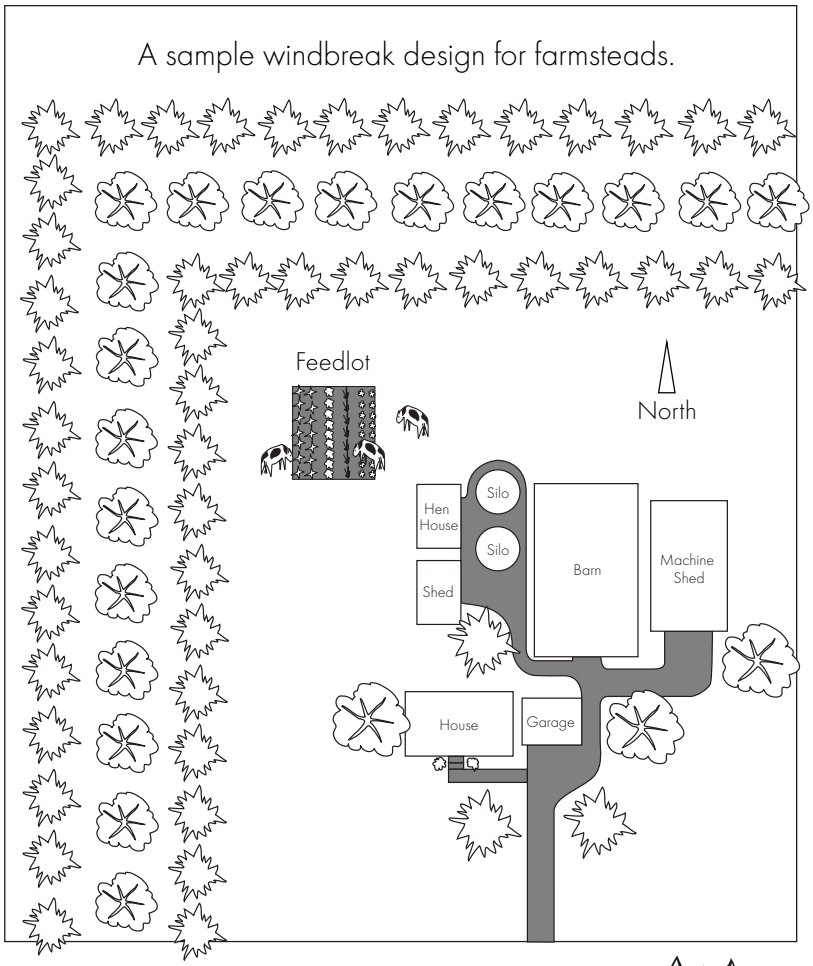
Review with students: Forests are sparse in the prairie grassland biome of Minnesota. Most natural stands occur along river banks and wetland areas. Trees were planted around homes or as windbreaks or shelterbelts in the countryside. On farms, plantings are planned to help protect people and animals from the cold northern and western winter winds. In this project, you design a shelterbelt to protect a farmstead.

1. From the construction paper, design symbols to represent the farm buildings: house, barn, shed, silo, etc. Add a feedlot for animals, too. Lay the farm buildings and feedlot in place. Leave enough room around the outside of the paper for shelterbelt plantings on the poster board.
2. Make symbols or draw figures to represent shrubs or trees that are planted around the buildings for landscape reasons.
3. Make symbols or draw figures to represent the evergreen trees to be used in the windbreak.
4. You won't be able to show scale on small worksheets, but distance is given in the following directions so you can estimate spaces needed.

Guidelines for planting:

1. Plant the windbreak on the north and west sides of farmstead buildings.
2. Plant the first row of plantings about 100 feet from buildings and feedlots and 50 feet beyond them.
3. Plant at least three rows for good protection.
4. Leave space between rows. (In real life, it's about 16 feet depending on type of trees.)

Some farmers use mostly evergreens in their windbreaks. Others mix the trees, using slower growing trees like pine and spruces on outside rows and faster growing trees like maple and ash in inside rows. This helps "fill in" spaces in the new shelterbelt quickly.



Enhancements

Math

Word Problems

Glance through the information in this *Teachers' Guide* and create word problems and situational math exercises using the forest as a base. The skills of your group will determine specifics. Some basic examples:

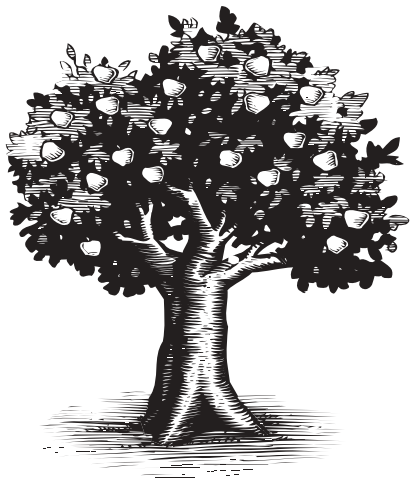
1. Fireplace wood is often measured in cords. A standard cord of wood is a stack that is 8 feet long, 4 feet wide, and 4 feet high. How many cubic feet is that?
2. Minnesota has 16.7 million acres of forested land, owned in the following percentages. What is the total number of acres owned by each group?
   Private owners - 32 percent
   State - 23 percent
   Federal - 21 percent
   Counties - 16 percent
   Industry - 8 percent
3. Vermont was about 35 percent forested a century ago. Today it is about 76 percent forested. What is the percentage of increase?
4. In 1990, Minnesota forest growth was 5.7 million cords and harvest 3.5 million cords. What was the difference? What is the percentage by which growth exceeds harvest?
5. Land in the U.S. is frequently measured in acres. An acre is 43,560 square feet (about the size of a football field). What is the metric unit of measurement most comparable to an acre? If one acre of land is equivalent to about 2.47 of that metric unit, what would be the size of a 1,000-acre forest in metric terms?
6. In wood terms, a "2x4x12" describes what?
7. A board foot is a lumber measurement for a board 1 foot long, 1 foot wide, and 1 inch thick. Imagine that you are going to build a bookcase that has five shelves, each 36 inches long, 12 inches wide, and 1 inch thick. How many board feet of lumber will you need for shelving alone? Next, suppose that the top and bottom shelves form the top and bottom of the bookcase. If the bookshelf is 5 feet tall, how many more board feet will you need to complete the back and sides of your bookcase? How many total board feet are needed for your bookcase?

Answers:

1. 128 cubic feet.
2. Rounded off: Private - 5.34 million acres; State - 3.84 acres; Federal - 3.51 million acres; Counties - 2.67 million acres; Industry - 1.34 million acres.
3. 202 percent increase.
4. Growth is greater; 2.2 million cords; growth exceeds harvest by 63 percent.
5. Hectare; 404.9 hectares.
6. A piece of wood 2 inches thick by 4 inches wide by 12 feet long; "2 x 4" is a common term for lumber 2 inches thick by 4 inches wide.
7. Shelving: 15 board feet; 25 more board feet for back and sides; 40 board feet in all.

FUN FACT

Big Drinkers



Trees require enormous quantities of water. A large apple tree in full leaf may absorb as much as 95 gallons of water from the soil every day. Most of the water goes to the leaves. On a sunny summer day, some trees move water up through their trunks at the rate of three feet per minute. A tree's wood is about half water.

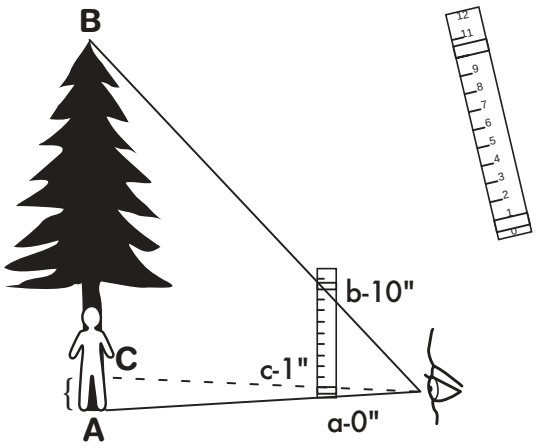
Measure That Tree

You'll need: For each pair of students, a 12-inch ruler, masking tape, a flexible tape measure, stakes, notepaper, and a pencil.

Tree Height Measurement. Students pair with a partner and select a tree. Each pair takes their 12-inch ruler and marks the 1-inch and 10-inch lines on the ruler with tape. One person then stands at the base of the tree. The other holds the ruler up in front of his or her own eyes at arm length and moves back until he or she can see the whole tree from top to bottom between the 0-inch and the 10-inch mark on the ruler. He or she then moves the ruler until the base of the tree (A) is exactly at 0 inches (a) and the top of the tree (B) is sighted exactly at 10 inches (b). (See diagram.) Then he or she sights out from the 1-inch mark (c) to a point on the trunk above the base (C). The partner marks this spot on the trunk with tape.

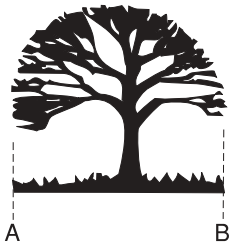
Measure the distance from the base of the tree to the 1-inch mark (A to C). Multiply by 10 to get an approximate idea of the height of the tree (A to B).

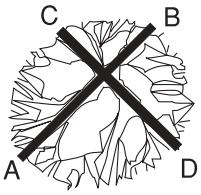
Ask students: Why might an urban forester be concerned about the height of a tree? (So it doesn't grow into overhead power lines.) Do trees grow to various heights? (Yes. For example, a red pine can grow to a height of 60 feet to 80 feet, sometimes 100 feet; a sugar maple can grow to a height of 80 feet; a paper birch can grow to a height of 65 feet to 70 feet; a red mulberry can grow to a height of 18 feet to 30 feet, sometimes 50 feet.)



Crown Spread Measurement. Set a stake directly under the outside edge of the crown farthest from the trunk (A) and another directly opposite it at the outer edge of the crown (B) on a line passing through the center of the tree. Next, set stakes marking the shortest diameter of the crown passing through the center of the tree (C and D). Measure both distances to the nearest foot with a tape measure. Add the two measurements together and divide the sum by two to find the average crown spread.

Ask students: Why is a larger crown spread better for the health of a tree? (A larger crown means more leaf area to produce food for the tree.)





Circumference Measurement. Measure, to the nearest inch, the distance around the tree at a point 4½ feet up from the ground. If the tree is on a slope, measure from the ground at the mid-point of the tree base. A flexible tape measure is a good tool to use.

Ask students: Is the tree with the smallest circumference the youngest? (Not always. The tree could be an old one that has been growing slowly due to poor or stressful conditions. See Resources, page 114 to get more information on things that affect tree growth.)

Use "Measure That Tree" Activity Sheet on page 78 to help with these tasks.

Ask a Pro

Interview a forester or arborist to learn how he or she measures, counts, and inventories trees. When and why is it necessary?

The Arts

Nature Photography

You'll need: Cameras and film.

Have students take a camera tour of a nearby forest. Try for creative shots. Share results!

Still Life Art

You'll need: Leaves, seeds, pine cones, and camera and film or drawing materials.

Artistically arrange leaves, seeds, pine cones, and other forest-related items to create a still life display. Photograph or illustrate the display.

Nature's Palette Dyes

You'll need: Raw materials for making dyes (see activity), white vinegar, stove or hot plate, screen or cheesecloth, and T-shirts or fabrics to dye.

Making dyes, inks, and art materials from natural materials is easy and fun. At the same time, you can learn a lot about conservation and safety. A nature hike is an opportunity to collect some of the things. Others can be found in the kitchen, grocery store, and greenhouse. In nature, don't take any materials whose removal would harm the environment in which it was found, and be sure not to collect plants that are protected by the law. Check with an adult to be certain no poisonous plants are collected. And play it safe; tasting wild plants and berries is off limits!

Late summer and fall are usually the best times to gather dyes from nature. In spring, you may have to rely on the kitchen or grocery store for materials.

Colors and Sources. **Yellow:** brown onion skins, marigold and goldenrod blossoms, sunflower petals; **orange:** roots, bark, leaves from sassafras; **bluish purple:** grapes or grape juice, blueberries, blackberries, raspberries; **green:** plantain leaves and roots, spinach leaves; **brown:** tea bags, bark, instant coffee, black walnut husks.

Preparation. Chop all materials into small pieces. Prepare each color separately—one part plant material to one part water. Add one tablespoon white vinegar to each pint of dye to help keep colors from fading. Bring to a boil, then simmer for about an hour. Add more water if needed. Cool and let sit overnight for brighter colors. Strain the dye through a strainer or cheesecloth.

Dip fabrics into the dyes and watch the color changes. More tips:

- Tie-dye T-shirts.
- Dye pillowcases and run sturdy cord through the hems for handy drawstring sacks.
- Dye sections of old sheets to make your own table covers, curtains, and more.

Hint: Carefully choose your drying spot for dyed fabrics as the dye may "seep" from your fabric into the drying surface.

Through the Mist

You'll need: Tissue paper (several colors), drawing paper, and liquid paste.

Cut the same tree silhouette from various colors of tissue paper. Overlay on drawing paper using liquid paste to hold them in place. They'll have a "misty," multi-colored appearance.

Games and Physical Activities

Forest Fitness

Explore recreational and fitness uses of forests and natural spaces, and do some of them if possible. Discuss:

a. How do trees and forests contribute to overall human recreation or exercise and lifetime sports?
b. How can people get good outdoor exercise if they have little equipment, time, or support from others (for example, teams)?
c. Discuss the physical and emotional value of trees and forests in helping people deal with the effects of stress. What could this mean to society in terms of medical expenses, work productivity, and social activities?

Performance Assessment

Task Statement

Students create and play a new Tree Bingo game using questions and answers on the following: Minnesota biomes, history of Minnesota forests, the importance of trees to our economy, careers in forest industry, urban forests, and windbreaks and shelterbelts. (See samples in Resources, pages 92-95.)

Grades 6-8 Standards

Identify the three Minnesota biomes, their general locations, and their types of forests.

Evaluate the values of windbreaks and shelterbelts.

Research local community forests and how they are used.

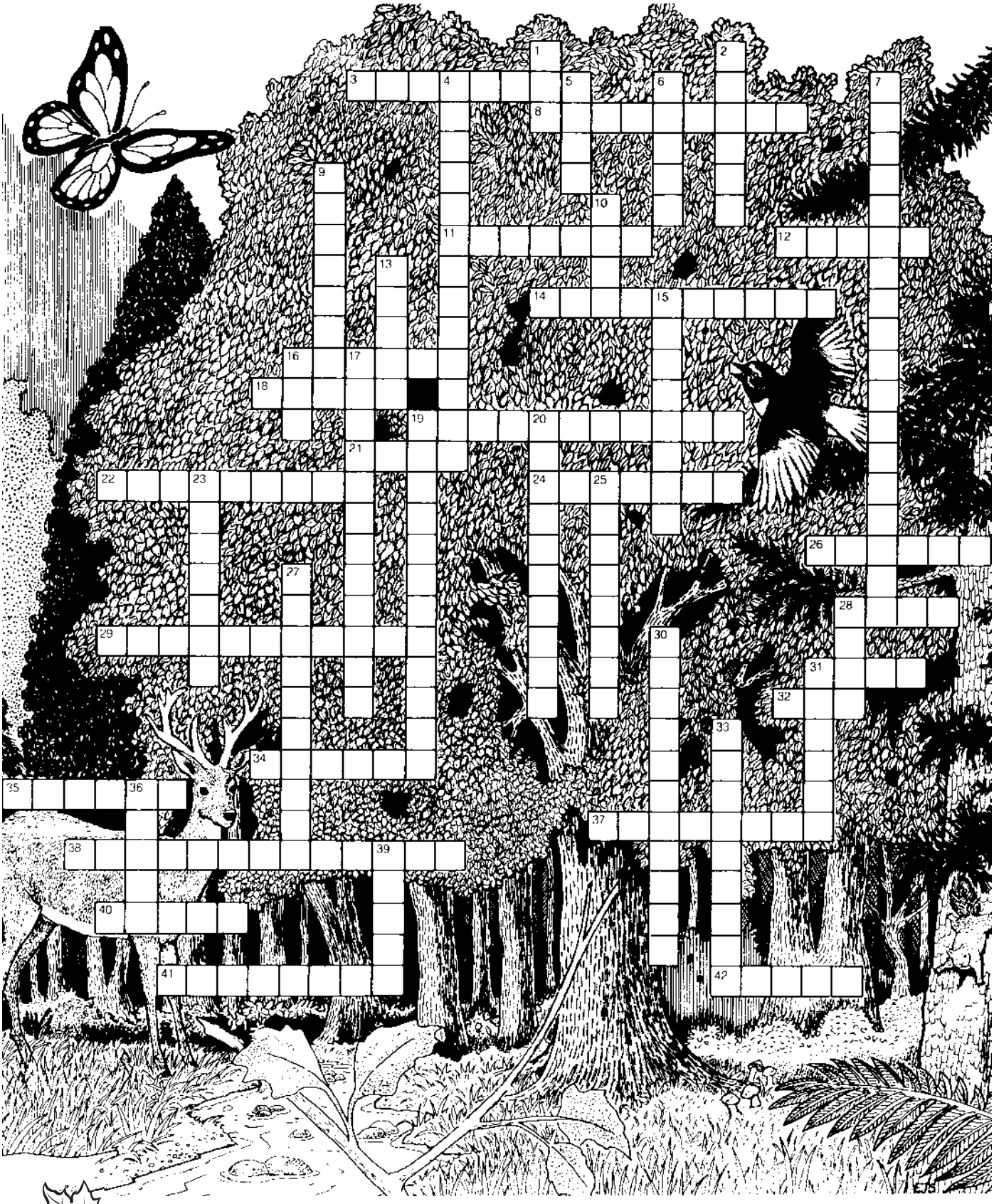
Rubric—Quality of Performance

4 Exceeds performance standard
3 Meets performance standard
2 Developing toward performance standard
1 Attempt made but many serious errors

Forest Facts Crossword

KID'S COPY

NAME: _____



Forest Facts Crossword Clues

This crossword puzzle reviews the information presented throughout this guide plus some things that may need to be researched. To make it easier for your students, list the crossword answers in random order on the board or on a reproduced "Word Bank" sheet for each student. The answers are on page 68.

Across

3. A form of air pollution called _____ is a serious threat to forests.
8. The _____ salamander lives in northern mixed forests. It gets its name from the stripe on its back.
11. Because the roots of trees hold soil in place, forests help prevent _____.
12. Both the oldest and largest plants in the world are _____.
14. The middle layer of the forest is called the _____.
16. A _____ is a community of trees and other plants, and of animals.
18. Decaying plant and animal matter in the soil is called _____.
19. A long tail helps the _____ balance as it scampers along branches and vines in the forest.
21. _____s, mosses, and lichens are plants that often grow on the forest floor.
22. The _____ is a prickly mammal that feeds on bark and other tree parts.
24. When you _____ your old newspapers, you're helping to conserve forest resources.
26. An old-_____ forest has many old, large trees. This type of forest also contains many snags and fallen logs.
28. A slimy, yellow invertebrate called the banana _____ lives in Pacific Coastal forests.
29. When people manage forests for more than one use at a time, they are practicing _____-_____ management.
31. A tree's _____ helps protect it from insects and disease.
32. A fallen tree, or _____, provides nutrients for insects, fungi, and other forest organisms.
34. Pines and spruces are types of _____-leaved trees.
35. The leaves and branches of a forest's tallest trees form its _____ layer.
37. _____ rain forests grow near the equator, where it is warm and where there is plenty of rain year round.
38. Many southern _____ _____ have been drained to provide land for crops and homes.
40. Maples and elms are types of _____-leaved trees.
41. Forests can help clean _____ air and water.
42. The wood _____, which nests in cypress swamps, is an endangered bird.

Down

1. A type of conifer called the subalpine _____ grows near icy mountain peaks.
2. Camping, birdwatching, and _____ are all recreational activities that you can enjoy in a forest.
4. _____, or the process of clearing away trees, is occurring in many of the world's tropical forests.
5. Western tanagers _____ in conifers or oaks.
6. The _____ moccasin lives in cypress swamps and feeds on fish, frogs, and other swamp creatures.
7. The _____ _____ _____, a bird of prey, lives in old-growth forests.
9. Many large, brightly colored _____s grow on the damp boreal forest floor.
10. _____ is a forest product we use to build homes and make paper.
13. Loblolly and shortleaf _____, which grow in the southern United States, furnish about one-third of the timber produced in this country.
15. Forests are a renewable _____, which means they won't "run out" if they are properly managed.
16. Its thick _____ coat helps the pine marten withstand the cold winter temperatures of the northern mixed forest.
17. The male _____ _____ jumps up on forest logs and drums to attract females.
19. With its strong jaws, the _____ can crush insects and other prey easily.
20. Many _____ live in the forest soil. If it rains, you may see them wiggle their way to the surface.
23. A region's _____, elevation, and soil affect what type of forest grows there.
25. Trees that bear their seeds in cones are called _____.
27. _____ _____ are found in many streams in the Pacific Northwest. If too much silt and debris get into the water, these tiny fish embryos may be damaged.
28. A standing, dead tree, called a _____, can be a home to many animals.
30. Animals and plants that break down dead matter into smaller parts are called _____.
31. _____ forests grow in cold, northern regions.
33. Each year at a certain time, _____ trees lose all their leaves.
36. This page is made of _____, a forest product.
39. Growing between the deciduous and boreal forests, the northern _____ forest contains both conifers and deciduous trees.

Adapted from the National Wildlife Federation's *"Forests are More Than Trees."*

Measure That Tree

NAME: _____

Pair up with a partner and try it for yourself. Take two copies of this page and measure and compare two different trees.

Height Measurement

1. Choose a tree.

2. Follow the directions on page 73. You may want to take a copy of them with you. With 0" at the base of the tree, 10" at the top, have your partner mark the tree at your 1" spot with a piece of masking tape.

3. Record the distance between the base of the tree and the masking tape marker here (round off to the nearest foot). _____ feet.

4. Multiply your answer in #3 by 10.

How tall is your tree? _____ feet.

Crown Spread Measurement

1. Follow the directions on page 73.

2. Record the distance (to the nearest foot) A to B here. _____ feet.

3. Record the distance (to the nearest foot) C to D here. _____ feet.

4. Add the distances together. _____ feet.

5. Divide your answer in #4 by 2.

What is the average crown spread? _____ feet.

Circumference Measurement

1. Follow the directions on page 73.

2. Write the tree's circumference here. _____ inches.

Extra Challenge: Sketch your tree to scale on graph paper!

Resources

About These Resources

These pages have been specially selected to give teachers and group leaders:

- **Activities and games** that cross grade levels and subject lines.
- **Background information** on selected tree-related topics.
- **Quotes, poems, songs,** etc., that can be used for Arbor Day celebrations or anytime.
- **Books and community resources** for more information.

These materials are ideal environmental education curriculum enhancements. The subject areas listed are suggestions; many of the materials are also appropriate in other subject areas. The pages are valuable, independent learning projects, too.

Most pages can be copied directly for use with students. Those activities that have both teacher guide information and student activity sheets are labeled.

Activities and Games

Background Information

Collections (For Arbor Day or Anytime)

Books and More

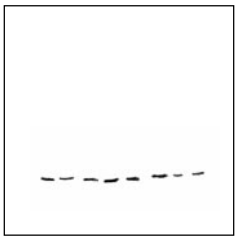
Drawing Trees

KID'S COPY

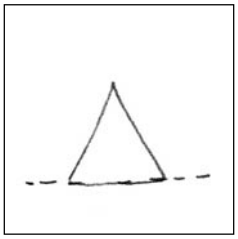
Drawing trees is fun and easy. Draw them your way, or try these step-by-step hints for drawing trees the way artists do! Use light lines when you draw crown shapes. The branches will be your final tree shape.

NAME: _____

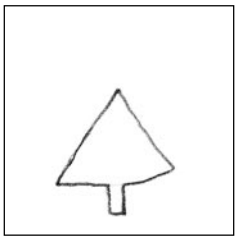
Needleleaf Trees



1. Draw a very light dotted line to mark your space.



2. Draw the crown shape.

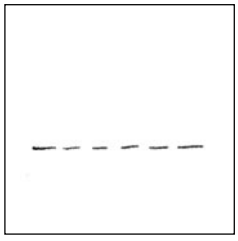


3. Draw in the trunk.

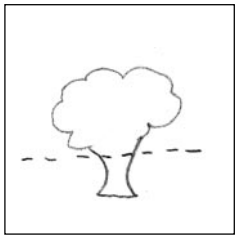
4. Shade in the shape using the side of a sharp pencil.

5. Finish the tree in the same way.

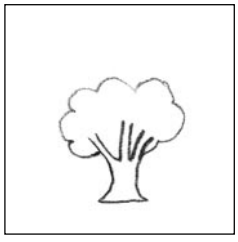
Broadleaf Trees



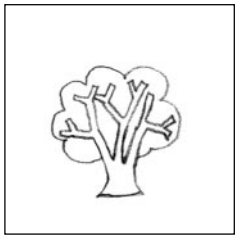
1. Draw a very light dotted line to mark your space.



2. Draw the crown shape and trunk.



3. Make branches. Draw a "V" inside each branch.



4. Continue drawing branches to fill in the tree.

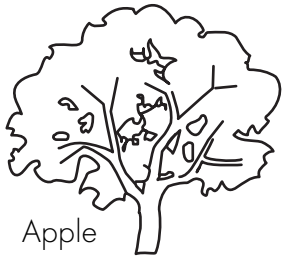
5. Shade in the leaves using the side of a sharp pencil.

Drawing Trees

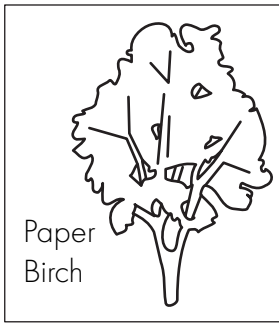
KID'S COPY

Basic Shapes

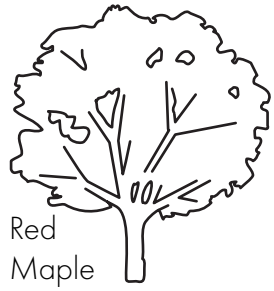
NAME: _____



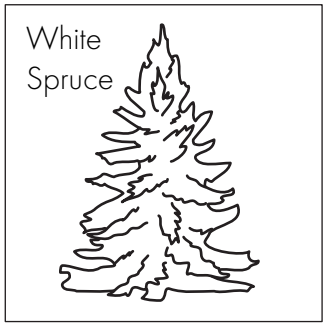
Broadly globe-shaped  Try to draw it!



Moderately oval-shaped  Try to draw it!



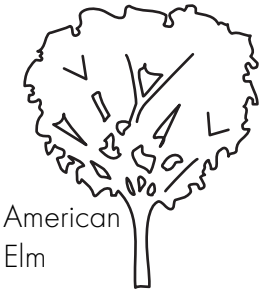
Broadly globe-shaped  Try to draw it!



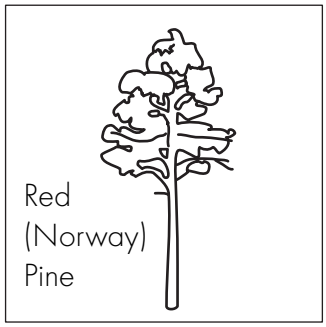
Pyramid-shaped  Try to draw it!

Broadly oval-shaped  Try to draw it!

Broadly dome-shaped  Try to draw it!



Broadly vase-shaped  Try to draw it!



Pyramid-shaped  Try to draw it!

From Paper to Plastic

Teacher Guide for Student Activity: Resources, page 84

It's hard to imagine life without trees. We use them to make everything from cardboard to chewing gum. In this activity your students can discover just how big a role trees play in their everyday lives.

First pass out a copy of "From Paper to Plastic" (Resources, page 84) to each student. Tell them there are more than 40 things in the picture made, in some way, from trees. Have them circle all the "tree objects" they can find. Then discuss their answers using the following information.

Putting Trees to Work

Building With Wood

People build a lot of different things with wood. When logs are brought to the sawmill, their bark is removed and they are carefully measured and cut into lumber. Most lumber is used to construct houses and other buildings. Some is used to make athletic equipment, crates, furniture, tool handles, wooden toys, works of art, and many other things. Even waste from the sawmill (small pieces of lumber, chips, and sawdust) can be mixed with special glues and pressed into "engineered" boards and other products.

Wood products in the picture: banister, baseball bat, blocks, bookshelf, broom handle, bulletin-board frame, cabinets, chairs, clock, counter, door, fence (see through open door), fruit bowl, molding (on walls), paintbrush handle, picture frames, sofa, stairs, stereo cabinet and speakers, stools, tables, tennis racket, umbrella handle, window frame, wood inside walls.

Making Paper

Paper is made from *cellulose,* the major component of cell walls in most plants. Most paper in the United States is made with cellulose that comes from trees. To turn a tree into paper, the bark is first stripped off and the trunk is chopped into small pieces, or *chips.* The chips are usually cooked with chemicals until they form an oatmeal-like *pulp.* (In many paper plants, the bark is also chipped and burned to produce energy so nothing is wasted.)

Next the pulp is washed and the impurities (such as dirt) are filtered out, leaving a pulp of cellulose fibers and water. This "clean" pulp is then sent through a series of machines where the fibers are flattened and broken apart so they will form a smooth sheet when the paper is dried.

Eventually the pulp is run onto screens and the water is drained off. Finally, the newly made paper is compressed and dried. Depending upon the chemical process used to make the pulp and the amount of refining the pulp goes through, different kinds of paper can be made. Coffee filter paper and heavy writing paper are examples.

Paper products in the picture: books, candy wrapper, cereal box, gift (wrapping and box), magazines, milk container, newspaper, notes on bulletin board, paper towels, CD cover inserts and record album covers.

Cellulose is Everywhere

Besides being used to make paper, cellulose is one of the ingredients of many other products. For example, it can be mixed with certain chemicals, turned into a thick liquid, and then squeezed through small holes or slits to form fibers. The fibers can be used to make carpeting or conveyor belts, or they might be spun into fabric (rayon and some others) for making clothes or furniture. Different kinds of plastic films, such as cellophane and photographic film, are also made from cellulose.

Cellulose is also added to certain substances that are used to make car steering wheels, toothbrush handles, Ping-Pong balls, and other plastic products. Depending on how it's processed, cellulose can be used in making explosives, thickeners in shampoo and salad dressing, and wallpaper paste.

Cellulose products in the picture: buttons, comb, curtains, eyeglasses frame, hairbrush handle, luggage, pillows, rug, upholstery on sofa, spools for thread.

About Bark

Tree bark has lots of different uses. For example, the spongy bark of the cork oak tree, which grows in the Mediterranean countries of Europe and Africa, is stripped off and made into bottle-cap liners, bottle stoppers, floats, and even heat shields for space vehicles.

Special chemicals in the bark of some trees also have a lot of different uses. For example, some trees produce *tannin,* which is used to cure leather.

Bark products in the picture: baseball (has a cork center), bulletin board.

Using the Ooze

Some trees ooze special saps called *gums* and *resins.* Gums and resins can be used to make many things including cosmetics, mouthwash, paint thinner, perfumes, soap, and coatings for vitamins and other pills. Other trees produce a special juice called *latex* that can be used to make conveyor belts, hoses, rubber tires, and other rubber products.

Gum, resin, and rubber products in the picture: paint, rubber gloves.

Eating Tree Food

People eat the fruit, nuts, roots, and bark (cinnamon for example) of many different trees. Most fruit and nuts can be eaten right off of the tree. But other tree "parts" must be cooked, dried, or processed in some way before people can eat them.

Ask students: Do peanuts come from trees? (No. They are a legume and are harvested from the ground.) Are coconuts a tree product? (No. A palm, which produces coconuts, is not a tree but a *monocotyledon,* a class of plants including lilies, orchids, and grasses.)

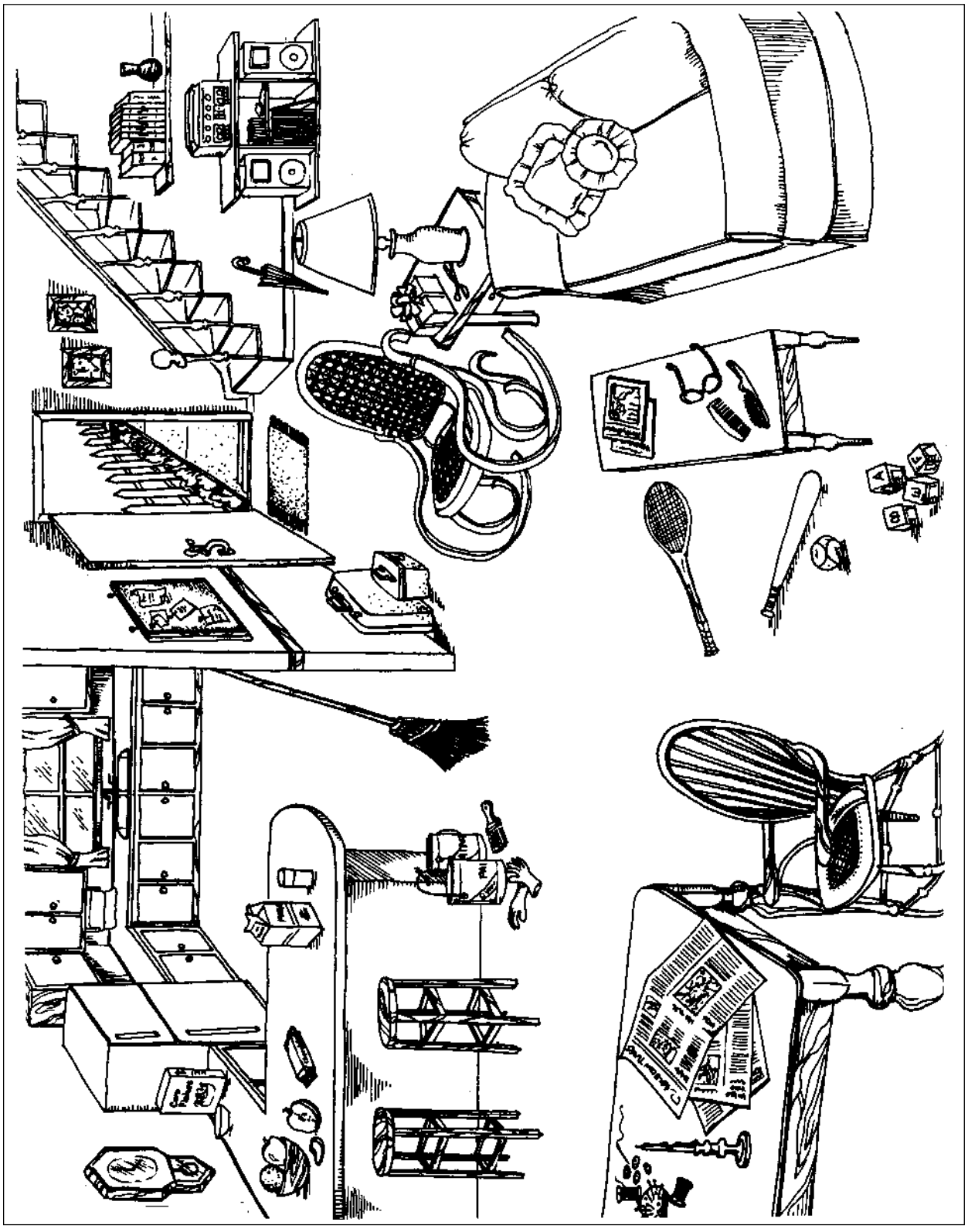
Tree foods in the picture: apples, chocolate bar (cocoa tree beans are used to make chocolate), orange.

Besides the products we've listed, substances from trees can also be used in making adhesives, asphalt, baby food, cleaners, inks, and medicines. Many trees are sources of natural fibers that can be made into clothes, furniture, and stuffing material for cushions and life jackets.

Adapted from *Ranger Rick's Naturescope, "Trees are Terrific."* Used with permission.

From Paper to Plastic

NAME: _____



From *Ranger Rick's Naturescope, "Trees are Terrific."* Used with permission.

Minnesota Tree Products

Teacher Guide for Student Activity: Resources, pages 86 and 87

Minnesota Tree Products

Minnesota's rich soils and variety of climates make an ideal home for many different kinds of trees. What are some of the forest products these different trees bring us? Read on...

Minnesota tree types are either *coniferous* or *deciduous.* Coniferous trees, also called conifers or evergreens, bear their seeds in cones and have thin, needlelike leaves that earn them the name needleleaf. They shed only a portion of their needles each year and people in the wood products industry often refer to them as softwoods. Minnesota's native conifers include white pine, red pine, balsam fir, black spruce, white spruce, white cedar, and tamarack.

Deciduous or broadleaf trees have covered seeds and drop their leaves each autumn. These trees are sometimes called hardwoods, although their wood is not necessarily harder than that of softwoods. Minnesota's native deciduous trees include elm, oak, aspen, cottonwood, birch, basswood, ash, and maple.

Read-to-Kids Listening Activity

You'll need: "Minnesota Tree Products" activity sheets, Resources, pages 86 and 87.

Read slowly so students can write their answers.

Here are just a few of the many products trees bring to our lives:

Paper birch: This tree has a white, papery bark that stands out against the dark bark of other forest trees. Its wood is used for firewood, furniture, and decorative items like baskets.

Ash: Strong, hard wood. Green ash is used for baseball bats, hockey sticks, handles, and firewood. Strips of black ash are used to make woven baskets.

Aspen: Once considered rather useless, the aspen is now the most commercially used tree species in the state. It's used in panel boards, construction materials, and to make paper.

Basswood: Light, soft wood. Used for carving, inexpensive furniture, even inner parts of shoes.

Maples: Beautifully grained wood popular for furniture and moldings. Sugar maples provide sap for maple syrup and are some of fall's most colorful trees.

Oak: Heavy, hard, strong wood. Used for heavy construction, beams and support braces, floors, and furniture.

Tamarack: Hard, heavy wood. Used for telephone poles, railroad ties, and posts.

White spruce: Used for paper, furniture, and canoe paddles. This is also a popular Christmas tree.

Red pine: Coarse-grained, hard wood good for building and construction. Minnesota's state tree.

Balsam fir: Used for paper and is one of the most popular Christmas trees.

White pine: Wood for lumber, building, and construction.

White cedar: Fragrant wood with "outdoors" scent that repels moths. Used for posts, poles, and cedar closets.

Cottonwood: Soft, light wood. Used for making paper.

Elm: Heavy, hard wood. A favorite for furniture and boat building.

Black spruce: Soft wood used mostly for pulp to make paper.

Answers to Read-to-Kids Listening Activity:

Paper birch: firewood, furniture, decorative items.
Green ash: baseball bats, hockey sticks, tool handles, firewood.
Quaking aspen: panel board, construction, paper.
Basswood: carving wood, inexpensive furniture, inner parts of shoes.
Sugar maple: syrup, furniture, colors to enjoy in autumn.
Bur oak: heavy construction beams, floors, furniture.
Tamarack: posts, telephone poles, railroad ties.
White spruce: canoe paddles, paper, furniture, Christmas trees.
Red pine: building, construction.
Balsam fir: paper, Christmas trees.
White pine: lumber, building, construction.
White cedar: posts, poles, cedar closets.

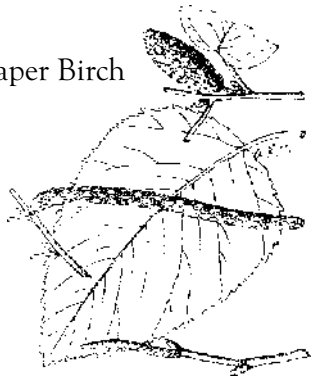
Minnesota Tree Products

KID'S COPY

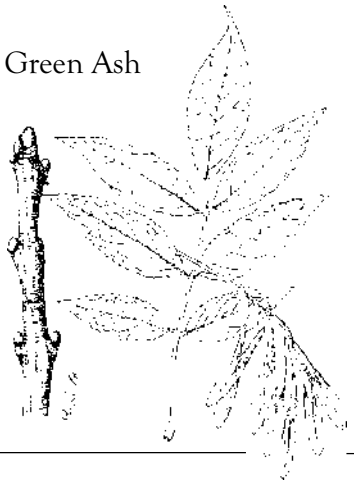
Listening Exercise: Listen as someone reads to you about Minnesota tree products (Resources, page 85). Make a list of the products for each tree as you hear them. Most, but not all of the trees you hear about, are shown on these pages. After the reading, go back and draw pictures of these products.

NAME: _____

Paper Birch

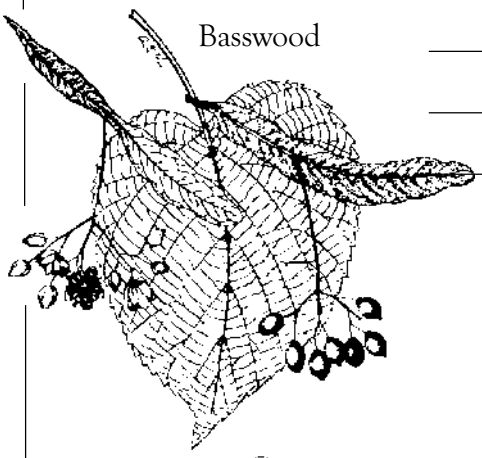


Green Ash

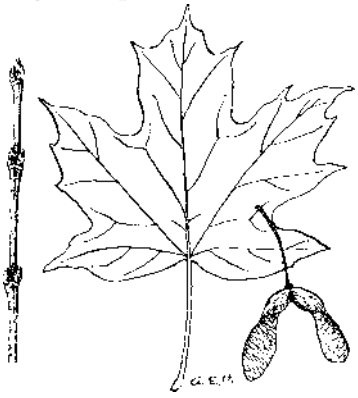


Quaking Aspen

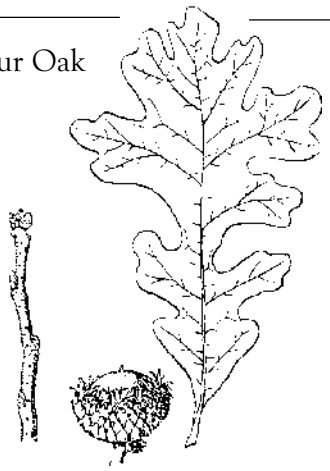
Basswood



Sugar Maple



Bur Oak



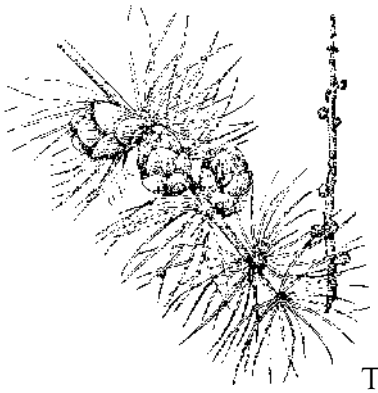
Answers on Resources, page 85. Read-to-Kids Listening Activity.

Minnesota Tree Products

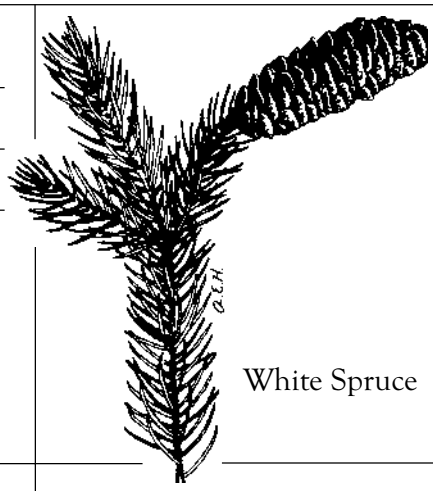
KID'S COPY

Listening Exercise: Listen as someone reads to you about Minnesota tree products (Resources, page 85). Make a list of the products for each tree as you hear them. Most, but not all of the trees you hear about, are shown on these pages. After the reading, go back and draw pictures of these products.

NAME: _____

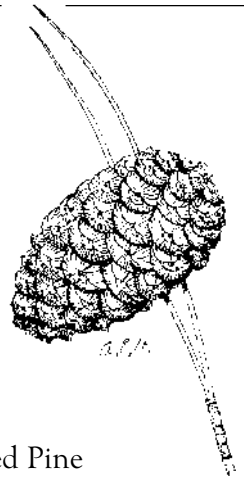


Tamarack

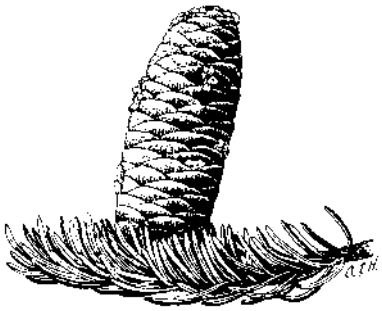


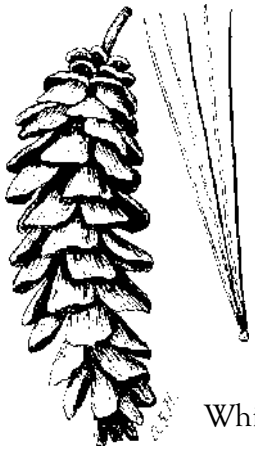
White Spruce

Balsam Fir



Red Pine





White Pine

White Cedar

Answers on Resources, page 85. Read-to-Kids Listening Activity.

Named After Trees (A Charting Activity)

Teacher Guide

You'll need: Chart paper, chart-starter captions on Resources, page 89, and "Trees, Trees" list on Resources, page 90. Put a header at the top of each of six sheets of chart paper; students do the rest!

Invite students to work in pairs to name and list as many trees as they can. Next, they review the "Trees, Trees" list (Resources, page 90). Finally, they try to add examples of tree names on each "Named After Trees" chart. They will know some from the local community. Do you have an Elm Street, an Applebee's Restaurant, an Oak Grove School? Ask students to suggest places to look to find tree names. You may want to carry on your name search over several days. In the process, your students can become better acquainted with a host of ready reference materials as they look for the tree names. How about checking out:

Day 1: The white and yellow pages of the telephone book.

Day 2: Maps and atlases.

Day 3: Encyclopedias, dictionaries, library materials.

Day 4: Newspapers and magazines.

Partners can work out-of-school, too. Encourage everyone to keep an eagle eye out for names in the news and signs in the community for the next few days. Here are a few samples of names your charts might show—

Towns and Cities Named After Trees

Pine City, MN	Pine Bend, OR
Elmwood, WI	Cedar Rapids, IA
Maple Grove, MN	Aspen, CO
Oakdale, MN	Birchwood, WI
Forest Lake, MN	Redwood City, CA
Maplewood, MN	Ironwood, MI

Rivers and Lakes Named After Trees

Willow River, MN	Forest Lake, MN
Apple River, WI	Birch Lake, MN
Pine Lake, MN/WI	Cottonwood River, MN
Cedar Lake, WI	

Businesses/Schools/Streets/Parks Named After Trees

Oak Grove Elementary
Maplewood Mall
Birch Run
Cedar Avenue
Learning Tree Child Care Centers
Willow Lane School

Songs, Stories/Poems, Movies Named After Trees

Tie a Yellow Ribbon 'Round the Old Oak Tree
Don't Sit Under the Apple Tree
Here We Go 'Round the Mulberry Bush
The Giving Tree
Maple Leaf Forever
Steel Magnolias
Oh Christmas Tree

People Named After Trees

Willow
Johnny Appleseed
Jack Lemmon
Nathaniel Hawthorne
Forest Gump
John Birch

Landforms Named After Trees

Cypress swamps
Redwood forests
Evergreen forests
Oak savannas

Discussion Prompters:

1. Which chart was the easiest to fill? Why do you think this is so?
2. How do things such as towns, rivers, lakes, businesses, etc., get their names? What besides trees are popular "themes" for naming things?

Chart Starter Captions

_ _

Towns and Cities Named After Trees

_ _

Rivers and Lakes Named After Trees

_ _

Businesses/Schools/Streets/Parks Named After Trees

_ _

Songs, Stories/Poems, Movies Named After Trees

_ _

People Named After Trees

_ _

Landforms Named After Trees

_ _

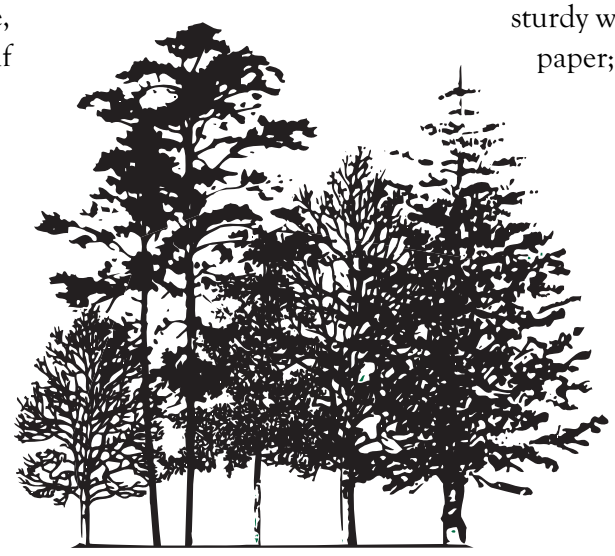
"Trees, Trees"

Reference List for "Named After Trees" Chart Activity

Alder
Almond
Apple
Apricot
Ash
Aspen
Avocado
Balsa
Balsam Fir
Banana
Banyan
Basswood
Bayberry
Beech
Birch
Bonsai
Box Elder
Brazil Nut
Bristlecone Pine
Butternut
Cacao
Cashew
Catalpa
Cedar
Cherry
Chestnut
Cinnamon
Coffee
Cork
Cottonwood
Crab Apple
Cypress
Date
Dogwood
Elm
Eucalyptus
Evergreen
Fig
Filbert
Fir
Grapefruit
Gum
Hackberry
Hawthorn
Hemlock
Hickory
Holly
Horse Chestnut
Ironwood
Juniper
Kumquat
Laurel
Lemon
Lime
Linden
Live Oak
Locust
Magnolia
Mahogany
Mango
Maple
Mimosa
Mountain Ash
Mulberry
Myrtle
Nectarine
Nutmeg
Oak
Olive
Orange
Papaya
Peach
Pear
Pecan
Pepper Tree
Persimmon
Pine
Pistachio Nut
Plum
Poplar
Prickly Ash
Redwood
Rhododendron
Rubber
Sassafras
Sequoia
Soapberry
Spruce
Sweet Gum
Sycamore
Tamarack
Teak
Tulip Tree
Walnut
Willow
Witch Hazel

Tips for Safe and Successful Nature Hikes and Field Trips

1. Choose a place that has as many trees as possible and is within walking distance or a short bus ride from your school. In the ideal situation, each student pair has one tree to study, but groups may be larger if necessary. Get permission from parents, landowners, and others as necessary before leaving the school grounds.
2. Many of the activities suggested in this *Teachers' Guide* may be used with bushes if trees are not plentiful in your area.
3. Before the trip, ask students to join you in deciding on a set of rules. Try to set "do" rules rather than "do not" rules. Usual rules include:
   - Always keep the teacher or adult group leader in sight.
   - Leave places in nature as you find them.
   - Avoid stepping on plants as much as possible.
   - Don't pick plants, pull off plant parts, or harm living things in any way.
   - Don't eat plant parts or anything else found in the forest.
   - Stay on paths and trails.
   - Choose nonliving things or only things in great abundance, like leaves or pine cones, if samples are collected to take back to the classroom.
   - Be quiet and move slowly so you don't disturb creatures living near the trees.
4. Encourage students to prepare a list of questions, or things they hope to discover. At all times, invite them to ask their own questions, and to compare and discuss their ideas freely with others. Gauge your questions, activities, and level of guidance to the attention span, interests, outdoor experience, and "personality" of the group.
5. Throughout the hike or trip, encourage students' observation skills and their sense of beauty.
6. Encourage students to use all their senses in experiencing trees.
7. Your role as teacher is important in helping students think about and observe their environment. Ask inquiry questions, have children compare and contrast, evaluate, find similarities and differences, estimate, predict, experiment, demonstrate, and chart.
8. Visit the same trees frequently and watch for changes. See "Trees Through the Seasons," Resources, page 123 for a variety of questions and activities appropriate for each season.
9. Some things you might want to take along to enhance the trip: a camera; video camera; cassette recorder; field guide to local trees, plants, and animal wildlife; binoculars; magnifying glasses; small bags for collecting samples; rulers and tape measures; clipboards and paper or notebooks with a sturdy writing surface; drawing paper; pencils; and markers.



Tree Bingo

Grades 1-3

Photocopy the word squares and a Bingo grid for each student. **Student Instructions:** Cut out the word squares and paste them anywhere on the Bingo card. Cut the scraps of paper around the edges into markers. **Caller or Leader Instructions:** Read the questions. Students place markers on the answers. Four in a row—down, across, or diagonally—is a "Bingo!"

Questions:	**Answers:**
1. What month is Arbor Month in Minnesota?	May
2. What part of the tree protects it from injuries?	bark
3. What is Minnesota's state tree?	red (Norway) pine
4. What type of tree drops its leaves every fall?	broadleaf tree
5. What are Minnesota's largest plants?	trees
6. What is one way people hurt trees?	carving on bark
7. Trees give off something we breathe in. What is it?	oxygen
8. What is the underground part of the tree called?	roots
9. What parts of the tree are in the crown?	branches and leaves
10. Another name for an animal's home is its...	habitat
11. What makes leaves look green?	chlorophyll
12. What do we call trees that usually hold their leaves (needles) over winter and have seeds inside cones?	needleleaf trees
13. What can be as large as a baseball or as small as the head of a pin?	seeds
14. Which Minnesota tree provides the most food for wildlife?	oak
15. What is one large, wild animal that is attracted to a young forest with new aspen trees?	deer

Tree Bingo

KID'S COPY

Grades 1-3

NAME: _____

B	I	N	G	O

May	trees	branches and leaves	needleleaf trees
bark	carving on bark	FREE SPACE	seeds
red (Norway) pine	oxygen	habitat	oak
broadleaf tree	roots	chlorophyll	deer

Tree Bingo

Grades 4-6

Photocopy the word squares and a Bingo grid for each student. **Student Instructions:** Cut out the word squares and paste them anywhere on the Bingo card. Cut the scraps of paper around the edges into markers. **Choose a leader.** The leader reads the questions. Each student places a marker when he or she has the correct answer. Four in a row—down, across, or diagonally—is a "Bingo!"

Questions:	**Answers:**
1. What is the center part of a tree called?	inner wood
2. What part of the tree protects it from injuries and pests?	bark
3. Who wrote, "I think that I shall never see a poem as lovely as a tree"?	Joyce Kilmer
4. Minnesota's state tree is...	red (Norway) pine
5. What kind of tree drops its leaves every fall?	deciduous
6. How much of the land surface of the earth is covered by trees?	one-third
7. What are the three R's?	reduce, reuse, recycle
8. What do we call businesses that produce a continuous crop of trees for harvesting?	tree farms
9. What type of person is responsible for planning and producing healthy forests?	forester
10. Three well-placed trees planted near a home can cut air conditioning by how much?	10 percent to 50 percent
11. During photosynthesis, trees take in carbon dioxide and give off what?	oxygen
12. Two important ways urban trees save energy is by cutting the need for what?	air conditioning and heating
13. What do we call tree rows planted to conserve heat or reduce soil erosion?	windbreaks
14. Throughout the world humans destroy an acre of forest (about the size of a football field) every...	second
15. One large, wild animal that is attracted to a young forest with new aspen growth is the...	deer

Tree Bingo

Grades 4-6

NAME: _____

B	I	N	G	O

inner wood	deciduous	forester	air conditioning and heating
bark	one-third	FREE SPACE	windbreaks
Joyce Kilmer	reduce, reuse, recycle	10 percent to 50 percent	second
red (Norway) pine	tree farms	oxygen	deer

Twelve For the Trees

Interview people to find someone to match each box. When you find a match, have him or her sign that box.

NAME: _____

Here's a person who:

1. Has planted more than five trees. _____	2. Knows what a city "heat island" or "concrete hot spot" is and can explain how trees could help cool these areas. _____	3. Can tell you where to call to reach a city, county, or state forester. _____
4. Has trees shading the south and west sides of his or her home that cut down the cost of air conditioning. _____	5. Has trees on the north or west sides of his or her home to block the wind and save heat. _____	6. Has taken a picture of a beautiful tree. _____
7. Uses city parks for fun and recreation. _____	8. Has planted one or more trees in the last year. _____	9. Has a bird feeder or has fed birds in another way. _____
10. Can explain how trees fight air pollution. _____	11. Uses leaves or wood chips as mulch for trees, lawns, and gardens. _____	*12. Bonus: Can name Minnesota's official state tree. _____

* The red (or Norway) pine is Minnesota's state tree.

We All Need Forests

Teacher Guide for Student Activity: Resources, page 99

What would your group do if they were in charge of 20,000 acres (8,000 hectares) of forest? If they owned a paper company, they would probably plant a species of fast-growing pine or other "paper tree" and manage as much of the forest as possible for pulpwood. If they were wildlife biologists, they would try to manage the forest in ways that keep the best habitat for different species of wildlife. And if they were recreational planners, they might manage the forest to provide good campsites, hiking trails, ski paths, fishing streams, bike paths, and wildlife study areas.

Most of the forests in this country are managed. How a forest is managed depends on what it will be used for. In the past, most forests were managed for only one type of use, such as for raising pulpwood trees. But today, many more are being managed for several different uses at the same time.

In this activity, your students get a chance to discuss different forest uses and how some of these uses compete. They'll also learn why managing for different uses is so important.

Ask students: What are some ways you or your family use forests? (For hiking, birding, hunting, fishing, camping, and so on.) List the uses on the chalkboard or a large sheet of easel paper. Ask students: How are forests important to wildlife? What important natural resources come from the forest? Next ask if someone can define the word *manage.* Ask students: In order for people to use forests in different ways, how must foresters manage forests in different ways?

Next pass out "We All Need Forests," Resources, page 99. Ask students to look at the three rows on the page. Start with the first row labeled "wildlife." How would this scene look to a rabbit, a bird, a squirrel? How would it look if it were "all cleaned up"? Discuss some of the ways forests are managed to help protect different species of wildlife. Then go on to the second row labeled "recreation" and discuss how forests are managed for different types of recreation. Move to the third row labeled "products" and discuss how forests also provide many products for us to use.

Use the following information to help start your student discussions.

Wildlife

Saving Snags: One way people manage for wildlife in a forest is by leaving dead trees, or snags, standing instead of cutting them down. Snags provide nesting cavities for many birds and mammals, such as owls, woodpeckers, wood ducks, bluebirds, raccoons, and squirrels.

Building Brush Piles: By building brush piles in a forest and along forest edges, forest managers help provide hiding and nesting sites for many animals that live on the ground such as foxes, rabbits, wood thrushes, and chipmunks.

Letting Logs Lie: Many types of animals use logs for nesting and hiding places. By not removing logs, managers help provide homes and feeding areas for many kinds of wildlife.

Building Feeders and Nesting Boxes: Putting nesting boxes in forests that have limited nesting sites helps attract wildlife. So can setting up feeding stations for birds and mammals.

Burning: For some species, the only way to maintain the right kind of habitat is to burn the area on a regular basis to get rid of undergrowth.

Picking the Right Plants: By planting certain types of trees and shrubs in a forest area, wildlife managers can provide habitat for specific types of wildlife.

Recreation

Compare the recreational activities shown on the "We All Need Forests" sheet with the list students came up with. Discuss how the forest is an important place for people to relax, enjoy nature, and exercise.

Some of the ways people use forests for recreation compete with the needs of wildlife and can also disrupt the plants that grow there. What are some examples? (To build ski slopes in a forest,

heavy equipment must come in and cut down trees to make the runs. Roads and parking lots, ski lodges, and other facilities are also built.)

Ask students: What are other ways recreational uses of the forest can harm the wildlife? The role of many forest managers is to balance the uses of a forest so wildlife can be protected and people can use it for recreation, too. Discuss ways this can be done such as making trails in areas where the least amount of natural vegetation needs to be removed, reinforcing trails where heavy foot traffic can cause soil to erode, having specific areas where campfires can be built to reduce the chances of these "recreational" fires escaping into the surrounding forest, or designing trails for multiple uses (skiing, hiking).

Products

Many forests are used for commercial purposes. Some forest areas are managed for lumber, some are managed for pulpwood, and some are opened up for oil, gas, and mineral uses. These uses can upset the forest community and compete with wildlife and recreational uses. For example, you probably wouldn't want to camp near a strip mine in a forest or hike along an area that is being harvested. Why is it important to have commercial uses in a forest? (People need forest products.) How would our lives change if we did not have the products shown in "We All Need Forests"?

Adapted from *Ranger Rick's Naturescope, "Trees are Terrific."* Used with permission.

For Creative Fun: Make Forest Collages

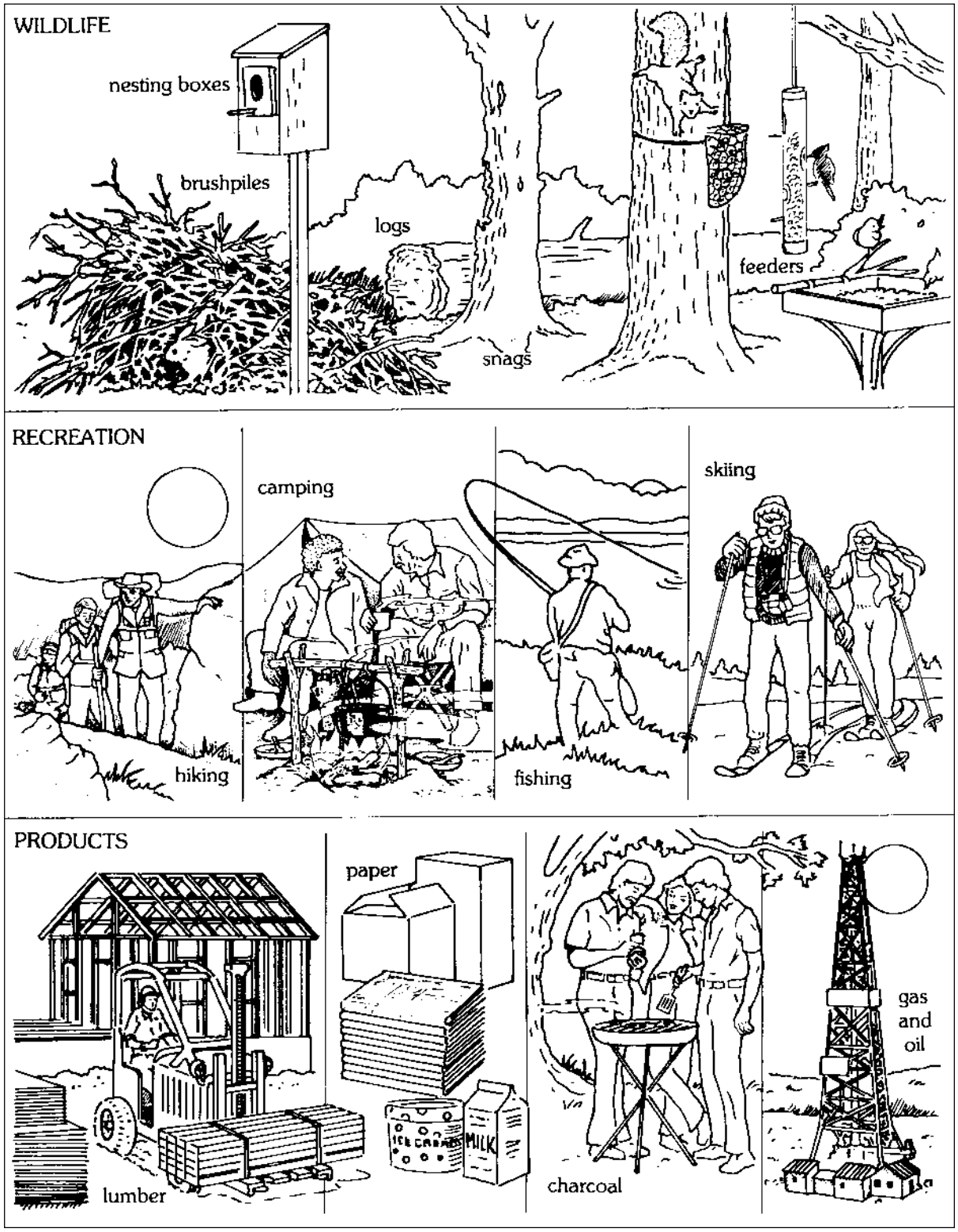
You'll need: Real forest products or magazines, drawing paper, and markers.

Invite students to make forest collages showing all the different uses of a forest. They can cut pictures from magazines, draw their own pictures, and tape or glue on pieces of real forest items such as toothpicks, paper, seeds, and roots. Have each person write a short paragraph explaining his or her collage, then hang the collages around the room.

We All Need Forests

KID'S COPY

NAME: _____



From *Ranger Rick's Naturescope, "Trees are Terrific."* Used with permission.

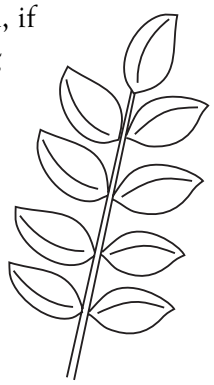
Collecting Leaves and Other Tree Treasures

KID'S COPY

Collecting leaves and other things from trees can be an interesting hobby. It is usually more satisfying to collect midsummer and fall leaves than the new leaves of spring because more mature leaves are tougher, stiffer, and more colorful than new leaves. Still, noticing and collecting leaves and other tree parts can be fun any time of the year.

Tips for Collecting Leaves

1. Take a newspaper or large magazine along when you collect leaves. You can slip the leaves between the pages to protect them from damage and from drying out too fast. Be sure the leaves are flat inside your pages.
2. Take leaves from the ground, if possible, rather than pulling them off trees.
3. Choose only good, undamaged leaves.
4. Make sure you take a whole leaf section and not just one leaflet when you are collecting leaves from trees that have compound leaves.



Compound leaf

Pressing Leaves Like a Pro

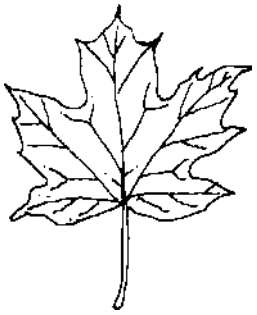
1. When you get home or into the school building with your leaves, press the leaves flat between layers of newspaper or other porous paper.
2. Set heavy weights such as books, bricks or blocks of wood on the paper to press the leaves.
3. Change the papers every couple of days. Dry paper absorbs water from the leaves and helps prevent mildew.
4. Keep your leaf collection in a place where there is good air circulation.
5. Press the leaves between waxed paper with a warm iron if desired, for long-lasting beauty. Or, if you wish to make a formal display to share with others, mount your leaves on cardboard. Label them to show their common and scientific names, where they were found, the date collected, and special notes. Use rubber cement to fasten the leaves on the cardboard.

Common Name:
Sugar Maple

Scientific Name:
Acer saccharum

Location Found:
Schoolyard

Date Collected:
9/18/03

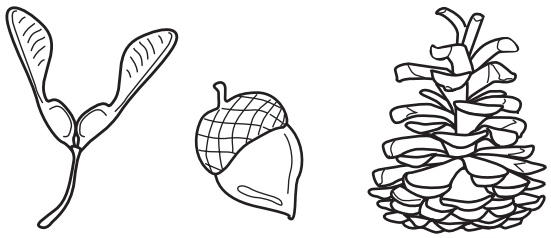


Collecting Other Tree Treasures

Collect fruits, nuts, unique seeds or blossoms, twigs, buds, cones, acorns, berries, etc. These may also be dried and mounted on cardboard for display.

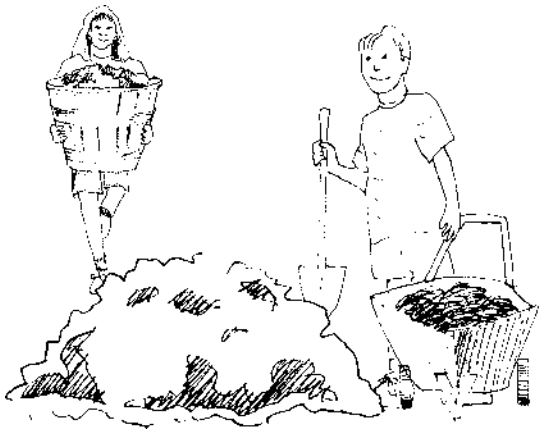
Tree treasures vary throughout the year. While some fruits and nuts won't be around until fall, spring is a good time to begin a collection. Unique buds, twigs, and seeds can be found in spring. If you're building a collection over several months, here are some treasures too good to miss: pods (honeylocust, black locust), winged seeds (maple, Norway spruce, white ash), hairy seeds (weeping willow, poplar), acorns (oaks—cup sizes vary), cones (many species of evergreens).

My Collection



winged seed acorn cone

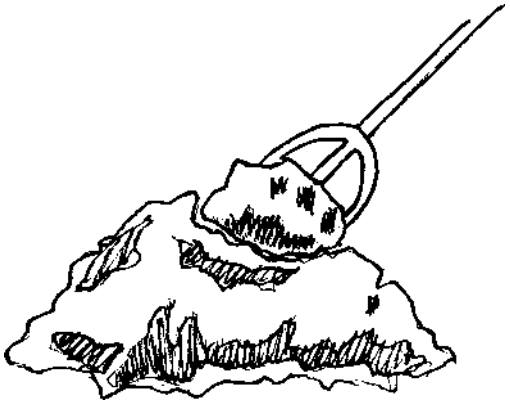
Compost Anyone?



1. Make a compost pile. Gather a big bunch of leaves and put them in a pile. Put layers of soil or manure between layers of leaves.

2. Put a brick in the center of the pile. (The brick absorbs heat, which helps to break down the compost material faster.)

3. Over the winter, add organic kitchen scraps, coffee grounds, and vegetable scraps. Don't use meat, bones, or eggshells.



4. Turn the pile over once in a while.

In the spring, dig to the bottom of the pile. Feel the brick. What do you notice? Use the compost to make your lawn and garden soil richer.

Examine Roots!

You'll need: Sharp sticks or forks and magnifying glasses.

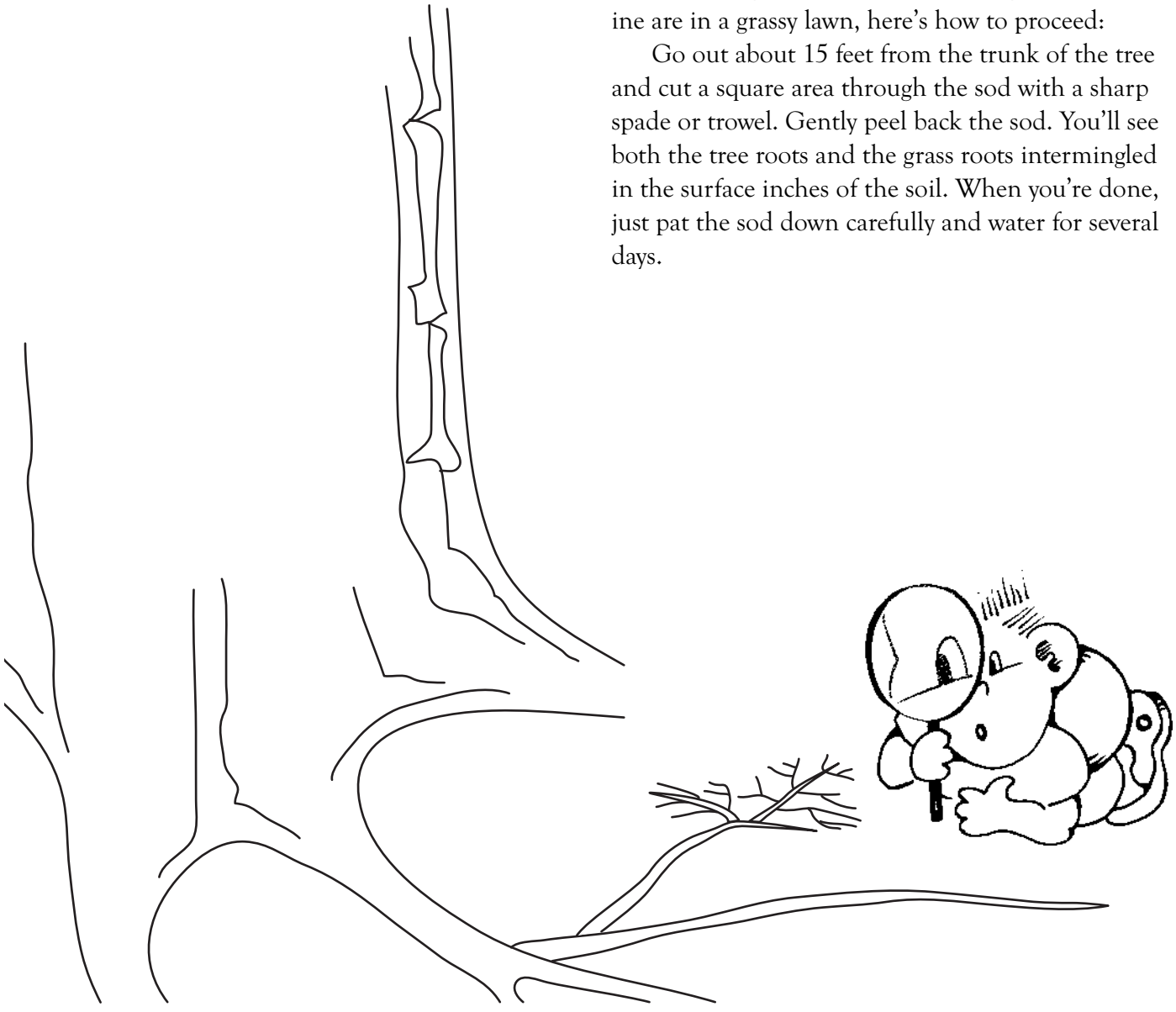
Most of the small absorbing roots of trees are in the forest litter layer and top inches of the soil. They are often smaller across than the lead in a pencil. You can easily expose them.

Carefully sweep away surface litter and soil with fingers and dig gently with a sharp stick or fork. These small roots are constantly growing, dying, and regrowing throughout the season, and can be examined with the eye or with a magnifying glass. A healthy root tip usually has a creamy white, pink, or light tan interior and will snap like a fresh garden bean. It has a pleasant odor that can be masked by the odor of good, clean earth. Unhealthy root tips are limp and dull in color, and sometimes stained blue or black by disease fungi. They often smell of rotting things. Have you uncovered healthy roots?

Dig (gently, please!) more deeply into the soil, and you'll see that most of the fine roots have grown upward into the surface layers of soil from larger roots growing horizontally. These horizontal roots are usually located 4 to 11 inches below the surface. Remember to replace soil and gently "pat" into place.

If the only tree roots available for you to examine are in a grassy lawn, here's how to proceed:

Go out about 15 feet from the trunk of the tree and cut a square area through the sod with a sharp spade or trowel. Gently peel back the sod. You'll see both the tree roots and the grass roots intermingled in the surface inches of the soil. When you're done, just pat the sod down carefully and water for several days.



Leaf Arrangements

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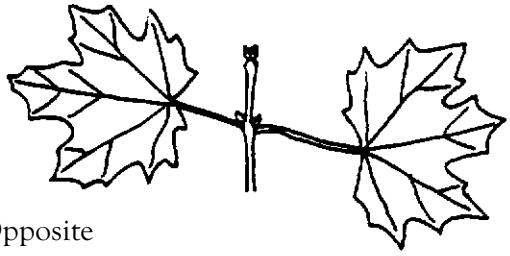
Most deciduous trees have leaves that follow one of these arrangements. Use this page as a guide and search your community for examples of each leaf type. How many of the arrangements can you find in your own community? What species of tree are they from?

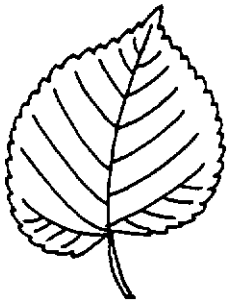
Leaf Placement on Branch



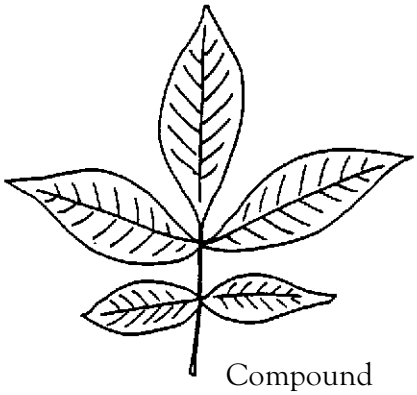
Opposite
Example: Maple

Alternate
Example: Oak

Type of Leaf



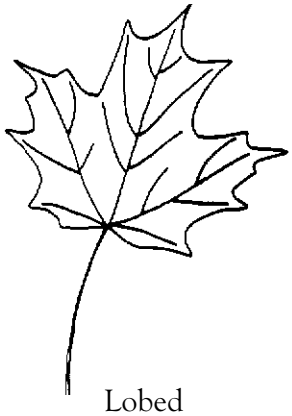
Simple
Example: Birch



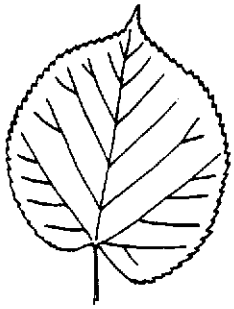
Compound
Example: Green Ash

Doubly compound
Example: Honeylocust

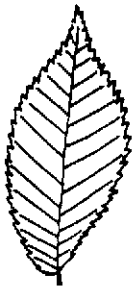
Margin on Leaf Edge



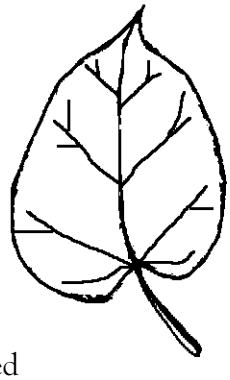
Lobed
Example: Maple



Singly toothed
Example: Poplar



Doubly toothed
Example: Elm



Smooth (leaves not toothed or lobed)
Example: Catalpa

Leaf Arrangements

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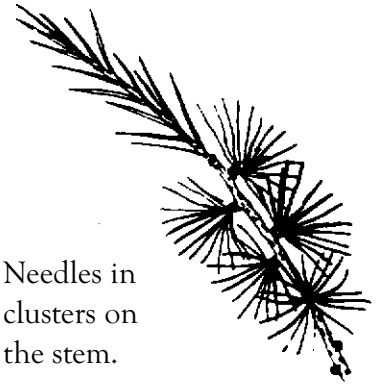
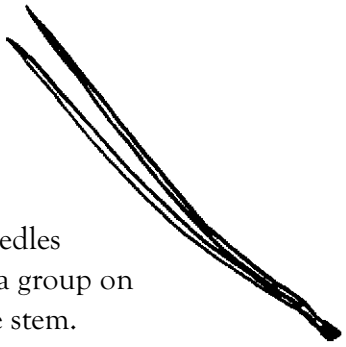
Needle Characteristics of Conifers



Needles in clusters on the stem.

Example: Tamarack



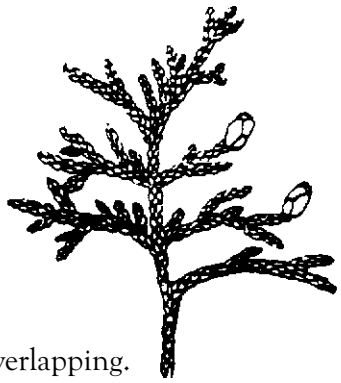
Needles in a group on the stem.

Example: Red (Norway) Pine

Needles are single on the stem.

Example: Balsam Fir

Needles overlapping on the stem.



Scalelike overlapping.

Example: Northern White Cedar

Awl-like overlapping.

Example: Red Cedar

Minnesota's Forests

Background

The history of Minnesota forests is much like that of forests throughout the United States. Forests have been exploited; many are now being rebuilt. Most are now managed so both our generation and future generations can enjoy things that only the forests can give us.

Minnesota's Biomes

The forests of Minnesota developed after the glaciers retreated about 10 to 12 thousand years ago. Those great ice sheets left soils and land features that were well suited for certain types of vegetation. With the warming of the climate after the glacial period, plants gradually built up on these soils. By the time humans arrived on the scene, there were three distinct biomes (biological communities of similar plants and their related animals) in what would later become Minnesota: the coniferous forest biome in the northeast, the deciduous forest of the east central and southeast, and the prairie grassland biome in the west and southwest. (See the Minnesota Biomes map, Resources, page 108.)

Coniferous Forest

The northeastern coniferous forest was the largest region of forest. The original forest included white, red (also known as Norway), and jack pines; black and white spruce; balsam fir, tamarack, northern white cedar; and some deciduous trees (notably the aspens and paper birch) that grow with coniferous trees. These trees did not grow in one big mixture, but tended to appear in definite areas. Soil and moisture conditions and the fire history of the area all affected which trees grew where.

After the first cutting of the coniferous forests, many forest fires swept the regions. These fires destroyed seed trees and young conifers. They helped the growth of some deciduous trees. Today most coniferous forests include a mixture of aspen and birch, and in places, oaks and other deciduous trees. They stand together with young pine, spruce, and fir.

Some conifers, such as balsam fir, are now gradually moving into aspen and birch forests. Balsam can grow in the shade and compete with these trees. If fire is kept out, part of the aspen-birch forests will in time be replaced by fir and spruce. Unfortunately, the pines are not successful in aspen and birch stands because these seedlings do not grow well in shade. This process of one species replaced by another over time as conditions change is called *succession.*

Deciduous Forest

The original deciduous forest region of southeast and east-central Minnesota had stands of tree species such as oak, elm, ash, black walnut, basswood, butternut, maple, cottonwood, willow, aspen, and many others. But these trees grew on soils that were good for growing agricultural crops.

As the settlers moved into the area, much of the deciduous forest land was cleared for agriculture. From 1820 to about 1920, many of the trees of the original forests were used to build homestead and farm buildings. The trees not used were often just cut, gathered into piles, and burned. Today, remnants of this deciduous forest still stand along the rivers and in many small woodlands. Today's trees are the same types of trees that originally covered the area.

Prairie Grassland

In the prairie grassland of western and southwestern Minnesota, the original forests grew along the valleys and flood plains of rivers and streams. The trees included willow, cottonwood, ash, box elder, elm, and occasionally oak, maple, basswood, or other deciduous trees. This area of Minnesota receives less moisture than the coniferous and deciduous forest regions. That's the main reason the land in western and southwestern Minnesota was not covered by forests. There was very little cutting of trees in this area, and today's forest is much like the original forest. Much of the prairie grassland, however, was converted into agricultural lands.

Forest Uses—Then And Now

The forests of Minnesota were used by American Indians long before European explorers discovered

the area. The forest was a place for shelter and medicine, and for forest products such as birch bark, poles, firewood, and foods (maple syrup, wild plums, berries, etc.). It was a place to hunt game. The forest was also sometimes a hindrance to American Indians. Occasionally, they burned areas to create open space. This space meant more browsing room for game and better hunting grounds.

As more and more settlers arrived, the forests were exploited for timber products and cleared to grow agricultural crops. The first big cutting of trees was probably by army troops stationed at Fort Snelling, where the state's first sawmill was built in 1821. The first commercial sawmill was built in 1839 at Marine On Saint Croix. The white pine lumber industry grew quickly in Minnesota from 1890 to 1930. For many years, Minneapolis-St. Paul was the largest sawmill center in the United States.

Wood was in great demand for all types of building and for fuelwood, so tree cutting was encouraged. Agriculturists believed practically all of Minnesota would "go under the plow" and that farming would be the main activity in all areas of the state. To make way for farming, those trees had to go! Logging became big business. After logging, the stumps and logging leftovers were burned. This burning to clear lands for agriculture led to some huge forest fires.

Fires play a big part in the history of forestry in Minnesota. In 1894, the Hinckley Fire, which covered a large area in Pine County, killed 418 people. The Chisholm Fire in 1908 and the Baudette-Spooner Fire in 1910 swept through huge parts of northern Minnesota and caused much suffering and loss. The last big forest fire in Minnesota was in the Cloquet-Moose Lake area in 1918. It caused the deaths of 438 people.

People tried to clear land and farm what was not very productive land until about 1930. By that time, only a few places of the original coniferous forest had escaped the ax or the flame. One of these areas became our first state park (Itasca) in 1891. The protection of this beautiful area of old-growth white and red (Norway) pine was a cooperative effort by state agencies, university professors, and the forest industries. This park, which includes the headwaters of the Mississippi River, is today one of the finest parks of its size in our nation. It is also a reminder to us of the original forest of northern Minnesota.

Minnesota's Forest Types Today

Today, aspen and birch forests cover more than one-third of the commercial forested area of Minnesota. The spruce-fir forest covers about 15 percent. Moving down in percentages are the lowland hardwoods, northern hardwoods, oaks, pines, cedars, and tamaracks. Minnesota now grows more wood than it is harvesting. Public agencies, Minnesota's forest industries, and small woodland owners have planted over 550 million trees, mostly conifers, to reforest areas where trees once grew.

Minnesota Forests Products Today

Minnesota's largest forest products industry is the pulp and paper industry followed by the structural board (oriented strandboard) industry. Over 70 percent of the wood harvested in the state is used for pulp, paper, and structural board.

Minnesota pulp and paper mills produce and sell products that bring over $1.2 billion into the state each year. Nine mills employ more than 5,000 men and women.

Each year we also harvest about 330 million board feet of lumber and logs; over 2.5 million Christmas trees and wreaths; 28,000 cords of matchwood and veneer logs; 50,000 posts and poles; and 1 million cords of fuelwood. These forest products (excluding pulpwood) are worth over $460 million. Other products include wild berries, nuts, fruits, maple syrup, cones, and birch bark.

About 61,000 people are employed by Minnesota's forest industries. Our forest products and their distribution are worth $8 billion each year. Forestry is Minnesota's third largest manufacturing industry.

The value of the forest goes far beyond its products. Think about its use in recreation, in protecting our soils and water, and in creating wildlife habitat. And there's no way to measure the great beauty and peace forests bring to our lives.

The Future of Minnesota's Forests

In years to come, we expect even greater use of our forests for products, recreation, and environmental protection. People will want more products from our trees. This will mean using tree parts previously thought of as unsalable, such as branches and leaves. Scientists in many research laboratories around the country are studying how we can best manage our rich forest resources. Environmental quality of our soil, water, and air must be protected.

The future of the forests of Minnesota is in the hands of our citizens. Minnesotans have an important role. We are guardians and stewards of a wonderful forest heritage!

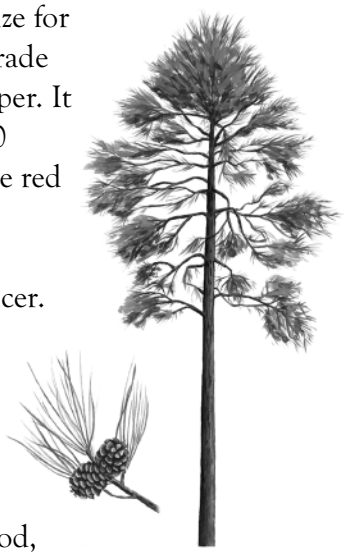
Special Minnesota Trees

Over 50 tree species are native to Minnesota (see Resources, page 109). Three of them are described below. Are any of them near your school, your home, or in your community?

Red (Norway) Pine

This beauty was named Minnesota's official state tree in 1953. The inner wood and bark are reddish. In the Lake States (Minnesota, Wisconsin, and Michigan), the tree is called Norway pine, but to others, it's the red pine. "Norway" may have been used by early English explorers who thought the red pine was the scotch pine of Norway.

The red pine is the most commonly planted tree species in Minnesota. In 30 years, a red pine is a marketable size for pulpwood to make high-grade printing and wrapping paper. It can also be grown 100-150 years for large sawlogs. The red pine is quite resistant to disease and fire, and is an outstanding timber producer. It's planted for erosion control, shelterbelts, windbreaks, Christmas trees, and wood for lumber, poles, cabin logs, railroad ties, pulpwood, and fuel.

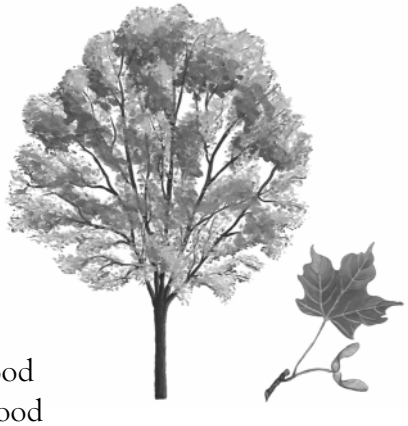


Tamarack

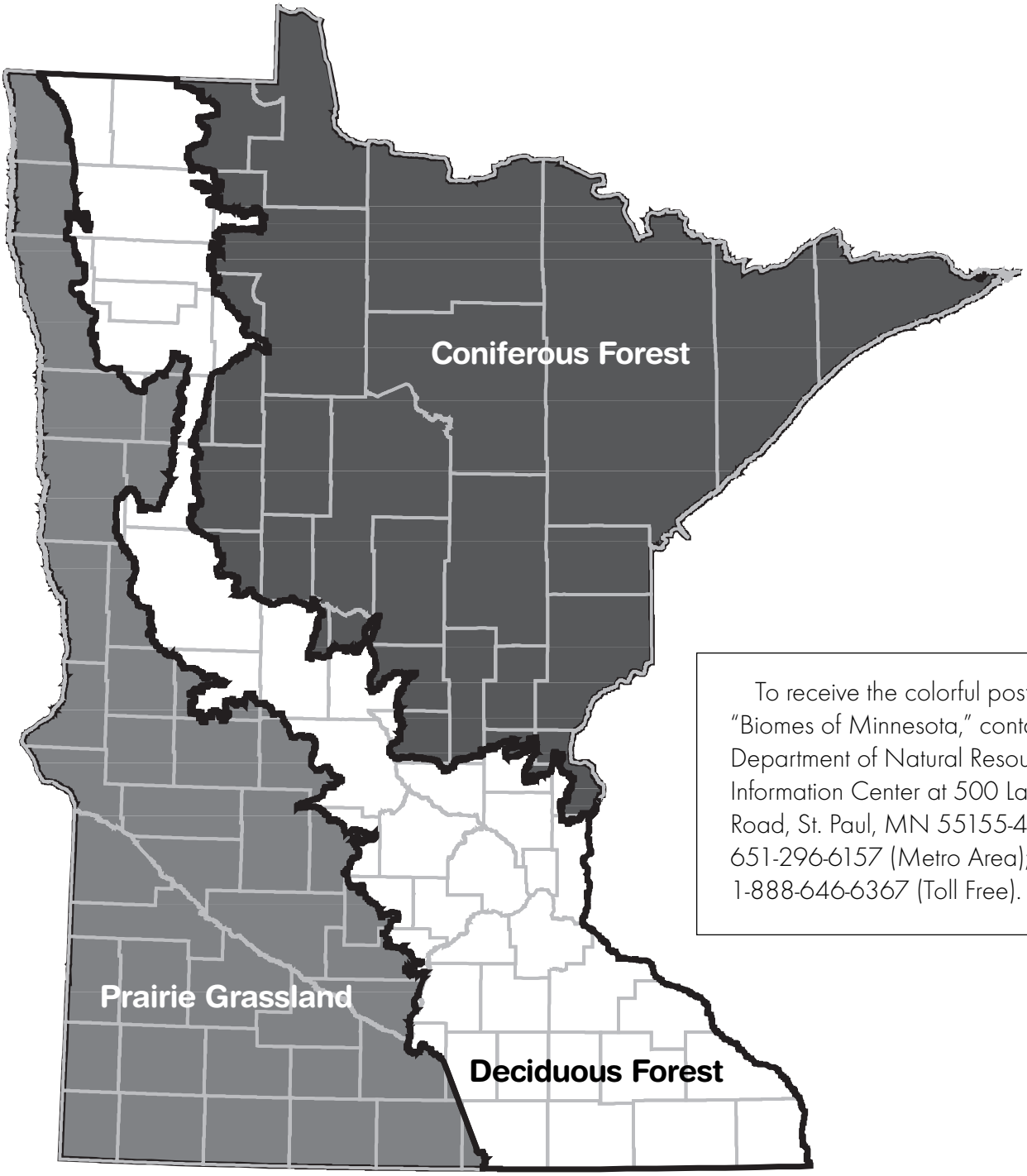
Tamaracks are also called eastern or American larch. They are Minnesota's only native conifer to have all its needles turn deep yellow and drop in autumn. The tamarack grows slowly and naturally on stagnant bogs like those of northern Minnesota. Change its soil and location, though, and it grows rapidly. Tamaracks may be 50-100 years old before reaching pulpwood size. Tamarack wood is durable and strong, but difficult to work with tools. It's used for posts, poles, ties, and pulp for making strong, tough papers and fiberboard.

Sugar Maple

This is the prized tree that produces the breath-taking crimsons and golds of autumn. One of Minnesota's finest trees, a sugar maple grows to heights of 80 feet or more. The trunk may reach a diameter of more than 3 feet. It grows slowly but isn't troubled by insects. It is called sugar maple because its sap has much sugar in the spring of the year. People bore a hole in the trunk, put a spout into the hole, and collect the sap in a bucket hung on the spout. The sap is boiled ... and boiled and boiled! Finally, it thickens and becomes syrup. It takes about 40 gallons of maple sap to make one gallon of syrup. Cook it even longer until all the water has boiled away, and it turns into maple sugar. If a maple tree is bored carefully, it may be tapped for many years. The wood from maples is a special forest treasure, too. It makes great firewood and beautiful hardwood flooring and furniture.



Minnesota's Biomes Map



To receive the colorful poster, "Biomes of Minnesota," contact the Department of Natural Resources' Information Center at 500 Lafayette Road, St. Paul, MN 55155-4040; 651-296-6157 (Metro Area); 1-888-646-6367 (Toll Free).

Minnesota's Native Trees

Many of the kinds of trees that grow in Minnesota today came from other places. As settlers arrived from other countries and states, they often brought with them precious seeds or cuttings from "back home." Eventually, many new species of trees took root and flourished in Minnesota.

But to 52 species of trees, Minnesota has always been home. These are our native trees, trees that grew naturally in the state. How many of them grow in your community? How many can you identify?

Conifers:

Cedar, eastern red (also called juniper) *Juniperus virginiana*
Cedar, northern white *Thuja occidentalis*
Fir, balsam *Abies balsamea*
Hemlock *Tsuga canadensis*
Pine, eastern white *Pinus strobus*
Pine, jack *Pinus banksiana*
Pine, red (also called Norway pine) *Pinus resinosa*
Spruce, black *Picea mariana*
Spruce, white *Picea glauca*
Tamarack (also called eastern or American larch) *Larix laricina*

Deciduous:

Ash, American mountain *Sorbus americana*
Ash, black *Fraxinus nigra*
Ash, green (also called red ash) *Fraxinus pennsylvanica*
Ash, northern mountain *Sorbus decora*
Ash, white *Fraxinus americana*
Aspen, bigtooth (also called largetooth aspen, poplar, popple) *Populus grandidentata*
Aspen, quaking (also called trembling aspen, poplar, popple) *Populus tremuloides*
Basswood, American *Tilia americana*
Birch, paper *Betula papyrifera*
Birch, river *Betula nigra*
Birch, yellow *Betula alleghaniensis*
Box Elder *Acer negundo*
Butternut *Juglans cinerea*
Cherry, black *Prunus serotina*
Cherry, pin *Prunus pensylvanica*
Coffeetree, Kentucky *Gymnocladus dioica*
Cottonwood, eastern *Populus deltoides*
Elm, American *Ulmus americana*
Elm, rock *Ulmus thomasii*
Elm, slippery (also called red elm) *Ulmus rubra*
Hackberry *Celtis occidentalis*
Hickory, bitternut *Carya cordiformis*
Hickory, shagbark *Carya ovata*
Honeylocust *Gleditsia triacanthos*
Hophornbeam, eastern (also called ironwood) *Ostrya virginiana*
Hornbeam, American (also called blue beech) *Carpinus caroliniana*
Maple, black *Acer nigrum*
Maple, mountain *Acer spicatum*
Maple, red *Acer rubrum*
Maple, silver *Acer saccharinum*
Maple, sugar *Acer saccharum*
Mulberry, red *Morus rubra*
Oak, black *Quercus velutina*
Oak, bur *Quercus macrocarpa*
Oak, chinkapin (also called yellow chestnut oak) *Quercus muehlenbergii*
Oak, northern pin (also called Jack oak, Hill oak) *Quercus ellipsoidalis*
Oak, northern red *Quercus rubra*
Oak, swamp white *Quercus bicolor*
Oak, white *Quercus alba*
Poplar, balsam (also called balm-of-gilead) *Populus balsamifera*
Walnut, black *Juglans nigra*
Willow *Salix species*
Many of Minnesota's native willows are shrublike; they do not reach tree-size. Distinguishing one willow from another is often difficult, even for a professional botanist.

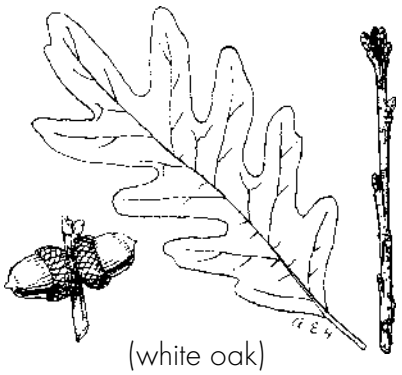
What determines why certain trees are "native" to an area? (Vegetation and landforms left after the glaciers plus the right climate, type of soil, moisture, access to sunlight, and other growing conditions for each species.)

To receive "Minnesota's Forest Treasures," a poster illustrating 35 of Minnesota's native trees, call the Department of Natural Resources' Information Center at 651-296-6157.

Name That Tree

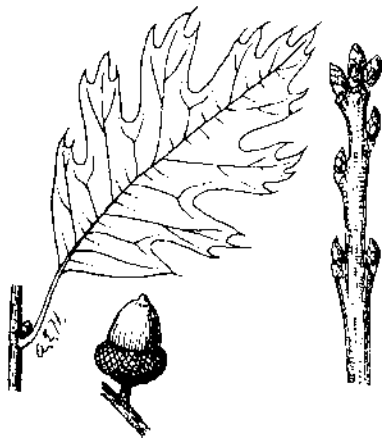
Deciduous (Broadleaf) Trees

Here's a leaf guide to some of Minnesota's common deciduous trees. How many of them can you find in your own community? It's a little harder to spot leaf differences in the spring, but as soon as the weather has been warm for several days, new leaves begin to emerge from their buds.



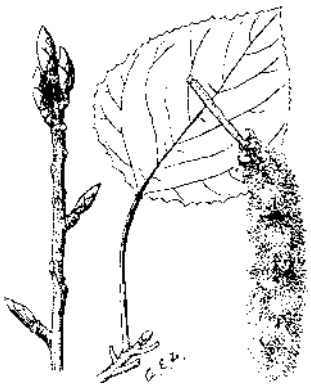
(white oak)

Oak: Distinct multi-lobed leaf shape. Turns many different colors in fall: brown, yellow, red, purple-red. White oaks have rounded leaf lobes. Red oaks have pointed lobes. Found mostly in central and southern Minnesota.



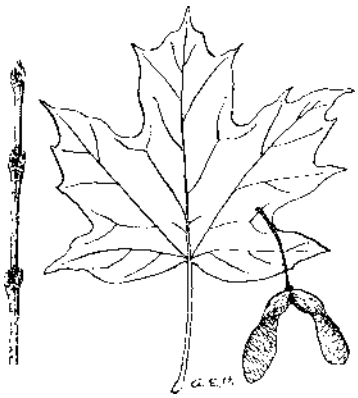
(red oak)

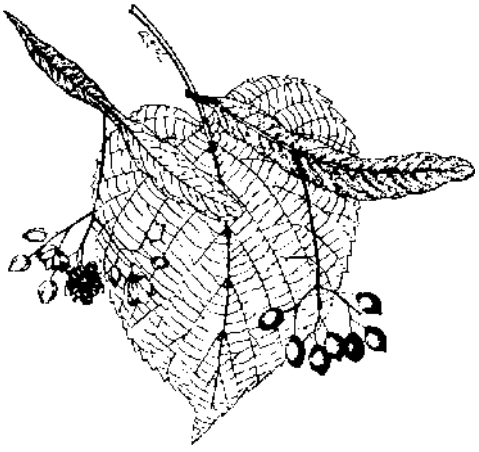
Paper Birch: The tree itself has white papery, peeling bark. Rounded leaf turns yellow and gold in fall. Has droopy flowering clusters called catkins in spring. Grows throughout Minnesota.



Quaking Aspen: Tree trunk is off-white or light grayish green. Heart-shaped leaf turns yellow in fall and "quakes" in the wind, so the tree is called "quaking" aspen. Wood mainly used in producing pulp for paper in Minnesota.

Sugar Maple: Three- to five-lobed, pointed leaves turn bright red, orange, yellow, gold in fall. Found in all of Minnesota, but most dense in central part of the state. A maple leaf is featured on the flag of Canada.





Basswood: Huge leaves turn gold and light brown in fall. Trees are known for fast growth and soft wood.

Coniferous (Needleleaf) Trees

Pines

Pines are cone-bearing evergreen trees with slender needles occurring in groups of two to five along the twigs. The needle groups are bound in bundles at the base. Only the white pine has five needles per bundle. All the remaining species have two or three needles per bundle.

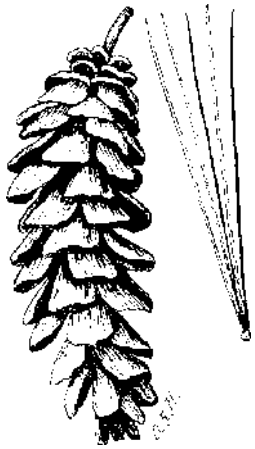
The pines are probably the most important timber trees in the world. Growing mostly on dry, sandy soils of little value, they yield not only lumber, but also turpentine, tar, pitch, and a medicinal oil. Seeds of many species rank high among the foods of nearly all game birds, rabbits, hares, squirrels, and chipmunks, and are also eaten by coyote and black bear.

Identifying some Minnesota pines:

Eastern white pine

Needles are 2" to 5" long; slender, soft, and flexible; bluish-green; occur in bundles of five.

Cones are 4" to 8" long; cylindrical with thin and often gummy scales.



Jack pine

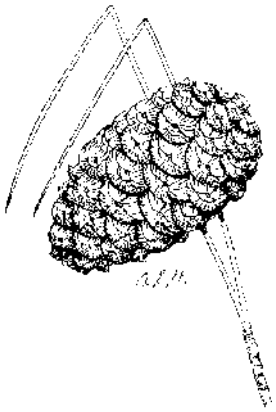
Needles are ¾" to 1½" long; ridged; sharply pointed; two in a bundle and slightly twisted.

Cones are 1¼" to 2" long; often strongly curved; brown when ripe.

Red (Norway) pine

Needles are 4" to 6" long; slender, straight, soft, and flexible; dark green; occur in bundles of two; break cleanly when bent.

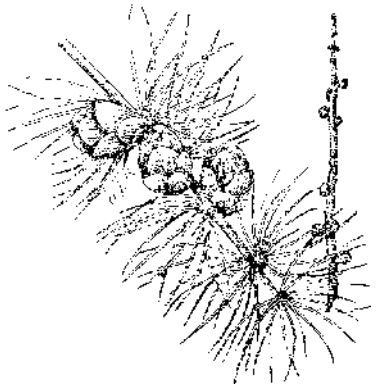
Cones are 2" long; light brown fading to gray; without spines or prickles and free from resin.



Tamaracks

The tamarack is Minnesota's only conifer that drops all or most of its leaves (needles) in autumn, leaving conspicuous warty "spurs" on the twigs. Needles are clustered at the ends of these spurs. The wood of the tamarack is very heavy, hard, strong, and durable. Its chief uses are for telephone poles, fence posts, railroad ties, and in ship building. The white-tailed deer seems to casually browse on it, and it is occasionally eaten by the varying hare. The seeds are eaten by a few species of birds and by the red squirrel.

Identifying the tamarack:



Tamarack (also called eastern or American larch)

Needles are ⅜" to 1" long; slender, and on short spurs; bluish-green; soft to touch; turn yellow in the fall.

Cones are ½" to ¾" long; oblong-ovoid in shape; stand erect on the twigs.

Spruces

Spruces are ornamental, sharply steeple-shaped evergreen trees of cold climates whose needlelike leaves are somewhat four-angled, short, stiff, and sharp. The needles grow individually from the twig, not in bundles, and are found all around the twig. When these needles are removed, the twigs and branchlets remain rough from the persistent needle bases.

Spruces often are used as Christmas trees, but their needles fall quickly upon drying out. The wood is soft, light, resinous, and straight-grained. It provides a principal source of pulp for paper and is valuable in construction work, interior finishing, and boat building. Some spruces are of great value in landscaping.

Identifying some Minnesota spruces:

Black spruce

Needles are ½" long; short, pointed, 4-sided; bluish-green; pleasantly aromatic in odor.

Cones are ½" to 1½" long; oval shaped; purple when young, dark brown when mature; scale edges ragged.

White spruce

Needles are ½" to ¾" long; 4-sided and crowded along branchlets; sharply pointed, having a slightly disagreeable odor when crushed; bluish-green when mature.

Cones are 1" to 2" long; scales thin and flexible when mature.

Firs

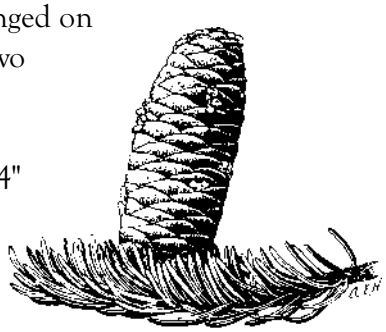
The balsam is the only "native" fir found in Minnesota. It has flat, individual needles arranged on the twigs in flat foliage sprays. It is a good Christmas tree that holds its needles. The balsam has soft, perishable wood that is often mixed with that of spruce to make paper pulp. Seeds are eaten by grouse; twigs are eaten by snowshoe hare, white-tailed deer, and moose; bark is gnawed by porcupine.

Identifying the balsam fir:

Balsam fir

Needles are ½" to 1" long; flat with rounded point; dark green and lustrous above and silvery white beneath; arranged on twig apparently in two ranks; resinous and fragrant.

Cones are 2" to 4" long; purplish to green; upright on branches.

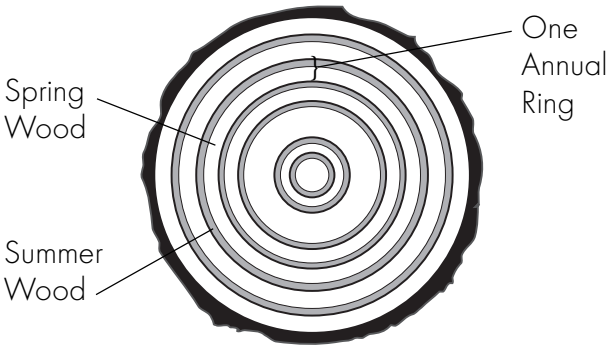


Nature's Timeline: Read the Rings!

How do trees keep growing wood every year? It's a fascinating story. Most trees in North America add new wood to their girth each year in a regular, predictable way. The new tissue is added right inside the bark by a thin layer of cells called the cambium. (See Resources, page 116.) With the warmth of spring, cambium cells begin to divide. The cambium cells on the outside become part of the tree's phloem, a band of inner bark through which the tree's food supply moves. The cambium cells on the inside become the xylem, a system of tiny tubelike cells that carry the tree's water supply. These xylem layers give us the annual rings.

As spring begins, new cells are added quickly, and the tree increases in diameter. In a cross section of a stump, this growth appears as a wide, light-colored band called earlywood or spring wood. But as the season moves on into summer and fall and the soil is less moist, the cells are added more slowly. The rings—called latewood or summer wood—are narrower and darker. Finally, the cold dry days of fall and winter temporarily halt growth altogether.

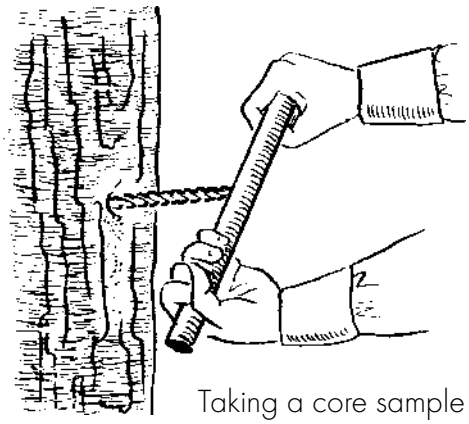
One light band and one dark band together make up a single year's growth and show as one annual ring. A new annual ring is added under the bark each year.



How Old Is This Tree?

School children everywhere are fascinated to find out the age of a tree through counting its rings. (Start at the outer (newest) ring just inside the bark and count in toward the center to know the age of the tree.) But scientists find many other fascinating bits of information tucked into the annual rings. Best known is the relationship between weather, growing conditions, and the width of the rings. Wide, light rings mean spring weather was good: warm days, lots of rain, good growing conditions. Narrower rings mean spring was probably cold or dry, and/or growing conditions were stressful. Perhaps the tree was crowded by others, shaded, or attacked by insect pests. Tree growth was limited.

The scientific study of annual growth rings even has its own name—dendrochronology. Stump study is part of this science, but core samples are often drawn from trees, too. The tree is not harmed, and the core sample, studied under a microscope, has fascinating tales to tell.


Taking a core sample

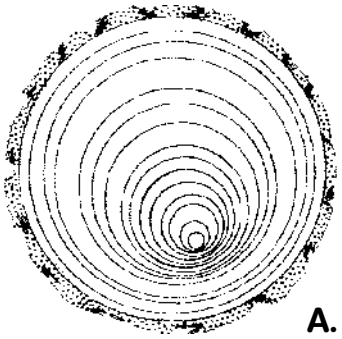
Information gleaned from tree rings helps foresters track growth rates and decide when to thin and harvest most economically. Long-covered scars are records of forest fires and other trauma. Narrow rings often coincide with historical records of insect or pest infestations. Global and environmental climate changes can also be seen. Dates of earthquakes and effects of volcanic eruptions can be read in the rings.

Tree rings are even an accurate way to figure the age of ancient buildings, boats, and other wooden things. It starts with studying the rings of a living tree, then matching those patterns with samples of older and yet older pieces of wood. The long-lived bristlecone pines of Nevada and California are an example. Some are nearly 5,000 years old themselves. By pattern matching, scientists have been able to create a historical timeline going back over 8,000 years!

Things That Affect Tree Growth.

Cross Section A:

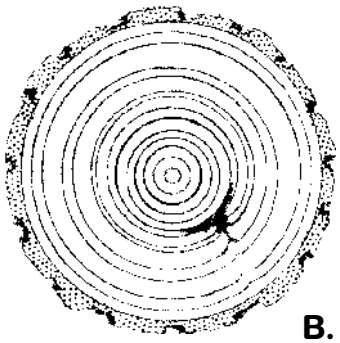
The uneven growth shown in the rings could have been caused by a fallen tree leaning against the tree (picture 1). The tree grew more on one side (wider rings) than the other, and curved up around the fallen tree. This uneven ring pattern could also belong to a tree growing on a steep slope (picture 2).



A.

Cross Section B:

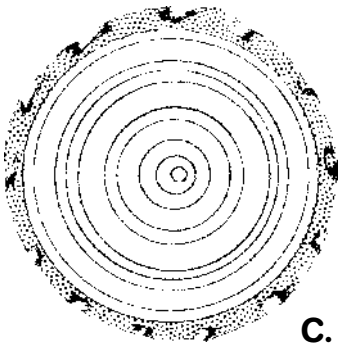
The scarring on this cross section was caused by a forest fire during the tree's sixth growing season (picture 3).



B.

Cross Section C:

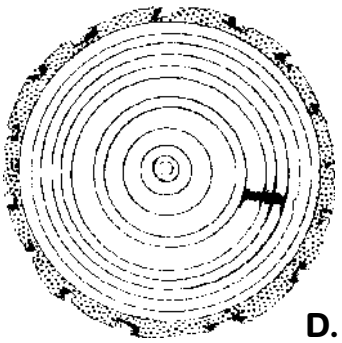
The narrow rings shown in this cross section could have been caused by several things such as drought (picture 4), heavy insect damage (picture 5), or damage from construction (picture 6). If a tree loses all or most of its leaves because of an insect attack or drought, it is not able to make food and grows very little that year. Root damage from the construction of a house or sidewalk too close to the tree reduces the water and minerals the roots can absorb.



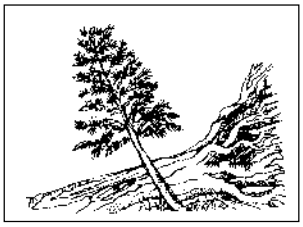
C.

Cross Section D:

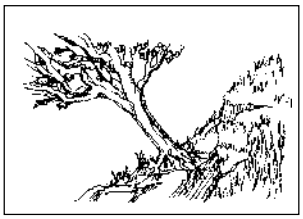
The mark beginning in year six is all that's left of a branch that died and fell off (picture 7). Eventually the tree's trunk grew around the remains of the branch and covered it. (The branch could also have been broken or cut off.)



D.

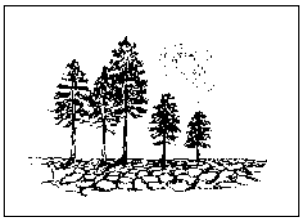


1. Fallen tree

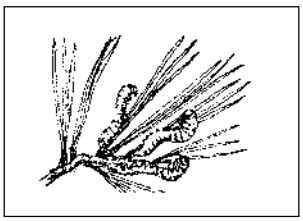


2. Growing on slope

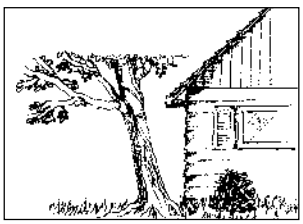
3. Fire



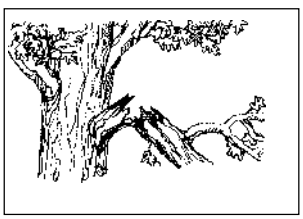
4. Drought



5. Insect attack



6. Construction



7. Dead branch

Parts of a Tree

Trees have three main parts—roots, trunks, and crowns (canopies). Each part has a special job to do in keeping the tree healthy and growing.

Roots

Explore roots and you'll discover a fascinating underground world. People who study trees are learning more each year about tree roots. They tell us the tree root system is probably the least understood part of a tree.

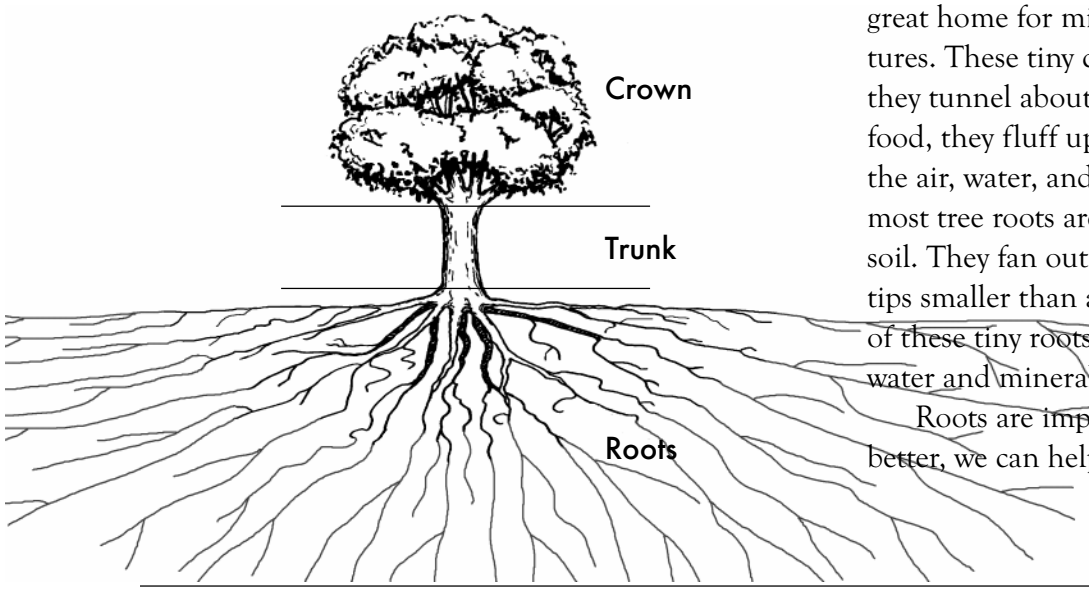
We've all seen sturdy trunks and leafy crowns of trees, and possibly tripped over the roots. But no human has ever seen a whole adult tree. Drawings in books are only part of the picture. To do it right, the page would have to be over 300 times larger than it is now!

What does a whole tree really look like? You'll have to use your imagination for what's underground, but here are some of the facts:

Almost all (about 99 percent) of the roots live and grow within three feet of the surface of the soil.

Roots don't just grow downward or toward any particular thing, but wherever they can get the moisture and minerals they need ... up, down, and sideways.

There's a connection between the root system and the rest of the tree. If part of the roots die, an equal amount of the crown may die, too.



Tree roots come in many different sizes. Some are so tiny you can only see them with a microscope. Others may be up to 12 inches or more across.

Large, woody roots grow horizontally (side to side), mainly in the top 12 inches of the soil and usually no deeper than 3 to 7 feet. They often stretch out from the trunk to take up a space four to seven times larger than the crown! These roots spread across an area that can be twice the height of the tree.

Why are roots important? To grow, all parts of the tree need to be healthy. Roots hold the tree in the ground so it can stand straight. They help the tree make food for itself. Roots absorb (soak up) water and minerals that move up through the trunk and are used by the tree to make food. They store energy (food), too.

Roots grow wherever they can get what they need: oxygen, water, minerals, and support. That means they won't grow where soil is too hard and pressed together, or where there is no oxygen. You may have seen roots of city trees follow cracks and crevices in pavements, pipelines, sewers, or cables. That's because there are air passages in these places that give oxygen and water to the trees. When roots are above ground where you can trip on them, it may be because the soil has washed away or become too packed to give them what they need underground.

The surface layers of soil, with rotting bits of leaves, are rich in organic elements. They make a great home for millions of insects and other creatures. These tiny creatures do much to help trees. As they tunnel about in the surface layers searching for food, they fluff up the soil and make pore spaces for the air, water, and minerals roots need. That's why most tree roots are found in the surface layers of the soil. They fan out in thousands of fine, short root tips smaller than a human hair. It's through the tips of these tiny roots that the tree absorbs most of its water and minerals.

Roots are important. By understanding roots better, we can help keep trees safe and healthy.

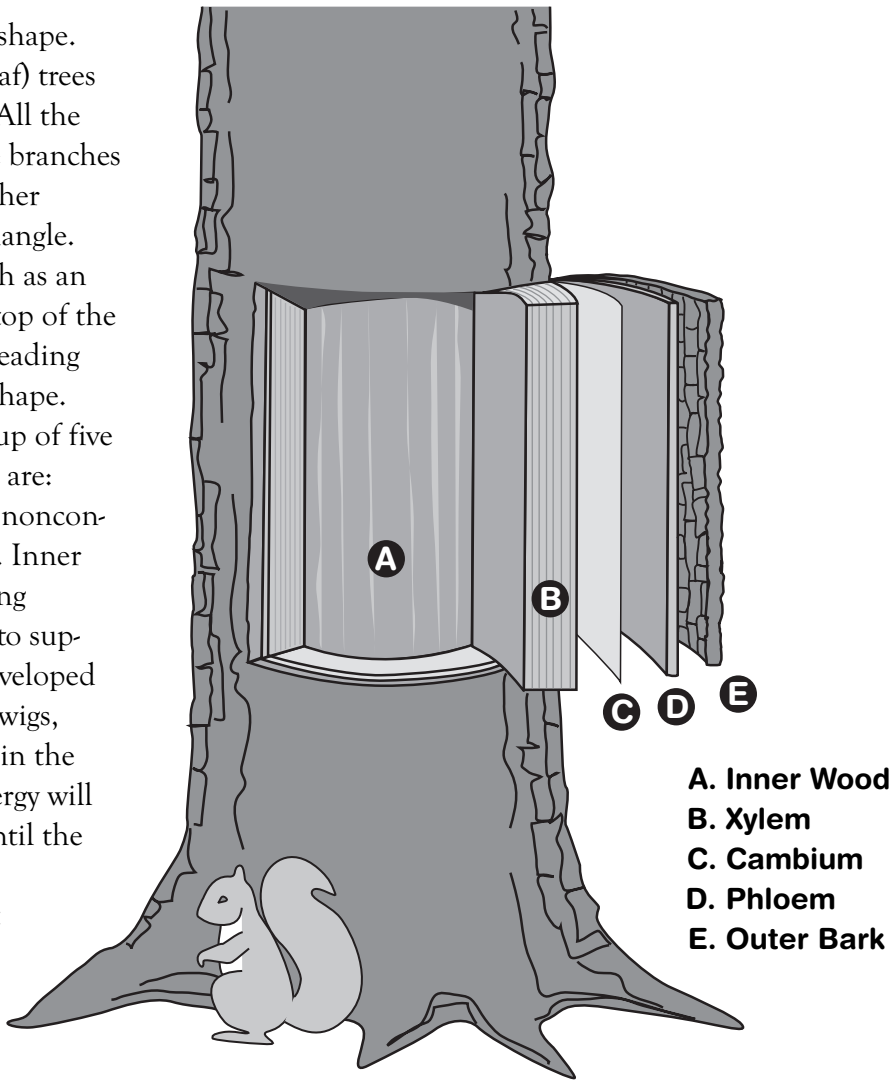
Trunks

Trunks and branches give a tree its shape. The trunks of most evergreen (needleleaf) trees grow straight up to the top of the tree. All the branches grow out from the trunk. The branches near the top are shorter than those farther down, giving the trees the shape of a triangle. The trunks of most broadleaf trees (such as an oak or maple tree) do not reach to the top of the tree. Instead, the trunk divides into spreading branches, giving the crown a rounded shape.

The trunks of most trees are made up of five layers. From inner to outer, these layers are:

A. Inner wood: This is the woody nonconducting tissues in the center of the tree. Inner wood has two main jobs: to store growing compounds and sugars (tree food) and to support the tree. After the tree has fully developed all its new parts for the season (leaves, twigs, seeds/fruits, etc.), the sugars are stored in the cells of the inner wood. This stored energy will help power next year's spring growth until the tree again fully develops its leaves.

B. Xylem: This is a band of cells at the outermost edge of the inner wood. It has tiny pipelines that carry water and small amounts of dissolved minerals from the roots to the leaves.



C. Cambium: This is a thin layer of growing tissue on the outside of the xylem. Its job is to make the trunk, branches, and roots grow thicker. The trunks and branches of most trees grow thicker as long as the tree lives. The cambium layer uses the sugar manufactured by the leaves to make new plant tissue. On its outside, the cambium makes new phloem. On its inside, it makes new xylem, which eventually becomes wood.

D. Phloem: This layer also has tiny pipelines. The food made by the leaves moves through the phloem to the other parts of the tree. This food is called sap.

E. Outer bark: This is the "skin" of hard, dead tissue that protects the living inner parts of the tree from injury. The outer bark stretches to let the trunk and branches grow thicker. The bark of a few kinds of trees, such as beeches and birches, is smooth because it stretches easily. But the bark of most other trees does not stretch well. As the trunk and branches grow thicker, they push against the bark. It finally cracks, dries, and becomes rough with large ridges. Most trees lose old bark from time to time and replace it with a new layer.

Remember: Bark needs our protection! A tree's outside bark protects it from insects, fungus, and disease. The phloem, which is on the inside of the outer bark and is often called inner bark, moves food from the leaves to the roots. Peeling, carving, or damaging a tree's bark may cause the tree to die.

Crown (Canopy)

The crown is the branches and leaves of the tree. It has the important job of making food for the tree.

Sunlight comes into a leaf through the leaf's skin, which is clear like glass. Beneath the skin are millions of tiny "bags" called cells. These cells are like little balloons filled with water and living jelly. Inside the cells are small green packages called chloroplasts. The chloroplasts are filled with green chlorophyll. The chlorophyll catches some of the sunlight that falls on a leaf.

While the chloroplasts are catching sunlight, other things are happening in the leaf. Air comes into the leaf through many tiny openings called stomata. Water, moving up from the roots far below through the xylem, flows through the leaf. The air and water mix together and flow into the cells.

These cells are like little factories. Here, the green chlorophyll works away. Using sunlight as a source for energy, it changes water and a gas from the air (called carbon dioxide) into a form of sugar. This process is called photosynthesis. The sugar made by the leaves is food or energy for the growing parts of the tree and for storage. During photosynthesis, the leaves also produce oxygen that is released into the atmosphere.

Some trees lose their leaves before winter; others do not. Why does this happen? As leaves make the food for the trees, they use water. A tree gets water from the ground. The roots take it in, then the water travels up the trunk to the leaves. In late summer, a thin layer of cork grows over the leaf-twig connecting spot. Water can no longer pass into the leaf. The days get shorter, with less sunlight energy for the chlorophyll. All spring and summer, chlorophyll has made the leaves look green, covering up the other color pigments like orange, red, and yellow. But as the leaves die in fall, chlorophyll disappears, the green is gone, and the other colors appear.

Another kind of tree, the needleaf (coniferous) tree, does things a bit differently. Its leaves are called needles and they fall off, but not all at once like the broadleaf (deciduous) trees. Needles fall off slowly over a two- to three-year period and are always replaced by new needles—just like the hair on your head!

Coniferous needles are tough and don't freeze in winter, so they don't lose water as quickly as other kinds of leaves do. By holding onto the water that's in them, they stay alive and green even in winter.

Flowers and Fruits

Other important parts of a tree include the flowers and fruits. Flowers and fruits are the ways in which most trees reproduce. The fruit is where seeds are found that will grow into new trees. Trees have many kinds of flowers. Some trees have very showy flowers. Others, such as coniferous trees, have small, plain flowers that are hardly noticeable.

The fruits of some deciduous trees (apples and cherries for example) have a tasty outer covering. The fruits of other deciduous trees like acorns and beechnuts are hard nuts. Ashes, elms, and maples have thin, winged fruits. Most coniferous trees bear their seeds in cones.

Planting a Tree

Plan Ahead

Scope out a site. Check with your parents if it's in your yard. If you are unable to plant in your yard, contact your city offices to see about planting on the boulevard or at a local park. Other possibilities might be your church, school, or parents' workplace. In any case, be sure to get approval from the person in charge. If there's any doubt about utilities, call the Gopher State utility hotline and get help from an expert to locate buried electric, gas, or other utility lines.

Call: TWIN CITIES, 651-454-0002
Greater Minnesota, 1-800-252-1166

Try to select a tree that will grow well on the site you've selected. Consider the soil type and moisture content. Is your site sandy and well drained? Or is it heavy clay, and so perhaps wet and possibly compacted? Remember, too, that there are a number of different growing regions in Minnesota. Some tree species do better in one region than another. Before choosing a tree, find out which kinds do well in your part of the state. Also make sure your site will "fit" your tree when it reaches its adult height and width. For help, check with your local nursery or garden center, city forester or tree inspector, Department of Natural Resources forester, county extension agent, or Soil and Water Conservation District specialist.

Where Can You Get Trees?

Your local nursery or garden center will have both large and small trees. Make sure the trees are Minnesota grown so you know they are acclimated to Minnesota's harsh winter weather.

Low-cost seedlings are available from the Minnesota Forestry Association. Seedlings are grown in a soil plug and are individually packaged in recyclable polybags to assure survival during transport. You can choose among several different tree species. For ordering information write or call:

Minnesota Forestry Association
P.O. Box 496
Grand Rapids, Minnesota 55744
218-326-3000 Toll Free, 1-800-821-8733

Tree planting programs may help you, too. The Soil and Water Conservation districts across Minnesota have local programs to help plant trees for soil and wind erosion control or reforestation. Seedlings are available at a low cost through this program. For more information, look for "Soil and Water Conservation District" under your county offices in the blue section of the white pages telephone book.

The Minnesota Department of Natural Resources (DNR) sells seedlings in large quantities. For more information, contact the DNR Information Center at 651-296-6157 (Metro Area) or 1-888-646-6367 (Toll Free).

Planting Your Trees

The root systems of both seedlings and saplings must be protected before the trees are planted. If the seedlings are bareroot, they must be kept moist at all times, and not exposed to wind and warm temperatures for more than three to five minutes before they are planted. Any drying damages the roots.

The roots of some saplings are already protected in containers or large clumps of dirt that are surrounded by burlap. Some saplings are purchased bareroot, however. All young trees, especially the bareroot trees, must be protected from extreme hot and cold.

It's important to plant your trees properly. Resources, page 119 shows proper planting techniques.

Trees are living things that need your care and protection. They need to be mulched and watered regularly after planting, too.

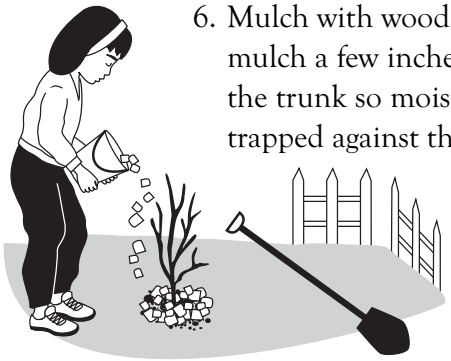
Planting a Tree

KID'S COPY

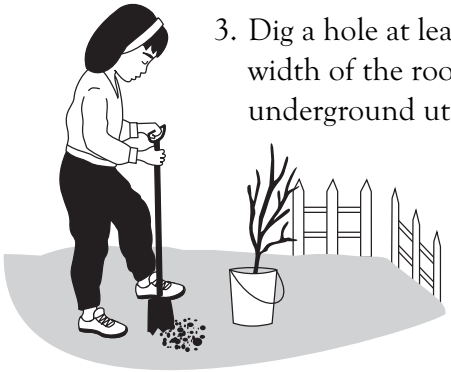
1. Choose a good spot for your tree. Don't forget to plan for its ADULT size.

5. Add more soil and lightly firm with foot.

2. Keep your roots moist all the time. Dry roots die.



6. Mulch with wood chips. Keep mulch a few inches away from the trunk so moisture isn't trapped against the trunk.

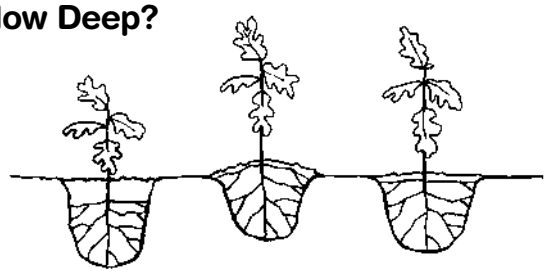


3. Dig a hole at least two times the width of the roots. Check for underground utility lines first!

7. Water regularly. Wait for shade!

4. Plant the tree at the right depth. (See "How Deep?") Gently add loose soil.

How Deep?



Too deep. Too shallow. Just right.

What care besides watering will your tree need in the months and years to come? (Protection from damage by people, animals, machines like lawn mowers, wind, disease, smothering by grass and ground cover, etc.) How will the tree get this protection?

Tree Enemies

Just like people and animals, trees can get diseases ... and it can be serious.

A fungus is a tiny organism that may be deadly to certain trees. Two diseases caused by a fungus that have had huge effects on the trees in Minnesota are Dutch elm disease and oak wilt.

Dutch Elm Disease

Dutch elm disease is caused by a fungus. It spreads from tree to tree in two ways: above ground and below ground. Above ground, elm bark beetles carry the fungus spores attached to their bodies and pass them into healthy trees when they feed on the branches. Below ground, the disease can be spread by root grafts (roots naturally growing together) when the roots of an infected tree happen to be grafted to the roots of a healthy tree.

Once in the tree, the Dutch elm disease fungus invades the water-conducting vessels of the elm. In an attempt to stop the invader, the tree forms blockages. Together with the fungus, these blockages plug the water-conducting vessels (xylem) of the tree and stop water movement within the tree. This causes the tree to wilt and die.

What are the signs of the disease?

The first sign of Dutch elm disease in a tree is wilting in one or more of the upper branches. Leaves on the branches turn dull green to yellow and curl, then become dry, brittle, and turn brown. Peeling bark from wilted branches of diseased trees shows light to dark brown streaks in the light-colored wood beneath the bark. In a cross section of the branch, you'll see a broken brown ring in the outermost wood of the wilting, dead, or dying branches, and sometimes small round patches of discoloration in the outer growth ring.

Some trees die several weeks after becoming infected, while others wilt slowly and survive for a year or longer.

How can we prevent the disease from spreading?

The best way to manage Dutch elm disease is to prevent it. The ways to prevent Dutch elm disease are described as "sanitation." This includes catching signs of the disease early, and getting rid of all weakened, dying, or dead elm trees. Stripping the bark from elm wood takes away elm bark beetle breeding places and sources of the fungus. The steps in a sanitation program include:

1. **Catch the disease early.** Foresters carefully inspect elm trees in any area where the disease has been found. This inspection turns up trees showing signs of disease.
2. **Separate the tree from others.** Foresters disrupt root grafts between infected and healthy trees. Once a tree is known to be diseased, root graft barriers are set up so the diseased tree's roots cannot spread the disease to healthy trees through root grafts. This root graft disruption can be done by trenching around infected trees.
3. **Destroy beetle-breeding sites.** Dead and dying elm wood, including standing trees and stacks of firewood logs, are breeding places for elm bark beetles. Beetles lay eggs under the bark of elm trees; the eggs hatch and produce another generation of beetles. Left to stand, an infected tree can harbor hundreds of thousands of beetles. If this tree is also infected with the fungus, each beetle carrying the fungal spores can then carry the disease to a healthy tree and introduce the spores into that tree as it feeds or establishes breeding sites. This is why removal of diseased trees is so important.

   Remove and dispose of all diseased elms and all elms killed or seriously weakened regardless of the cause. Elm wood may be chipped so none remains with sufficient bark to serve as beetle-breeding sites. If chipping is not possible, diseased elm wood should be burned (where permitted) or buried in a landfill.

   If elm wood is to be used for firewood, the woodpile should be covered and sealed with heavy plastic from April through October to destroy beetles within the wood. To prevent tears in the plastic, place old tires or burlap sacks between the wood and plastic. Seal edges of the plastic under a layer of soil. Sealing firewood under plastic is usually necessary only

the first year because the bark loosens and the wood becomes unsuitable as a breeding site.

Oak Wilt Disease

Oak wilt is a disease found from Minnesota east to Pennsylvania, south to South Carolina and Tennessee, west to northern Arkansas and southern Texas. In Minnesota it is most serious in the southeast to the east-central part of the state. It is found south of a line from St. Cloud to Taylors Falls all the way to the Iowa border, and east of a line from St. Cloud to Mankato.

How is the disease spread?

Oak wilt disease is similar to Dutch elm disease in several ways. First, oak wilt is also caused by a fungus that invades the tree's outer sapwood (outer xylem), and second, it causes the tree to wilt and die. Once in the tree, the oak wilt disease fungus invades the water-conducting vessels of the tree. In an attempt to stop the invader, the tree forms blockages. Together with the fungus, these blockages plug the water-conducting vessels (xylem) of the tree and stop water movement within the tree. This causes the tree to wilt and die.

As with Dutch elm disease, the fungus that causes oak wilt is carried from tree to tree in two ways. Below ground, it is spread through grafted roots when the roots of a diseased tree grow together with the roots of a healthy tree. Above ground, the fungus can be spread by sap-feeding beetles. After a tree is killed, the oak wilt fungus creates fruiting or spore-bearing material with a sweet odor that attracts the beetles. As the beetles crawl on the material, spores of the fungus stick to them. They then fly to other oaks that have been wounded and have exposed wood, and infect the healthy trees.

What are the signs of the disease?

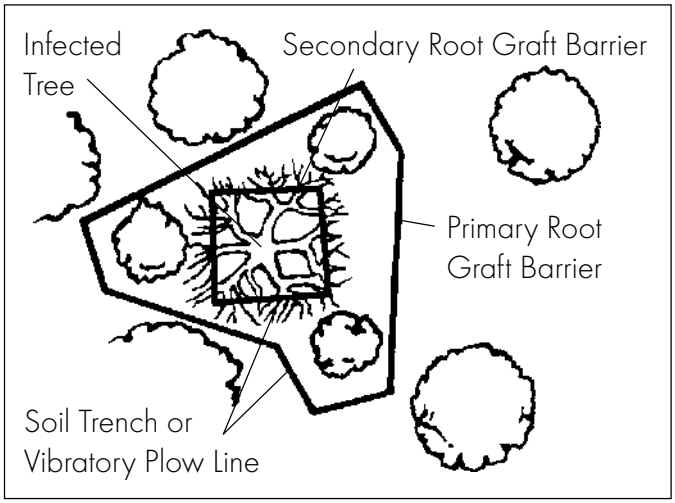
As with Dutch elm disease, the first sign of oak wilt disease in a tree is wilting. It usually starts near the top of the tree and then quickly involves the entire crown. You'll also see brown to black streaks in the outer wood of the diseased tree.

Another sign of oak wilt is changes in leaf color. The leaves of red oaks turn dull green, bronze, or tan beginning at the outer edges of the leaf.

How can we prevent the disease from spreading?

Some of the steps to prevent oak wilt disease from spreading are similar to those of Dutch elm disease. First, the disease must be found, and diseased trees isolated from healthy trees by separating the root grafts. As with Dutch elm disease, root graft separation is done by mechanically trenching around infected trees. Second, it is important to promptly remove all infected trees that still have bark attached, before the oak wilt fungus produces spore mats under the bark. If oak wood is debarked to hasten drying and to prevent spore formation, it can also be used for firewood. If the wood is not debarked, the woodpile should be covered with heavy plastic from April through October. To prevent tears in the plastic, place old tires or burlap sacks between the wood and plastic. Seal edges of the plastic under a layer of soil. Sealing firewood under plastic is usually necessary only the first year because the bark loosens and the wood becomes unsuitable as a breeding site.

Another way to prevent oak wilt from spreading is to protect oak trees from being wounded, especially during April, May, and June each year. Trees should not be pruned during this time and working around trees should be avoided if at all possible. If wounding does occur during April, May, or June due to storm damage or other causes, a wound dressing should be applied to prevent sap flow.



Trees: They're Important!

Why Do We Need Trees? Think About It!

- Trees help supply oxygen we need to breathe. Yearly, each acre of young trees can produce enough oxygen to keep 18 people alive...
- Trees help keep our air supply fresh by using up carbon dioxide that we exhale and that factories and engines emit...
- Trees use their hairy leaf surfaces to trap and filter out ash, dust, and pollen particles carried in the air...
- Trees cut down the amount of gaseous pollutants in the air as they release oxygen...
- Trees lower air temperatures by giving us shade that saves on air-conditioning costs...
- Trees increase humidity in dry climates by releasing moisture as a byproduct of food making and evaporation...
- Trees give us a constant supply of products—lumber for building, cellulose for paper and fiber, nuts, mulches, oils, gums, syrups, and fruits...
- Trees slow down forceful winds. Shelterbelts in fields protect soil, windbreaks around farm buildings protect people and animals, and living snow fences near highways help keep snow off roads...
- Trees cut noise pollution by acting as sound barriers. Each 100-foot width of trees can absorb about six to eight decibels of sound. Along busy highways, which can generate as much as 72 decibels, less noise is a relief for people living nearby...
- Trees provide food and shelter for birds and wildlife and for us...
- Trees shade us from direct sunlight. They are welcome in parking lots on hot sunny days...
- Trees camouflage ugly scenery, unsightly city dumps, auto graveyards, and mine sites...
- Tree leaves break the flow of pelting raindrops on the soil surface and give the soil a chance to soak up as much water as possible...
- Tree leaves, when fallen, cover the ground to keep the soil from drying out...
- Tree leaves, by decaying, fertilize the soil. They replace minerals and enrich the soil to grow better plants...
- Tree roots hold the soil and keep silt from washing into streams...
- Tree roots help air get beneath the soil surface...
- Trees soothe us with pleasing shapes and patterns, fragrant blossoms, and seasonal splashes of color...
- Trees break the monotony of endless sidewalks and miles of highways...
- Trees beautify our gardens and decorate our back yards...
- Trees soften the outline of the masonry, metal, and glass cityscape...
- Trees increase the value of property...
- And trees provide for America's economic growth and stability.

—Excerpted from a U.S. Forest Service booklet prepared by the Northeastern Forest Experiment Station, Upper Darby, Pennsylvania.

Trees Through the Seasons

Teacher Guide

Most of the activities in this guide are geared toward spring. They're things you can do in connection with your Arbor Day or Arbor Month celebrations.

Yet trees offer fascinating learning opportunities all year long. Don't miss out on the other seasons! The following pages take you "through the year" with trees. Another year, you may want to make trees a whole-year learning adventure. A great ongoing activity is to have students "adopt" trees that they can identify and observe through all the seasons. Each student creates a scrapbook about his or her tree and how it changes through the seasons.

If individual student scrapbooks don't fit your school program, scan and choose other activities as each season arrives. Some activities are interchangeable from season to season. Your students will develop new interests in trees along with better scientific observation skills. You'll probably discover a lot of new things about these intriguing giant plants yourself!

Trees Throughout the School Year

1. Starting in the fall, encourage each student to choose a special tree and to make a scrapbook called "My Adopted Tree." The scrapbook should have a strong cover so it will last all year. Each time a new drawing or project is completed, it goes into the scrapbook. Display the books for all to enjoy during Arbor Month. Students bring them home at the end of the year.
2. Once each season, ask: How has your tree changed? Each student draws a detailed picture of his or her tree, including all changes and at least six objects found in its environment (flowers, birds, animals, rocks, snow, seeds, grass, etc.).
3. Ask: What animals or insects can be seen near or on your tree during each season? Look in crevices of the bark, on the leaves, along the bottom of the trunk, and on branches and twigs. Make a picture list of the things you see each season.
4. On nature walks, challenge students:
   - Close your eyes. What sounds do you hear around your tree? What do you smell around your tree? What do you feel on and around your tree? Open your eyes. What do you see around your tree?
   - Choose a dead or nearly dead tree to compare with yours. How are they the same? How are they different?
   - Take seasonal photographs of three or four different kinds of trees. Put them in school-year order and compare them at the end of the school year. Make a bulletin board display of your photographs.

Autumn Questions and Activities:

1. What words would you use to describe your tree at this time of year?
2. Take a leaf from your tree back to the classroom. Examine it with a magnifying glass. What do you see? Iron it between two pieces of waxed paper and place it in your scrapbook.
3. Are there holes in some of the leaves on your tree? Why? Has something been eating them? What?
4. What is inside leaves to make them green? (Chlorophyll.)
5. Why do leaves change color in fall? (The chlorophyll disappears from the leaf as the days become shorter. The yellow, orange, red, and brown pigments that are also in the leaf now show through.)
6. Why do leaves fall off the trees in autumn? (When the leaves are not producing food, a cork layer grows over their leaf-twig connecting spot. The leaves no longer get water. They dry up and lose their hold on the branches. The wind blows them off.)

7. How much time has passed between the first color changes in the leaves of your tree and the time the tree is left bare?
8. Will a green leaf change color if it is put in a cold place? Put a green leaf in a plastic bag and put it in a refrigerator. Watch the color changes for a few days.
9. What will happen to a green leaf when we boil it? Boil a green leaf for five to 10 minutes. (Use hot burners only with adult supervision.) The water goes through a series of color changes. Collect several tablespoons of water as boiling proceeds. Include a sample of clear water. Keep the samples in order. Compare and discuss the changes. Remove the leaf from the water. What happens to the color?
10. How do the seeds from your tree differ from the seeds on other trees? How are they alike?
11. What is inside a seed from your tree? Cut it in half and look at it with a magnifying glass.
12. How do seeds from trees travel?
13. How did your tree probably begin growing?
14. What protects the buds during fall and winter?
15. Does your tree have any injuries? Who or what might have made them? (If there is a well-formed scar or if the injury is painted black, the wound is probably the result of planned pruning.)
16. Can you find holes that might have been made by woodpeckers?
17. Are there any cocoons on your tree?
18. What happens to a tree when it dies? (It rots or decays and becomes part of the soil again. This is good since it adds food to the soil.)
19. Is there "pollution" around your tree? Which litter is nature-made and which is human-made? (Dispose of all human-made litter.)
20. What geometric shapes do you see on or near your tree?

Winter Questions and Activities:

1. What words would you use to describe your tree at this time of year?
2. When does a tree stop growing? (Trees "sleep" or "rest" during the winter but never stop growing until they die.)
3. What are your tree's food or water needs during the winter? (Compare this to the hibernation of bears.)
4. Are the needles of pine trees leaves? (Yes.)
5. Do evergreens ever lose their needles? (Yes. When new ones grow, the old ones fall off, but never all at once.)
6. How do evergreen needles stay alive in the winter? Look at some through a magnifying glass. (A covering of thick wax keeps them from losing water. They do not dry out and die in the winter.)
7. Will evergreen branches change color if they are brought inside? Clip a small branch from a spruce or pine tree and bring it to school. Put the branch in a sugar-water solution such as is used for Christmas trees. Watch the changes for several days.
8. Why is the bark of most trees rough and cracked? (The bark is not elastic enough to stretch as the tree grows.)
9. Why do trees have bark? (To protect the insides, like our skin.)
10. Make bark rubbings. Place a piece of paper over the bark and rub the side of a crayon firmly against the paper. Compare your rubbing with other rubbings. Place it in your scrapbook.
11. Measure around the trunk of your tree with a string or a tape measure. Compare your tree with others.
12. How can you tell the age of a tree? (Find a stump or a log and count the age rings in it.)
13. How old is your tree? Borrow an increment borer from a forester to take small cores from the trees. Count the rings.
14. How thick is the bark of your tree?

15. Will some wood from your tree float? Which of your group's trees are made of the heaviest wood? Which of your trees are made of the lightest wood? (Use the core taken with the borer or a small twig from each tree as "floating" samples.)
16. Do the branches show signs of where the leaves used to be? (Look for "leaf scars" with a magnifying glass.)
17. Are there tracks in the snow around your tree? What made them?

Spring Questions and Activities:

1. If they haven't already done so, invite each child to "adopt" a tree to observe and learn about all year long.
2. What evidence do you see of your tree "waking up"?
3. Cut a twig from your tree in the early spring. Bring it to the classroom and put it in water. Watch the bud scales open and the leaves unfold. Keep a record of when the twigs were put in the water, when the leaves appeared, and when the bud scales dropped off.
4. What makes the buds begin to grow? (Day length is increasing, making more "sun time" available. Warming temperatures allow water movement within the tree.)
5. Take a bud from your tree back to class. Examine it with a magnifying glass. Iron it between two pieces of waxed paper and put it in your scrapbook.
6. What part of the tree makes food? (Leaves make food for the trees. They use air, water, and sunlight to make food. This process is called *photosynthesis.)*
7. When do leaves make food? (During the day. Photosynthesis takes place only in the light.)
8. Why are leaves arranged on the branches the way they are? (So they don't overlap and block sunlight to the ones below.)
9. How does water get to the leaves? (It travels through tubelike cells in the roots, trunk, and branches of the tree.)
10. Where are the roots of your tree?
11. Do some of the roots show above ground?
12. Why do the roots of the trees spread so far in the ground? (To form a strong base and to drink up minerals and moisture from the earth.)
13. Tie a plastic bag around the leaves of a small branch. Look at the branch after a few days. What do you see? (Drops of moisture should appear on the bag. Moisture is released from cells in the leaf. It moderates the air temperature and relative humidity surrounding the leaf. This is called *transpiration.)* Put another plastic bag around a dead twig and compare the two bags. (Remember to remove the bags when done.)
14. Is the whole tree growing? (Trees grow in length only near their tips, but they grow in diameter at their roots, trunk, and branches.)
15. Taste the sap from a maple tree. Is it sweet? (Trees make sugar. We use the sugar sap from maple trees to make syrup.)
16. What movements does your tree make?
17. Look for a "food chain" near your tree. (Birds eat spiders, spiders eat other insects, and insects eat leaves, etc.)
18. Take a picture of each student's tree. Mix up the pictures. Can each student find the picture of his or her own tree?
19. Make a picture list of all the things you think trees are good for. Some possibilities:
    Trees give us:
    - moisture in the air
    - beauty
    - shade
    - flowers, fruit, and nuts
    - saps and oils
    - wood pulp for making paper, plastic, and rayon
    - wood for building
    - a place to climb
    - places for birds' nests
    - food and homes for animals and insects
    - better soil

(See Resources, page 122 for more ideas.)

Summer Questions and Activities:

1. If they haven't already done so, ask each child to "adopt" a tree to observe and learn about all year.
2. How is your tree like the others? How is it different?
3. Is your tree dead or alive?
4. Are there any nests in your tree? Why is it a good place for a nest? (The branches hold the nest in place. The nest is hidden and out of reach of many enemies.)
5. Are there many plants growing under your tree?
6. Are there more leaves on one side of the tree than on the other? Why? (The tree may get more sun on one side.)
7. Do you see buds near the leaves of your tree? When are buds for the next season's leaves made? (At the same time as leaves and new shoots, during elongation in spring.) When will these buds grow into leaves?
8. Take two leaves from your tree back to class. Examine them with a magnifying glass. Try to match your leaves to the leaf pictures in a tree identification book. What kind of tree is your tree?
9. Iron one leaf from your tree between two pieces of waxed paper and place it in your "My Adopted Tree" scrapbook.
10. Make a leaf print with the other leaf from your tree. Place the leaf on newspaper. Brush the leaf with ink or paint. Move the leaf to a clean newspaper. Place a porous paper over the leaf and rub gently to transfer the ink or paint from plant to paper. Let the paint dry, and place the print in the scrapbook.
11. Gather a small piece of bark, a twig, a seed from your tree, and a small plastic bag of soil from under your tree (use a large spoon or trowel). Mount all these on a piece of heavy paper and place them in your scrapbook.
12. Take two temperature readings, one under your tree and the other away from its shade. How much do they differ? (Note: When taking a temperature in the sun, shade the bulb of the thermometer.)
13. Does there seem to be a breeze under your tree when there isn't any away from its shade? Why? (The cool air under the tree is heavy and pushes the warm air away as it sinks to the ground.)

Evaluation (If a Year-Long Project)

Your evaluation of each student's skills and conceptual developments should be guided by the contents of "My Adopted Tree" scrapbooks, responses to questions, and participation in discussions. The questions listed here are designed to help you make good subjective evaluations. You'll need to adapt the questions to meet your students' age level.

a. How well did the student follow directions?
b. How much direction did the student require?
c. Did the student formulate new questions?
d. Did the student design new experiments to answer these questions?
e. Did the student recognize cause and effect relationships?
f. Could the student state the problem to be solved?
g. Did the student arrive at conclusions by himself or herself?
h. How many characteristics of his or her tree did the student identify?
i. Could the student describe enjoyable and useful ways of using trees?
j. Did the student compare and contrast the characteristics of his or her tree with those of other trees?
k. Could the student predict the outcome of his or her investigations?
l. Could the student predict changes in his or her tree?
m. How well did the student use his or her five senses?

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Tree Holidays
(For Arbor Day Ceremonies or Anytime)

People throughout the United States and the world have set aside special days and times of the year to celebrate their appreciation of trees. Here are just a few of those holidays. Challenge your group to research and discover others. *Chase's Calendar of Annual Events* and other books that list holidays are available at the Reference Desk of many libraries and media centers. They offer a good place to start the search. Surfing the Internet may also yield more events.

The holidays listed below without specific dates are those that occur on moveable days. Check library reference materials for their specific dates in any given year.

January-February
Tu B'shivat—the New Year of the Trees. Arbor Day of the Jewish people observed on the 15th day of Shivat on the Jewish calendar. (Also spelled B'Shevat.)

February
Baika-Sai—Plum Blossom Festival in Japan. Time for appreciating flowering trees.

March 14
Johnny Appleseed Day.

March 24
Maple Syrup Festival in Vermont.

March-April
Cherry Blossom Festival in Japan.

April
Kalpa Vruksha—Spring festival and tree planting time in India. Children often celebrate and receive gifts as they are seated around a tree getting its new leaves for the year.

April 21
John Muir's Birthday (1838). This naturalist and writer did much to preserve trees and wilderness areas.

April 22
International Earth Day, first observed in 1970.

Last Friday in April
U.S. National Arbor Day. Twenty-two states including Minnesota also celebrate on this day.

April-May
Cherry Blossom Festival in Washington, D.C. Cherry trees presented to the United States by Japan and planted in the Potomac River Tidal Basin are in full bloom.

May
Arbor Month in Minnesota.

May-June
Poinciana Festival in Miami, Florida, centers around the royal poinciana trees of the area.

June 5
World Environment Day, established by the United Nations in 1972.

August 11
Gifford Pinchot's Birthday (1865). A conservation leader, Mr. Pinchot was the first chief of the U.S. Forest Service and founder of the Society of American Foresters.

November 14
Tree Fest in Tunisia.

November
Arbor Day in Western Samoa.

December 22
International Arbor Day. Encourages tree planting in the southern hemisphere and winter tree planting in other areas where the climate is suitable.

Quotes and Reflections

Trees inspire us. Throughout the ages, poets, writers, and painters have praised the forest as a place of great beauty. For American Indians and many other indigenous peoples, trees are a sacred gift from Mother Earth. People of all ages, in all walks of life, often find strength, wonder, and a sense of peace in trees.

With trees bringing about such strong feelings, it is no wonder hundreds of people have been moved to write about them or about preserving the earth upon which they grow. Stories, poems, and songs are all part of the lore.

Here is a collection of some favorite quotes about trees and about the natural world. Use it for "quote of the day" activities, as inspirations for learning about particular authors, as environmental education enhancements, and more.

A people without children would face a hopeless future; a country without trees is almost as hopeless.
—Teddy Roosevelt, Arbor Day, 1907

For mine is the old belief ... There is a soul in every leaf.
—M. M. Ballou

Did you know that trees talk? Well they do. They talk to each other, and they'll talk to you if you listen. I have learned a lot from trees: sometimes about the weather, sometimes about animals, sometimes about the Great Spirit.
—Tatanga Mani, a Stoney Indian

No shade tree? Blame not the sun, but yourself.
—Old Chinese Proverb

An old tree is hard to straighten.
—French Proverb

Today I have grown taller from walking with the trees.
—Karle Wilson Baker

The mountains, I become part of it
The herbs, the fir tree, I become part of it
The morning mists, the clouds, the gathering waters, I become part of it,
The wilderness, the dew drop, the pollen...
I become part of it.
—Navajo Chant

If you would know strength and patience, welcome the company of trees.
—Hal Borland

Where I sit is holy,
Holy is the ground.
Forest, mountain, river,
Listen to the sound.
Great Spirit circle
All around me.
—Author Unknown

One generation plants the trees; another gets the shade.
—Old Chinese Proverb

He that plants trees loves others beside himself.
—English Proverb

The woods are lovely, dark and deep.
But I have promises to keep
And miles to go before I sleep,
And miles to go before I sleep.
—Robert Frost

Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.
—Robert Frost

I would not move to Minnesota; you cannot grow apples there!
—Horace Greeley

Trees are sanctuaries.
Whoever knows how to speak to them,
Whoever knows how to listen to them, can learn the truth.
—Herman Hesse

Character is like a tree and reputation like its shadow. The shadow is what we think of it; the tree is the real thing.
—Abraham Lincoln

Though a tree grow ever so high, the falling leaves return to root.
—Malay Proverb

There is a certain respect, and a general duty to humanity that ties us to trees and plants.

—Michel de Montaigne

Woodman, spare that tree!
Touch not a single bough!
In youth it sheltered me
And I'll protect it now...

—George P. Morris

Although we depend on nature for our survival, most of us lack understanding of the ways in which living plants support our life and can improve its condition.

—Rogers C. B. Morton

You can gauge a country's wealth, its real wealth, by its tree cover.

—Dr. Richard St. Barbe Baker

The planting of a tree shows faith in the future.

—Charles Schultz

Like the trees we are visitors, guests of the earth.

—Kim R. Stafford

A man has at least a start at discovering the real meaning of human life when he plants a shade tree under which he will never sit.

—Eldon Trueblood

If a tree dies, plant another in its place.

—Linnaeus

If you want to be happy for a year ... plant a garden. If you want to be happy for a lifetime, plant a tree.

—Author Unknown

We have not inherited this earth from our parents; we are borrowing it from our children.

—American Indian Saying

I never saw a disconcerted tree. They grip the ground as though they liked it, and though fast rooted, they travel about as we do. They go wandering forth in all directions with every wind, going and coming like ourselves, traveling with us around the sun two million miles a day.

—John Muir

Man did not weave the web of life. He is merely a strand in it. Whatever he does to the web, he does to himself.

—Chief Sealth (Seattle)

If men spit upon the ground, they spit upon themselves. This we know—the earth does not belong to man; man belongs to the earth.

—Chief Sealth (Seattle)

Be like a tree in pursuit of your cause. Stand firm, grip hard, thrust upward, bend to the winds of heaven, and learn tranquility.

—Dedication to Dr. Richard St. Barbe Baker, Father of the Trees

The trees in the streets are old trees, used to living with people, family trees that remember your grandfather's name.

—Stephen Vincent Benet

My Own Favorite Quotes

Tree Poems
(Select Age Appropriate)

What Do We Plant When We Plant the Tree?

What do we plant when we plant the tree
We plant the ship which will cross the sea,
We plant the mast to carry the sails,
We plant the planks to withstand the gales—
The keel, the keelson, the beam and knee—
We plant the ship when we plant the tree.
What do we plant when we plant the tree?
We plant the houses for you and me.
We plant the rafters, the shingles, the floors,
We plant the studding, the lath, the doors,
The beams and siding, all parts that be,
We plant the house when we plant the tree.

What do we plant when we plant the tree?
A thousand things that we daily see.
We plant the spire that out-towers the crag,
We plant the staff for our country's flag,
We plant the shade from the hot sun free:
We plant all these when we plant the tree.
—Henry Abbey

Trees

I think that I shall never see
A poem as lovely as a tree;

A tree whose hungry mouth is pressed
Against the earth's sweet flowing breast;

A tree that looks at God all day
And lifts her leafy arms to pray;

A tree that may in summer wear
A nest of robins in her hair;

Upon whose bosom snow has lain
Who intimately lives with rain;

Poems are made by fools like me,
But only God can make a tree.
—Joyce Kilmer

Trees of the Fragrant Forest

(For six children. As they take their places on the stage, those in seats recite the first stanza.)

Trees of the fragrant forest,
With leaves of green unfurled,
Through summer's heat, through winter's cold
What do you do for our world?

First: Our green leaves catch the raindrops
That fall with soothing sound,
Then drop them slowly, slowly down;
it's better for the ground.

Second: When, rushing down the hillside,
A mighty fresh stream foams,
Our giant trunks and spreading roots
Defend your happy homes.

Third: From burning heat in summer
We offer cool retreat,
Protect the land in winter's storm
From cold, and wind, and sleet.

Fourth: Our falling leaves in autumn,
By breezes turned and tossed,
Will rake a deep sponge-carpet warm,
Which saves the ground from frost.

Fifth: We give you pulp for paper,
Our fuel gives you heat;
We furnish lumber for your homes,
And nuts and fruit to eat.

Sixth: With strong and graceful outline,
With branches green and bare,
We fill the land through all the year,
With beauty everywhere.

All: So listen! From the forest
Each one a message sends
To children on this Arbor Day:
"We trees are your best friends!"
—Unknown

Trees

Trees are the kindest things I know,
They do no harm, they simply grow.

And spread a shade for sleepy cows,
And gather birds among the boughs.

They give us fruit in leaves above,
And wood to make our houses of,
And leaves to burn on Halloween,
And in the spring new buds of green.

They are the first when day's begun,
To touch the beams of morning sun.

They are the last to hold the light,
When evening changes into night.

And when the moon floats on the sky,
They hum a drowsy lullaby.

Of sleepy children long ago—
Trees are the kindest things I know.
—Unknown

Arbor Day

"Tree Planting Day" they called it
in Nebraska long ago.
Now we call it Arbor Day, and
Oh, I love it so!
I love to plant a growing thing—
A tree, a shrub, a vine—
And know it will for years and years
Keep growing there, a sign
To children who come after me
That someone thought of them,
And left behind a living friend
More precious than a gem.
—Betty Foust Smith

Tree Tunes

There are dozens of songs about trees, plants, and/or natural wonders. Some possible recording artists and songs to enjoy with children include:

"Maple Leaf Rag" —Traditional
"Tie a Yellow Ribbon 'Round the Old Oak Tree" —Tony Orlando & Dawn
"America the Beautiful" —Traditional
"This Land is Your Land" —Woody Guthrie and others
"Tapestry" —Don McLean
"Different Drummer" —Stone Ponies
"Dog and Butterfly" —Heart
"East of Ginger Trees" —Seals and Croft
"Rocky Mountain High" —John Denver
"Annie's Song" —John Denver
"Forest Lawn" —Tom Paxton
"Backstreets" —Bruce Springsteen
"Down in the Willow Garden" —Traditional
"Lullabye of Byrdland" —Traditional
"Trees" —Rush
"Don't Sit Under the Apple Tree" —The Andrews Sisters
"Lemon Tree" —Trini Lopez
"Appalachian Spring" —Aaron Copland
"The Little Nut Tree" —Traditional
"Big Yellow Taxi" —Joni Mitchell
"Carolina in the Pines" —Michael Murphy
"The Ash Grove" —Traditional

Others:

The Man Who Planted Trees

By Jean Giono

In a day when much of the world that was once forested has become desert, the following article is a shining example of what one person can do to reverse that trend or prevent it from occurring. When French/Italian author Jean Giono was asked by American magazine editors in 1953 to write about an unforgettable character, he chose to write about Elzeard Bouffier—the man who planted trees. Because Bouffier was created in Giono's imagination as a person who might exist and would be quite unforgettable if he did, the story was initially rejected. Vogue *magazine was the first to publish it, and within a few years it was translated into several languages. For years, it has inspired reforestation efforts worldwide. As reprinted here, the article is an adaptation of the original story,* The Man Who Planted Trees, *published in hardcover and paperback by Chelsea Green Publishing Company of Post Mills, Vermont. The 54-page book includes 20 wood engravings by artist Michael McCurdy. The book is available by calling 1-800-639-4099.*

About 40 years ago, I was trekking across the mountain heights in that ancient land where the Alps thrust down into Provence. In the deserted region, everything was barren and colorless. Nothing grew there but wild lavender.

After three days of walking, I found myself amidst unparalleled desolation. I had no water. I camped near the vestiges of an abandoned village. The clustered houses suggested there must once have been a well or a spring. Indeed, there was a spring, but it was dry.

It was a fine June day brilliant with sunshine. But over the unsheltered land, the wind blew with unendurable ferocity. It growled over the carcasses of houses like an enraged dragon. I moved camp.

After five hours of walking, I glimpsed in the distance a small black silhouette and took it for a solitary tree. I started toward it. It was a shepherd. Thirty sheep were lying about him on the baking earth.

He gave me a drink from his water gourd and, a little later, took me to his cottage. He drew his water—excellent water—from a very deep natural well.

He spoke little. It is the way of those who live alone. He lived not in a cabin, but in a real house of stone. It bore plain evidence of how his own efforts had reclaimed the ruins. The sound of the wind against its tiles was the sound of sea waves hitting the shores.

He was cleanly shaved. All his buttons were firmly sewed on. His clothes had been mended with meticulous care. He did not smoke. His dog was as silent as he was friendly, without being servile.

It was understood from the first that I should stay for the night. The nearest village was a day away. The shepherd shared his food with me.

Then he fetched a small sack and poured out a heap of acorns on the table. He began to inspect them, one by one, with great concentration, separating the good from the bad. I offered to help him. He told me it was his job. After he had set aside a large enough pile, he counted them out by 10s. When he had thus selected 100 perfect acorns, he went to bed.

The next day I asked if I might be there for another day. He agreed. In the morning he opened his pen and led out his flock. Before leaving, he plunged his carefully selected sack of acorns into a pail of water.

Instead of a stick, he carried an iron rod, thick as a thumb and 5 feet long. His pasture was in a valley. He left his flock in the care of his dog and

climbed a ridge. I followed. I was afraid he would rebuke me for my indiscretion. Instead he invited me to go along. We climbed to the top of the ridge.

There he began thrusting his iron rod into the earth, making a hole in which he planted an acorn. He refilled the hole. He was planting an oak. I asked him if the land belonged to him. He answered no. Did he know whose it was? He did not. Nor was he interested in finding out. He planted his 100 acorns with the greatest care.

I must have been fairly insistent in my questioning, for he answered. For three years he had been planting trees in this wilderness. He had planted 100,000. Of them, 20,000 had sprouted. Of the 20,000, he still expected to lose about half to rodents and the unpredictable designs of Mother Earth. There remained 10,000 oak trees to grow, where nothing grew before.

I began to wonder about the age of this man. Fifty-five, he told me. His name was Elzeard Bouffier. He had a farm in the lowlands once. There he had lived his life. He had lost his only son, and then his wife. Then he had withdrawn into this solitude. He felt that this land was dying for want of trees. Having no pressing business of his own, he had resolved to remedy this state of affairs.

I told him that in 30 years his 10,000 oaks would be magnificent. He answered simply that, given life, he would have planted so many trees that those 10,000 would be a drop in the ocean.

Presently he was studying the reproduction of beech trees and had a beech-nut nursery near his house. The seedlings, which he protected from his sheep with a wire fence, were beautiful. He was also considering birches for valleys where there could be moisture below the surface.

We parted the next day. The war started in 1914, and I became a soldier. As soldiers do, I forgot everything but the war. I forgot about the old man and his trees, too.

Five years later, the war was over. I took to the road again, to the barren lands, following my wanderlust.

Elzeard Bouffier had not died. In fact, he was extremely spry. He had changed jobs. Now he had only four sheep. He had gotten rid of his sheep because they threatened his young trees. He had imperturbably continued to plant.

The oaks of 1910 were then 10 years old and higher than either of us. His forest measured 11 kilometers by 3 (6.8 by 1.86 miles). It had all sprung up from the hands and soul of this one man—a man who could be as effectual as God in realms other than that of destruction. Creation seemed to come about in a sort of chain reaction. I saw water flowing in the brooks that had been dry since the memory of man. As the water reappeared, so there reappeared willows, rushes, meadows, gardens, flowers, and a certain purpose in being alive.

Hunters and forest officials came to see this wonderful "natural" forest. When they saw that it was all the work of one man, they did not meddle. They left him to himself. He worked in such total solitude that toward the end of his life, he lost the habit of speech. Or perhaps he saw no need for it.

The only serious danger to his work occurred during the Second World War. Cars were being run on wood-burning generators. There was never enough wood. Cutting was started among his oaks. But railway lines were so far away that the effort flopped. The shepherd saw nothing of it. He was 30 kilometers away, planting his trees in peace. He ignored the war of 1939 as he did that of 1914.

I saw Elzeard Bouffier for the last time in June of 1945. He was then 87.

I had started back along the route through the wasteland. But now there was a bus. I no longer recognized the scenes of my earlier journeys. Only when I heard the name of the village could I actually believe I was in the region that had been all ruins and desolation once.

The bus put me down at the village that in 1913 had a few houses and fewer inhabitants. The living was bad. Living in excessively harsh climate in winter and in summer, there was no escape from unceasing conflict of personalities. Irrational ambition reached

inordinate proportions in the continual desire for escape. The soundest characters broke under the perpetual grind. They had been savage creatures. Malice, mistrust, and hatred had composed the spirit of the land. They were little removed, physically and morally, from the conditions of prehistoric man. There were epidemics of suicides and frequent cases of insanity. All around them, nettles were feeding upon the remains of abandoned houses, left beached in time. And over all there was the wind, the ceaseless, rattling wind, to rasp upon the nerves.

Their condition had been beyond hope. They had to wait for nothing but death, a condition which rarely predisposes to virtue.

But everything had changed. Even the wind. Instead of the harsh, dry wind, a gentle wind was blowing, laden with scents. A sound like water came from the mountains; it was the forest wind. Most amazing of all, I heard the sound of water falling into a pool. A fountain had been built, and it was flowing freely. What touched me most was that someone had planted a linden by its side. It must have been four years old and already in full leaf, the incontestable sign of resurrection.

The village bore signs of labor for which help is required. Ruins had been cleared away, dilapidated walls torn down, and houses restored. The new houses were surrounded by little gardens where vegetables and flowers grew in orderly confusion. The war just finished had not allowed full blooming of life, but Lazarus was out of the tomb. I saw little fields of barley and rye. Deep in the narrow valley, the meadows were turning green.

One man, armed only with physical and moral resources, was able to raise this land from wasteland. The old and unlearned shepherd who fathered this miracle died in peace at the hospice in Banon in 1947.

—Reprinted from *American Forests,* July 1986, pages 25-26. Used with permission.

The Book Nook

Here are some books to help your students find out more about trees and forests. The interest and reading levels of each book are listed so you know which ones to recommend. Ask your media center specialist or librarian to help you find other forest-related materials.

A Sand County Almanac by Aldo Leopold. Oxford University Press: 1949. Interest level: Grades 8-Adult. Reading level: Grade 9. Features an essay on nature and wildlife for every month of the year.

A Tree for Me by Nancy Van Laan. Alfred A Knopf: 2000. Interest level: Grades K-3. Reading level: Grade 2. A child climbs five different trees, looking for a place to hide and finding an increasing number of animals already in residence, until finally the perfect tree is found.

Acorn to Oak Tree by Oliver S. Owen. Abdo & Daughters: 1994. Interest level: Grades 3-6. Reading level: Grade 3. Learn how the tiny acorn sprouts first into a seedling and then a sapling, which will later become the mighty oak.

Apple King by Francesca Bosca. North-South Books: 2001. Interest level: Grades PreK-2. Reading level: Grade 2. A selfish king keeps a beautiful apple tree and its wonderful fruit all to himself, until an invasion of worms teaches him a lesson about sharing.

Apple Trees by John F. Prevost. Abdo & Daughters: 1996. Interest level: Grades 2-4. Reading level: Grade 4. Presents brief information about the roots, trunk, leaves, fruits, and varieties of apple trees, pests that affect them, and their economic uses.

Apple Trees by Gail Saunders-Smith. Pebble Books: 1998. Interest level: Grades K-2. Reading level: Grade 1. An apple tree is described in simple text and photographs as it goes through the seasons.

Autumn Leaves: A Guide to the Fall Colors of the Northwoods by Ronald M. Lanner. Northword Press: 1990. Interest level: Young adult. Reading level: Young adult. Northern American trees in their fall colors are described through text and photographs.

Be a Friend to Trees by Patricia Lauber. Harper Collins Publishers: 1994. Interest level: Grades 1-3. Reading level: Grade 3. Discusses the importance of trees as sources of food, oxygen, and other essential things.

Beautiful Christmas Tree by Charlotte Zolotow. Houghton Mifflin Company: 1999. Interest level: Grades K-3. Reading level: Grade 3. Although his elegant neighbors do not appreciate his efforts, a kind old man transforms his rundown house and a small neglected pine tree into the best on the street.

Big Tree by Bruce Hiscock. Boyds Mills Press: 1999. Interest level: Grades 1-4. Reading level: Grade 4. Follows the development of a large old maple tree from its growth from a seed during the American Revolution to its maturity in the late 20th century.

Birches by Robert Frost. Henry Holt: 1988. Interest level: Grades 3-6. Reading level: Grade 4. An illustrated version of the well-known poem about birch trees and the pleasures of climbing them.

Blue Spruce by Mario Cuomo. Sleeping Bear Press: 1999. Interest level: Grades K-4. Reading level: Grade 3. When a storm knocks down the blue spruce tree in a boy's yard, he and his father work with all their might to right the tree again.

Champion of Arbor Day: J. Sterling Morton by Sandy Beaty. Acorn Books: 1999. Interest level: Grades 4-12. Reading level: Grade 6. The story of J. Sterling Morton, one of this nation's environmental visionaries.

Cherry Tree by Ruskin Bond. Boyds Mills Press: 1996. Interest level: Grades K-3. Reading level: Grade 3. A story from India in which a little girl plants a cherry seed and cares for the cherry tree through its difficult life. A story about life and growing older.

Cottonwood Trees by John F. Prevost. Abdo & Daughters: 1996. Interest level: Grades 2-4. Reading level: Grade 4. Provides basic information about the cottonwood, including its structure, economic uses, and the pests and diseases that affect it.

Dead Log by Jen Green. Crabtree Publishing Company: 1999. Interest level: Grades 2-4. Reading level: Grade 4. Describes the various creatures and plants that live in, on, or under a dead log.

Dead Log Alive! by Jo S. Kittinger. Franklin Watts: 1996. Interest level: Grades 4-7. Reading level: Grade 6. Describes the variety of animal and plant life found on, in, and around dead logs, and explains the role that dying trees play in nature's cycles.

Dinosaur Tree by Douglas Henderson. Aladdin: 1999. Interest level: Grades 3-6. Reading level: Grade 4. Traces the life cycle of a tree in the late Triassic period and what happens to the tree when a storm capsizes it 500 years later.

Elm Tree and Three Sisters by Erika Weihs. Viking Penguin: 2001. Interest level: Grades K-3. Reading level: Grade 3. When three young sisters plant a tiny elm tree in their barren back yard, they find it becomes an integral part of their lives as they grow older.

Encyclopedia of North American Trees by Sam Benvie. Firefly Books: 2000. Interest level: Grades 6-12. Reading level: Grade 7. Describes 278 species of trees and their characteristics.

Exploring Tree Habitats by Patti Seifert. Mondo Publishing: 1994. Interest level: Grades 1-5. Reading level: Grade 4. Explore the world and discover a tremendous variety of tree habitats and animal life.

Fantastic Trees by Edwin Menninger. Timber Press: 1995. Interest level: Grades 5-12. Reading level: Grade 6. A humorous but factual survey of unusual trees with strange habits such as producing flowers and fruit underground, telling time, making noises, and creating their own rain.

Fire: Friend or Foe by Dorothy Hinshaw Patent. Clarion: 1998. Interest level: Grades 4-8. Reading level: Grade 7. Discusses forest fires and the effect they have on both people and the natural world.

Fires of Autumn: The Cloquet-Moose Lake Disaster of 1918 by Francis M. Carroll. Minnesota Historical Society: 1990. Interest level: Grade 10-Adult. Reading level: Grade 10. Tells the dramatic stories of the origins of the fires and of the survivors and victims in the major disaster areas.

Forest Fire by Christopher Lampton. Millbrook Press: 1995. Interest level: Grades 3-6. Reading level: Grade 6. Describes, in text and color photographs, the causes for forest fires, how they are detected, techniques used to put them out, and the damage that is made. Examines the beneficial effects of small fires on plant and animal life.

Forest Fire! by Mary Ann Fraser. Troll Associates: 1996. Interest level: Grades 1-2. Reading level: Grade 1. Describes the forest life cycle and the destructive and renewing aspects of forest fires.

Forests by Andy Owen. Heinemann Library: 1998. Interest level: Grades 2-4. Reading level: Grade 3. Introduces the various forests of the world, including mangrove, broadleaf, evergreen, and rain forests.

Forests and Woodlands by Rose Pipes. Raintree/Steck-Vaughn: 1999. Interest level: Grades 2-5. Reading level: Grade 4. Introduces some notable forests and woodlands around the world, including the taiga in Russia, the eucalyptus woodlands in Australia, and the mangrove forests of Central and South America.

From Acorn to Oak Tree by Jan Kottke. Children's Press: 2000. Interest level: Grades K-2. Reading level: Grade 2. Follows the journey of an acorn and explains how it becomes an oak tree.

Grandfather Four Winds and Rising Moon by Michael Chanin. HJ Kramer: 1994. Interest level: Grades PreK-2. Reading level: Grade 1. Grandfather Four Winds helps his young grandson learn the lessons of courage, gratitude, generosity, and faith from the old apple tree that is sacred to their people.

Great Dimpole Oak by Janet Taylor Lisle. Puffin Books: 1999. Interest level: Grades 3-7. Reading level: Grade 5. The citizens of Dimpole rally together to save an historic oak tree from being cut down.

Hellroaring: The Life and Times of a Fire Bum by Peter M. Leschak. North Star Press of St. Cloud: 1994. Interest level: Grades 6-8. Reading level: Grade 7. Chronicles the author's adventures as a wildland firefighter.

Hopper's Treetop Adventure by Marcus Pfister. North-South Books: 1997. Interest level: Grades K-2. Reading level: Grade 2. While searching for nuts in the forest, Hopper the hare meets a friendly squirrel and climbs up into his tree to spend time with him.

How Trees Help Me by Bobbie Kalman and Janine Schaub. Crabtree Publishing: 1992. Interest level: Grades 1-6. Reading level: Grade 4. Find out about the parts of a tree, why trees are important, and the life of a tree. Includes a short story, "The Troll and the Tree," and fun activities to do to learn about trees.

If the Trees Could Talk by Stuart A. Kallen. Abdo & Daughters: 1994. Interest level: Grades K-3. Reading level: Grade 3. A tree talks about how it was planted and the important part it plays in the environment.

In a Tree by David M. Schwartz. Gareth Stevens: 1999. Interest level: Grades 1-3. Reading level: Grade 3. Introduces, in simple text and photographs, the characteristics of some of the trees and animals that can be found in a forest. Includes a caterpillar, raccoon, yellow warbler, owl, squirrel, a white pine, and an oak.

In the Deep, Dark Forest by Paul Humphrey. Raintree/Steck-Vaughn: 1995. Interest level: Grades K-3. Reading level: Grade 1. Looks at different plants and animals that live in the forest.

John Blair and the Great Hinckley Fire by Josephine Nobisso. Houghton Mifflin Company: 2000. Interest level: Grades 3-5. Reading level: Grade 4. Tells how a brave African-American porter helped save many lives when the train on which he was working was caught up in the horrendous firestorm near Hinckley, Minnesota in 1894.

Kid's Guide to How Trees Grow by Patricia Ayers. Power Kids Press: 2000. Interest level: Grades 2-5. Reading level: Grade 4. Describes the basics of how different types of trees grow.

Living Tree by Nigel S. Hester. Franklin Watts: 1990. Interest level: Grades 3-5. Reading level: Grade 4. Examines the parts of a tree and its life cycle from seedling to decay.

Log's Life by Wendy S. Pfeffer. Simon & Schuster: 1997. Interest level: Grades K-3. Reading level: Grade 3. Introduction to the life cycle of a tree.

Maple Trees by Marcia S. Freeman. Pebble Books: 1999. Interest level: Grades K-2. Reading level: Grade 1. Simple text and photographs describe the trunks, branches, leaves, seeds, and life cycle of maple trees.

Mighty Tree by Dick Gackenbach. Harcourt Brace Jovanovich: 1992. Interest level: Grades K-3. Reading level: Grade 3. Three seeds grow into three beautiful trees, each of which serves a different function in nature and for people.

Minnesota Trees by David M. Rathke. Minnesota Extension Service: 1995. Interest level: Grades 4-Adult. Reading level: Grade 7. Introduces more than 100 trees found in Minnesota forests and back yards.

Money Tree by Sarah Stewart. Farrar Straus & Giroux: 1994. Interest level: Grades K-3. Reading level: Grade 1. In summer the leaves on the strange tree growing in Miss McGillicuddy's yard are harvested by many people, but when Miss McGillicuddy thinks about needing firewood for the winter, she realizes the tree may have another use.

Night Tree by Eve Bunting. Harcourt Brace Jovanovich: 1991. Interest level: Grades K-2. Reading level: Grade 2. A family makes its annual pilgrimage to decorate an evergreen tree with food for the forest animals at Christmas time

Oak Trees by Marcia S. Freeman. Pebble Books: 1999. Interest level: Grades K-2. Reading level: Grade 1. The trunks, branches, leaves, and seeds of oak trees are described with simple text and photographs.

Pearl Plants a Tree by Jane Breskin Zalben. Simon & Schuster: 1995. Interest level: Grades K-3. Reading level: Grade 1. In the spring Pearl and Grandpa plant an apple tree. The celebration of Arbor Day in the United States and around the world is discussed.

Pine Tree Parable by Liz Curti Higgs. Word: 1997. Interest level: Grades 1-2. Reading level: Grade 1. A farmer and his wife, who grow trees to sell for Christmas, give their prized, perfect tree to a poor family who cannot afford to pay for it.

Quaking Aspen by Bonnie Holmes. Carolrhoda: 1999. Interest level: Grades 2-4. Reading level: Grade 3. Describes the life cycle of the quaking aspen, its role in the ecosystem, and how it is threatened by animals and people.

Red Leaf, Yellow Leaf by Lois Ehlert. Harcourt Brace Jovanovich: 1991. Interest level: Grades K-3. Reading level: Grade 3. A child describes the growth of a maple tree from seed to sapling.

Science Project Ideas About Trees by Robert Gardner. Enslow Publishing: 1997. Interest level: Grades 4-9. Reading level: Grade 6. Contains many experiments introducing the processes that take place in plants and trees.

Secret Life of Trees by Chiara Chevallier. DK Ink: 1999. Interest level: Grades 1-3. Reading level: Grade 2. Details the parts and inner lives of trees and all the organisms that live within them.

Someday a Tree by Eve Bunting. Clarion: 1993. Interest level: Grades K-3. Reading level: Grade 3. A young girl, her parents, and their neighbors try to save an old oak tree poisoned by pollution.

Spotter's Guide to Trees of North America by Alan F. Mitchell. EDC Publishing: 1992. Interest level: Grades 2-Adult. Reading level: Grade 6. How to identify over 85 species of trees.

The First Forest by John Gile. Worzalla: 1989. Interest level: Grades K-4. Reading level: Grade 4. Originally created as a bedtime story for the author's children, this fanciful tale tells how the first trees came to be and teaches about the need to respect each other and the earth.

The Giving Tree by Shel Silverstein. Harper & Row: 1964. Interest level: Grades K-4. Reading level: Grade 2. A classic tale of a tree that keeps giving throughout the decades.

The Tremendous Tree Book by Barbara Brenner and May Garelick. Boyds Mills Press: 1979. Interest level: Grades K-4. Reading level: Grade 4. Celebrates the marvels of trees in a simple rhyme style.

Tree by David Burnie. Dorling Kindersley: 2000. Interest level: Grades 4-8. Reading level: Grade 7. Photographs and text explore the anatomy and life cycle of trees, examining the different kinds of bark, seeds, and leaves, the commercial processing of trees to make lumber, the creatures that live in trees, and other aspects.

Tree Book by Pamela Hickman. Kids Can Press: 1999. Interest level: Grades 3-5. Reading level: Grade 4. Information and activities to help children learn about the different kinds of trees living throughout the country.

Tree in a Forest by Jan Thornhill. Greey De Pencier Books: 1991. Interest level: Grades K-4. Reading level: Grade 4. Presents the life story of a 200-year-old maple tree.

What's Inside Trees? by Jane Kelly Kosek. Power Kids Press: 1999. Interest level: Grades 3-6. Reading level: Grade 4. Describes what is inside trees, how they use sunlight and obtain nourishment, how they grow and reproduce, and how they can be protected in their endangered status.

Wild in the City by Jan Thornhill. Owl Communications: 1999. Interest level: Grades K-2. Reading level: Grade 1. Describes the variety of wildlife living right in Jenny's neighborhood.

Wildfire by Patrick Cone. Carolrhoda: 1997. Interest level: Grades 3-6. Reading level: Grade 6. Briefly traces the history of wildfire before going on to discuss types, when and where they start, their behavior, ecological effects, fighting and preventing them.

For More Information

Environmental Education Resources:

- Sharing Environmental Education Knowledge (SEEK)
  525 South Lake Avenue
  Suite 400
  Duluth, MN 55802
  218-529-6258
  1-888-668-3224 (Toll Free)
  http://mnseek.net

"Hands-On" Classroom Learning Experiences:

- Project Learning Tree
  Minnesota Department of Natural Resources
  500 Lafayette Road
  St Paul, MN 55155-4044
  651-296-3406
  http://www.dnr.state.mn.us/forestry/learning_tree
- Project WILD-Aquatic WILD
  Minnesota Department of Natural Resources
  500 Lafayette Road
  St. Paul, MN 55155-4007
  651-297-2423
  http://www.dnr.state.mn.us/fish_and_wildlife/project_wild
- Project WET
  Minnesota Department of Natural Resources
  500 Lafayette Road
  St. Paul, MN 55155-4032
  651-297-4951
  http://www.dnr.state.mn.us/waters/project_wet
- School Forest Program
  Minnesota Department of Natural Resources
  500 Lafayette Road
  St. Paul, MN 55155-4044
  651-297-2214

General Reference:

- Minnesota Department of Natural Resources
  Information Center
  500 Lafayette Road
  St. Paul, MN 55155-4040
  651-296-6157 (Metro Area)
  1-888-646-6367 (Toll Free)
  http://www.dnr.state.mn.us
- Minnesota Department of Agriculture
  Agronomy and Plant Protection - Shade Tree Program
  90 West Plato Boulevard
  St. Paul, MN 55107
  651-296-8507
  http://www.mda.state.mn.us

Specific forest questions may be directed to:

- Minnesota Department of Natural Resources
  Division of Forestry
  500 Lafayette Road
  St. Paul, MN 55155-4044
  651-296-4491
  http://www.dnr.state.mn.us/forestry
- Extension Forest Resources
  University of Minnesota
  1530 North Cleveland Avenue
  St. Paul, MN 55108
  612-624-3020
  http://www.cnr.umn.edu/FR/extension
- Extension Wood and Paper Science
  University of Minnesota
  2008 Folwell Avenue
  St. Paul, MN 55108
  612-624-7712
  http://www.extension.umn.edu/topics.html?topic=2
- North Central Research Station
  Forest Service, U.S. Department of Agriculture
  1992 Folwell Avenue
  St. Paul, MN 55108-6148
  651-649-5000
  http://www.ncrs.fs.fed.us
- State and Private Forestry, Northeastern Area
  Forest Service, U.S. Department of Agriculture
  1992 Folwell Avenue
  St. Paul, MN 55108
  651-649-5244
  http://www.na.fs.fed.us/spfo

State Forests and State Parks:

- Minnesota Department of Natural Resources
  Information Center
  500 Lafayette Road
  St. Paul, MN 55155-4040
  651-296-6157 (Metro Area)
  1-888-646-6367 (Toll Free)
  http://www.dnr.state.mn.us

National Forests:

- Chippewa National Forest
  200 Ash Avenue Northwest
  Cass Lake, MN 56633
  218-335-8600
  http://www.fs.fed.us/r9/chippewa
- Superior National Forest
  8901 Grand Avenue Place
  Duluth, MN 55808
  218-626-4300
  http://www.fs.fed.us/r9/superior

National Park:

- Voyageurs National Park
  3131 Highway 53
  International Falls, MN 56649
  218-283-9821
  http://www.nps.gov/voya

Arbor Day Celebrations:

- Minnesota Arbor Month Partnership
  500 Lafayette Road
  St. Paul, MN 55155-4044
  651-296-4491
  http://www.dnr.state.mn.us/forestry/arborday

Reference Materials:

- Minnesota Extension Distribution Center
  University of Minnesota
  Room 20 Coffey Hall
  1420 Eckles Avenue
  St. Paul, MN 55108
  612-625-8173
  http://www.extension.umn.edu

Places to Visit and Learn More:

- Forest History Center
  2609 County Road 76
  Grand Rapids, MN 55744
  218-327-4482
  http://www.mnhs.org/foresthistory
- Hinckley Fire Museum
  106 Old Highway 61
  Hinckley, MN 55037
  320-384-7338
- Minnesota's Bookstore
  117 University Avenue
  St. Paul, MN 55155
  651-297-3000 (Metro Area)
  1-800-657-3757 (Toll Free)
  http://www.comm.media.state.mn.us
- Minnesota Landscape Arboretum
  3675 Arboretum Drive
  P.O. Box 39
  Chanhassen, MN 55317
  952-443-2460
  http://www.arboretum.umn.edu
- Northland Arboretum
  Northwest 7th Street
  P.O. Box 375
  Brainerd, MN 56401-0375
  218-829-8770
  http://www.brainerd.net/~thearb

Additional Information and Materials:

- American Forests
  910 - 17th Street Northwest
  Suite 600
  Washington, DC 20006
  202-955-4500
  http://www.americanforests.org
- Minnesota Association of Soil and Water Conservation Districts
  790 Cleveland Avenue South
  Suite 216
  St. Paul, MN 55116
  651-690-9028
  http://www.maswcd.org
- Minnesota Forest Industries
  903 Medical Arts Building
  324 West Superior Street
  Duluth, MN 55802
  218-722-5013
  http://www.minnesotaforests.com
- Minnesota Forestry Association
  P.O. Box 496
  Grand Rapids, MN 55744
  218-326-3000
  1-800-821-8733
  http://www.mnforest.com
- Minnesota Shade Tree Advisory Committee
  1200 Warner Road
  St. Paul, MN 55106
  http://www.mnstac.org
- Minnesota Society of Arboriculture
  110 Green Hall
  1530 North Cleveland Avenue
  St. Paul, MN 55108
  http://www.isa-msa.org
- National Arbor Day Foundation
  100 Arbor Avenue
  Nebraska City, NE 68410
  402-474-5655
  http://www.arborday.org
- National Audubon Society
  700 Broadway
  New York, NY 10003
  212-979-3000
  http://www.audubon.org

- National Symbols Program—Woodsy Owl and Smokey Bear
  Forest Service, U.S. Department of Agriculture
  500 Lafayette Road
  St. Paul, MN 55155-4044
  651-205-4570
  http://www.symbols.gov
- National Tree Trust
  1120 G Street Northwest
  Suite 770
  Washington, DC 20005
  202-628-8733
  1-800-846-8733
  http://www.nationaltreetrust.org
- National Wildlife Federation
  11100 Wildlife Center Drive
  Reston, VA 20190-5362
  1-800-822-9919
  http://www.nwf.org
- Society of American Foresters
  5400 Grosvenor Lane
  Bethesda, MD 20814
  301-897-8720
  http://www.safnet.org
- Temperate Forest Foundation
  14780 Southwest Osprey Drive
  Suite 355
  Beaverton, OR 97007-8070
  503-579-6762
  http://www.forestinfo.org
- The Nature Conservancy
  4245 North Fairfax Drive
  Suite 100
  Arlington, VA 22203-1606
  703-841-5300
  1-800-628-6860
  http://www.nature.org
- Tree Trust
  2350 Wycliff Street
  Suite 200
  St. Paul, MN 55114
  651-644-5800
  http://www.treetrust.org

Other Sources for Information:

- Why leaves change color
  http://www.na.fs.fed.us/spfo/pubs/misc/autumn/autumn_colors.htm
  http://www.na.fs.fed.us/spfo/pubs/misc/leaves/leaves.htm
  http://www.na.fs.fed.us/spfo/pubs/fs/colors/colors.htm
- Video loan library—Forest Service, U.S. Department of Agriculture
  http://www.r5.fs.fed.us/video
- Tree fact sheets
  http://www.fw.vt.edu/dendro/dendrology/syllabus/biglist_frame.htm
- High school environmental competition
  http://www.envirothon.org
- Urban forestry information
  http://www.treelink.org
- Natural Inquirer—a science education resource journal for Grade 5 and older
  http://www.naturalinquirer.usda.gov
- Quality photographs of forest insects and disease organisms
  http://www.forestryimages.org
- City foresters
- County extension offices
- Local arboretums and botanical gardens
- Local libraries
- Local natural history museums
- Local tree nurseries
- Local parks
- Nature centers
- University departments of biology, botany, conservation, and forestry

For further information or to obtain additional copies contact:
The Minnesota Arbor Month Partnership
500 Lafayette Road
St. Paul, MN 55155-4044
651-296-4491

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