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FOREST RESOURCES MEMBER'S MANUAL

ADVANCED

MINNESOTA EXTENSION SERVICE

UNIVERSITY OF MINNESOTA
4-H YOUTH DEVELOPMENT

FORESTS FOREVER

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Chapter 1

FIRE!

(Fire Management)

Fire—Past Tense

In 1988, fires raged through Yellowstone National Park in Wyoming. Scores of fire fighters from the U.S. Forest Service, state forestry agencies, and even the U.S. Army battled blazes. The fires burned close to a million acres in and around the park. This is more than half the total land area of Yellowstone Park, although the damage was not as severe as this figure indicates, since the fire burned in a mosaic pattern and left much of the "burned" area untouched or only lightly burned.

How do fires as catastrophic as this get started? How could forest managers prevent these fires? Are fires bad or good for the forest? The answers to these questions require a basic understanding of fire behavior.

The Fire Triangle

Fire is a chemical reaction that requires three main ingredients:

- fuel (carbon)
- oxygen
- heat

These three ingredients make up the fire triangle. If any one is not present, a fire will not burn.

Fuel generally is available in ample quantities in the forest. Fuel must contain carbon. It comes from living or dead plant materials (organic matter). Trees and branches lying on the ground are a major source of fuel in a forest. Such fuel can accumulate gradually as trees in the stand die. Fuel also can build up in large amounts after catastrophic events, such as insect infestations or disease. Trees and branches left on the ground after a logging operation can become fuel too. In Yellowstone an insect infestation (pine bark beetle) in the early 1980s killed many trees, providing a buildup of fuel.

Oxygen is present in the air. As oxygen is used up by fire, it is replenished quickly by wind.

Heat is needed to start and maintain a fire. Heat can be supplied by nature through lightning. People also supply a heat source through misuse of matches, campfires, trash fires, and cigarettes. Logging equipment, trains, and automobile exhaust systems also can supply a heat source for fire. Once fire has started, it provides its own heat source as it spreads.

THE FIRE TRIANGLE

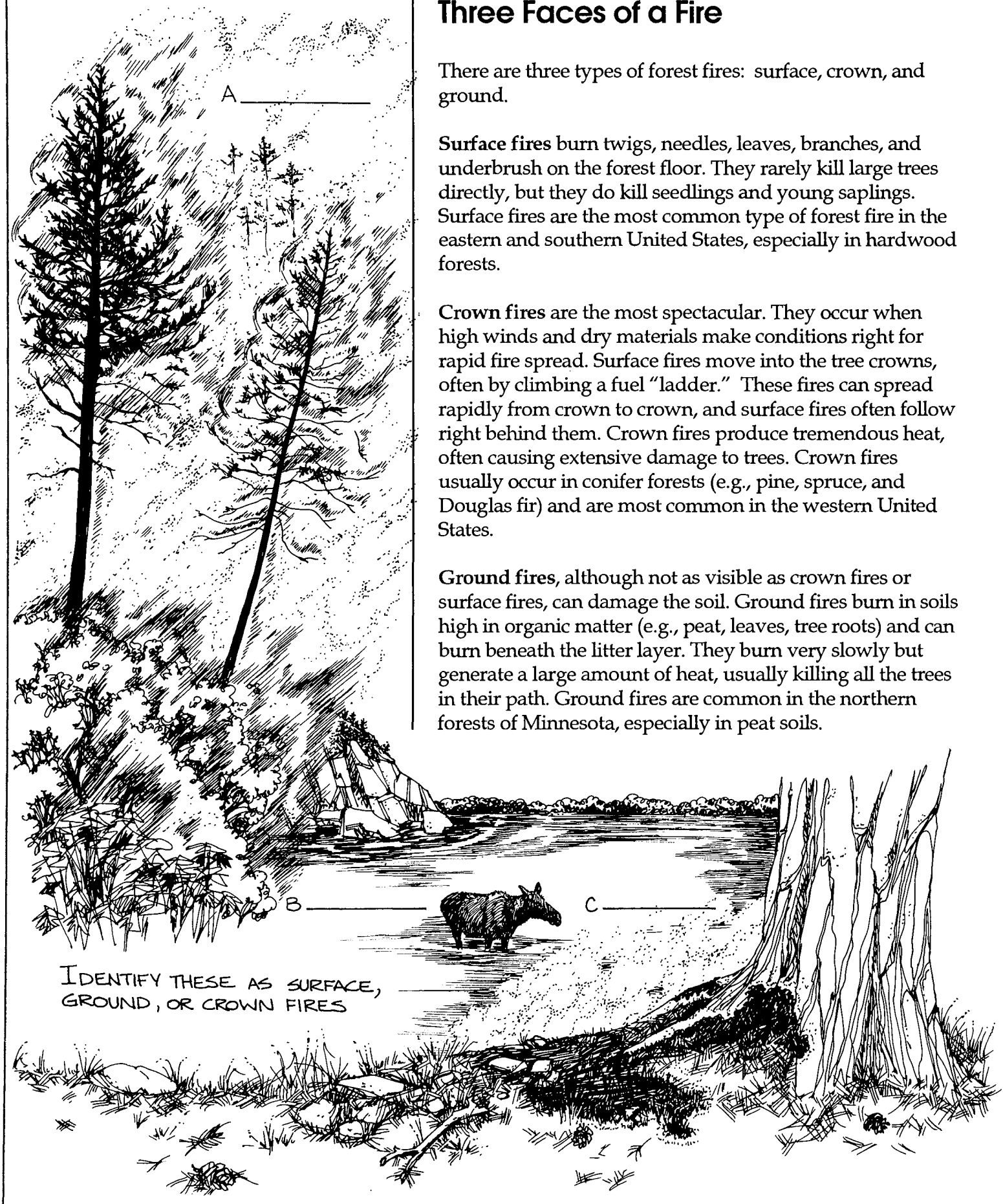
Three Faces of a Fire

There are three types of forest fires: surface, crown, and ground.

Surface fires burn twigs, needles, leaves, branches, and underbrush on the forest floor. They rarely kill large trees directly, but they do kill seedlings and young saplings. Surface fires are the most common type of forest fire in the eastern and southern United States, especially in hardwood forests.

Crown fires are the most spectacular. They occur when high winds and dry materials make conditions right for rapid fire spread. Surface fires move into the tree crowns, often by climbing a fuel "ladder." These fires can spread rapidly from crown to crown, and surface fires often follow right behind them. Crown fires produce tremendous heat, often causing extensive damage to trees. Crown fires usually occur in conifer forests (e.g., pine, spruce, and Douglas fir) and are most common in the western United States.

Ground fires, although not as visible as crown fires or surface fires, can damage the soil. Ground fires burn in soils high in organic matter (e.g., peat, leaves, tree roots) and can burn beneath the litter layer. They burn very slowly but generate a large amount of heat, usually killing all the trees in their path. Ground fires are common in the northern forests of Minnesota, especially in peat soils.



Fire Control

Once a fire starts, fire fighters control it by "breaking" one leg of the fire triangle. This means that one of the necessary ingredients for maintaining fire—fuel, oxygen, or heat—must be eliminated.

To break the fuel leg, a fire fighter might:

- build a fire line by removing all fuel down to the bare soil in a band in front of the advancing fire. This can be done by hand with tools known as scalpers, or with bulldozers and other heavy equipment.

- light a backfire. A backfire is a fire deliberately set by fire fighters that burns all the fuel backward toward the fire. This stops the advancing fire by eliminating fuel in its path.

To break the oxygen leg, a fire fighter might:

- cover burning fuel with soil, using hand tools or bulldozers.

To break the heat leg, a fire fighter might:

- soak high-value buildings with water or with a water/foam mixture. Water absorbs heat and prevents the fuel from heating up to the temperature at which it will burn.

- dump fire retardant on the fire from an airplane. A retardant will cool down the fuel.

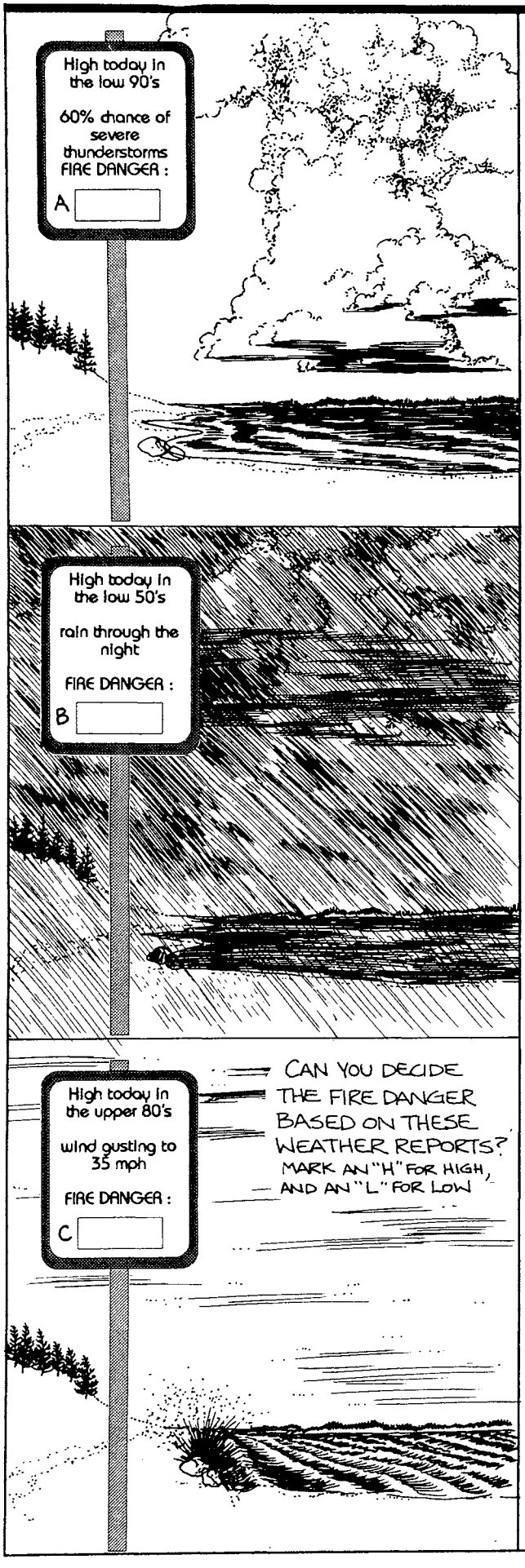
- in the case of ground fires, inject water into the ground to cool the fuel.

- separate fuels and break them apart to diffuse the heat.

- cut down and break apart tall, burning, dead trees to remove a source of airborne sparks.

Fire Prevention

Foresters have one other important method of breaking the fire triangle. They "attack" the fire before it starts with fire prevention measures.



Fire Prevention Rules for Woodland Owners

- Maintain a cleared firebreak around your woodland. Make sure the firebreak is cleared to bare mineral soil. Although the firebreak may not stop a fire, it provides a good starting place for fire suppression crews to build larger lines.
- If your woodland is larger than 20 acres, construct some trails or roads to provide better access to all areas and to break it into smaller units.
- Thin and prune pine and spruce-fir stands. If you don't, these trees can form a fuel ladder that lets surface fires climb into tree crowns. Adding buffer strips of hardwoods to stands is also helpful, since fire does not carry as well in hardwoods.
- Chip or break up slash left on the ground from logging so that it decays faster.
- Remember, education can be more powerful than a bulldozer in fighting forest fires. Spread the word about fire safety measures.

Fire Weather

Weather is the major factor affecting the fire triangle. In the Yellowstone fire, weather conditions contributed to the fire's ferocity.

High temperatures and dry air lower the amount of moisture in fuels, making them ignite and burn more easily. In the Yellowstone fire, fuels had a two percent moisture content, an extremely low reading.

Wind also contributes to fire. Strong winds help dry out forest fuels. After a fire has started, winds bring in new oxygen to replace that which the fire has used. The wind also helps a fire spread by pushing it. In Yellowstone, winds were gusting 50 to 70 miles per hour, with steady winds of 40 miles per hour.

Storms affect the likelihood of fire, too. Lightning can cause fires when it strikes trees or dry grass. Fewer fires occur in years with abundant rainfall than in dry years. During wet years, plants remain green and do not ignite or burn well. In 1988, Yellowstone was experiencing its worst drought in 120 years of recorded weather history.

Fire—Friend or Enemy?

Fire plays an important role in shaping the composition of forests. Fires that occurred more than a century ago affect the appearance of our forests and prairies today. Many of the aspen and jack pine forests today in the Lake States are the direct result of forest fires 20 to 100 years ago.

Fire that is not controlled or managed properly creates problems. Not only can it kill trees, but also it can damage them in other ways. Trees that survive a major fire may be scarred, creating an entry point for insects and diseases. When weakened by fire, trees are less able to fight off insect or disease attacks.

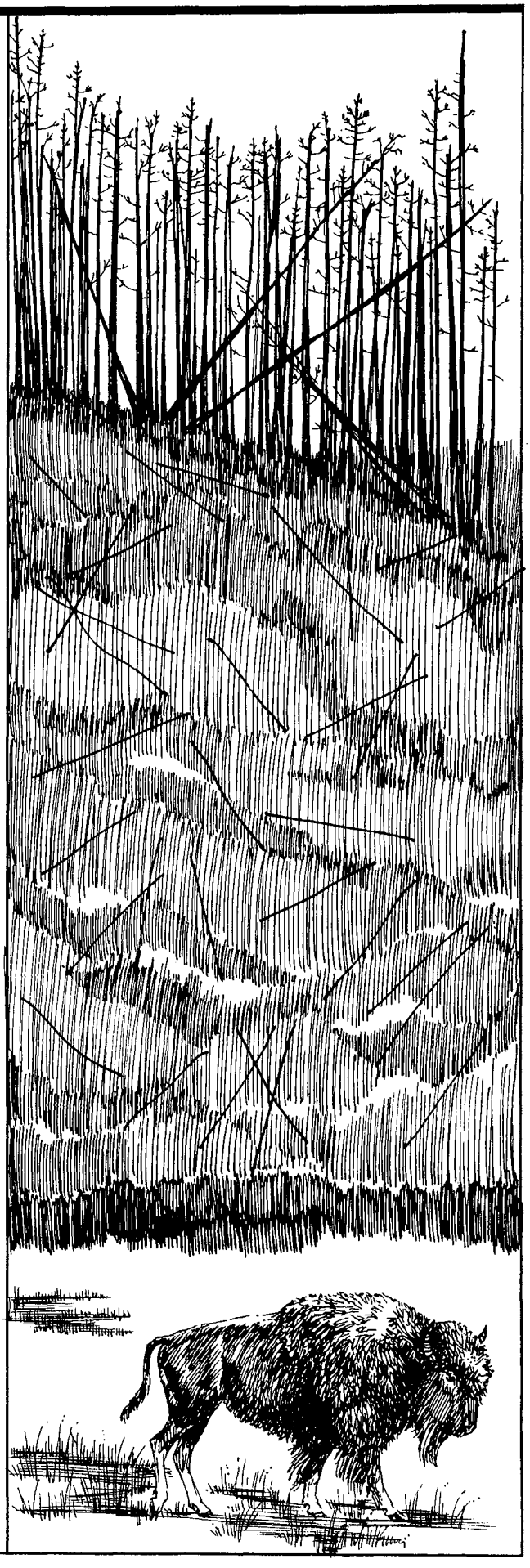
Still, fires perform several needed functions in forests, so foresters speak of "fire management" as well as "fire prevention." If we were to eliminate all fires from a forest, fuels would build up, and eventually a very disastrous fire could take place. This happened in Yellowstone in 1988.

Foresters often set surface fires to help reduce the amount of fuel present and thus prevent major fires. In the southern United States, foresters set fires every two or three years to reduce unwanted understory vegetation in pine forests and to control tree diseases. Fires are set in recently logged areas to remove debris and prepare the site for replanting.

Fire helps some tree species reproduce. Jack pine, for example, has **serotinous cones**, which don't open and release their seeds until they are exposed to a heat source such as fire. Fire helps other seeds get started by killing competing vegetation and removing dry litter on the soil surface to expose moist mineral soil.

Fires also improve the habitat for some wildlife. Fires create forest openings and maintain shrubs for wildlife food and shelter.

The changes brought by fire are not always bad. The Yellowstone fires blackened land, killed trees, and destroyed certain animal habitats. But the forest is a renewable resource. These charred, blackened areas already are developing into meadows and regenerating their lodgepole pine and aspen stands. The habitats that were destroyed will be gradually replaced by new habitats for new animals. Yellowstone is undergoing a renewal, the birth of the next 100 years.



Career Considerations

A forest fire fighter is specially trained to suppress fires. Often, the fire fighter will be a forester or forest technician. The fire fighter can expect long days and long nights of work during fire season. Fighting a forest fire requires knowledge of fire behavior, endurance, alertness, good physical condition, and speed. A fire fighter digs fire line, chases hot spots, uses water packs or hoses, and wields a chainsaw in the battle against blazes. The work is hard, but very exciting. A two- or four-year forestry or forest technician degree is a good background for entering this field.

EnviroQuotes

"But the main thing is, folks just hate to see the park change. They think it's being ruined. People have a tendency to want things as they are, but in nature nothing stays as it is. . . . Nature is hollering, 'I'm getting ready to start over!' We'd like to shout, 'No! Not now! We're not ready for you!' But that ain't the way it works, folks . . . ." John Krebs, a fire behavior analyst, on the 1988 Yellowstone fire in *Journal of Forestry*, December 1989.

Tree-vial Pursuit

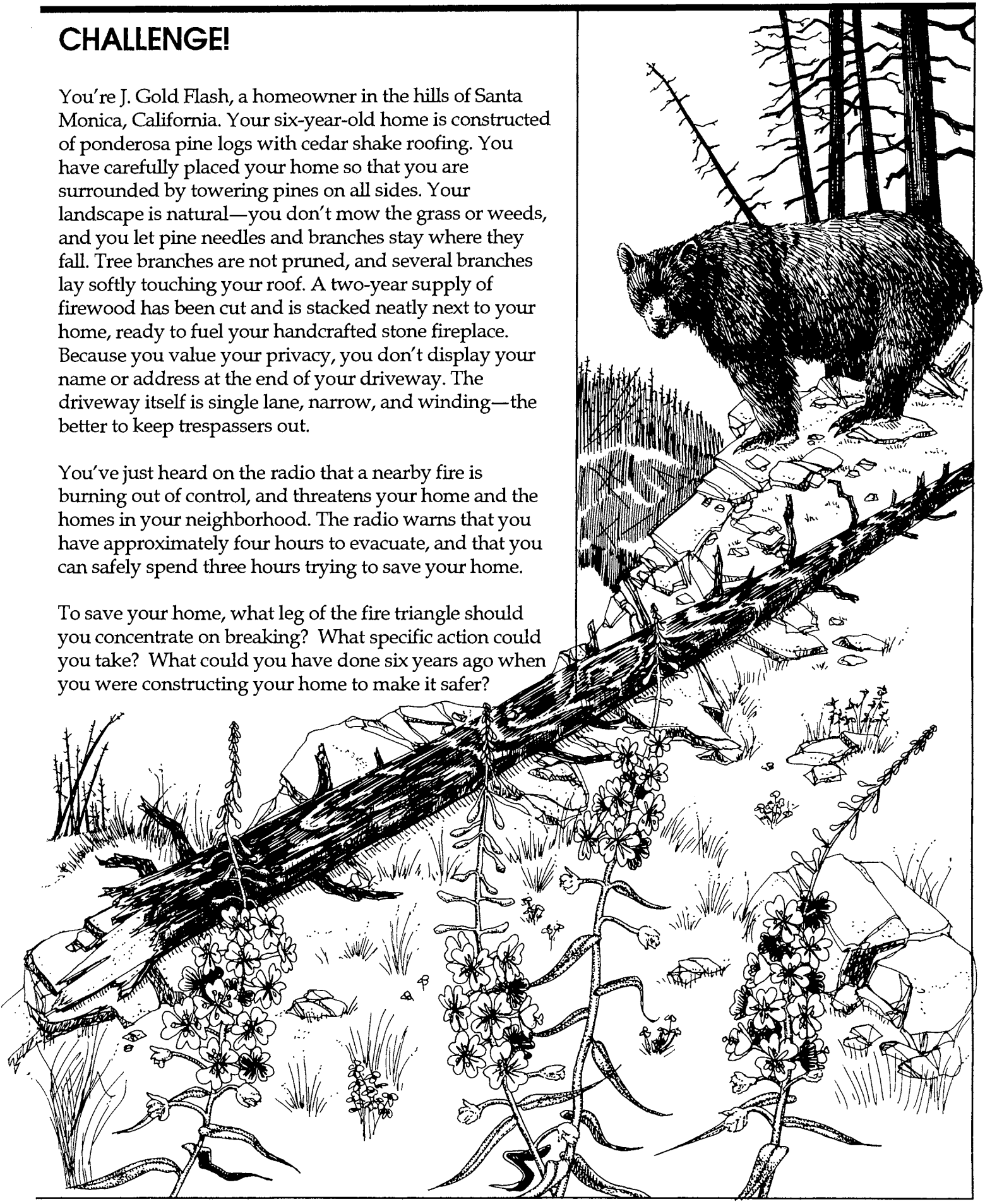
More than $145 million was spent to suppress the Yellowstone area fires in 1988.

CHALLENGE!

You're J. Gold Flash, a homeowner in the hills of Santa Monica, California. Your six-year-old home is constructed of ponderosa pine logs with cedar shake roofing. You have carefully placed your home so that you are surrounded by towering pines on all sides. Your landscape is natural—you don't mow the grass or weeds, and you let pine needles and branches stay where they fall. Tree branches are not pruned, and several branches lay softly touching your roof. A two-year supply of firewood has been cut and is stacked neatly next to your home, ready to fuel your handcrafted stone fireplace. Because you value your privacy, you don't display your name or address at the end of your driveway. The driveway itself is single lane, narrow, and winding—the better to keep trespassers out.

You've just heard on the radio that a nearby fire is burning out of control, and threatens your home and the homes in your neighborhood. The radio warns that you have approximately four hours to evacuate, and that you can safely spend three hours trying to save your home.

To save your home, what leg of the fire triangle should you concentrate on breaking? What specific action could you take? What could you have done six years ago when you were constructing your home to make it safer?



Minnesota State Fair

4-H Forest Resource Premium List rules are:

1. The exhibit should not exceed 12" deep x 18" wide x 22" high.

2. Exhibits should include a project title and your name.

See the booklet *State Fair Premium Guidelines,* available from your local county extension agent, for information.

Tips For Making a Three-Sided Display:

- ✔ It's a good idea to get your leader, parent, or other adult to help you.
- ✔ Use a material such as hardboard, particleboard, or plywood. Posterboard is not sturdy.
- ✔ Open displayed dimensions should not exceed 12 inches deep by 18 inches wide by 22 inches high.
- ✔ Use hinges to attach the sections to each other.
- ✔ Paint or cover the background with adhesive paper, if you'd like.

Yearning to Learn . . .

Additional Activities

In the following activities, remember the basic rules of conservation. Do not damage or destroy the plants and animals you are studying. Leave all ecosystems unchanged. Have a positive impact on the forest.

Take part in a fire prevention campaign in your community or 4-H club. Wildfires burn not only forests and prairies, but also homes and other buildings. Prepare a plan for this campaign. Give a demonstration on fire prevention to your club using charts, posters, slides, or film.

Make your own charcoal, under a leader's or parent's guidance. In a barbecue grill or campfire bed, start a fire using wood chips two to three inches in diameter. When the fire is blazing hot, cover it with soil. After six hours or more, dig up the burned wood. The wood should be charcoal. Restart the charcoal, again under a leader's supervision, and cook some hot dogs or marshmallows! Be sure to fully extinguish the fire before you leave the area.

Burn some forest debris, under a leader's or parent's supervision. In a charcoal grill or campfire ring, try to ignite and burn:

- green pine needles (wet)
- dry, dead pine needles
- green leaves
- brown, dead leaves
- peat
- rocks

and other forest debris. Observe how different fuels burn, and whether all forest fuels can be easily ignited.

Make a poster to teach fire education or safety to the public. The poster should be colorful and should emphasize a fire safety issue. Your poster should concentrate on fire source and prevention, (e.g., using spark arresters on chainsaws in forested areas) or fuels (e.g., how to reduce burnable fuels in home/lake cabin yards).

Exhibits/Fair Projects

Prepare a display showing correct uses of fire to improve a forest. The display should contain at least three photographs or drawings of these activities, and should be displayed on a three-sided display board. Each picture should be appropriately captioned.

Prepare a display showing a low fire hazard forest area and a high fire hazard forest area (use photos or drawings). Show four methods of preventing or controlling fires and how each method affects a leg of the fire triangle. Use either a three dimensional display mounted on plywood or in a box, or a three-sided display panel.

Burn at least six different types of pine cones, under a parent's or leader's supervision, in a small grill or campfire ring. Extract the cones from the fire with tongs or a similar instrument before they burn completely. You are trying to simulate a ground fire, which moves quickly. Also, place six cones from the same species in the hot sun for three to five days. Mount the cones on plywood with proper species identification. Summarize what happened to each cone, and indicate whether you believe the cone is serotinous.

Make a poster to teach a concept of fire safety, as suggested in "Additional Activities" above. The poster should be approximately 18 inches by 36 inches.

Make a Wildlife/Wildfire game. Design and build a board game that tells participants where animals go during a fire. For example, bears and elk move out of the way of fires. Animals such as mice and ground squirrels burrow underground. Snakes survive if they can crawl into a hole. Fish stay in streams, which aren't heated by the fire. Animals such as porcupines don't burrow or run fast—they might not survive a fire. Be sure to have rules and a way to determine who wins the game.

Make a historical display of fire activity in your area. Using photos or evidence of fire such as burned bark (fire scars), diagram the history of fire in your town or surrounding area. Your local historical society and library can help you with the information.

Pick a tree species and show how fire helps or hurts the species. Make a display showing a forest before and after a fire. Show how this species is either eradicated or encouraged by fire. Show any special fire-related features of the species, such as thick bark (red pine) or serotinous cones (jack pine). Use a plywood board and three dimensional display or three-sided panel board.

Answers to Ground/ Surface/Crown Fires on Page 2:

A = CROWN
B = SURFACE
C = GROUND

Answers to Fire Weather Quiz on Page 4:

A = H
B = L
C = H

Chapter 2

SILVICULTURE

(Growing a Forest)

Making a Stand

Silviculture is the practice of producing a forest. It involves managing the establishment, growth, species composition, and quality of a forest. Silviculture enables a forester to produce wood products, improve wildlife habitat, enhance recreational opportunities, control soil erosion, and maintain high water quality.

Foresters must understand a plant's interactions with its environment to practice silviculture. Specific silvicultural activities include:

- harvesting trees
- thinning a dense stand of trees
- regenerating trees
- choosing the best tree species for a site
- pruning trees
- fertilizing trees
- controlling pests
- other activities that improve a forest or maintain it in a productive, healthy condition

Silvicultural practices often deal with large areas of forest, rather than specific trees. However, a forest rarely is **homogeneous** (the same composition throughout). For this reason, foresters commonly divide a forest into **stands.** A stand is an area of forest land that has similar tree species composition, tree age, and site quality throughout. At least 90 percent of the trees in a **pure** stand are of a single tree species. A **mixed** stand has more than one predominant tree species. Most mature stands are mixed.

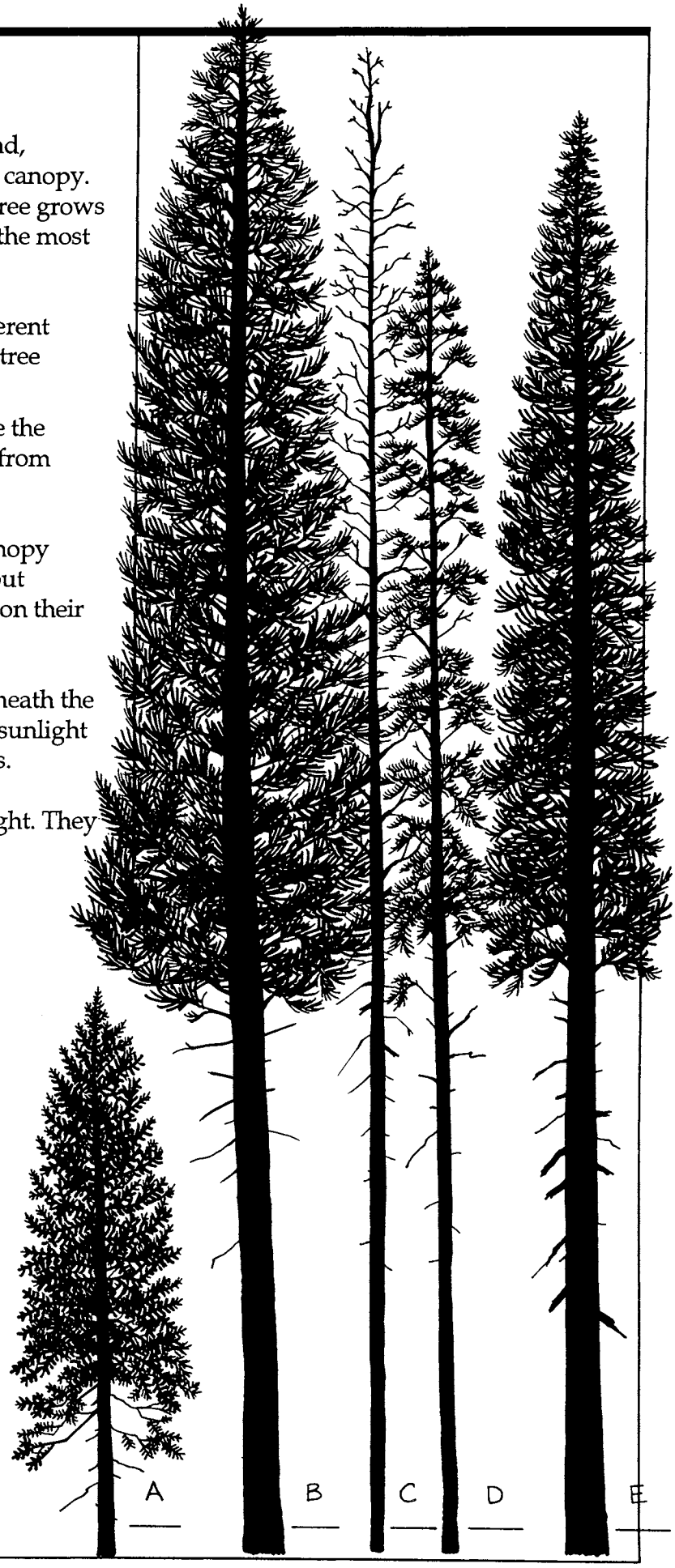
Stands also can be **even-aged** or **uneven-aged**. When trees are all approximately the same age, the stand is even-aged. Usually, trees in even-aged stands are about the same size. Trees in even-aged stands commonly are shade-intolerant species that have invaded a disturbed site. Or, they might be a tree plantation. Uneven-aged stands have at least three distinct **age classes** (all trees within an age class originate from a single event, e.g., planting or fire), but commonly have many age classes. Trees in uneven-aged stands vary widely in size.

Tree Classifications

In a forest stand, especially an uneven-aged stand, individual crowns occupy different levels in the canopy. The position of a tree crown affects how well a tree grows relative to its closest competitors. Trees that get the most sunlight generally grow fastest.

Silviculturists classify trees based upon five different crown levels. This system is known as the Kraft tree crown classification.

- **Dominant** trees have crowns that rise above the general canopy level. They get full sunlight from above and from all sides.
- **Co-dominant** trees make up the average canopy level. Their crowns receive overhead light, but dominant trees restrict some of the sunlight on their sides.
- **Intermediate** trees occupy a position underneath the dominants and co-dominants. They receive sunlight from above but no direct light from the sides.
- **Suppressed** trees receive no overhead sunlight. They usually are slow-growing and weakened.
- **Dead** trees.



LABEL THE TREES:

DO = DOMINANT

C = CO-DOMINANT

I = INTERMEDIATE

S = SUPPRESSED

D = DEAD

Methods of Harvest and Regeneration

Much of silviculture involves harvesting and growing new trees. The harvest method chosen for a stand often depends on economics (some methods of harvest are more expensive than others) and ecological requirements of the trees to be regenerated. Harvest methods that produce even-aged stands are **clearcutting, seed-tree**, and **shelterwood**. The **selection** method produces uneven-aged stands.

Clearcutting: In clearcutting, loggers cut all the trees in a stand, creating an open, bare area. Clearcutting only refers to situations where a forest is allowed to regrow on the site. When trees are cut to convert land to agriculture or development, the process is called deforestation.

After clearcutting, trees can regenerate in several ways They may grow naturally from seedlings already on the site before the harvest, from seed that blows onto the site, from stump sprouts, or from root suckers. Forest managers may reforest clearcut areas artificially by planting seedlings or cuttings, or by direct seeding. Clearcutting favors regrowth of tree species that are shade-intolerant. It produces even-aged stands.

Seed-tree: This method of harvest is similar to clearcutting except that loggers leave a few scattered trees to supply additional seed to the harvested area. These "seed trees" are the healthiest dominants and co-dominants of a stand, and are species that are not susceptible to windthrow (being blown down by wind). Planting or direct seeding usually is not required, since the seed trees regenerate the stand. The seed-tree method works best with tree species that produce a large amount of wind-disseminated seed. It produces even-aged stands.

Shelterwood: In the shelterwood method of harvest, loggers harvest a stand in two or more cuts. The first cut is called the **seed cut**; it removes enough of the trees to allow light to reach the ground and enable seedlings to grow. Enough trees remain to supply seed and to protect the area from poor growing conditions (too much light and high soil temperatures). The seed trees are harvested in a process called the **removal cut** five to ten years after new seedlings have started to grow. The young seedlings then receive all the light they need for rapid growth. The shelterwood method produces even-aged stands.

Selection: The selection method of harvest produces uneven-aged stands. In this method, loggers harvest individual trees or groups of trees throughout the stand. Large diameter, high quality trees and smaller trees that are crowded are usually chosen for harvest. Undesirable species, trees with poor form, damaged trees, and diseased or insect-infested trees also should be harvested. New seedlings then grow in openings created by removing larger trees. Stands managed with the selection method can be cut every ten years or so, as young trees grow to acceptable size. Shade-tolerant tree species such as basswood, sugar maple and ash can be successfully managed using this method.

Prescribing a Treatment

Foresters often prescribe special treatments for individual stands. These treatments are aimed at improving the quality and quantity of wood that eventually will be harvested from the stand.

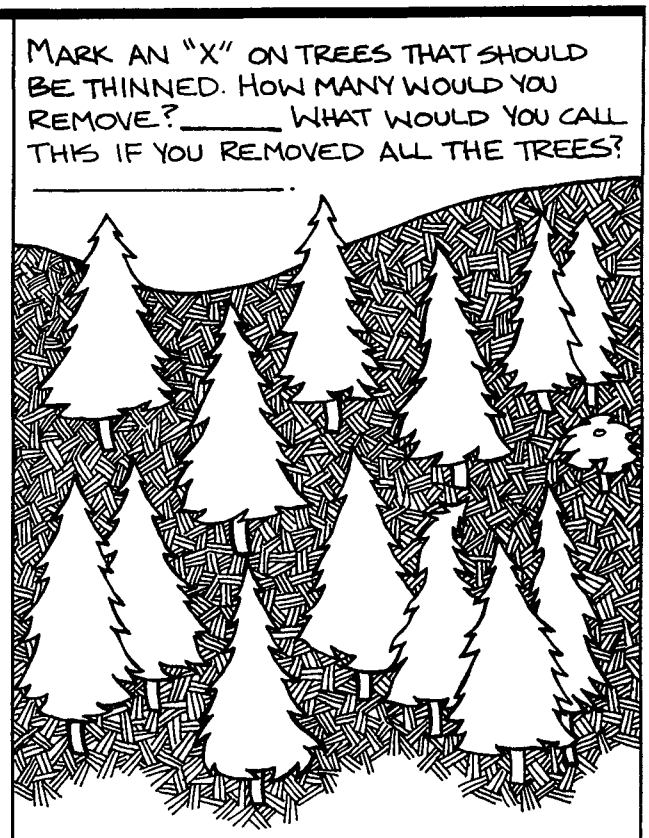
Often, **intermediate cuttings** are made between major harvests. Their purpose is not to prepare a stand to grow new trees, but to improve the conditions for the trees that are currently growing.

An **improvement cut** removes undesirable tree species, damaged trees, and trees with poor form. **A thinning** removes trees in dense stands to permit the remaining trees to grow faster.

Pruning is the careful removal of a tree's lower limbs to reduce the number of knots in the wood and so increase its value. Because of the high labor cost, only high-value tree species such as black walnut are pruned in forests. Trees usually are pruned when they are three to six inches in diameter. Trees in urban yards or community forests sometimes are pruned to look better.

Sanitation involves removal of insect- or disease-infested material to prevent the spread of the infestation to healthy trees.

A **salvage cut** involves harvesting insect-ridden, diseased, or fire-damaged trees for wood products before they completely lose their economic value. For example, pines killed by bark beetles usually are harvested the following season.



Fertilization may increase tree growth where there is plenty of soil moisture but soil nutrients are in low supply. Fertilization seldom is economical but may be appropriate where foresters manage trees intensively on short rotations. Foresters fertilize some species of poplar and aspen to add rapid growth and to shorten the rotation period (the period of time from seedling to harvest).

Herbicides are used to control weeds and other plants when seedlings are being established. This treatment is called **release**—the new seedlings are being "released" from competing vegetation. Foresters also use herbicides in some forests to control brush and so make it easier to work in the stand.

Silvicultural methods to improve the growth or quality of a forest are continually being developed and refined. New combinations of treatments also are being tested. Patient trial-and-error evaluations help the art and science of silviculture progress.

Career Considerations

A **logger** harvests timber from the forest. Loggers must operate their businesses efficiently to return a profit. They must know how to purchase timber, design access roads, sell logs, comply with forest management plans, and operate heavy equipment, all while performing basic business tasks. A college education is not necessary, but technical training with a solid business background will help a logger succeed.

EnviroQuotes

"We have not inherited the earth from our fathers; instead, we have borrowed it from our children." (unknown)

Tree-vial Pursuit

If Americans did not recycle newspapers, it would take only six years to fill half of all U.S. landfills with newspaper.

CHALLENGE!

You are Ima G. Forester, forest supervisor for the U.S. Forest Service in Big Pine National Forest in the western United States. You work and live in Little Fork, the town surrounded by Big Pine National Forest.

You recently approved a plan for increased harvesting of Douglas fir and red cedar. This makes the local forest products industries, loggers, mill workers, shopkeepers, and townsfolk of Little Fork very happy, since they will profit financially from the action.

However, out on the East Coast, a lawyer says that the planned harvest volume for the Big Pine is too great. He is concerned that the red-backed sap slurper, a rare nongame bird that nests in the Douglas fir and red cedar of the Big Pine, will be eradicated by the increase in logging. He obtains a court injunction to prevent you, the forest supervisor, from increasing the harvest.

Meanwhile, the folks in Little Fork are getting anxious to see the harvesting begin. They argue that without the increased volume of logging, the town will be forced to shut down its two mills, and that the local economy will collapse.

The Little Fork newspaper and national news media reporters rush to your office to interview you. What is your stand? Will you fight the court injunction and argue on behalf of the increased harvest volume, or will you concede that wildlife such as the red-backed sap slurper may be harmed by harvesting? Why? Is there a way to make everyone happy?

Yearning to Learn . . .
Additional Activities

In the following activities, remember the basic rules of conservation. Do not damage or destroy the plants and animals you are studying. Leave all ecosystems unchanged. Have a positive impact on the forest.

Classify trees in a local woods, using the Kraft tree crown classification. Observe which trees in an area are dominant, which are co-dominant, etc. What is the overall health of the suppressed and intermediate trees? What species are common in the dominant and co-dominant classifications?

Count seeds. Build three box seed traps out of cardboard, about 3 feet, 4 inches on each side. Cover the traps with large-holed mesh wire. Place the traps 10, 30, and 50 feet from the base of a large-crowned, open-grown tree during the period in which seeds fall. Every two or three days, count and record the number of seeds in each trap. Answer the following questions:

- Which trap collected the most seed?
- Which trap collected the least seed?
- How would you explain this difference?
- What would these results mean for a large clearcut area?

Add the total amount of seed collected and multiply by 4,000 to get the amount of seed dispersed per acre. If you had planted 640 trees per acre, how many seeds would reach the ground?

Visit a recently clearcut area. Record any brush, debris, bushes, and regeneration in the area. What signs of wildlife do you see? Check with the local forester and find out what plans have been made to regenerate the site (e.g., direct seeding, planting, or natural methods).

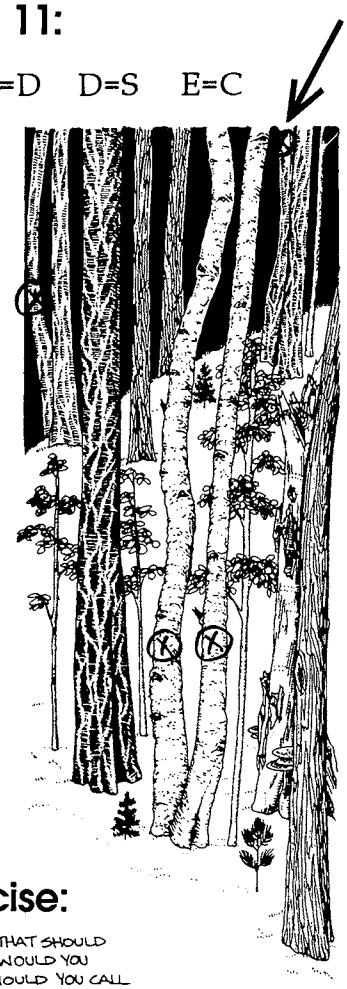
Exhibits/Fair Projects

Make a display of a forest showing dominant, co-dominant, intermediate, suppressed, and dead trees. Show how a tree's position in the canopy affects its growth rate. Label each tree with the correct classification.

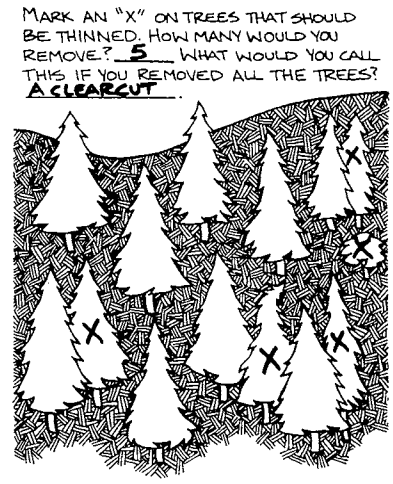
Answers to Tree Classification Quiz on Page 11:

A=I B=DO C=D D=S E=C

Answers to Selection Cut Exercise:



Answers to Thinning Exercise:



Make a model or exhibit of one of the harvesting and regeneration methods. Be sure to explain the method of harvest and regeneration.

Make a model, draw pictures, or take photographs of four types of stand treatment. Note the species you are showing for each method.

SPROUTS FROM THE ROOTS OF AMERICAN CHESTNUT TREES CONTINUE TO GROW, ONLY TO BE KILLED BY CHESTNUT BLIGHT BEFORE THEY CAN REACH MATURITY.

Chapter 3

FOREST INSECTS AND DISEASES

(An Introduction to Forest Entomology and Pathology)

Tree Pests

The forest is home to an abundant diversity of organisms, including insects. Many insects play important roles in a forest ecosystem. The dark, shiny ground beetle preys on the gypsy moth, a serious pest of the forest. Other insects serve as food for wildlife, or as pollinators. Some insects, however, cause tremendous damage to a forest. They reduce the growth rate of trees, transmit diseases, weaken trees so they are more susceptible to attack by other insects or diseases, or even kill trees. The study of forest insects is **forest entomology**.

Forest pathology is the study of tree diseases and tree mortality. Diseases that strike trees range from mild to very severe. In many of our towns and cities, Dutch elm disease has killed thousands of American elms. The American chestnut was once the major hardwood timber species in eastern forests, but chestnut blight, a disease introduced from Asia, has killed almost every tree. On commercial forest lands, the U.S. Forest Service estimated that almost half as much timber was lost one year to disease as was harvested. (This total included lost wood production as well as dead trees.)

Forest managers must be able to identify and understand the insect pests and diseases that attack forests so that they can manage forests to minimize damage.

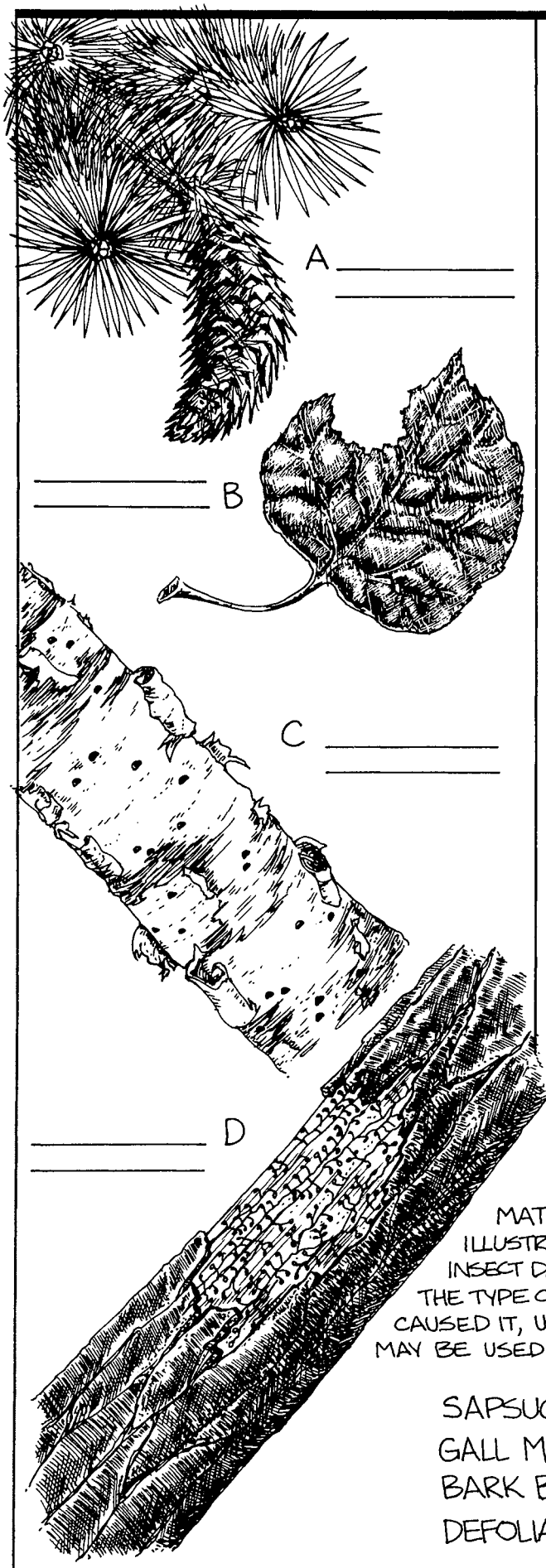
Entomology Up Close

Insects that damage trees can be classified by the type of damage they produce. Each insect species has a preferred part of the tree on which it feeds. Some insects eat leaves; others suck juice from the leaves, eat buds, bore through the bark and wood, or feed on seeds.

Defoliators eat a tree's leaves or needles. Without leaves or needles, trees cannot make the sugar they need to grow. Most deciduous trees can survive one year of defoliation, although their growth rate will slow. Several years of defoliation generally will kill the tree. Heavy infestations can strip the leaves from entire stands of trees. Conifer trees can be killed by just one year of defoliation. Some insects eat the entire leaf. The spruce budworm prefers tasty young needles on balsam fir and spruce, and will strip all the new growth from these trees. Other insects eat all of the leaf except the veins. Some insects **skeletonize** a leaf by mining between the upper and lower leaf surfaces or by eating all but the upper surface, leaving only a thin layer of cells. The most damaging insects are those that eat the entire leaf. Skeletonizers cause less damage because the leaf can still photosynthesize, although at a reduced level.

Sapsucking insects draw sap and plant juices from trees using their hollow, straw-like mouth parts. They feed on needles, leaves, shoots, or stems. The Saratoga spittlebug is a sapsucking insect infesting red and jack pine plantations. Like other sapsucking insects, the Saratoga spittlebug weakens trees, slows their growth, and makes them susceptible to diseases. In heavy infestations, these sapsucking insects also can kill the tree.

Bark-boring insects are very damaging to forests. These insects feed on the cambium and inner bark of a tree, disrupting the transport of water and nutrients. Many bark-borers attack only trees weakened from disease or drought. The bronze birch borer, a greenish-bronze beetle, attacks birch and poplar trees when they are weakened by drought or other conditions. Trees attacked by bark borers have small holes in the bark where adult beetles have exited.



Some bark-boring insects carry tree diseases. Dutch elm disease is spread by bark beetles that carry disease spores in their mouth, then feed in twig crotches of elms. Insects that carry a disease are called **vectors** of the disease.

Terminal and shoot-boring insects infest the tips and shoots of small trees, primarily in the forest or in plantations. Their feeding can damage the shape and growth rate of the tree.

Twig borers or girdlers can kill or weaken small trees by feeding on the main stem. They occasionally are important pests. The cottonwood twig borer stunts young trees and seriously affects their economic value.

Cone and seed insects damage seed crops. Some insects invade cones to make galleries (tunnels where eggs are laid). Others use the seeds as food. These insects are of economic importance mainly in seed orchards and commercial nut trees (e.g., pecan and walnut). They also destroy seeds that might have been food for wildlife. Acorn weevils destroy much of the acorn crop that otherwise would be eaten by squirrels, deer, and birds.

Gall makers affect tree growth by stimulating a tree to grow abnormally, forming a lump of tree tissue called a gall. Galls vary in shape and can appear on leaves, buds, stems or roots. Gall makers are not especially harmful to forest ecosystems, but they can be serious pests on ornamental and Christmas trees.

MATCH THE ILLUSTRATIONS OF INSECT DAMAGE TO THE TYPE OF INSECT THAT CAUSED IT, USING THIS LIST. SOME TYPES MAY BE USED MORE THAN ONCE OR NOT AT ALL.

SAPSUCKER	SKELETONIZER
GALL MAKER	CONE INSECT
BARK BORER	SHOOT BORER
DEFOLIATOR	TWIG BORER

Insect Management

How can forest managers control harmful insects? Foresters concentrate their efforts on:

- **suppression**—controlling existing insect populations; and
- **prevention**—preventing insect outbreaks.

Suppressing Insect Epidemics

Foresters suppress insect epidemics using a variety of methods. These include biological control, use of chemicals, sanitation, and mechanical control.

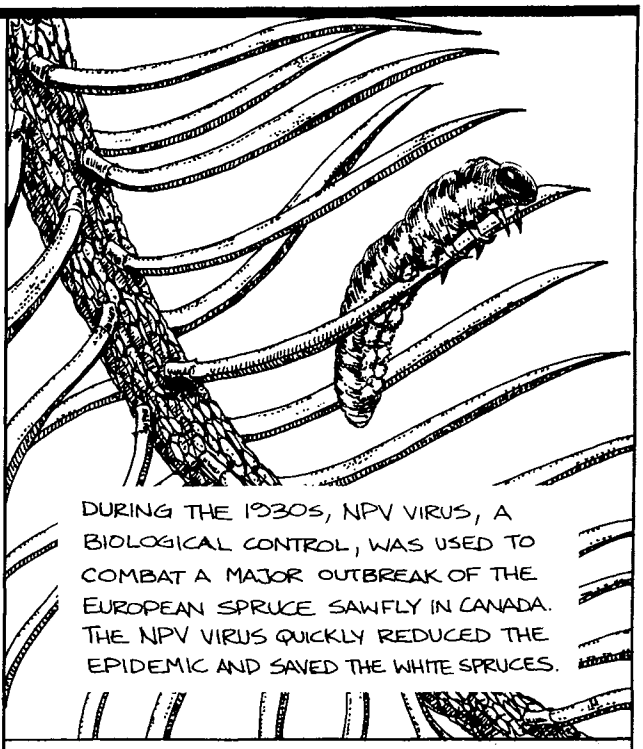
Biological control reduces insect populations by the introduction of natural predators, competitors, or diseases. Introduced predators attack the unwanted insects. Biological controls can be specific to the pest so they destroy that insect without harming others.

Chemicals called insecticides were used extensively in the past to control insects. Insecticides can provide a quick response in the face of insect epidemics. Use of insecticides is carefully regulated in order to avoid damage to other forest wildlife.

Behavioral chemicals send signals that confuse insects so that they will not reproduce, or will gather in chemical traps.

Sanitation involves harvesting insect-infested trees. Loggers remove the infested trees from the forest and sell the wood to a mill, where it is made into products. Sanitation procedures are aimed at removing the insects from an area, so that they can't infest healthy trees.

Mechanical procedures for controlling insects include cutting down, chipping, peeling, or burning infested trees to destroy insect habitat. This wood seldom is used commercially.



DURING THE 1930S, NPV VIRUS, A BIOLOGICAL CONTROL, WAS USED TO COMBAT A MAJOR OUTBREAK OF THE EUROPEAN SPRUCE SAWFLY IN CANADA. THE NPV VIRUS QUICKLY REDUCED THE EPIDEMIC AND SAVED THE WHITE SPRUCES.

Preventing Insect Epidemics

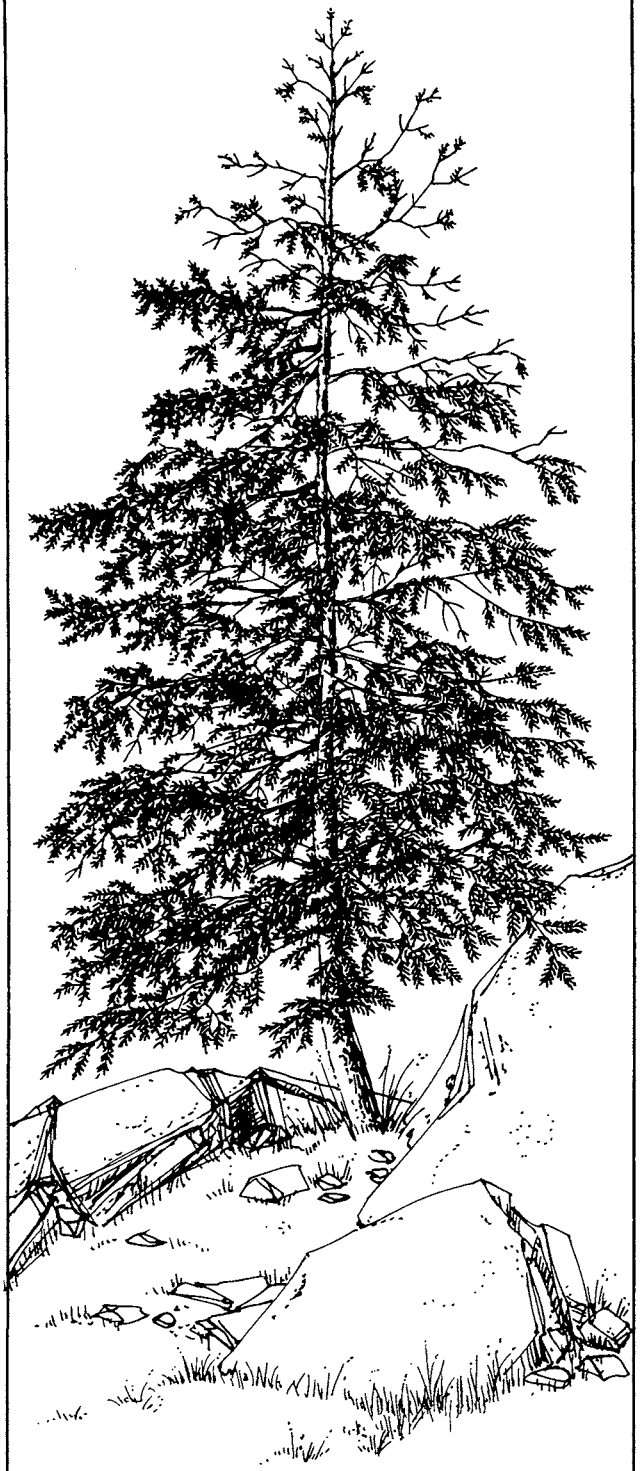
Foresters focus on two methods of preventing insect epidemics—regulation and silviculture. In preventing insect epidemics, forest managers are thinking ahead about the types of potential insect problems a forest may have.

Regulatory controls include laws that prohibit the transport and entry of insect pests.

Quarantines prohibit the movement of infested material into an area.

Containment policies prevent movement of insects or infested material out of an area.

Silvicultural controls reduce insect populations through stand management practices that create favorable growing conditions for trees. Healthy trees are more likely to be unattractive to pests and to recover more quickly if pest damage occurs.



THE EFFECTS OF ACID RAIN - FIRST CALLED "FOREST DEATH" - WERE OBSERVED IN EUROPE DURING THE 1970s. ACID RAIN IS FORMED WHEN SULFUR DIOXIDE AND OTHER POLLUTANTS ARE INCORPORATED INTO RAIN. THIS RAIN CAN KILL TREES AND ACIDIFY LAKES, DESTROYING HABITAT.

Pathology Up Close

To understand how to control tree diseases and mortality, we need to know the causes. Forest pathologists classify diseases and mortality as either **biotic** (caused by a living organism) or **abiotic** (caused by something that is not alive). The chart below lists the major biotic and abiotic agents of tree disease and mortality.

Diagnosing tree diseases and finding causes of mortality is a specialized job. Just as a physician is uniquely qualified to diagnose human ailments, a forest pathologist is educated and trained in the science of diagnosing tree disease and mortality. Pathologists look for disease signs and symptoms. Different symptoms suggest different diseases.

Biotic Agents

- Fungi (plural of fungus): microscopic plants
- Bacteria: one-celled microorganisms
- Viruses: microscopic agents composed largely of protein
- Nematodes: microscopic worms
- Seed plants: mistletoe family

Abiotic Agents

- Temperature and light: too hot, cold, shady, or sunny
- Moisture: too much or not enough
- Nutritional deficiencies: not enough nitrogen, phosphorus, potassium, or other elements
- Air pollution: sulfur dioxide, ozone, etc.
- Salt: from de-icing salt roads in winter
- Mechanical damage: construction, lightning, animals, lawn mowers

Biotic Agents of Tree Disease

Fungi: There may be as many as 100,000 different species of fungi. Most don't cause tree diseases, but the diseases that fungi do cause are more numerous and serious than the diseases caused by any other biotic agent. Different fungi attack different parts of the tree, including leaves, branches, trunk and roots.

Fungi often appear as soft, fleshy fruiting bodies called **mushrooms**. Woody mushrooms growing on living or dead trees are **conks**. Conks are obvious signs that fungi are present, but fungal strands (called hyphae) may extend for several feet beyond these fruiting bodies.

Fungi cause by far the largest numbers of forest diseases. These diseases are grouped by the part of the plant that is infected, or the type of infection, as follows:

- Root diseases
- Leaf diseases
- Vascular wilt diseases
- Canker diseases
- Rust diseases
- Decay in living trees
- Decay in wood products

Fungal diseases include severe pathogens such as Dutch elm disease (a vascular wilt disease), white pine blister rust (a rust disease), oak wilt (a vascular wilt disease), and chestnut blight (a canker disease). These diseases kill many trees.

Other fungal diseases don't kill trees, but instead present problems to the wood products industry and to homeowners. Decay of wood products by fungi can reduce the volume of fuelwood, pulpwood, and stored lumber and can reduce the structural soundness of wood in buildings, homes, and even boats.

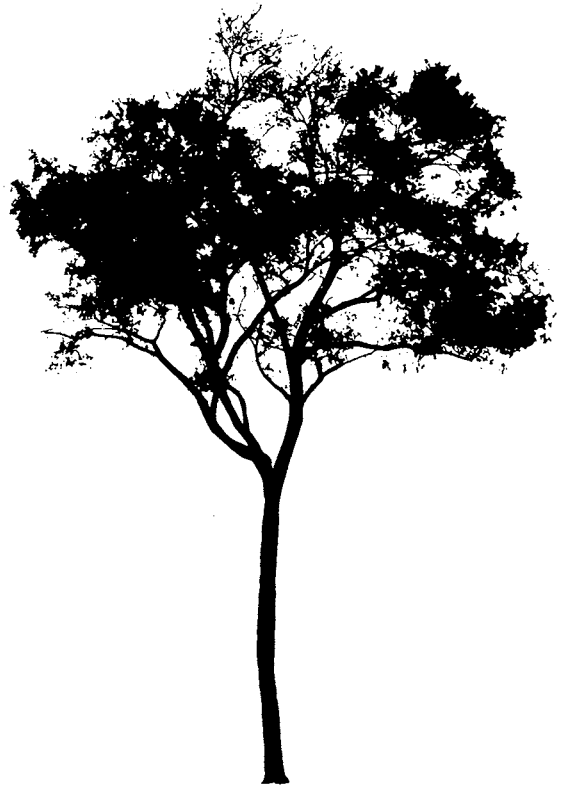
Bacteria: Bacteria are the smallest plants. They cause many serious tree diseases, especially on fruit and nut trees, but their effect on forests is minor. Bacteria symptoms include galls. Some bacterial galls kill young trees by disrupting the water and nutrient flow through their stem (called **girdling**). Others may endure and grow for many years without killing a branch or tree. Bacteria also cause wetwood disease in elm, which affects the aesthetic value of the tree.

Viruses: Viral diseases are not found often on forest trees. Phloem necrosis, a virus, affects American elms. Infected trees usually die within a year or two.

Nematodes: Nematodes can occur on forest trees, although the specific damage they cause is not fully understood. Root-knot nematodes, dagger nematodes, and other members of this parasitic group infect forest trees throughout the United States, particularly in the South.

Seed Plants: Diseases caused by seed plants such as mistletoe can seriously harm trees, especially Douglas fir and spruce. Mistletoe symptoms include abnormal growth and sprouting of branches, forming a broom-like appearance. These diseases can damage growth, reduce seed production, and decrease tree vigor.

FUNGI REPRODUCE BY SPORES. SOME SPECIES CAN PRODUCE UP TO 30 BILLION SPORES, WHICH ARE CARRIED THOUSANDS OF MILES BY THE WIND.



Controlling Tree Diseases

Since tree diseases often are very difficult to diagnose, it isn't always possible to prevent a disease from killing a tree or stand of trees. However, when an outbreak of a specific disease such as oak wilt threatens, foresters try to manage and suppress the disease using control measures similar to those employed for insect epidemics. Foresters suppress the disease outbreak with sanitation and mechanical procedures to insure that it does not expand beyond the first group of infected trees. Chemical control measures also are used to combat diseases. Chemicals are sometimes used to give individual trees resistance to a disease—American elms, for instance, may be injected with chemicals to help them fight off Dutch elm disease.

Foresters spend much of their disease prevention effort on silvicultural controls. They try to keep the growing conditions for a forest as optimum as possible so that it will not be susceptible to tree diseases in the first place. For example, foresters do not cut or prune oak trees in May and June, knowing that this is the period during which oaks are susceptible to infection by oak wilt. Regulatory controls, including quarantine and containment, also help prevent the spread of disease to and through a forest.

Abiotic Agents of Tree Mortality

All trees and plants require five items in the correct amounts for optimal growth. They are:

- sunlight
- temperature
- carbon dioxide
- water
- nutrients

If one or more of these items is not available in sufficient quantities, a tree's health may be harmed as severely as it would be by a biotic disease. If these items are available in excess, the tree also may be harmed. For example, a drought can weaken trees, making them more susceptible to insects. On the other hand, a tree subjected to flooding or puddling also can be stressed or killed.

Temperature and nutrients are other factors that help or inhibit a tree's growth. Extremes of temperature, either hot or cold, can weaken or kill trees and seedlings. Nutrient concentrations that are too low or too high also can harm trees.

Air pollution—for example, toxic gases or acid rain—is another abiotic agent that can devastate a forest. Urban trees in particular may experience slowed growth due to high carbon monoxide, sulfur dioxide, hydrogen fluoride, and ozone levels. Some tree species are more resistant to air pollution than others, and city foresters keep this in mind when selecting species to reforest urban parks and boulevards.

Chemical damage from salt used to de-ice roads can cause forest dieback and mortality. This agent can be combated by minimizing the use of de-icing salt or by planting resistant trees such as spruce along highways where de-icing salt use is high.

Mechanical damage—direct physical damage to the tree—is a problem largely in construction areas. It can injure roots, bark, or treetops, inhibiting the tree's ability to photosynthesize. Damage from home, sewer line, and road construction all contribute to decline of shade tree populations in many urban areas.

Career Considerations

A forest entomologist is an expert on forest insect identification and control. A forest pathologist carries the same specialty in tree disease. Both kinds of professionals often find employment in a state or federal agency. These specialties require at least a four-year college degree in entomology or pathology, with advanced degrees preferred.

EnviroQuotes

"Even if it could be proven that a certain species had no utility for us or our descendants, and that it could be plucked from its ecosystem at no cost, we should still be obliged to protect it for its sake and our own." G. Jon Roush, writing in *The Nature Conservancy Magazine*, November/December 1989.

Tree-vial Pursuit

A piece of dead or dying elm branch the size of a small fireplace log can produce up to 1,800 bark beetles. Imagine how many beetles an entire dying elm tree can produce!

CHALLENGE!

You are Stu Marmot, an urban forester for the growing metropolis of Sweden Prairie. You have just received a phone call from Mr. Tenner. His Norway pine is not doing too well. In fact, the tree has grown very little in the three years since it was planted. You agree to go out and look at the tree.

When you arrive at Mr. Tenner's house, he is pouring a bucket of bluish water on the Norway pine, and is ordering the tree to grow. You correctly surmise that the blue water is a fertilizer mix. You also note that the tree is growing on the north side of the house, near a large overhang that provides continuous shade.

Mr. Tenner greets you heartily. He says "I don't know what I'm doing wrong. I watered the darn thing every day throughout the drought." (You note that the tree is standing in a puddle of water.) "I fertilize it regularly. I don't let the kids play around the tree, because I know that will compact the soil and hurt the oxygen supply. So, what does my tree have?"

What is wrong with Mr. Tenner's tree? List the symptoms, and possible causes for these symptoms. What advice would you give Mr. Tenner? (Hint: you might want to focus on the abiotic agents of tree mortality to diagnose this tree's problems.)

For more information, see:

Your 4-H Entomology Project
4H-BU-0316
Minnesota Extension Service
Distribution Center
For ordering information, call:
(612) 625-8173.

Yearning to Learn . . .

Additional Activities

In the following activities, remember the basic rules of conservation. Do not damage or destroy the plants and animals you are studying. Have a positive impact on the forest.

Survey insect damage in your neighborhood, park, or nearby forest. Watch for insect-caused problems such as borer or bark beetle damage, partially eaten leaves or needles, and damage caused by sapsucking insects or cone borers. Record each type of damage you see, the tree species on which you observed it, and whether you saw an insect cause the damage.

Gently pull apart a rotting log and look for insects. Draw or collect a sample of each type of insect you find. Use an insect book to identify your insects. Why were the insects living in the rotting log?

Cut the stem off of a fresh, full-grown mushroom and place the mushroom cap flat side down on a piece of white paper. Cover the cap with a drinking glass or jar to eliminate air currents. After a few hours, lift the glass and the mushroom cap and you will see a spore print on the paper. The white lines show where the mushroom rested and the colored lines are the mushroom spores. Spores may be brown, white, black, pink, yellow, or rust colored. Spore prints are used to identify mushrooms. An identification book that gives spore color for different mushrooms can help you identify the mushroom.

Investigate a tree disease such as oak wilt, chestnut blight, white pine blister rust, Dutch elm disease, or nectria canker. Learn what tree species the disease attacks, how it damages the tree, and how (or whether) the disease can be controlled.

Exhibits/Fair Projects

Prepare a display about a harmful forest insect. Include drawings or photos of the insect's life cycle; information about the damage it does; and a sample of one of the tree species which the insect harms (oak leaf for gypsy moth, aspen leaves for tent caterpillar, birch bark for the bronze birch borer, etc.). Include a description of possible suppression methods. Use a three-sided display board for effective presentation.

Prepare a display about a beneficial forest insect. Include drawings, pictures, or photographs of the insect's life cycle; information about the benefits it provides; and a sample of one of the tree species the insect helps.

Collect at least ten forest insects from at least two insect orders (you will need a book on entomology to find the correct order for the insects). Label each insect with the date of collection and species of trees in the area in which you collected it. Instructions for collecting and displaying insects are found in *Your 4-H Entomology Project.*

Choose one tree disease and illustrate its life cycle. Discuss the agent of the disease, how it infects a tree, the results of infection, how it passes from one tree to another, and how it can be controlled. Some diseases to consider are oak wilt, white pine blister rust, nectria canker, and Dutch elm disease.

Collect photos of diseased or dying urban trees. Find examples of at least six different diseases or causes of mortality (biotic and/or abiotic). Identify the tree species and the type of agent that is infecting or killing that tree.

Collect at least six different conks or fungi from trees. Identify the fungi and the tree species they are infecting. Research and illustrate the life cycle of each disease.

Make a display showing at least six different causes of disease/mortality in urban trees. These causes can include abiotic as well as biotic agents. Use photographs or drawings of actual trees, and list some preventive measures (e.g., death of pines lining a freeway can be prevented by limiting application of de-icing salts in the winter).

Answers to the Insect Match on Page 18:

A = GALL MAKER
B = DEFOLIATOR
C = BARK BORER
D = BARK BORER
E = CONE INSECT
F = SKELETONIZER

Chapter 4

FOREST STEWARDSHIP

(An Introduction to Watershed, Recreation, and Wildlife Management)

Uses of the Forest

In a cold, roving stream a brook trout darts back to its hiding place beneath the roots of a bank-side tree. An angler nearby ties a fly to the fishing line and gracefully arches it onto the surface of the water. Casting several times, the angler finally is rewarded with a quick tug of the line. As the late spring snow melts into the stream, the angler lands the brightly colored brook trout. After admiring the fish for a quick moment, the angler gently removes the hook from the side of the trout's mouth, and releases the fish back into the clear, clean water.

Forests can be managed for a wide variety of uses, including watershed protection, recreation, wildlife, forage, and timber. A small area of forest may not always provide all of these uses, but a large area of forest often does. Being a steward of the land means balancing the various demands on and capabilities of the forest.

Watershed Management

Water is one of the most important products of a forest. In mountainous areas of the western United States, more than 90 percent of the water supply originates in forests. Nationwide, more than 60 percent of runoff (water that flows over land into streams or other bodies of water) originates in forested watersheds. Runoff replenishes our rivers and lakes but may carry sediments (soil particles) or other pollutants. Forest management practices affect both the quantity and quality of water flowing from forested areas.

Forests produce less runoff than non-forest areas. This is because leaves intercept rain and snow. Much of this precipitation evaporates back into the atmosphere, so less water reaches the ground.

Trees and forests also affect the timing of runoff. In areas that receive large amounts of snow, trees shade the ground and slow the rate of snow melt. By delaying snow melt, forests moderate stream flows longer into the summer.

Forests also help water remain clear and pure by lessening soil erosion. Fallen leaves and twigs slow the speed of water running over the forest floor, allowing more water to soak into the ground. Tree roots also hold soil in place. Trees are especially important along stream banks, where rapidly moving water can loosen and wash away soil.

Timber Harvesting and Watersheds

Because forests play such a big role in water movement, changes we make in the landscape also change water quantity and quality. Timber harvesting, especially clearcutting, may increase runoff for a year or two. Without trees, more precipitation reaches the ground and there may be less litter to slow runoff. Snow also melts more quickly in the spring because the sun shines brightly on it. This extra runoff enters rivers and can erode soil along stream banks. Runoff from harvested areas also may carry more soil particles, which are deposited into streams or rivers. Sediment is a form of pollution.

Logging road construction is a big culprit in the increased sediment in runoff from harvested areas. Soil erosion on logging roads can be minimized by:

- keeping the road as level as possible (less than 10 percent slope)
- diverting water from the roads with deflectors and culverts
- seeding the roads to grass after logging ends
- avoiding stream crossings where possible

Soil erosion is more likely to be a problem on steep terrain than on level terrain.

INDICATE WHETHER YOU THINK EACH SCENE BELOW SHOWS SOUND WATERSHED MANAGEMENT PRACTICES

A _____

B _____

C _____

D _____

Ways to Conserve

Here are ways you can conserve water. Spread the word!

- Turn off the water when shaving or brushing your teeth.
- Fix leaky faucets, which can lose 50 to 100 gallons a day.
- Put a weighted plastic bottle in your toilet tank, to use less water per flush.
- Install a water-saving shower head, which cuts flow in half in the shower.
- Mulch your garden! This will help the soil retain water, so you'll need to turn on the sprinkler less often.

WHY MANAGE FOR WATER?

Watershed is one of the most important uses of the forest. Forests must be managed properly to insure an abundant, clear supply of water. Without proper management, our water supply suffers. But how does this affect you?

Household Usage: An average person in the Lake States uses the following amounts of water:

Shower - 30-60 gallons/shower
Bath - 30 gallons/bath
Brushing teeth - 2 gallons/time
Flush toilet - 6-8 gallons/flush
Washing machine - 30-50 gallons/wash
Food preparation/clean up - 10-20 gallons per time

Food Production: Farm animals and plants use approximately the following amounts:

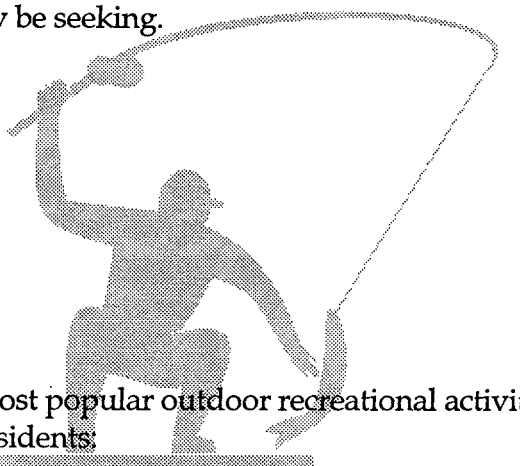
Horse, dry cow, beef animal - 12 gallons/day
Milking cow - 35 gallons/day
Hog - 4 gallons/day
Sheep - 2 gallons/day
100 chickens - 4 gallons/day
Corn - 54 gallons/plant/season
Potato - 25 gallons/plant/season
Tomato - 35 gallons/plant/season
Wheat - 25 gallons/plant/season

Recreation Management

Recreation is a product of the forest just as lumber, wildlife, and clean water are forest products. The forest provides many recreational activities that enrich our lives.

How would the activities you enjoy be affected if there were no forests?

Managing outdoor recreation in forests has become more complex as greater numbers of people participate in outdoor activities and compete for the same space. Forest recreation planners design space for both people and resources to properly mix activities for a given area of forest. In some cases, activities must be separated. For example, snowmobiling is often separated from skiing and hiking so that noise does not interfere with the solitude that others may be seeking.



Most popular outdoor recreational activities for Minnesota residents:

	percent of recreation time
• walking/hiking	18%
• biking	12%
• fishing	12%
• pleasure driving	8%
• swimming	6%
• boating	5%

More than half of Minnesotans' outdoor recreation time occurs during the 17 weeks of summer. [1]

[1] *Data from "Trend Reports," Issue 43, February 1990, Minnesota State Planning Agency*

The following is a list of recreational activities that people enjoy. Place an "X" beside the activities that you would consider appropriate for forests.

_____ Golfing
_____ Downhill skiing
_____ Boating
_____ Hiking
_____ Snowmobiling
_____ Fishing
_____ Hunting
_____ All terrain biking
_____ Canoeing
_____ Berry picking
_____ Camping
_____ Target shooting
_____ Tennis
_____ Picnicking
_____ Football
_____ Nature study
_____ Horseback riding
_____ Soccer
_____ Baseball
_____ Orienteering
_____ Swimming
_____ Bicycling
_____ Basketball
_____ Skating
_____ Archery
_____ Cross country skiing
_____ Playgrounds

Wildlife Management

Wildlife management is the management of wild animal populations and their habitats. Wildlife play an essential role in forest ecosystems and in the food chain that links plants and animals (including humans).

A forester can increase or decrease an animal population by changing its habitat. Timber harvesting may improve habitat for some wildlife species while damaging habitat for other species. After a pine stand has been harvested and regenerated, white-tailed deer find ideal forage among new pine seedlings. Pine martens, however, need older pines for cover. Forest managers must carefully consider the types and requirements of wildlife present when planning a timber harvest.

An important concept to wildlife managers is **carrying capacity**, the number of animals of a given species that an area can support without being degraded. When a species' population exceeds the carrying capacity, damage can occur to both the animal and the forest. Animals weakened by malnutrition become more susceptible to diseases. Trees and regeneration may be damaged by overbrowsing as the animals compete for limited food.

Wildlife managers consider the successional stages of the forest in analyzing the types of wildlife present in a forest. Some animals prefer early successional stages such as aspen, birch, and jack pine regeneration, especially for their forage. Other animals cannot find cover, food, or nesting sites in newly harvested areas, and move on to older tree stands.

Foresters and wildlife managers often set priorities in wildlife species management. These priorities often are based on the current population of the animal, and whether the animal is endangered or threatened. In certain areas of the forest, a specific animal species will be given careful consideration when planning a cut. The forester will strive to reduce the negative impacts of timber harvesting on this species. For some animals, this means that dead trees will be left as **snags** for homes, nesting, or forage. Clearcuts may be broken into smaller cuts with undisturbed forest in between to maximize the availability of edges where animals like to forage. Old growth forests may be left intact to preserve animal species that need the older trees for cover and forage.

The Moose of Isle Royale

Isle Royale is a 210-square-mile island in Lake Superior about 11 miles from the Ontario shoreline. In the early 1900s, moose arrived (probably by swimming) on the island from the Ontario mainland.

Year	Moose Population
1964	821
1965	897
1966	1274
1967	1614
1968	1279
1969	1362
1970	1444[2]

Using the figures above, calculate the average annual moose population on Isle Royale. This will give you an estimate of carrying capacity during the mid- to late 1960s.

Estimated carrying capacity, Isle Royale, mid-1960s:_____

Carrying capacity changes over time, partly because of successional changes in the vegetation. For example, during the dry year of 1936, fires burned more than 45 square miles of Isle Royale. Early successional species such as aspen and birch regenerated in the burned areas, providing a renewed food source for the moose.

Based on the information above, would you estimate that the moose population:
_____ increased during the 1940s?
_____ decreased during the 1940s?
_____ remained relatively stable during the 1940s?

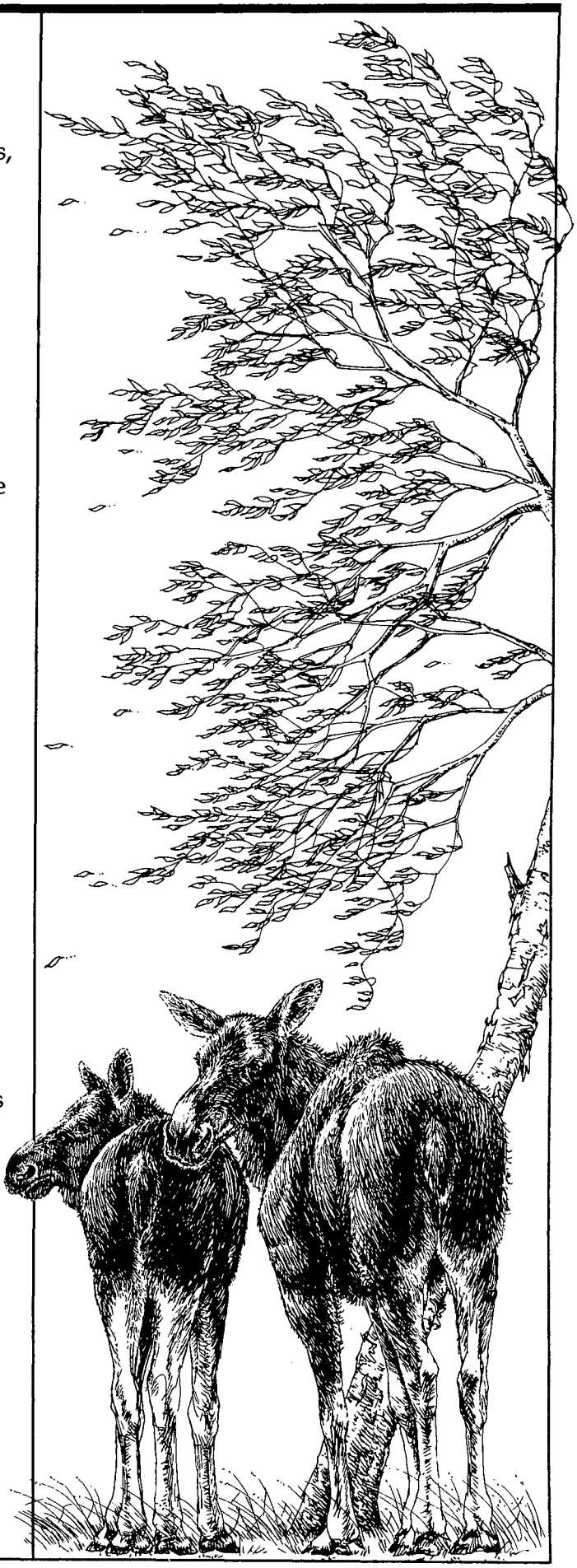
Factors independent from the habitat, such as weather, predators, and disease, also influence the number of animals that survive in any given year.

In the late 1940s ice formed a bridge between the shore and Isle Royale. Wolves crossed this bridge and eventually established packs on Isle Royale.

After the wolf was introduced, did the moose population:
_____increase?
_____decrease?
_____remain the same?
Why?

_____

[2] *From Peterson, R.O. Wolf Ecology and Prey Relationships on Isle Royale. National Park Service Scientific Monograph Number 11, 1977.*



Career Considerations

A recreation manager oversees the natural resources that make an area popular. The manager coordinates trail building and upkeep, information services (maps and signs), building construction and upkeep, and use of the area. Recreation managers can be found in national, state, and local parks and forests. Generally, a four-year degree, with emphasis on forestry or recreation management, is required.

EnviroQuotes

"The forest is gone long before the last tree is gone."—Rick Brown, speaking on the cutting of old growth forests in the Pacific Northwest in *National Wildlife,* December-January 1990.

Tree-vial Pursuit

Scientists estimate that more than 30 million insect species live in tropical rain forests.

WCCO TV produced a series about our forests, called *Forests 4 Ever.* It's an excellent video for learning about trees and the environment. To order a copy, send a blank videotape and a check for $5.00 to:

Jon Carlson
WCCO TV—*Forests 4 Ever Request*
90 South 11th Street
Minneapolis, Minnesota 55403

CHALLENGE!

You are Lynn N. Hans, a forest manager for the Short Prairie State Forest. You have just gotten word from the state office that Kate Clementine Rocksrud, a local philanthropist, has died and left the Short Prairie State Forest 10,000 acres of forest land adjoining Lake Superior. You are in charge of preparing a management plan for this area.

The local snowmobile clubs are lobbying your office to establish 67 miles of snowmobile trails on this new land. These trails would cross six small undeveloped lakes and two rivers, and would run through bald eagle nesting areas. The trails also would be routed through prime moose habitat.

A cross-country skiers' group, led by local activists Susan and John Block, wants to prohibit all motorized vehicles, including snowmobiles, from this area. Group members point out that the acreage is pristine and undeveloped. They do, however, want 42 miles of cross-country ski trails developed on the land.

The local chapter of a national conservation group wants to set aside the area as a wildlife sanctuary, arguing that the area is environmentally sensitive and home to important animals like the bald eagle and moose.

Tom (Ted) Grey, a local resort owner, wants to open the area to boaters and anglers, and wants Short Prairie State Forest to build roads, docks, and boat accesses on the lakes, as well as stock the lakes with trout.

Local loggers led by Arte Marthey, mayor of a nearby town, want authorization to harvest approximately 6,700 acres of black spruce and aspen-birch stands. They point out that this would boost the economies in towns surrounding the Short Prairie State Forest.

How would you manage this land? What type of:

—recreation management plan will you draft?
—wildlife management plan will you draft?
—overall usage plan will you draft?

Who will benefit from your plan? Who will not benefit? Are you going to be able to make everyone happy?

Yearning to Learn . . .

Additional Activities

In the following activities, remember the basic rules of conservation. Do not damage or destroy the plants and animals you are studying. Leave all ecosystems unchanged. Have a positive impact on the forest.

Observe the amount of sediment in a flowing stream. Take a large glass jar and collect water away from the bank just above the stream bottom. Do not disturb the bottom of the stream or the bank (this would cause more sediment to get into your jar than the stream normally carries). Allow the sediment to settle for about 48 hours without disturbing the jar. Using a ruler, measure and record the depth of the sediment. Do this experiment at least twice, collecting at least one sample during the spring and one later in the summer. Compare your measurements. Which sample has the most sediment? If there is a difference, how can you explain it?

Look at a map of a forested recreation area (park or forest) with which you are familiar to see how recreation facilities have been located or designed. As you look at it, answer the following questions:

- What conflicts might occur between motorized and non-motorized trail activities? How might they be minimized?
- Why are camping and picnicking areas located where they are? What natural resources are located nearby?
- What rules are there for visitors? What is the purpose for each? How do visitors learn about the rules?

Visit a local forested recreation area to participate in a forest recreation activity with your leader, other 4-H members, or your family. As you participate, look at ways in which the facilities have been designed to make them easy and safe for people to use. What types of signs and maps are used to assist people? What rules are posted to ensure that visitors have a safe, enjoyable experience? What trees, plants, or other natural features make this area a desirable place to visit? If possible, talk to the park or forest manager to see what is involved in managing the facility.

Visit a beaver dam. Look for signs of beaver activity—fallen aspen logs on the shore, beaver prints, and, of course, the beaver dam itself. Quietly observe the area for a few hours, and see if you are lucky enough to spot any beavers at work! What would happen to the beavers if their habitat changed—for instance, if the pond dried up? What would happen if their source of food—aspen and other trees nearby—were removed?

Plant the landscape for wildlife that you planned above. Observe the animals using your landscape. It may take a number of years for your plants to become established enough for wildlife to really use it. Remember that you are planning for the future! Make a detailed drawing of your landscape, and record the number of birds and other wildlife that use your area during a two-hour period. Also note any seasonal variations in wildlife use that may occur.

Build nest boxes for birds of your choice and put them in your yard or neighborhood. *Woodworking for Wildlife* by Carrol Henderson is a good reference.

For more information, see:

Woodworking for Wildlife
by Carrol Henderson
Available from:
Document Center
117 University Avenue
St. Paul, MN 55155
For ordering information, call:
(612) 297-3000

Answers to Watershed Management Practices:

A = NO
B = YES
C = NO
D = YES

Answers to Recreation Management Quiz:

All of these recreational activities can be provided in a properly managed forest.

Answers to Moose of Isle Royale Exercises:

Carrying capacity—1242 moose.
Moose populations increased during the 1940s, due to increase supplies of food. Moose populations decreased after the introduction of the wolf because wolves are predators of moose.

Exhibits/Fair Projects

Make a model of the role of trees in protecting water quality. Include a tree, rainfall, clouds, water areas, etc. Explain on your model how the presence or absence of trees affects water quality in an area.

Prepare a three-sided display showing the amount of water needed by different household, farm, and business activities, and ways of conserving water in these activities.

Survey recreational use of an urban forest or campground. Design a survey that can help foresters manage the site for maximum user satisfaction. Give the survey to at least 20 individuals or groups. Compile the data and exhibit the questionnaire, data, and any conclusions you have reached about survey results in a report.

Draw a map and draft a plan for a recreation trail for a local forest. Your trail can accommodate any recreational activity or combination of activities that you wish—hiking, skiing, snowmobiling, etc. Draw a map of your forest showing the trail location and the location of interesting natural features along the trail. Remember, you want to maximize user pleasure, yet minimize impact on the forest. Include user rules and regulations in your plan.

Prepare a three-sided display on the life of a wild animal species found in your area. Include a range map showing where the animal can be found and pictures of the animal. State whether the animal is abundant, threatened, or endangered (this information is available from your state natural resources agency). Include a description of the animal's habitat requirements.

Make a display using drawings or photographs of wildlife tracks that you have identified. Include tracks from at least eight different species. For each species, include a brief description of the animal and of the type of habitat it prefers.

Chapter 5

FOREST PRODUCTS

(Resources of the Forest)

The Woods We Use

Forests provide many essential products, including wood. Americans use more wood annually than all other industrial materials combined. Our private, state, and national forests provide us with much of the wood we use, but we also import wood from other countries. The United States is the largest importer of wood in the world.

Wood products are renewable resources. While there is environmental disturbance associated with harvesting wood, it often is of a shorter term and less invasive than other resource gathering such as oil drilling and mining.

Harvesting Trees

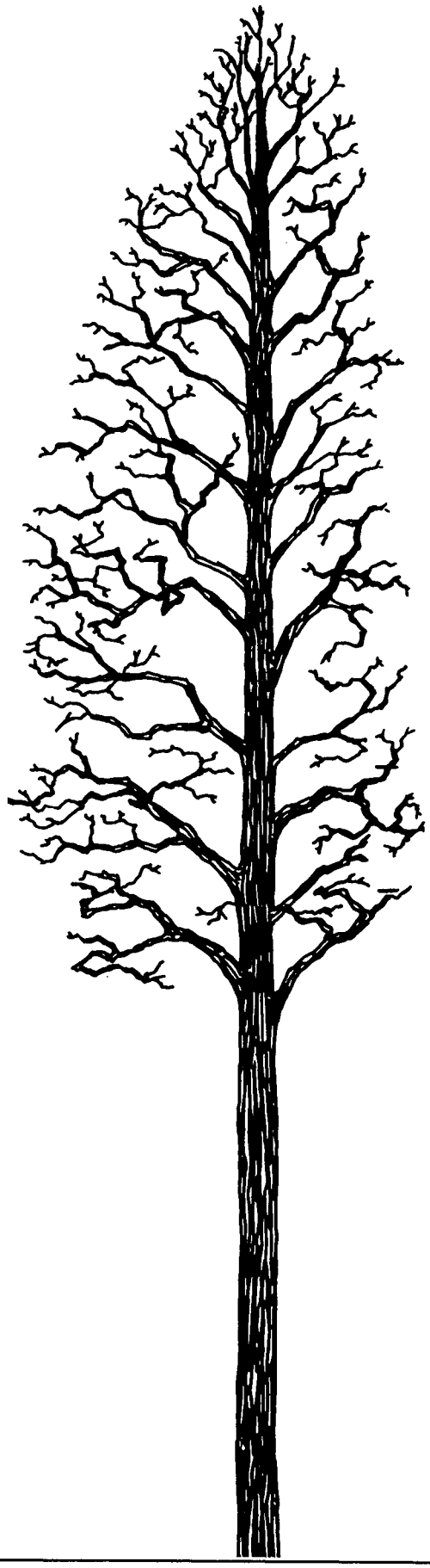
Wood is obtained from forests through timber harvesting. The first step in timber harvesting is the selection of specific stands and trees. From there, timber harvesting involves:

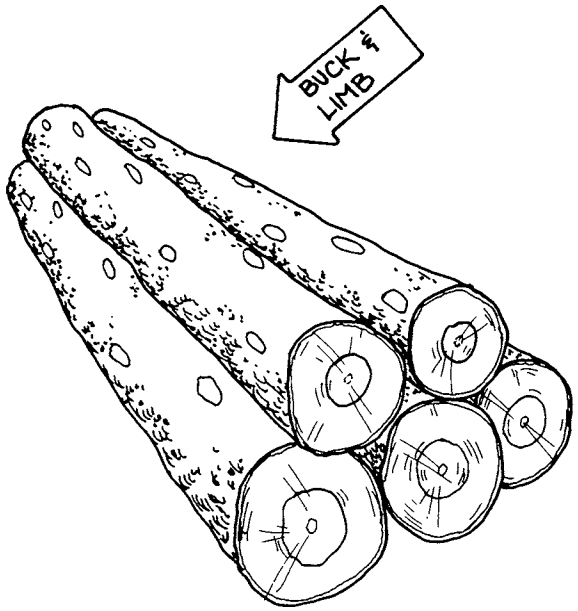
1. designing and building a system of access roads and trails;

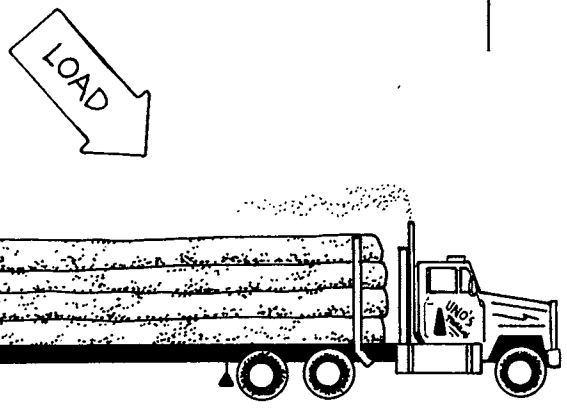
2. **felling** (cutting) the trees using chainsaws or feller/bunchers;

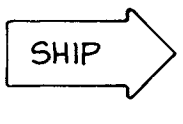
3. moving the trees (called **skidding** or **yarding**) to a log **landing** (area where logs are collected to be loaded) using skidders, farm tractors, bulldozers, horses, or even helicopters in rugged or environmentally sensitive areas;

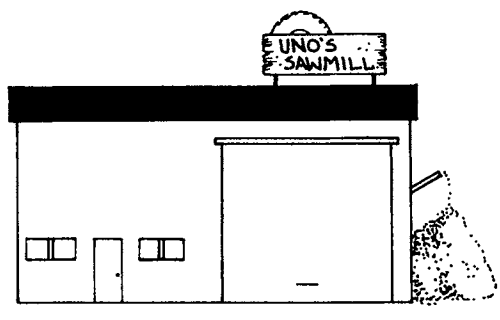
4. removing the tree's limbs (**limbing**) and cutting the stem into appropriate lengths (**bucking**), either in the woods or at the landing;











5. loading the logs onto trucks using a front-end or knuckleboom loader;

6. if paper or fuel is the desired product, chipping the logs into small pieces at the landing using a machine called a chipper, then loading these pieces onto a truck;

7. hauling the logs or chips to a mill.

Timber harvesting is a dangerous occupation. Through training and experience, loggers learn to operate machinery safely and to use necessary safety equipment such as a hard hat and chainsaw chaps.

Processing Wood

After timber is harvested and transported to the mill, it undergoes **primary processing**. During this phase, the log is made into basic products such as fuelwood, lumber, pulp, veneer, particleboard, paper, hardboard, insulation board, plywood, or medium-density fiberboard.

Secondary processing occurs when the primary products are converted into more specific products. Furniture, windows, pallets, cabinets, mobile homes, and toys are examples of these products.

The Story of Lumber

Although there are more than 1,000 species of trees in the United States, most lumber made today comes from only a few of these species. Approximately three-quarters of the wood we use comes from softwood (conifer) species such as pine and fir. Buildings often are constructed with softwood lumber. Hardwood lumber is used mainly for furniture, flooring, and handles, although some hardwood lumber also is used in construction.

Sawmills process logs into lumber. Sawmills of today can be highly automated, but the process of making lumber remains simple. The logger hauls logs from the forest to the mill where they are unloaded onto large piles to await further processing.

Logs being made into lumber typically first pass through a debarker, which mechanically removes much of the bark. They then are rolled one at a time onto a vise-like machine called a carriage. The carriage holds a log in place while the headsaw cuts it into planks. A conveyor carries the planks to an edger, which saws the boards into desired widths. Trimmer saws next cut the boards into desired lengths. (Mills use the extra small leftover pieces of wood as fuel or pulp.)

The edged and trimmed boards then move along another conveyor belt where workers grade them according to wood quality. This lumber is then seasoned, or dried, either in the yard or in an ovenlike structure called a **kiln**.
Finally, the dried rough lumber passes through a **planer** (a set of rotating knives), which gives it a smooth, finished surface. The finished lumber is graded again before it is shipped to stores and lumberyards.

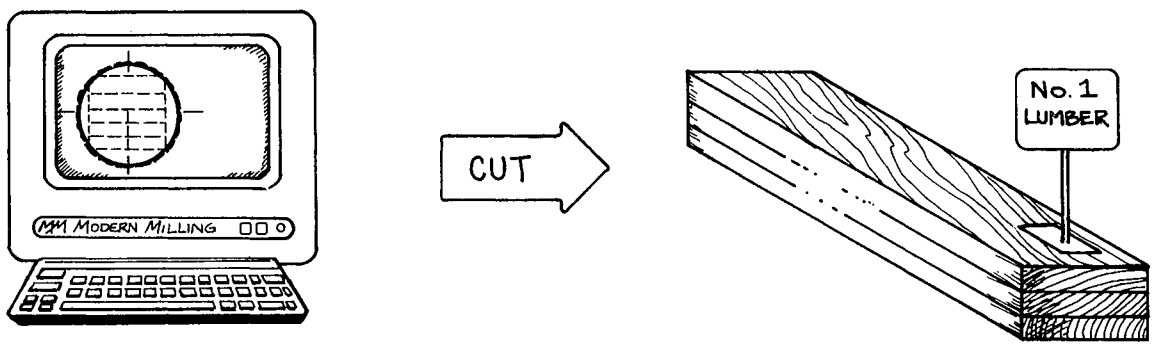
Products From Wood

You probably recognize most of the wood materials used in home, farm, and industrial construction as products of the forest. But did you know wood also is used in making clothing (rayon), wood plastics, photographic film, charcoal, insulation, and fireworks? Even the blades for giant wind generators, turpentine, and surgical gloves are products of the forest.

Put an " X " by the items below that you think contain wood or are wood products.

_____ cellophane
_____ erasers
_____ race car tires
_____ cattle feed additives
_____ newspaper
_____ ceiling tiles
_____ ceramic vases
_____ paint resins
_____ *National Geographic*
_____ table tennis paddles

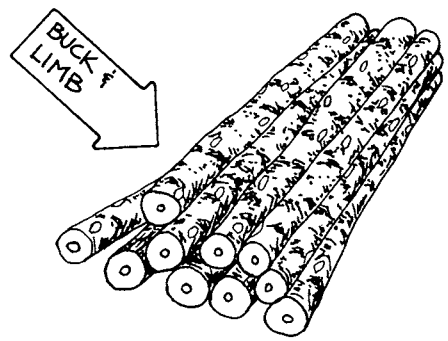
Wood is a remarkable feat of natural engineering. It can be stronger than steel of equal weight, yet, under certain circumstances, it can be tied into a knot. The structure and properties of wood help determine its uses. These properties are a function of tree species, growth rate, and tree (stem) form.



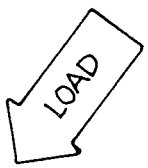
Wood Sandwiches

Plywood is a large, flat wood-and-glue "sandwich" made of thin layers of wood called **veneer**. Mills make veneer in many different ways, most often using a rotary lathe or a slicing knife. Thickness ranges from 1/110 of an inch to 3/8 of an inch.

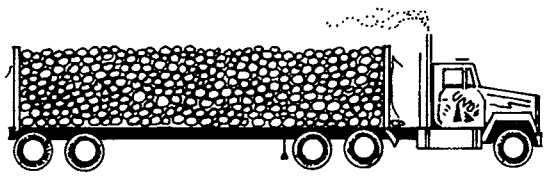
In the slicing method of making veneer, the log moves up and down against a knife that shaves off a thin piece on each downward stroke. In a rotary-cut system, a lathe holds a steam-softened, debarked log. The log rotates against a long stationary knife, which cuts the veneer in one long sheet, somewhat like unwinding a roll of toilet paper.



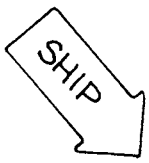
Veneer is clipped to remove defects and then is carefully dried in huge ovenlike driers. Workers then form the dried veneer into standard-size sheets by gluing several pieces together.

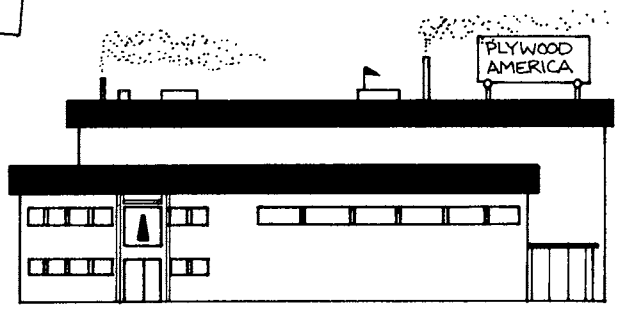


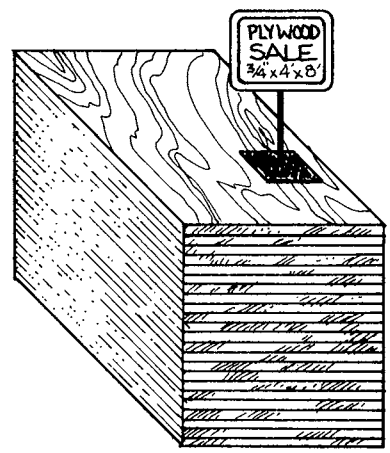
Standard-size veneer sheets are coated with glue and stacked so that the grain of each layer runs at right angles to the next one. (This gives plywood strength and durability.) The completed panels are placed into powerful presses that help the glue bond to the wood. Finally, the finished plywood is trimmed, sanded, strapped, and prepared for shipping.



Standard plywood panels measure four feet wide and eight feet long. They can be as thin as 3/64 of an inch or as thick as two inches or more, depending on the intended use. Plywood is widely used in building construction and for decorative purposes such as paneling and furniture.







Paper Maker

This book—like most others—is made from a mixture of wood fibers, water, and chemicals, called **pulp**. We each use more than 600 pounds of paper and paperboard (thick paper) per year.

Before wood is made into pulp, the bark must be removed from the logs. At the mill, jets of water blast bark away, or the logs are tumbled against each other to remove the bark.

Mills turn wood into pulp in one of three ways:

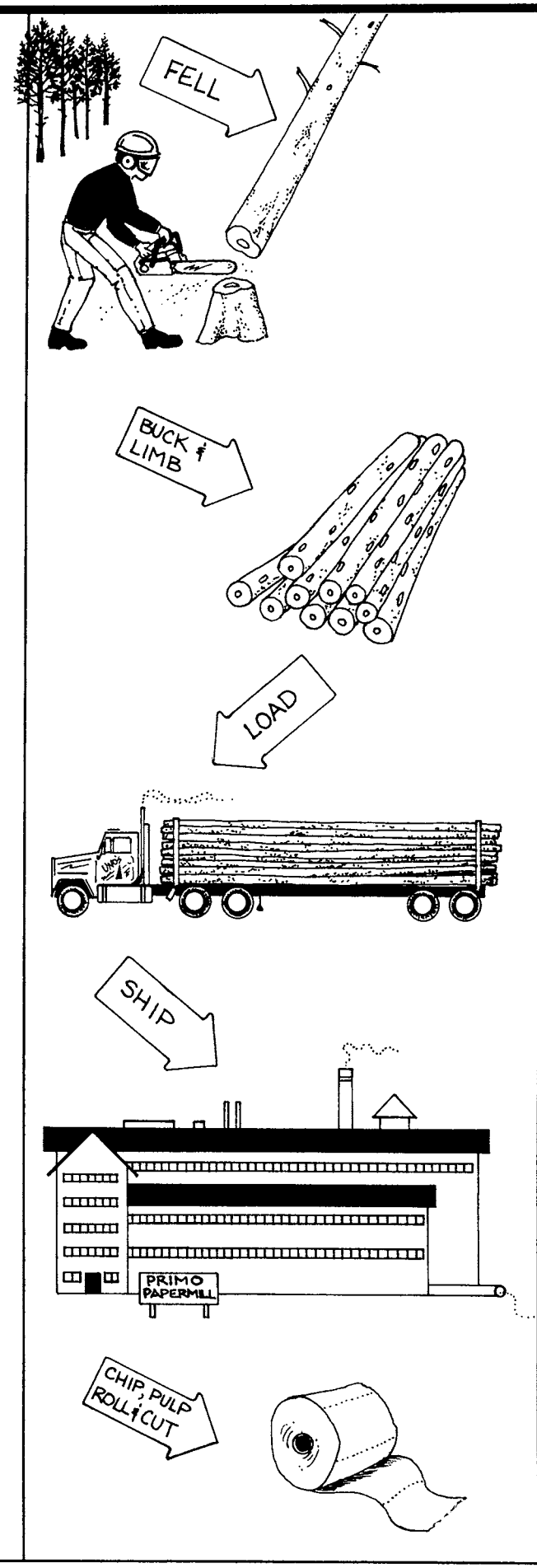
- mechanically, using a method such as the groundwood process, where wood is pressed against a grindstone and the fibers are ground off into water;
- thermally, using heat to resoften wood chips; or
- chemically, "digesting" the wood with a sulfate or sulfite process.

A single pulp-making operation may combine these methods to take advantage of the best features of each. Mechanical pulping, for instance, gives high fiber yields (up to 95 percent) but requires a lot of energy and produces relatively weak, easily yellowed paper. Pulp made from the chemical process has a much lower fiber yield (40 to 50 percent). No matter which pulping process is used, the pulp must be washed and screened before it can be made into paper.

If the pulp is to be used for whitened papers, it next is bleached. From here the pulp goes through a washer and is sprayed with water as it revolves on large drums. Next, it goes into the beater, which rubs and frays the fibers until they are more flexible. For the finer grades of paper, a sizing solution (starch or glue) is added to seal pores. Color also may be added at this point.

The pulp is diluted and fed onto a broad wire screen that drains off part of the water. It then moves through roller presses that squeeze out more water.

Workers dry pulp by winding it through steam-heated rotating drums. Then it is passed through chilled steel rollers to smooth it and give it uniform thickness. The resulting finished paper is wound into large rolls and cut to size.



Recycle It!

Recycling is an age-old idea. Early settlers in America carefully reused and recycled items, because goods were scarce. Quilts were made from bits of old clothes, and corn husks were turned into mattresses. Even nature recycles. Dead material on the forest floor is broken down by microorganisms into nutrients, which in turn feed future generations of trees. These trees eventually become dead material. And so the cycle continues.

Interest in recycling has increased due to several reasons, including: landfill limitations, costs of imports, and favorable production costs associated with recycling. Despite what you may think, paper does not break down in a landfill rapidly, unless it is exposed directly to sunlight. Currently, about 23 percent of U.S. newsprint is produced from old newspapers that have been recycled. Since newsprint is by far the major U.S. paper import product (accounting for 47 percent of all total imported paper), substantial efforts are being made to recycle this product to reduce imports.

Recycling paper consists of three different activities:

- collecting the recyclable materials (from curbside, specially designated containers, etc.);
- preparing (sorting) these materials for appropriate markets; and
- actually recycling the materials by manufacturing new products.

When different kinds of papers are mixed, the higher grade papers (like photocopy paper) are downgraded by the large amounts of lower-grade papers (like newsprint). To avoid this, it is necessary to separate waste paper by grades before recycling. Newspapers and cardboard can be recycled into newsprint and egg cartons. Typing and note papers from offices can be recycled into shoeboxes and tar paper. Photocopy paper can be made into high quality paper, paper plates and cups, and tissues.

Paper Making Revisited: The process of turning waste paper into a new paper product is different from the process of making paper from wood. Waste paper is brought to the mill, where it is then repulped by mixing it in water and beating it with a machine called a hydrapulper. This procedure separates fibers from unusable material, forming a fiber-and-water sludge. Plastics and other unusable solids are filtered out, and this sludge is then thickened. The sludge is mixed with water, air is added, and any ink that remains floats to the surface as foam. The foam is then vacuumed out of the sludge mixture. The de-inked mix, consisting of 4 percent fiber and 96 percent water, is then laid out to form paper sheets. Sometimes the pulp must be bleached with chemicals to give it whiteness and brightness.

It takes less energy to produce some paper products from recyclable papers than from virgin timber. These savings result from reduced energy needs in the process and in cutting and transporting timber. They can be offset, however, by the energy (mostly fossil fuels) needed to collect, transport, and de-ink the waste paper.

Other Wood Products

Particleboard is made of small pieces of wood bonded with resin and hot-pressed into panels. These panels have carefully controlled strength and durability. Like plywood, particleboard can be made into hundreds of products. Although boards made of any type of wood particle are correctly termed particleboard, some are marketed under a name that describes the specific type of particle used, such as waferboard or oriented-strand board (OSB).

Particleboard is made in a variety of sizes and thicknesses to meet end product requirements. Furniture cores are made from particleboard, and these in turn are overlaid with veneer. Particleboard also is widely used in covering roofs, floors, and walls of buildings.

Wood is reduced to individual fibers and then formed into a mat (similar to that used in making paper) to produce **hardboard, medium-density fiberboard,** and **insulation board.**

Hardboard is a medium to high-density product used in furniture, wall paneling, doors, siding, signs, and roofing material. Truck doors, roof panels, back window decks, and even dashboards are made from molded hardboard. Hardboard is different from other fiber products because it requires very little resin (glue) in its manufacture, but relies instead on lignin, the natural binding material in wood. Medium-density fiberboard uses synthetic resin to bond fibers together instead of lignin. It is used for panels, doors, and table tops.

Insulation board, a low-density product, is used for acoustical ceiling tile, exterior sheathing (covering) for walls in homes, and as roof decking or floor underlayment.

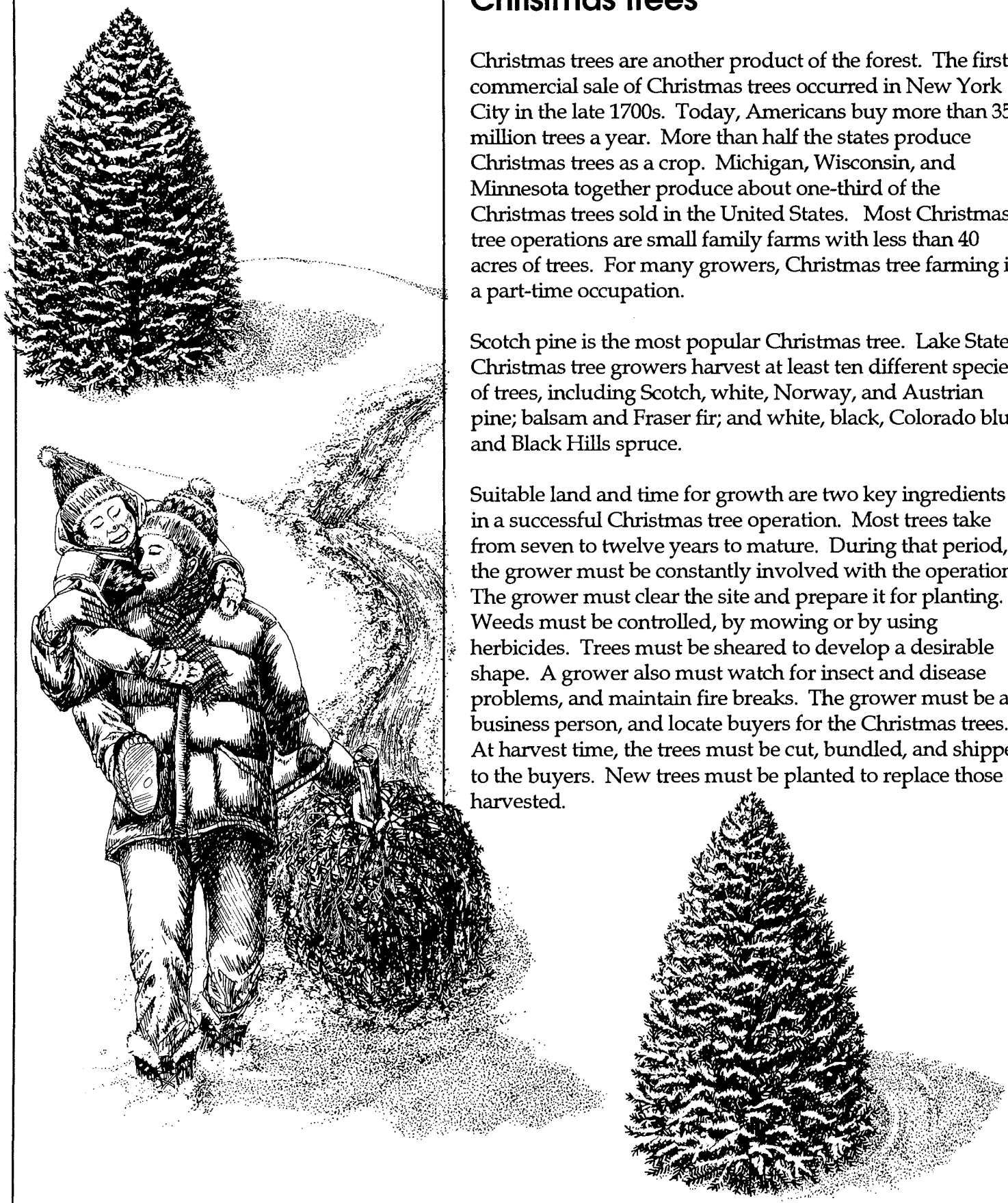
These are only a few of the many shapes wood takes as it is modified to meet our needs. Other wood products include posts, poles and pilings, mine timbers, railroad ties, shingles and shakes, cooperage, lath, matches, toothpicks, excelsior, and turpentine.

Christmas Trees

Christmas trees are another product of the forest. The first commercial sale of Christmas trees occurred in New York City in the late 1700s. Today, Americans buy more than 35 million trees a year. More than half the states produce Christmas trees as a crop. Michigan, Wisconsin, and Minnesota together produce about one-third of the Christmas trees sold in the United States. Most Christmas tree operations are small family farms with less than 40 acres of trees. For many growers, Christmas tree farming is a part-time occupation.

Scotch pine is the most popular Christmas tree. Lake States Christmas tree growers harvest at least ten different species of trees, including Scotch, white, Norway, and Austrian pine; balsam and Fraser fir; and white, black, Colorado blue, and Black Hills spruce.

Suitable land and time for growth are two key ingredients in a successful Christmas tree operation. Most trees take from seven to twelve years to mature. During that period, the grower must be constantly involved with the operation. The grower must clear the site and prepare it for planting. Weeds must be controlled, by mowing or by using herbicides. Trees must be sheared to develop a desirable shape. A grower also must watch for insect and disease problems, and maintain fire breaks. The grower must be a business person, and locate buyers for the Christmas trees. At harvest time, the trees must be cut, bundled, and shipped to the buyers. New trees must be planted to replace those harvested.



Sugar Maples: The Art of Making Maple Syrup

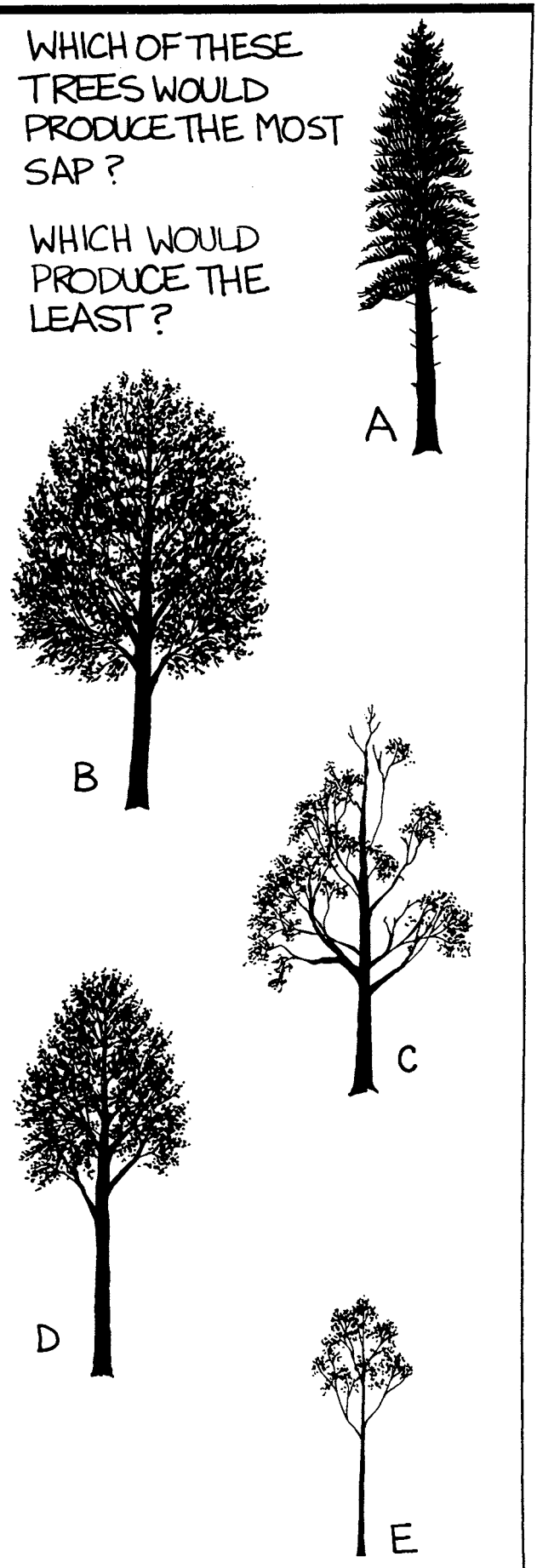
Maple syrup and maple sugar are strictly North American forest products, made from the sap of maple trees. Sugar maple provides three-quarters of the sap used. Hobbyists and syrupers also may use boxelder, black maple, and other maples to produce syrup, although these do not have as high a sugar content as the sugar maple. Sugar maples occur mainly in southeastern Canada and in the northeastern United States as far west as Minnesota. Quebec accounts for more than 75 percent of the world's supply of maple syrup products.

For many sugarbush (maple syrup operation) owners today, making maple syrup is a hobby; for others, syrup is a major cash crop. Since the maple syrup season occurs in late winter and early spring, it rarely competes with other farm work.

In the spring, a tree converts stored starch to sugar. The sap that is collected contains some of this sugar. The best sap flows, or "runs," occur in late winter and early spring when temperatures dip to below freezing at night and rise above freezing in the daytime. The best producing trees are those with the largest crowns.

A syruper taps a maple tree by inserting a spigot, or tap, into the wood. A bucket or bag is attached to this tap, and the sap drips out of the tree into the container. As the containers fill, they are collected and the sap is poured into a tank or other collecting device. (An alternate method for collecting sap is saplines, a series of tubes that run tree-to-tree and move sap downhill into a collector.) An evaporator or fire and trough is used to boil the sap, reducing water content and converting it to maple syrup. When it first comes from the tree, maple sap is a clear liquid with a faint, sweet taste. Heating produces chemical reactions that give maple syrup its special flavor and brown color.

The amount of sap needed to make a gallon of syrup varies with the sweetness (percent of sugar) of the sap. The sugar content of maple sap ranges from less than 1 percent to more than 10 percent, but averages 2 to 3 percent. For trees with a 2 percent sugar content, nearly 43 gallons of sap are needed to make 1 gallon of syrup! A taphole may yield about one quart of syrup each year.



Career Considerations

A wood scientist studies the structure and use of wood to improve wood products. A wood scientist may study how to dry wood to prevent warping and cracking; develop preservatives that protect wood from decay, insects, or fire; or develop a new process for converting wood into lumber, paper or plywood. A four-year college degree with a major in forest products or wood technology can help you enter this field.

EnviroQuotes

"Like winds and sunsets, wild things were taken for granted until progress began to do away with them. Now we face the question whether a still higher standard of living is worth its cost in things natural, wild and free. . . We of the minority see a law of diminishing returns in progress; our opponents do not." Aldo Leopold, from a foreword to *A Sand County Almanac: And Sketches Here and There.* Oxford University Press, Inc, 1977.

Tree-vial Pursuit

The typical consumer uses a 100-foot tree every year. If you are 18 years old, you've used up 18 such trees in your lifetime!

CHALLENGE!

Good morning! You are Globe Al Consumer, a typical student at Plasticside High. This morning an announcement on the radio informs you that, due to environmental considerations, the government has banned the use of all wood products.

"So what?" you yawn, as you get ready for school. You reach for your favorite banana yellow rayon shirt (the shirt manufacturer chose rayon because of its colorfast properties). But wait! Rayon is a wood product. So now you:

_____ put on your grey wool sweater with the ketchup stain.
_____ borrow a polyester blue flowered shirt from your big sister/brother
_____ decide to wear your white cotton pajama top (the one with the picture of the homeless puppy with the big brown eyes) to school.

Your clothing problem temporarily solved, you run to grab a bite of breakfast. But wait! Your breakfast cereal contains aspen particulate (the "fiber" part of the cereal). You choose instead:

_____ to eat that last bit of pineapple pizza from last night's dinner (but don't cut it on the countertop—the counter is a wood product).
_____ to eat the leftover chocolate cookies your little sister made (she accidentally used Worcestershire sauce instead of vanilla—which is a good thing, since artificial vanilla also is a wood product).
_____ to skip breakfast—after all, you'll have a 15-minute break in just six hours, and you probably can grab a pack of Cheezees—if the store still sells them (the packaging . . . yes, a wood product).

Your breakfast dilemma solved, you now face the big test: how to get to Plasticide High, four miles away, in less than two minutes (you overslept, and besides, there was that wood products thing to deal with). You:

_____ cross using your mom's Honda Prelude off the list, since rayon, a wood product, lines the radial steel tires.
_____ give up on the thought of taking the bus, because your bus pass is paper.
_____ start walking. But avoid the roads and walkways. They contain particulate wood products (in the portland cement).

Yearning to Learn . . .

Additional Activities

In the following activities, remember the basic rules of conservation. Do not damage or destroy the plants and animals you are studying. Leave all ecosystems unchanged. Have a positive impact on the forest.

Visit an active timber harvesting operation in your area. (Make sure you get permission from the logger in advance and be sure to wear a hard hat). Take some pictures of the harvesting activities. Report on what you saw and show the pictures at the next project or club meeting.

List the items in your home that come from the forest. List them under headings of Solid Wood Products (lumber, furniture, plywood, fuelwood, posts, etc.), Wood Fiber Products (paper, fiber/particleboard, cardboard, etc.), and Miscellaneous Products (maple syrup, turpentine, fruits, nuts, etc.)

Visit a sawmill, paper mill, plywood plant, or other wood product plant. Write a brief report on your visit and present it to your club. Describe the different machines you saw, how they worked, and what type of trees were used.

Visit a Christmas tree farm and interview the owner. Questions could include:

- What type of trees do you grow?
- How many years does it take before the trees can be harvested?
- What is your biggest insect/disease/pest problem?
- How do you market your trees?

Write an article about your visit, including quotes from the interview. Submit this article to your school or town newspaper.

Demonstrate planting, shearing, or other Christmas tree maintenance operations at your 4-H meeting. Or, work in a retail lot or on a cut-your-own Christmas tree farm. Report your activities to your club.

Visit a local maple syrup operation. After your visit, write a brief description of the operation, including the number of taps used and where the syrup is sold.

For more information see:

Homemade Maple Syrup
CD-FS-1067
Available from:
Minnesota Extension Service
Distribution Center
For ordering information, call:
(612) 625-8173

Tap a maple tree and make syrup on your own. You may have a suitable tree in your yard or you may know relatives or friends who own a small woodlot. Using photographs or a model, demonstrate the project, start to finish. Be sure to include a small sample of the syrup with your fair entry.

Addresses

Minnesota Christmas Tree
Growers Association
P.O. Box 124
Osseo, MN 55369

Minnesota Forest Industries
208 Phoenix Building
Duluth, MN 55802

Minnesota Maple Syrup
Producers Assn.
Route 1, Box 132
Randall, MN 56475

Forest Products Extension
204 Kaufert Lab, U of M
St. Paul, MN 55108

Forest Resources Extension
University of Minnesota
102 Green Hall
St. Paul, MN 55108

Minnesota DNR - Div. of Forestry
500 Lafayette Road
St. Paul, MN 55155

Answers to Wood Products Quiz:

All of the items are wood products.

Answers to Sugar Maple Quiz:

Answers, Page 43

Most sap: B
Least sap: E or A, which is a conifer

Exhibits/Fair Projects

Take pictures of active harvesting operations (felling, skidding, limbing, bucking, etc). Mount your pictures on a three-sided display using the correct sequence of events. Find out from the loggers what type of product will be made from the harvested trees and include a picture of this end product.

Visit a wood processing plant (sawmill, paper mill, etc.) and take pictures (if allowed) or sketch the process. Or, build a model of machinery used in a primary or secondary process. Mount pictures on a three-sided display board, or build the model on a plywood or other sturdy base. Be sure to include appropriate labels.

Using one tree species, make a display that explains uses of the species' wood. Describe at least three products. Include a photograph of your chosen tree along with a leaf, twig, and cone or fruit (seed).

Collect samples of wood from at least ten different tree species in your area. Each sample should be a straight section of a branch at least 1-1/2 inches in diameter and 7 inches long and should include the bark. Polish the cut surface with sandpaper, and apply several coats of linseed oil or varnish. Mount the wood samples on a piece of plywood or lumber. (Insert two wood screws from the back to attach each sample.) Beneath each specimen, write or type the name of the sample and at least two uses.

Collect twigs from seven tree species used as Christmas trees in Minnesota. Prepare a display with these samples (properly identified) and a photograph of each tree.

Visit an active Christmas tree farm and talk with the owner (you may volunteer to help with the operation). Prepare a display or book of photographs showing important operations in Christmas tree production (planting, shearing, protecting from insects, harvesting, and marketing).

Set up a display using photographs or models of a commercial maple syrup operation, from tapping the trees to packaging the finished product. For contrast, show a hobbyist's operation or historical perspective methods of making maple syrup.

Chapter 6

SPECIALIZED WOODLANDS

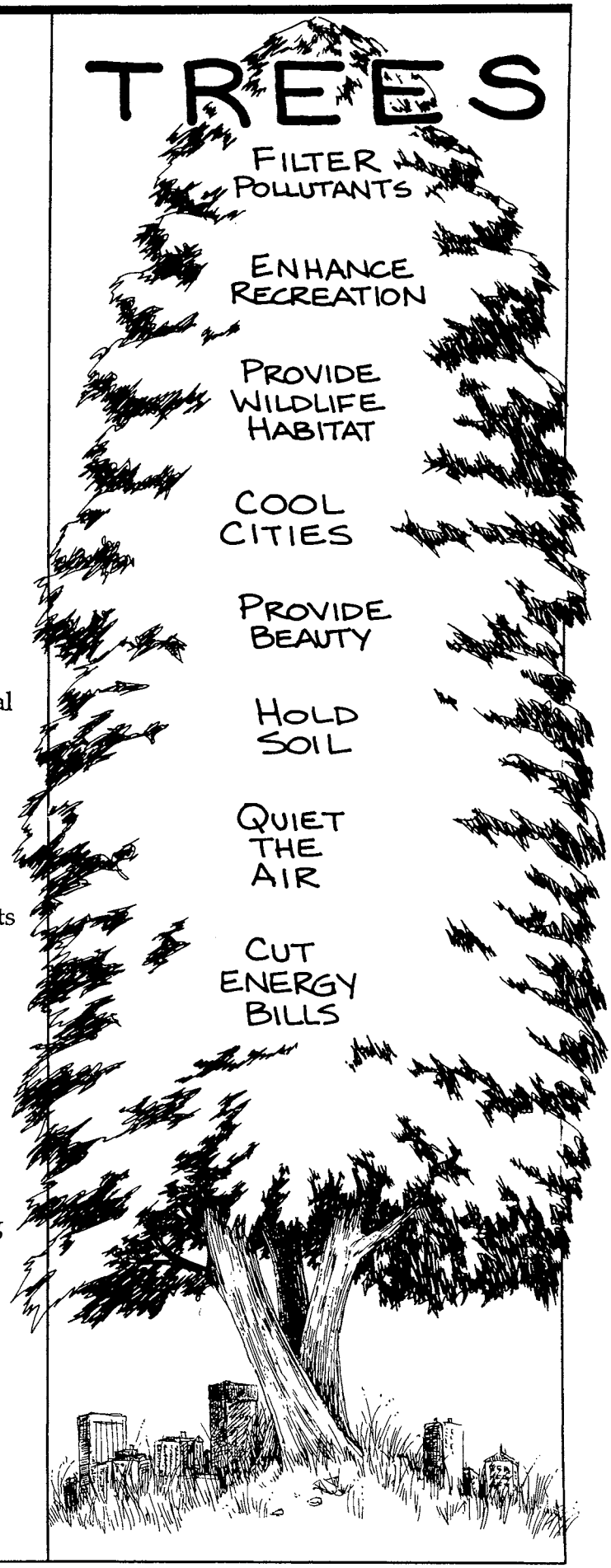
(Windbreaks and Shelterbelts, Urban Forestry)

City Trees, Rural Trees

The practice of forestry is not limited to the old oaks of Nerstrand woods or to huge stands of trembling aspen. Trees are all around us. Forest management is practiced in a single backyard as well as on several hundred acres. Small areas of trees grown for specific purposes, such as urban forests and rural windbreaks and shelterbelts, are called specialized woodlands. Such areas are managed even more intensively than many large woodlands. Rural landowners plant windbreaks and shelterbelts carefully. In cities, individual trees tend to have a higher value, both economic and aesthetic, making them "worth" special attention.

Field Windbreaks and Farmstead Shelterbelts
European settlers introduced windbreaks and shelterbelts to the Great Plains more than a century ago. The settlers were uncomfortable with the vast, treeless expanses of the plains and hoped to break the monotony by moving saplings from river bottoms to their homesteads.

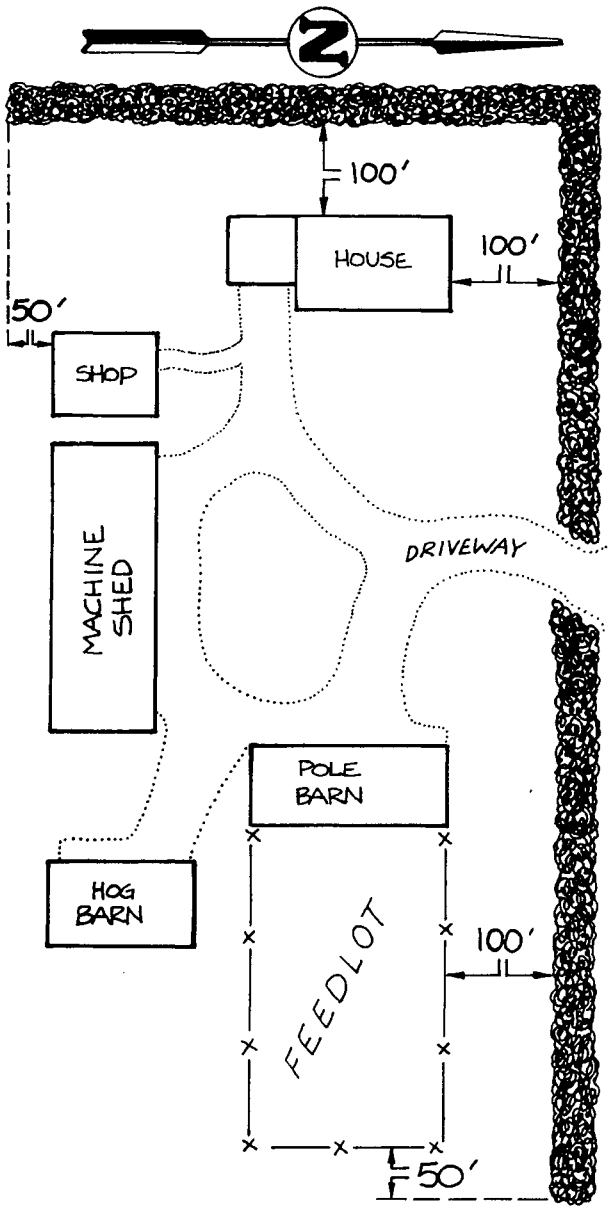
Besides enhancing the visual landscape, shelterbelts and windbreaks also decrease wind speed. A **field windbreak** is used to decrease the wind speed across a farm field. This reduces soil erosion and increases the uniformity of snow distribution over the field, providing uniform soil moisture for crops in the spring and summer. Farmstead shelterbelts reduce wind speed around farm buildings and homes. In the winter a shelterbelt can reduce home heating costs and control drifting snow. In summer, shelterbelts serve as a source of cool shade. They also filter dust from the air and reduce noise from traffic and farm machinery. In any season, shelterbelts, like windbreaks, create wildlife habitat.



For more information, see:

Field Windbreaks,
NR-FO-0824

Farmstead Shelterbelts,
NR-BU-0468
Available from:
Minnesota Extension Service
Distribution Center
For ordering information, call:
(612) 625-8173.



Windbreaks and shelterbelts usually are planted in the wide open agricultural areas that once were prairies. These areas usually have hot, dry summers, cold winters, and strong winds. Species used for windbreaks and shelterbelts should be able to grow in areas of relatively low rainfall and should be able to resist insects and diseases. They should have crowns that are fairly narrow and moderately dense.

Field Windbreaks

Field windbreaks usually are a single row of trees. To be most effective, windbreaks should be planted perpendicular to prevailing winter winds. They substantially reduce wind speed for a distance equal to about 15 times their height on the leeward side. If one tree row is not sufficient to protect an entire field, additional tree rows should be planted across a field at distances of 15 to 20 times the expected mature height of the trees.

Hardwood trees usually are recommended for windbreaks. Species with dense crowns and widely spreading branches, such as Siberian elm, need to be spaced 15 to 20 feet apart. Other species, such as ash, have narrow crowns, and should be spaced 10 to 12 feet apart.

Farmstead Shelterbelts

A farmstead shelterbelt is made up of several rows of trees and shrubs to maximize wind protection. An effective shelterbelt might include one row of shrubs, three rows of hardwoods, and three or four rows of conifers. The number of rows, however, depends partly on available space.

A shrub row is very effective at catching snow. If planted too close to other tree rows, the shrubs will cause snow to accumulate in the tree rows, breaking branches from the trees. A shrub row should be planted about 70 feet from trees on the windward side of the shelterbelt, or 20 to 30 feet from trees on the leeward side.

Urban Forestry

Community forests include the trees that grace the streets, parks, open spaces, and yards of cities, towns, and villages. Sometimes it's strange to think of trees in a city as part of a forest. Still, the vegetation and wildlife found in a town or city are part of a complex forest ecosystem. Management of this forest is the role of urban foresters.

Urban forestry includes:

- designing and establishing tree plantings;
- protecting and maintaining trees;
- removing unwanted trees; and
- encouraging use and enjoyment of the urban forest.

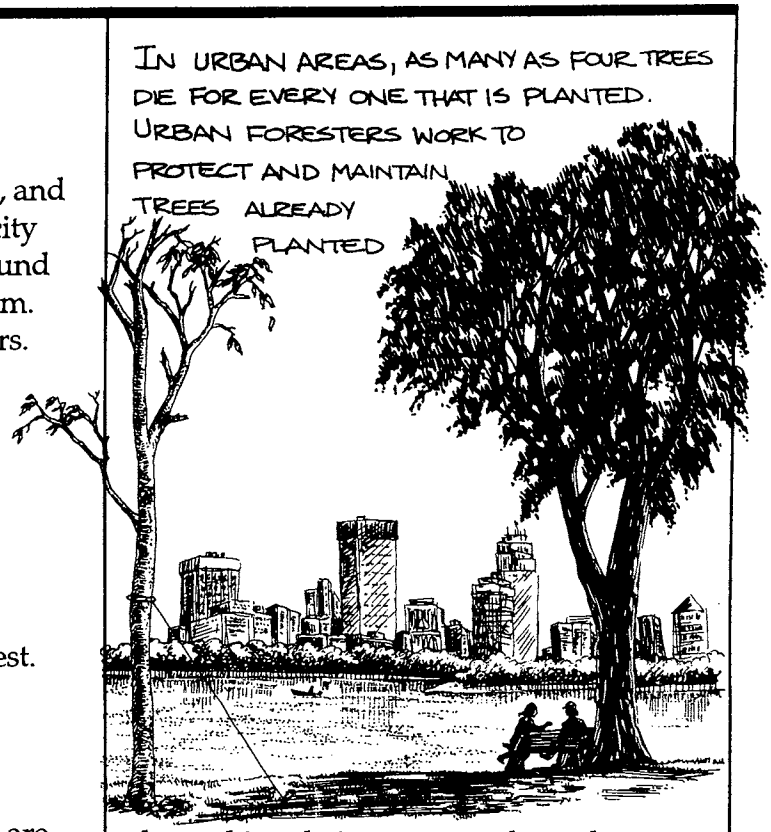
Tree Benefits

The bright yellow leaves of the sunburst honeylocust are more than just a pretty face on an urban street. These leaves, as well as the entire tree, are hard at work, providing the city with a wide range of benefits.

Trees play an important role in modifying **temperature** in cities. Cities usually are a few degrees warmer than rural areas. Trees lower summer temperatures by intercepting, reflecting, and absorbing energy from the sun—in simple terms, trees provide shade. Tree leaves also serve as tiny air conditioners by giving off moisture that absorbs heat. Trees obstruct, guide, and deflect **wind** in urban areas. Trees planted next to a home create a dead-air space next to walls. This space acts as additional insulation, decreasing heat loss from the building in winter and so reducing energy use.

Trees help control **soil erosion** in cities by reducing the amount and force of rainfall reaching the ground. Tree litter also helps reduce the surface flow of water that can carry away soil particles. Tree roots hold soil particles together, reducing erosion.

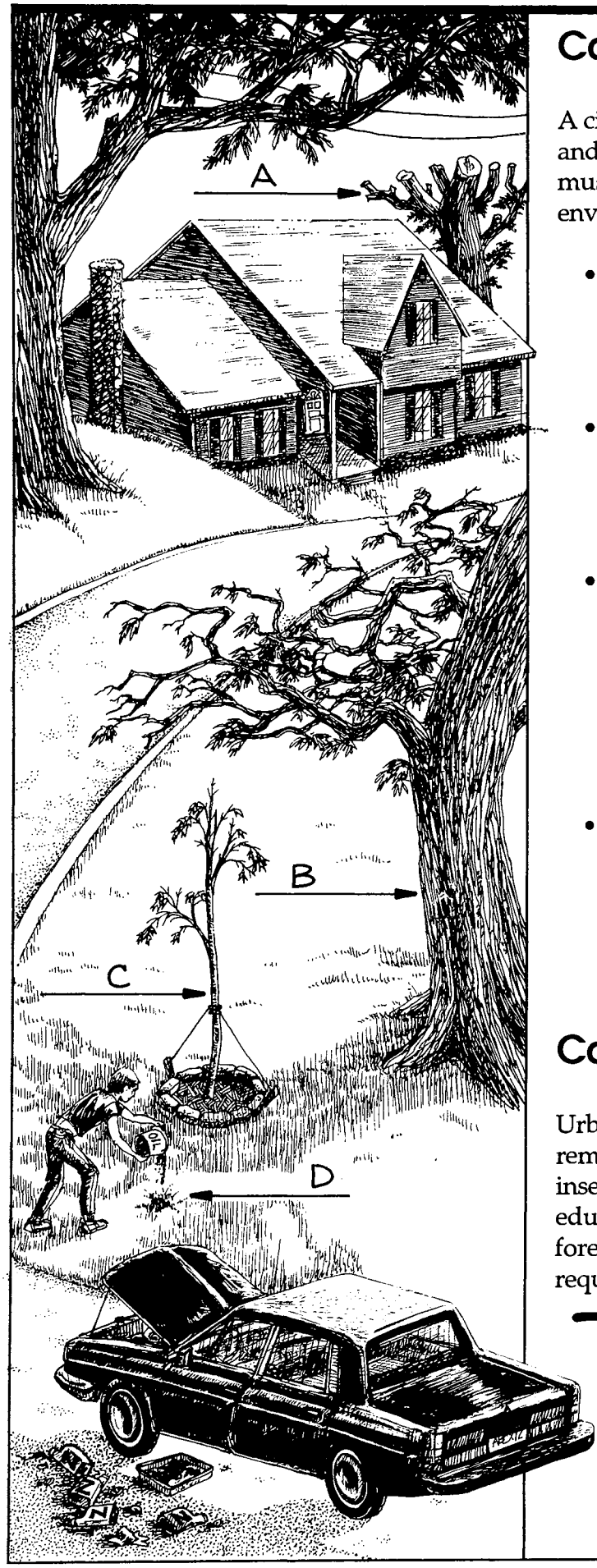
Trees and shrubs (especially when planted in rows or as hedges) reduce the amount of **noise** that reaches a person's ear by absorbing, deflecting, and scattering sound waves. Trees also help mask undesirable sounds by making their own sounds, such as whispering and rustling leaves.



Trees absorb certain gaseous **pollutants**, including ozone. They also reduce particulate pollutants and dust by trapping them on leaves, stems, and branches. Rain eventually washes these particles from the tree surfaces. Trees also can make a city smell better—their foliage or flowers often are fragrant.

Many people who live in the city depend on natural areas for **recreation**. City parks are great for walking, skiing, jogging, and bicycling. Trees also provide homes for **wildlife**. Squirrels, blue jays, wood ducks, moles, and even bats all use trees for their habitat.

One of the most important roles of trees in urban environments is **beautification**. Trees improve the appearance of city buildings and private lots. Homes with healthy trees in their yards generally have a higher value than homes without trees.



Caution: Slow Growth Ahead

A city can be a stressful place for trees. The concrete, granite and glass environment is different from a forest. City trees must be fairly hardy to withstand the onslaught of urban environmental problems, such as:

- **Space limitations.** City trees generally have a limited amount of space in which to grow. Streets, sidewalks, buildings, underground utilities, and overhead wires often interfere with tree development.

- **Poor soils.** Urban soils often are drastically different from those in a forest. They often are compacted and have poor aeration (insufficient oxygen). Necessary nutrients often are scarce in these soils.

- **Pollution.** Pollution is more acute in an urban environment. Automobiles are a principal source of air pollutants, but other sources such as factories also cause pollution problems. Casual use of **herbicides** (chemicals used to kill plants) can poison or damage trees. Salts used to keep roads free of ice can damage the plants lining those roads.

- **People pressures.** People also can hurt trees by compacting their soil and digging around roots. This is especially a problem during construction. A tree's bark and cambium can be harmed when people mow too closely to the trunk or carve initials on it. Trees also are frequent targets for cars careening out of control!

Career Considerations

Urban foresters oversee the planting, maintenance, and removal of urban trees. They design landscapes, identify insect and disease problems, and work constantly to educate people about trees. A four-year college degree in forestry with special coursework in urban forestry is usually required for entry into the field.

Trees at Risk

A. Topped Trees

B. Construction Damaged Trees

C. Drought Stressed Transplants

D. Trees Exposed to Hazardous Waste

EnviroQuotes

"(Song) birds serve as indicators of environmental health, and when our forests can no longer sustain them, something is obviously wrong." Dr. David Wilcove, writing in *The Nature Conservancy Magazine*, January/February 1990.

Tree-vial Pursuit

Twenty large city shade trees are needed to offset the noxious emissions generated by an auto driven 60 miles in one day.

CHALLENGE!

You are Sub Herbs, the proud owner of a quarter-acre wooded lot in a new housing development. You are eager to start construction on your dream home, a brick-faced rambler complete with a hot tub and kitchen recycling center.

You chose this property originally because of the large red oaks and smaller maples on the site. You decided it was time to get back to nature, and have carefully designed the master bedroom balcony to face the maples.

After hasty consideration, you pick a construction firm to build your house. Will Gitcha and Associates come recommended by your brother-in-law, and since they are listed in the phone book, you assume they are reputable. Their prices seem very reasonable, also.

Twelve months later, after many delays, you home is completed. You notice right away that leaves are turning brown on two or three oaks in the front yard (it's only mid-July), and several other oaks have been removed by the contractor's bulldozer. Four of the remaining oaks have bark/cambium damage from machinery banging against them. One majestic oak now has four feet of new fill burying part of its trunk. Most of the maples in the backyard have been bulldozed, and the remaining two have been damaged by the bulldozer. One of these is leaning at a 90-degree angle.

List the possible disease and damage problems (by species) present in your trees.

_____

_____

_____

What amount of further mortality can you expect among your trees in the future?

_____

_____

_____

What could you have done before home construction started to insure the survival of your trees?

_____

_____

_____

Yearning to Learn . . .

Additional Activities

In the following activities, remember the basic rules of conservation. Do not damage or destroy the plants and animals you are studying. Leave all ecosystems unchanged. Have a positive impact on the forest.

Observe wildlife use in a shelterbelt. Establish two sheltered, camouflaged locations from which you can observe wildlife that may use the shelterbelt. Make at least two, two-hour observations per month at each location for three consecutive months. Take photographs or find pictures of the wildlife you see. Note what the animals are doing. Make a display of your information.

Plant and care for a tree in your yard. Prepare a tree diary. Include the species, the date planted, how you chose the location, and photographs of the planting process and of the tree during different seasons of the year. Include significant events in your tree's life such as wildlife use and the date leaves began to change color.

Exhibits/Fair Projects

Construct a model of a farmstead shelterbelt. Use natural materials to symbolize trees and shrubs (e.g., pine cones, moss, twigs). Make sure you note the spacings used in your rows and the distance between the shelterbelt and other structures on the farmstead.

Using drawings and/or photographs, prepare a three-sided display showing the correct way to plant and care for city trees. Be able to explain your drawings and photos.

Draw a picture to scale of a local area such as a schoolyard or street. Sketch in existing trees and shrubs, specifying the species of each. Also sketch in trees and shrubs you would add. On the back of your sketches, explain your choices of plants and their locations.

Inventory the trees on a neighborhood street (at least two blocks) or in a park. List the species and the number of trees of each. Note the number of trees of each species that appear to be healthy and unhealthy and describe any maintenance needed. Include one photograph or drawing of each species with your display.

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