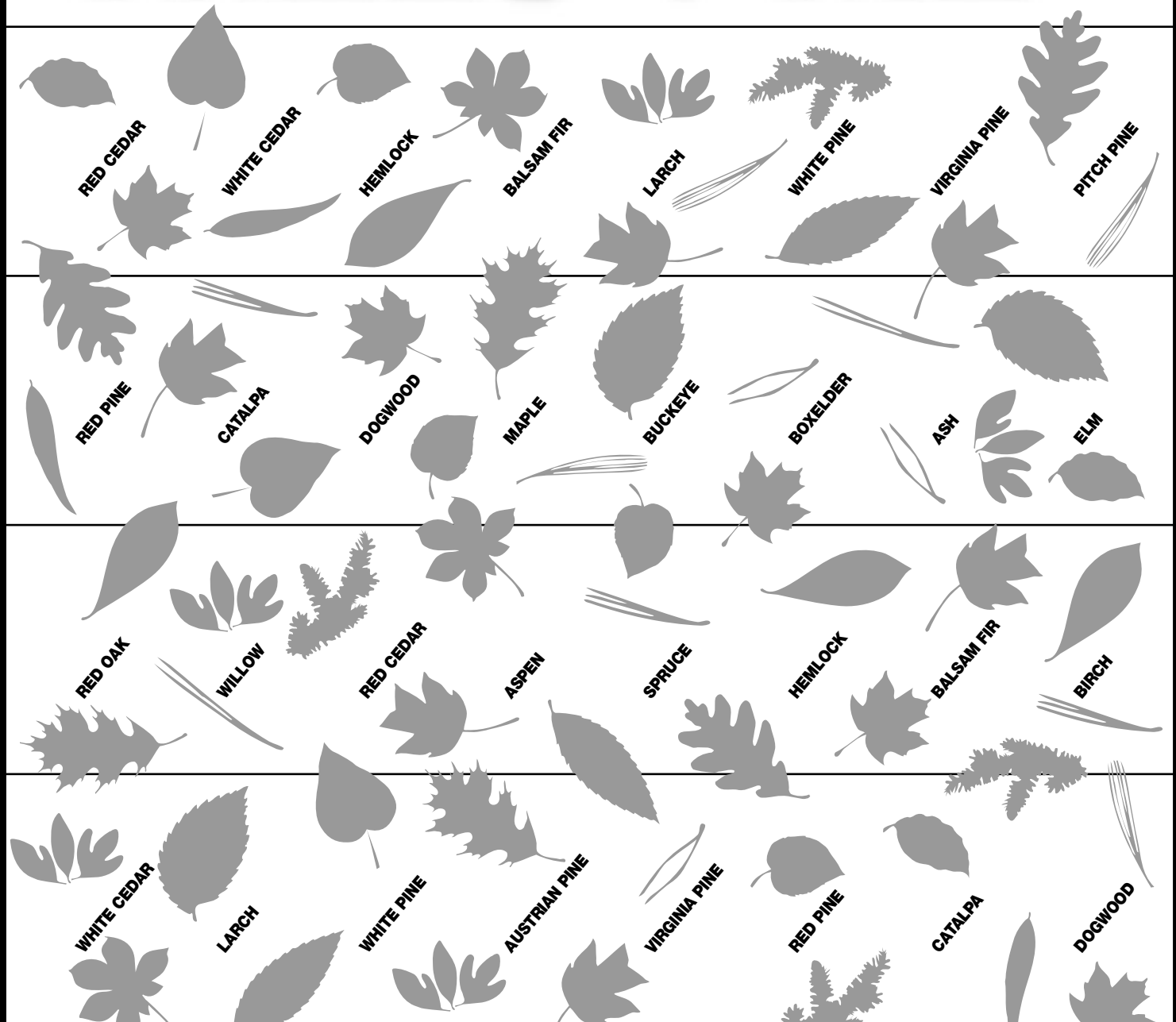


TREES + ME =



FORESTRY



18 U.S.C. 707

Adapted for use in Pennsylvania by
Robert S. Hansen, extension forester in Bradford County, and
James C. Finley, assistant professor of forest resources.

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THE LIFE OF A TREE

Seeds and Tree Growth

A NEW BEGINNING

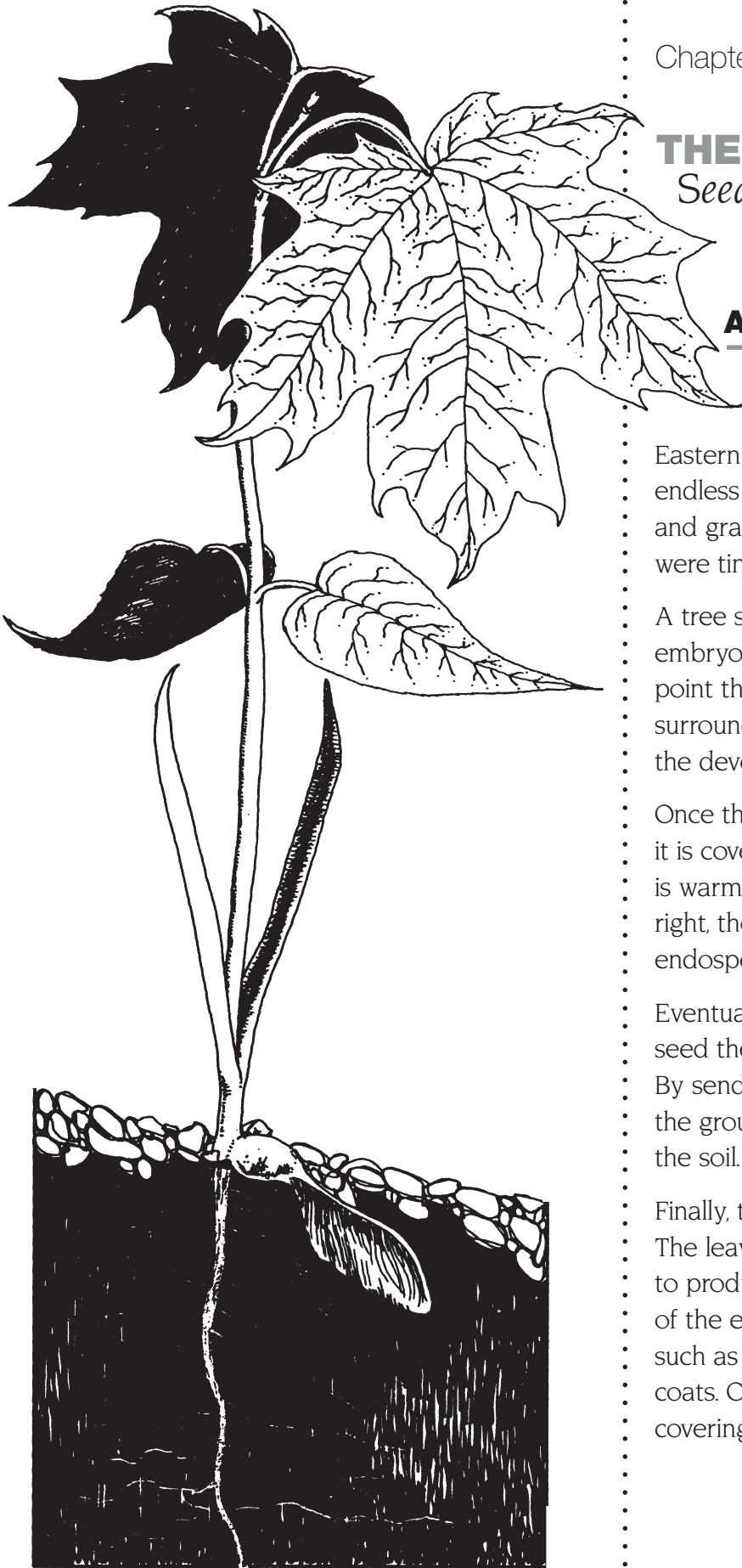
In the woods called "Hearts Content" in the Allegheny National Forest, a grove of Eastern hemlock stands silent, embracing the endless blue sky of an August day. They are old and grand now. But once, years ago, these giants were tiny seeds.

A tree seed contains an embryo (baby) tree. This embryo already has tiny leaves, a stem, and a point that will become a root. The embryo is surrounded by **endosperm**—the food supply for the developing tree.

Once the seed falls from the tree to the ground, it is covered by leaves and soil. When the ground is warm enough and other conditions are just right, the seed begins to grow, using the endosperm for food.

Eventually, the endosperm is consumed. The seed then must seek other sources of nutrients. By sending out a root, the seed anchors itself to the ground and draws water and nutrients from the soil.

Finally, the tiny tree emerges from the ground. The leaves appear. They enable the growing tree to produce its own food. The shell, or **seed coat**, of the embryo tree then falls off. Some seeds, such as acorns, have tough, protective seed coats. Other seeds, such as maple, have light coverings.



Seeds are scattered in many different ways.

Animals eat seed-bearing fruit and then deposit the seeds on the soil in their scat. Wind carries winged and other light seeds. Sticky seeds often cling to an animal's fur (or your sweater!) and ride along to a new location. Lakes and streams give some seeds a "boat ride" to new areas. And, of course, gravity pulls seeds from the trees, giving them a long ride downhill to a new home.

The shaggy, spreading silver maple drops seeds onto the soil in the early summer. These seeds are already mature. They start to germinate, or grow, shortly after they hit the ground. The nut-bearing black walnut, on the other hand, drops its seeds in the fall. These seeds are **dormant**, and will not germinate until the spring. Dormant seeds must go through a cold spell before they germinate. In nature, winter provides this cold treatment.



Some seeds must be softened before they will germinate. Their tough seed coat can be softened by the digestive systems of animals, such as birds or cattle that eat the seed.

For example, grouse eat juniper berries and then disperse the seeds in their droppings.

Seeds from most tree species germinate best on bare mineral soil, which has the moisture that they need. Seeds germinating on leaf litter (leaves scattered on the forest floor) often die for lack of water. Their roots cannot penetrate dry litter to reach the moist soil.



SEED SHUFFLE

Seeds are useful not only for reproducing trees, but also as sources of food for people and animals such as bears, squirrels, and songbirds.

Unscramble the letters below to identify the seed products and write them on the lines.

wasltnu _____

Popular for baking; unique flavor

bnecrierars _____

Grows in bogs; used in holiday baking

carnos _____

Made into flour by American Indians

uconoct _____

Grows in the tropics; seed is big and edible

ureiserbelb _____

Bears love these; they make great muffins!

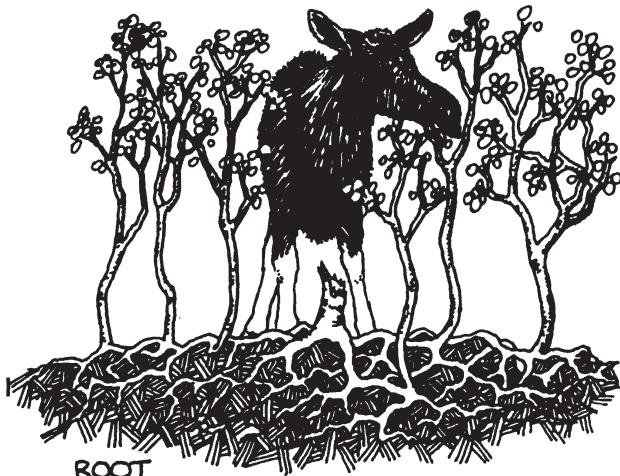
zetushanl _____

Grows on shrubs; squirrels love them.





STUMP SPROUTS



ROOT SUCKERS



LAYERING

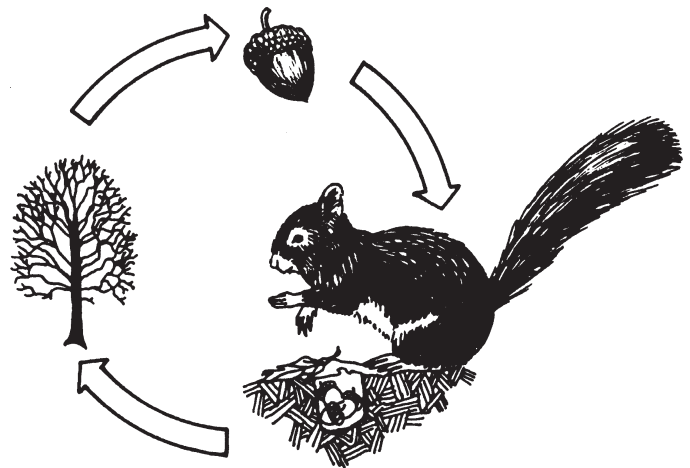
A NEW BEGINNING, PART II

Many trees get their start in life as seeds. But not all! Did you know there are other ways that trees can reproduce?

Stump sprouts develop from the stump of a recently cut tree. They commonly grow from the stumps of deciduous trees such as oak, basswood, red maple, and willow.

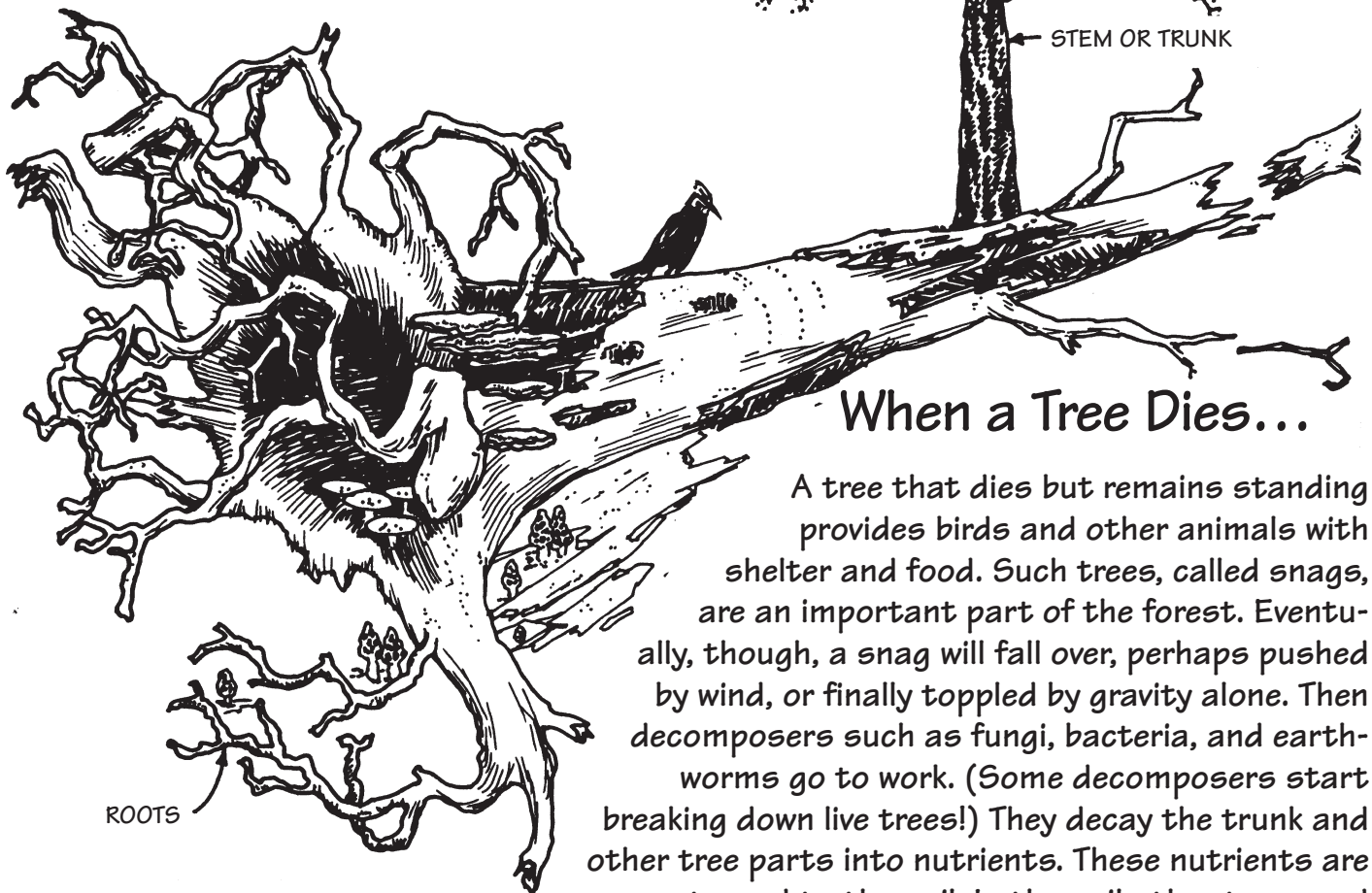
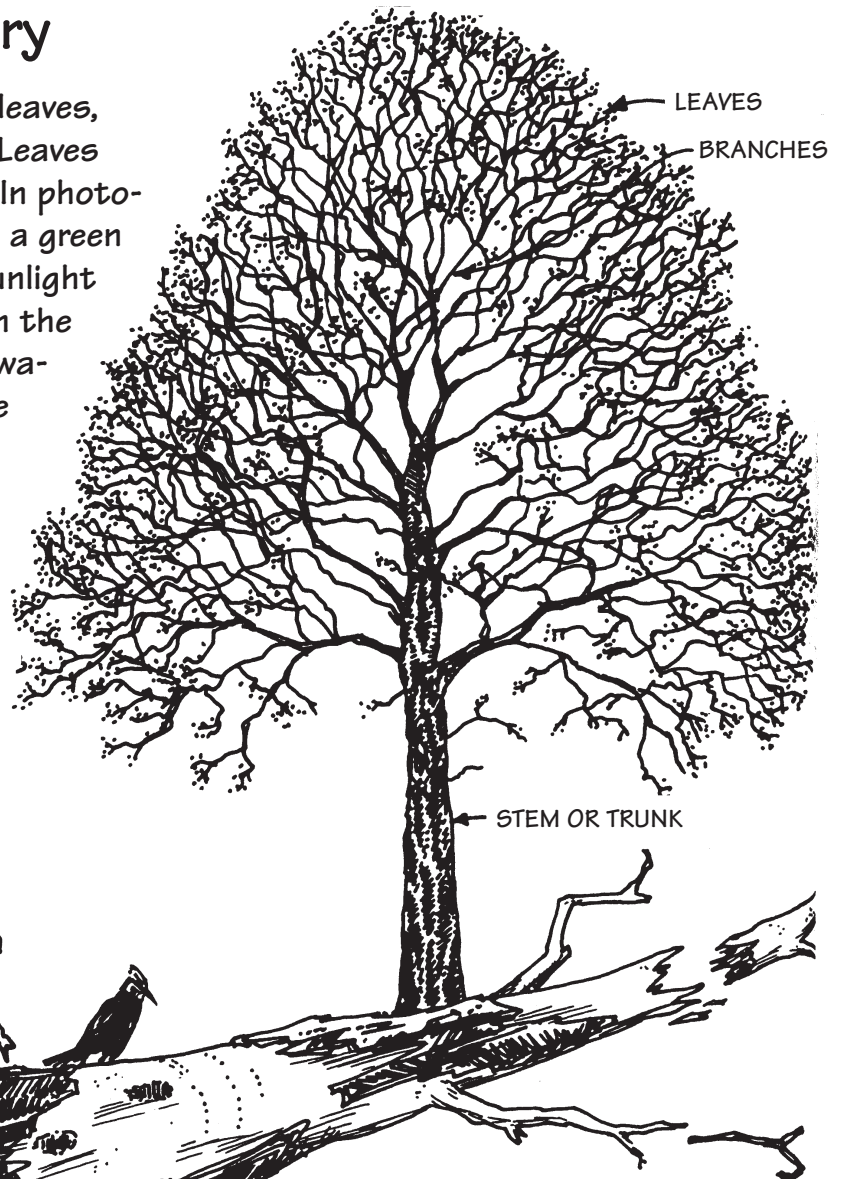
Root suckers are new shoots that develop from special buds on the roots of a few species of trees. Aspen trees grow from root suckers after the parent tree has been harvested. Root suckers grow very fast.

Layering occurs when the branch of a living tree touches the ground, becomes covered by leaf litter or soil, and takes root. A new tree is created at this junction. Northern white-cedar is one tree that can reproduce by layering.



The Forest Food Factory

A growing tree has four main parts: leaves, branches, stem or trunk, and roots. Leaves make food through photosynthesis. In photosynthesis, chlorophyll (say kloro fill), a green molecule found in the leaves, uses sunlight energy to remove carbon dioxide from the air. The carbon dioxide is mixed with water from the soil to create sugar. The tree uses this sugar as food. The roots anchor the tree and absorb water and minerals needed by the leaves. The stem and branches also carry water and minerals to the leaves. They also carry manufactured sugar from the leaves to the roots and other parts of the tree.



When a Tree Dies...

A tree that dies but remains standing provides birds and other animals with shelter and food. Such trees, called snags, are an important part of the forest. Eventually, though, a snag will fall over, perhaps pushed by wind, or finally toppled by gravity alone. Then decomposers such as fungi, bacteria, and earthworms go to work. (Some decomposers start breaking down live trees!) They decay the trunk and other tree parts into nutrients. These nutrients are returned to the soil. In the soil other trees and plants can use these nutrients again. Nature is the ultimate recycler.

Growing...Growing...Grown!

We have looked at several ways in which a mighty tree starts its life. But how does a tree grow from a tiny shoot into a forest giant?

Trees undergo three different kinds of growth:

- height
- diameter
- root

Height Growth

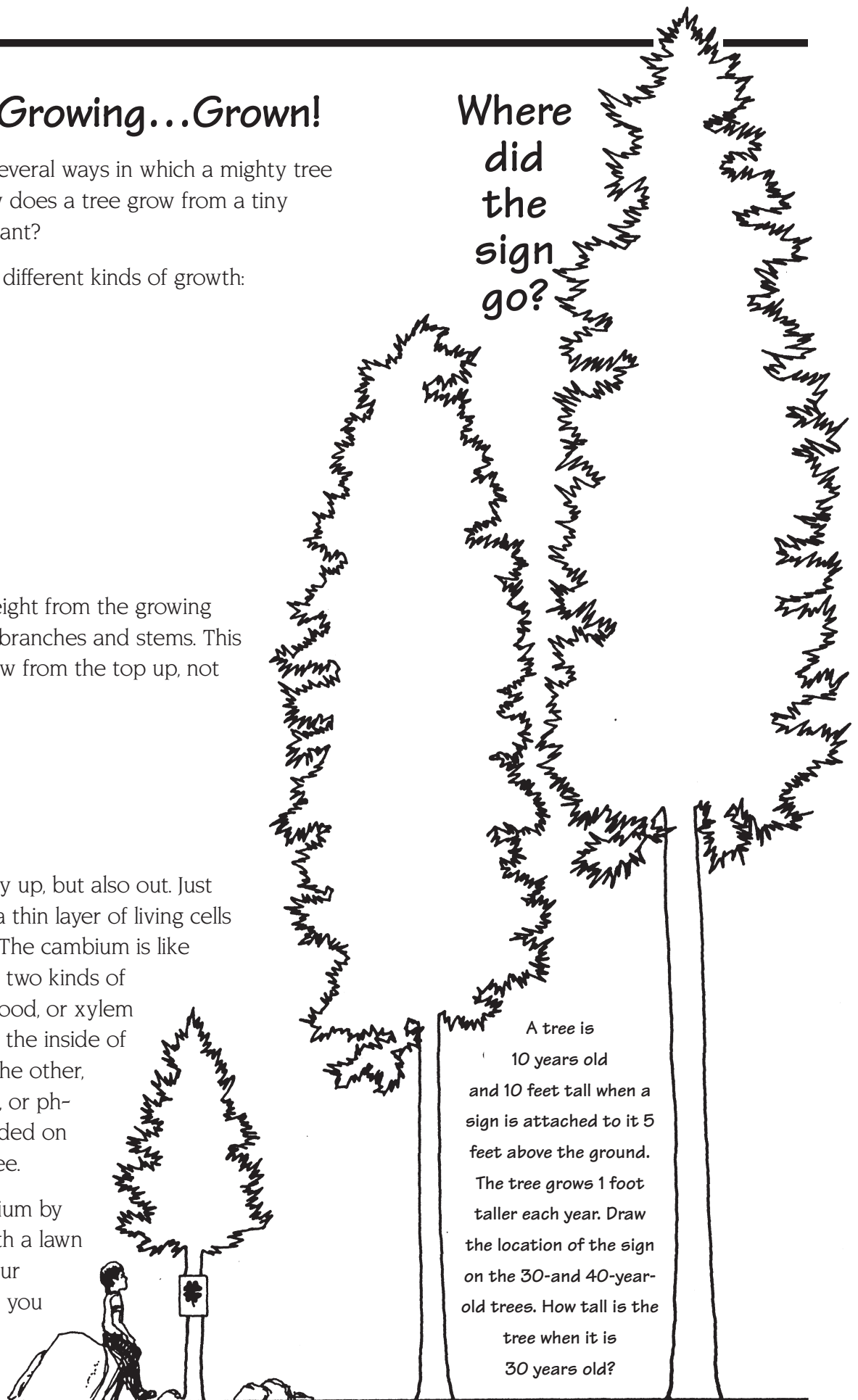
A tree expands in height from the growing points at the end of branches and stems. This means that trees grow from the top up, not from the ground up.

Diameter Growth

A tree grows not only up, but also out. Just beneath the bark is a thin layer of living cells called the cambium. The cambium is like a factory that makes two kinds of products. One, the wood, or xylem (zi-lem), is formed on the inside of the cambium layer. The other, called the inner bark, or phloem (flow-em), is added on the outside of the tree.

If you hurt the cambium by bumping the tree with a lawn mower or carving your initials into the trunk, you damage the tree's factory.

Where
did
the
sign
go?



Root Growth

Roots expand in diameter from a cambium layer also. They grow longer from their tips, just like branches and main stems do. The major difference is that roots grow down instead of up.

THE HEART OF THE STORY

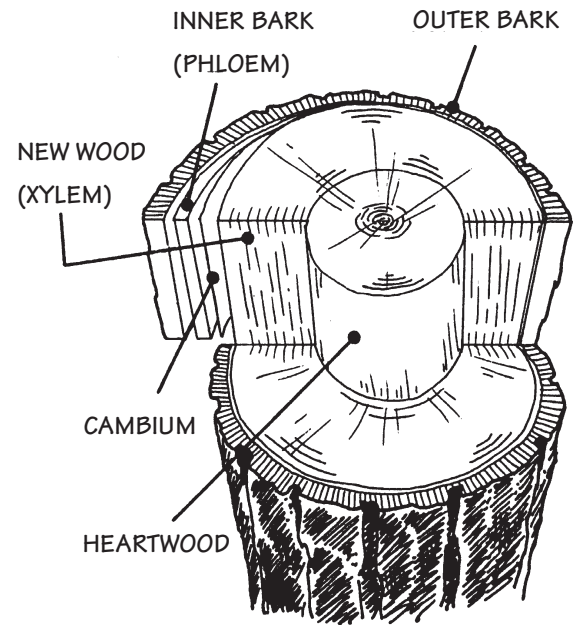
Outer bark is the “skin” of the tree. Outer bark does several things. It protects the tree from injury. The bark is a barrier to insects and diseases. It also insulates the tree from winter cold and summer heat.

Inner bark (phloem) has tubes through which food travels from the leaves down to the branches, stem, and roots. When phloem cells die, they become part of the outer bark.

New wood (xylem) carries minerals dissolved in water upward from the roots.

A **cambium** cell layer is wrapped around the wood. It makes new bark (phloem) and new wood (xylem) every year.

Heartwood is the backbone of the tree. Heartwood is not living wood. It supports the tree. It also is the place where many waste products from the tree collect.



QUIZ FOR THE REAL WHIZZES

Fill in the blanks below using the words at the end. Whiz through this!

1. Seeds that go through a period of cold before they germinate are called _____.
2. _____ is a thin layer of growing cells between the inner bark and new wood.
3. _____ is the conversion of water and carbon dioxide into a sugar.
4. The _____ support the tree's crown and serve as a transport line for sugar and water.
5. When a seed _____, it starts growing.
6. The cambium produces _____ and _____.
7. Dark, narrow rings of wood are called _____.
8. The _____ anchor the tree and absorb water and minerals from the soil.
9. _____ are the food factories in a tree.
10. Light, wide rings of wood are called _____.
11. _____ is a green material in leaves that is used to make sugar.

cambium

chlorophyll

dormant

germinates

leaves

phloem

photosynthesis

roots

springwood

stem and branches

summerwood

xylem

DIARY OF A PAPER BIRCH

I am a paper birch. The drawing on the next page shows a cross section of my trunk. Throughout the spring and summer, I add new layers of wood to my trunk. The wood I make in spring (**springwood**) grows very fast, and is lighter colored because the cells are large. The wood I make in the summer (**summerwood**) grows much more slowly, and the wood is dark because the cells are small. Each year's growth of light and dark wood is called an **annual ring**. Count my dark rings, and you will know my age. If you study my annual rings closely, you can learn my life story.

At 16 years of age, I was growing fast. That year I got lots of sunlight and plenty of rain. That year, the trunk of another tree leaned against me, tilting me at an angle. In order to stand upright again, I made my rings wider on the lower side. This extra growth, called **reaction wood**, helped me to balance myself.

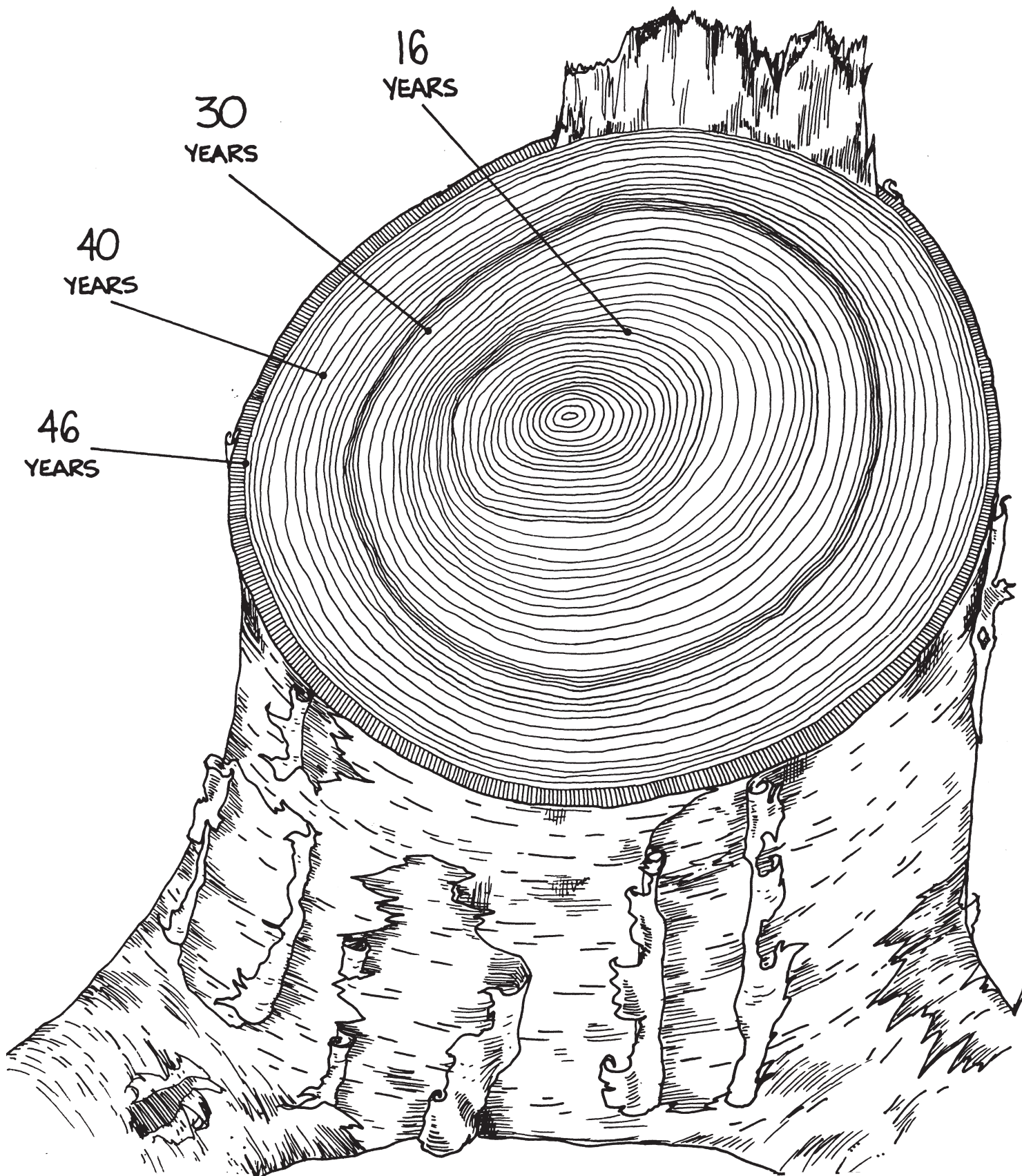
When I was 30 years old, a terrible drought hit this forest. It lasted four years. I grew very slowly in those years, so my rings are very narrow. I thought I would soon be food for the decomposers, but I managed to survive.

At age 40, the forest had thinned from the last drought, so I had room to grow again. I didn't have to compete with so many other trees for sun, water, and nutrients.

Now I am 46, and quite naturally my growth is slowing a bit. I have enjoyed my life in the forest. I enjoy watching all the changes.

My scientific name is:

Betula papyrifera



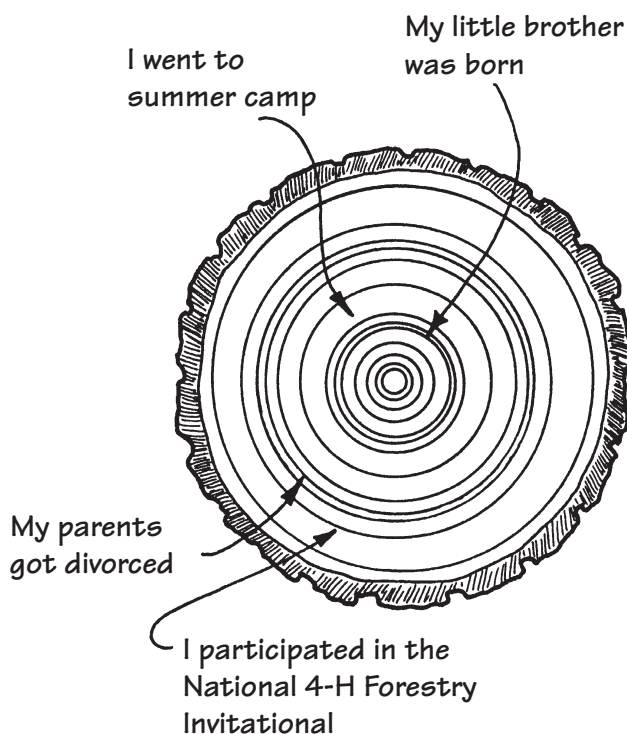


CAREER CONSIDERATIONS

A wood scientist develops useful products from wood. These scientists may work in laboratories of private industries, universities, or governmental agencies. To become a wood scientist, you may start at a university or college in the department of wood products. Scientists are like sleuths. They look for clues that no one else can see!

LEAVE THE ANSWER TO ME

Trees' annual rings show what their growing conditions were like. Pretend that you have annual rings. Draw your own life story. Which years did you have wide rings (good growing conditions)? Did you have any narrow rings? Here's an example for you?



TREE-VIAL PURSUIT

Do you know how leaves change color? The bright, clear days of autumn trigger leaves to produce large amounts of sugar. The cool nights slow down the movement of the sugar, trapping it in the leaves.

Sugar kept in the leaves causes an increase in the production of certain chemicals that cause bright coloration. At the same time, the production of chlorophyll, which is green, drops.

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 animal homes unchanged. Have a positive impact on the forest.

Collect and germinate seeds from a tree in your neighborhood. The kind of seed you should use depends on the time of year.

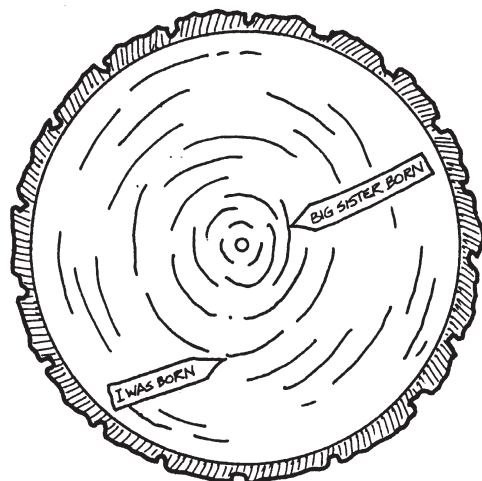
In the spring you will have the best luck with elm, red maple, or silver maple seeds. Plant these seeds in a pot of regular soil. Cover them with one-fourth of an inch of soil and keep the soil moist. Keep track of how many days it takes for the seeds to germinate. It may take a few weeks so be patient!

If you collect seeds in the fall, you will have the best results with pine seeds. You can plant seeds from red pine as soon as you collect them. White pine seeds will need a pretreatment. To pretreat these seeds, place a moist paper towel on a small plate. Put the seeds on the paper towel and cover them with another moist paper towel. Place this seed "sandwich" on a dish in the

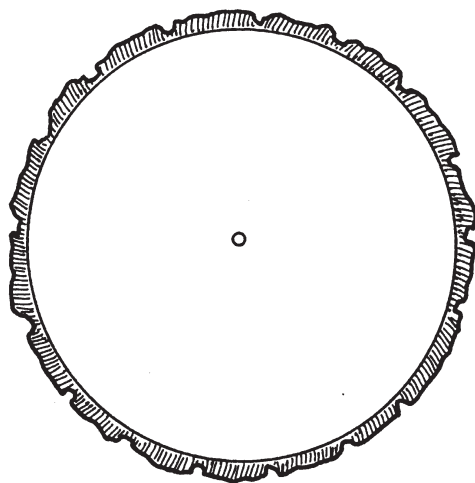
refrigerator. Keep the paper towel moist. Change the paper about once a week. After about 60 days, remove the seeds and plant them in a pot one-fourth of an inch deep containing regular soil. Keep the soil moist.

Hunt for seeds in the woods. Collect as many different kinds of seeds as you can find. Where did you find these seeds? Were they on the ground, hanging from a branch, or floating on a lake? Are the seeds heavy? Are they big or small? How do you think they got to where you found them? Which (if any) are seeds that animals might eat?

MAKE A FAMILY TREE!



Obtain a cross section of wood at least 2 inches in diameter, preferably from a tree that is at least 40 years old. Starting from this year's growth, count back the rings and label the ring that grew the year you were born. (Use a small label and glue.) Do this for other members of your family, too. Draw your own family ring history here:



ANSWERS

Seed Scramble

- | | |
|----------------|----------------|
| 1. walnuts | 4. coconut |
| 2. cranberries | 5. blueberries |
| 3. acorns | 6. hazelnuts |

Growing...Growing...Grown!

When 30 years old, the tree is 30 feet tall. The sign is always at 5 feet above the ground because trees grow in height from the top, not from the bottom.

Quiz for the Real Whizzes

- | | |
|----------------------|-----------------|
| 1. dormant | 7. summerwood |
| 2. cambium | 8. roots |
| 3. photosynthesis | 9. leaves |
| 4. stem and branches | 10. springwood |
| 5. germinates | 11. chlorophyll |
| 6. xylem-phloem | |

ROUNDUP AND FAIR PROJECTS

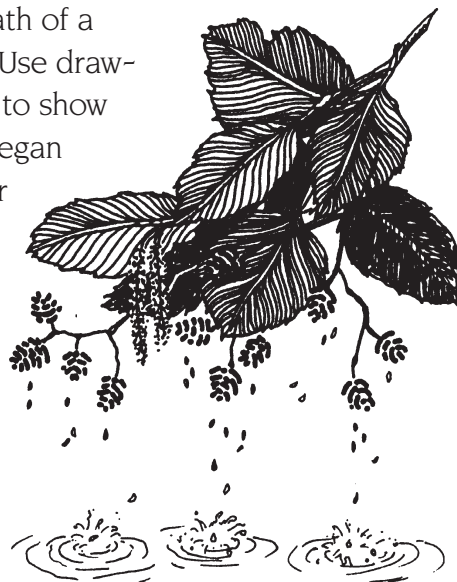
Make a seed collection using at least eight different species. Group them according to how the seeds travel. For example, your groups might include seeds distributed by animals, seeds eaten by birds, and seeds that float in the wind. Display your seeds in a box or glue them onto a three-sided display board. Also display each species' seed cut in half, to show the inside.

Prepare a display

showing the life and death of a particular tree. Use drawings or models to show how this tree began life as a seed or by suckering, stump

sprouting, or layering. Draw or build a model of the tree as a healthy adult, and then as a log on the

forest floor. Illustrate what is happening to the log as it is decomposed. Use drawings, pieces of moss, leaves, and other forest matter to construct the display. Use either a three-sided display board or a box for your project.



Make a display based on a cross section of a tree stem. Your cross section should show at least 20 years' growth. Study the growth ring patterns and figure out this tree's "life story." Note which years were good and which were tough. Label your cross section with dates, and prepare a short report explaining the annual ring patterns.

CHANGE IN THE FOREST FOREST SUCCESSION

The Forces of Change

Centuries ago, Pennsylvania was covered with pine and hemlock forests. Then the settlers came, bringing saws and plows. One by one they cut the towering hemlock and white pine trees until only stumps and hardwoods remained. Fires started by passing trains or by the settlers burned through these areas. As farms grew, the number of pines and hemlocks decreased. Change came to the forest.

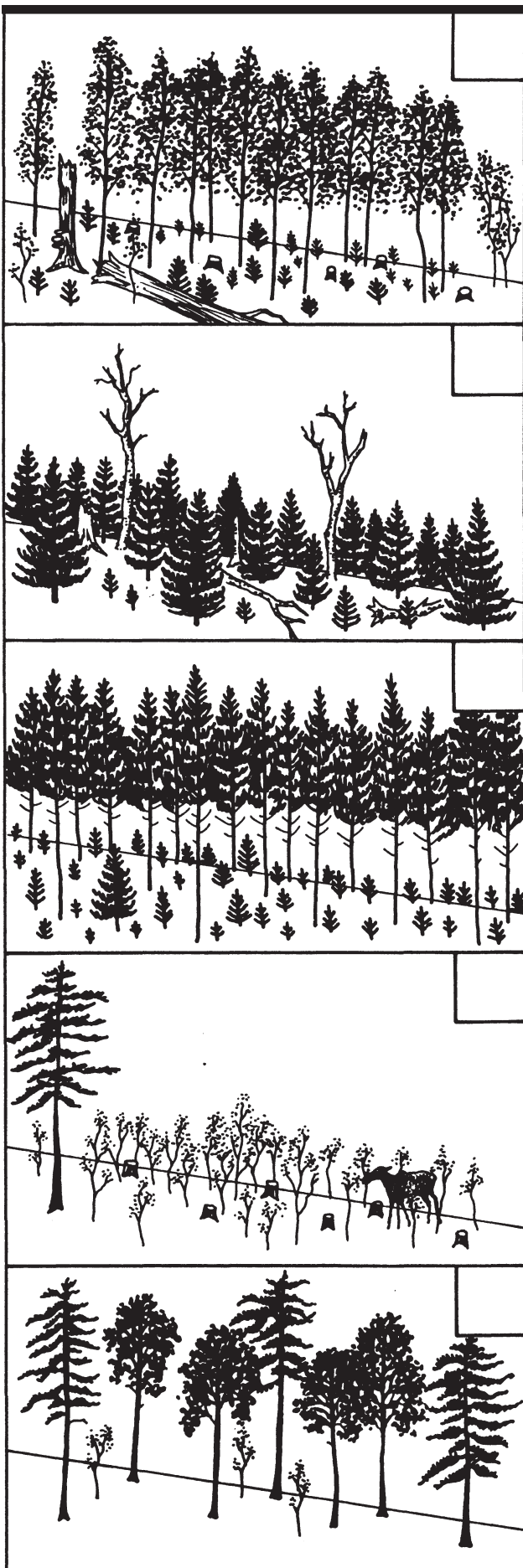
Various hardwoods, an important part of the original forest, now ruled the areas where pine and hemlock trees reigned. A new cycle of **succession**, the gradual change in the type and amount of plants in an area, had been started by the settlers.

Fire, logging, plowing, and other events sometimes disturb an area of land. When formerly dominant plants and trees are removed, succession begins. New plants take over the area where the old plants once lived.

Mark an "X" by the events that might start succession in a forest

- | | |
|------------------------------------|---|
| <input type="checkbox"/> tornado | <input type="checkbox"/> logging |
| <input type="checkbox"/> hurricane | <input type="checkbox"/> fire |
| <input type="checkbox"/> floods | <input type="checkbox"/> large numbers of insects |
| <input type="checkbox"/> drought | <input type="checkbox"/> plowing/land clearing |





MADE IN THE SHADE

When you remove trees, you take away the shade for new trees on the ground. The first new seedlings to grow in this area often like sunlight, but not shade. Aspen, paper birch, cherry, and ash are some common **shade intolerant** plants, also known as **pioneers**.

Once shade intolerant trees settle into an area, they make a bit of a problem for themselves. Younger pioneer trees can't grow up in the shade of their taller parents. The younger pioneer trees, remember, need lots of sunlight. This means that different tree species will start to take over beneath the parents.

These other tree species are shade tolerant—they can grow and reproduce in the shade. Shade tolerant tree species include sugar maple, American basswood, American beech, and hemlock. When the pioneers die out, the shade tolerant trees dominate the area.

A **climax** forest is a forest in which the overstory trees are the same species as the understory trees. Climax trees remain until fire, harvesting, or another force disturbs the area again.

In the drawings on the left, label the correct series of events in the succession. Use a "1" for the first stage, "2" for the second, and so on, until you reach a climax forest.

THERE'S NO PLACE LIKE HOME

Animals are very particular about their surroundings. Every animal has a specific environment, or habitat, that it likes the best. This preferred habitat meets that animal's special needs for food, water, shelter, and space.

When a forest changes, the animal species that live there also change. Different stages of succession are ideal habitat for different types of wildlife.

Some animals are **generalists** because they like many types of habitats. The black bear likes berries found in the early successional stages of a forest. Yet the bear also needs mature forests for shelter.

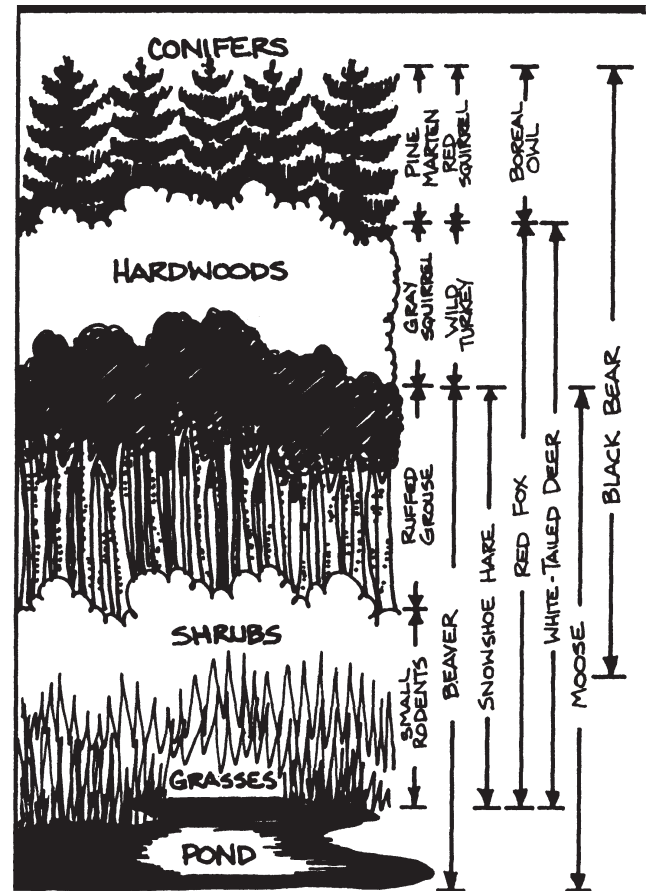
In the Pacific Northwest, the northern spotted owl needs old forests of Douglas-fir and western hemlock. The northern spotted owl is a specialist because it survives best in one type of habitat.

When a habitat is changed, either by people or by nature, it can't support the same animals.

SUCCESSION AND PRODUCTS

Forest succession also affects the types of products a forest produces. A forest in the early stages of succession has many shade intolerant trees. These trees—ash, cherry, and oak—make good wood products. Often foresters will try to slow or stop succession, so that these favored trees can grow.

Other products need a climax forest. Sugar maple is needed to make maple syrup. Woodland owners who want to produce syrup will often try to make this successional stage last.



In this picture, which animals would you call specialists. Why? Which animals would you call generalists? Why?

- pine marten: _____
- small rodents: _____
- ruffed grouse: _____
- gray squirrel: _____
- beaver: _____
- wild turkey: _____
- red squirrel: _____
- red fox: _____
- boreal owl: _____
- snowshoe hare: _____
- moose: _____
- black bear: _____
- white-tailed deer: _____

SHADE TOLERANCE

Intolerant

red pine
black cherry
black walnut
paper birch
quaking aspen
black willow
white ash

Intermediate

eastern white pine
red maple
oaks
American elm

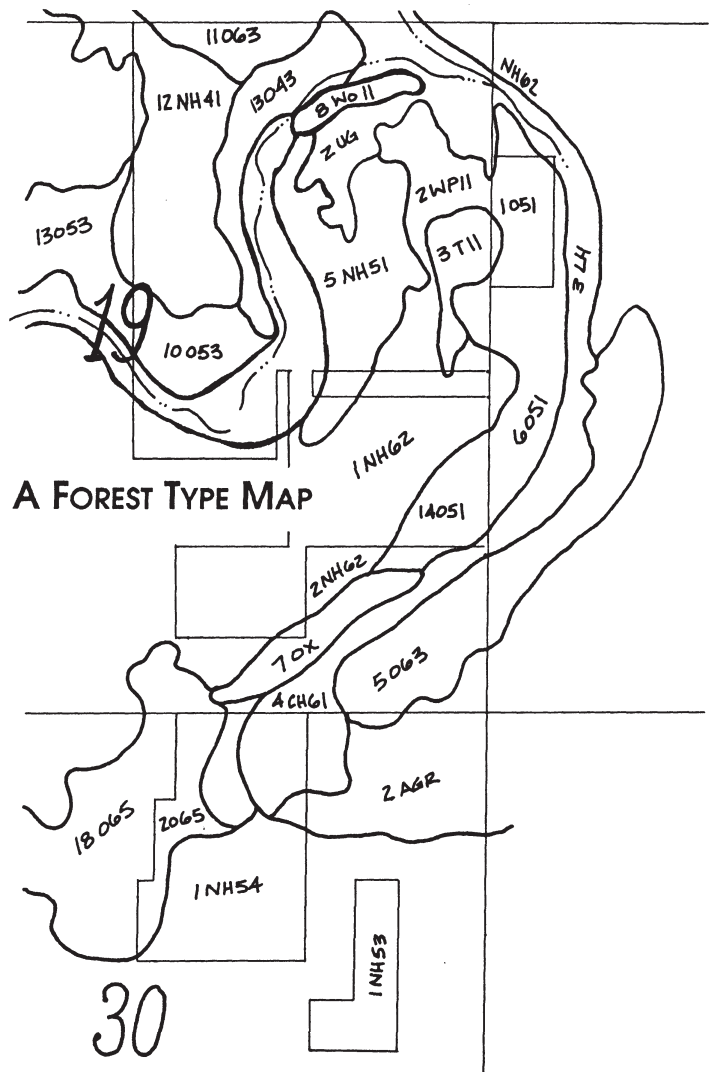
Tolerant

eastern hemlock
sugar maple
ironwood
American basswood
American beech

FOREST TYPES

Each forest is a special blend of tree species growing together in one community. This collection of tree species is not random. Certain tree species occur together because they need similar soils, water, and light. We call a collection of species that occur together a **forest type**.

Forest types are named for their main tree species. Quaking aspen and paper birch rule an aspen-birch forest type, although other tree species also can be found there. Foresters often map the location of forest types. The map helps them decide how to manage certain areas.



See if you can match each tree species below with the forest type where it would be found. More than one species can match each forest type.

SPECIES NAME	FOREST TYPE
bigtooth aspen	maple-basswood
white oak	
black cherry	oak-hickory
white birch	
eastern white pine	black cherry-maple
red oak	
sugar maple	
shagbark hickory	pine-hemlock
red pine	
American basswood	
eastern hemlock	aspen-birch

CAREER CONSIDERATIONS



Wildlife managers conduct habitat improvement programs, and monitor wildlife populations. They also teach the public about game (hunted animals, such as deer and moose) and nongame (animals that aren't hunted, such as songbirds) wildlife. You'll have to know a great deal about animals to be a wildlife manager. A good place to start is at a college or university.

QUIZ FOR THE REAL WHIZZES

Fill in the blanks below using the words at the end. Whiz through this!

1. A _____ is an animal that can use many different types of habitat.
2. A collection of tree species that occur together is a _____.
3. _____ plants and trees love shade.
4. A gradual change in the type and amount of trees over a long period of time is called _____.
5. An animal that requires a certain type of habitat is a _____.
6. Invading intolerant plants also are called _____.
7. Plants that do not like shade are called _____.
8. A _____ forest exists when the tree species in the overstory are the same species found in the understory.

Answers:	forest type	pioneers
	climax	intolerant
	tolerant	succession
	specialist	generalist

note the plants that are growing. Are they weeds, grasses, shrubs, or trees? If tree seedlings appear, try to identify them to the genus level (for example, oak, pine, or aspen).

Photograph or sketch your plot each time you visit it, and record the date. Continue this activity for at least two years. Don't expect a climax forest; that usually takes a few hundred years!

After at least two years, prepare a display using photographs or sketches and the information you gathered to illustrate the different plants that invaded the area over time.

You also could build a model to illustrate the succession you observed—use forest materials, twigs, and other materials that resemble the plants you observed. (This activity is adapted from *Project Learning Tree, Activity Guide for Grades 7–12*, American Forest Institute, 1977.)

Prepare a display that illustrates wildlife found in at least two different forest types. For each forest type, do the following?

- Photograph or collect pictures of the forest type.
- Identify the common tree species in the forest type.
- Identify at least two wildlife species found in that forest type.
- Include a picture or photograph of the animals mentioned. Mount your photographs or pictures on a three-sided display board or in a box.

Expand on the forest typing activity **from page 34**. Gather tree species data for at least three distinct forest types in the area. Then map the area. Mount the map on a three-sided display or poster board along with your forest data sheets.

ANSWERS

Succession Disturbances

All of these events are capable of starting succession.

Succession Series

top to bottom: 3; 4; 5; 2; 1

Specialist/Generalist Quiz

Specialists

small rodents
ruffed grouse
gray squirrel
wild turkey
red squirrel

Generalists

snowshoe hare
red fox
white-tailed deer
black bear
beaver

Forest/Species Match

maple-basswood: sugar maple, American basswood

oak-hickory: white oak, red oak, shagbark hickory

black cherry-maple: black cherry, sugar maple

pine-hemlock: eastern white pine, eastern hemlock

aspen-birch: bigtooth aspen, white birch

Quiz for the Real Whizzes

1. generalist
5. specialist
2. forest type
6. pioneers
3. tolerant
7. intolerant
4. succession
8. climax

PENNSTATE



College of Agricultural Sciences
Cooperative Extension

Name _____

Address _____

Name of club _____

Leader's name _____

Diameter of tree (inches)

6

7

8

9

10

11

12

13

FOR STANDING TREES

To Read Diameters: Hold Stick 25 Inches From Eye Against To Read Heights: Stand 100 Feet From Tree and Hold Stick

Height (No. Foot Logs)

1

1

2

2

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

Against Tree At Height of 4 1/2 Feet.
Hold Stick Vertical 25 Inches From Eye.

2
1

3

3
2
1

4

4
2
1

5

4-H Club Motto

"To make the best better"

4-H Club Pledge

I pledge
my head to clearer thinking,
my heart to greater loyalty,
my hands to larger service, and
my health to better living, for
my club,
my community,
my country, and
my world.

4-H Club Colors

Green and White



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