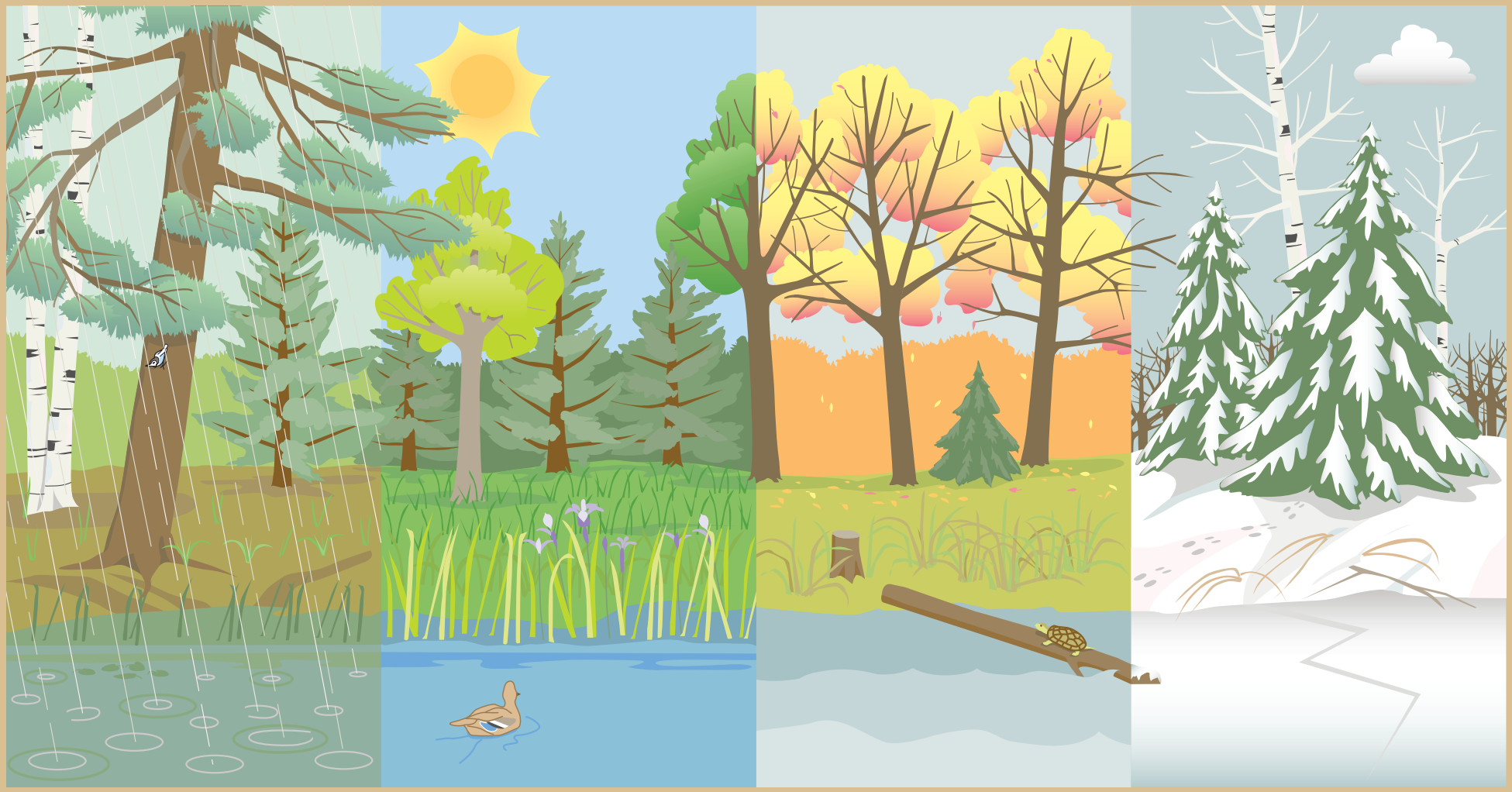


Trees For All Seasons

What Is a Tree?

A tree is a woody plant that can grow to be 15 feet or higher and usually has a single stem and a crown (branched-out area) at the top.

Two Kinds of Trees

Minnesota trees can be divided into two main types: deciduous and coniferous.

Deciduous trees drop their leaves each autumn. Deciduous trees are sometimes called angiosperms, broadleaf trees, or hardwoods. Oaks, maples, and elms are deciduous trees.

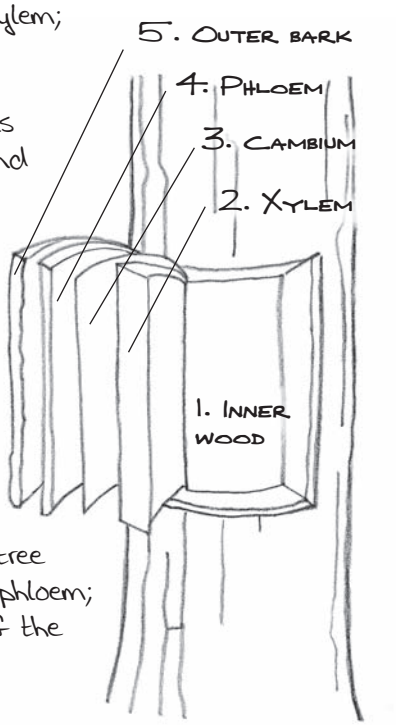
Coniferous trees are trees that produce seeds without fruits or nuts. Most coniferous trees bear seeds in cones, have needles instead of broad leaves, and keep their needles in winter. Coniferous trees are also called gymnosperms, evergreens, or softwoods. Spruces, firs, and pines are coniferous trees.

Reading the Rings

A tree's trunk is like a highway. It transports water and nutrients from the soil to the leaves. It transports food in the form of sugars from the leaves to the rest of the tree.

The trunk is made up of five layers:

1. Inner wood: dead xylem; stores food and supports the tree
2. Xylem: tubelike cells that move water and nutrients from roots to the rest of the tree
3. Cambium: layer that produces phloem and xylem
4. Phloem: tubelike cells that move sugar (called sap) from leaves to the rest of the tree
5. Outer bark: dead phloem; protects the rest of the tree.



During the growing season, the cells in the cambium divide to make new xylem and phloem. In spring they divide quickly and add a thick, light-colored layer. Later in the season growth slows, and the new layer is darker and thinner.

You can find a tree's age by counting the number of dark rings. You can also tell something about the growing conditions from a tree's rings. Thick rings mean good growth, while thin ones indicate tough times.

Spring

Spring is an awakening time for Minnesota trees. As the air warms, sap rises from the roots, carrying nourishment to the branches.

Coniferous trees develop new shoots. The shoots expand to form new stems and needles. On deciduous trees, buds begin to swell. Then they open into new shoots and leaves.

Blooming Branches

Most deciduous trees reproduce by forming flowers. In some species, each flower has both male and female parts. Others have separate male and female flowers. In yet others, male and female parts develop on separate trees.

A tree that has conspicuous catkins hanging from its branches in the spring probably is wind-pollinated.

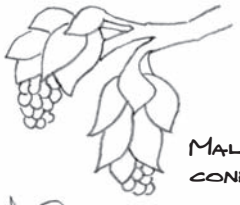
For seeds to form, pollen from the male parts must come into contact with the female parts. In many species, pollen is carried by wind. In species with fragrant or showy flowers, pollen may be carried by insects.

Deciduous tree seeds are distributed in various ways, too. The wind carries seeds with wings, such as maple and aspen. Birds and mammals spread seeds hidden in fruits and nuts. Water and gravity also carry seeds away from their parent tree.

New Cones, New Life

Coniferous trees have two kinds of cones. The male cones produce pollen. The wind carries pollen through the air. Some lands on female cones. The pollen and eggs join to make a new seed. The seeds have tiny wings that help them fly through the air when they fall from the cones.

A new tree develops when pollen from the male cone fertilizes the female cone.



Male cone

Female cone

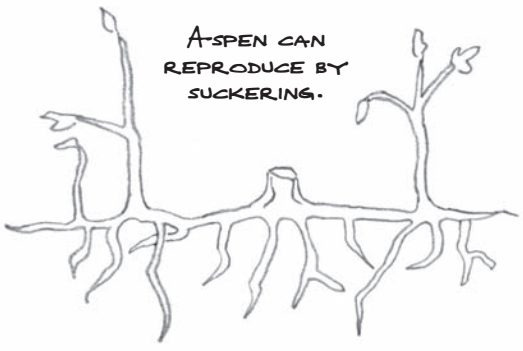
Red pine cone

Red pine seed

Many trees can grow new trunks without seeds. Aspens send out shoots from their roots. As a result, they can cover a large area soon after trees are harvested. Cottonwoods can sprout from green sticks. Sometimes fence posts made from cottonwood sprout roots and begin to grow! Some trees grow new trunks from stumps.

Maple seeds have "wings" that allow the wind to help disperse them.

Aspen can reproduce by suckering.



Oak can reproduce by stump sprouting.

Summer

From early in the morning until late at night, summer sunshine provides the energy trees need to make new wood, twigs, and leaves.

Seeds to Trees

Many tree seeds germinate in summer. Sunlight and moisture send the seed signals to begin to sprout. Water softens the seed shell and expands the food inside. A root grows downward. A stem pushes up toward the sunlight.

How Trees Grow

Trees grow throughout their lives. They get bigger in three places: root tips, cambium, and buds.

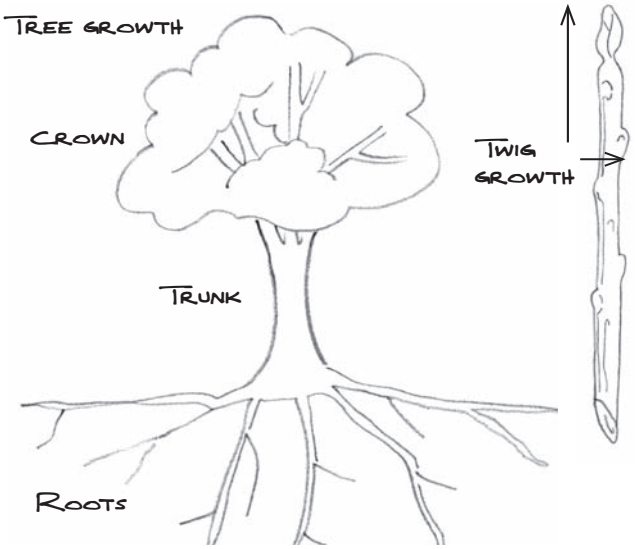
- The roots grow longer as cells in the root tips divide.
- New shoots, twigs, and leaves form as buds open and grow.
- The trunk and branches grow thicker as the cambium (the layer of cells beneath the bark) makes new layers of xylem and phloem (the cells that carry water, sugar, and nutrients up and down the tree).

Just like people, a tree needs water, nutrients, and energy to grow. A tree draws water and nutrients from the ground through its roots. Like other plants, it uses energy from the sun, captured by chlorophyll and other pigments in the leaves, to transform carbon dioxide and water into sugar. This process, called photosynthesis, takes place in the leaves. The sugar then travels through the branches and trunk to nourish the rest of the tree.

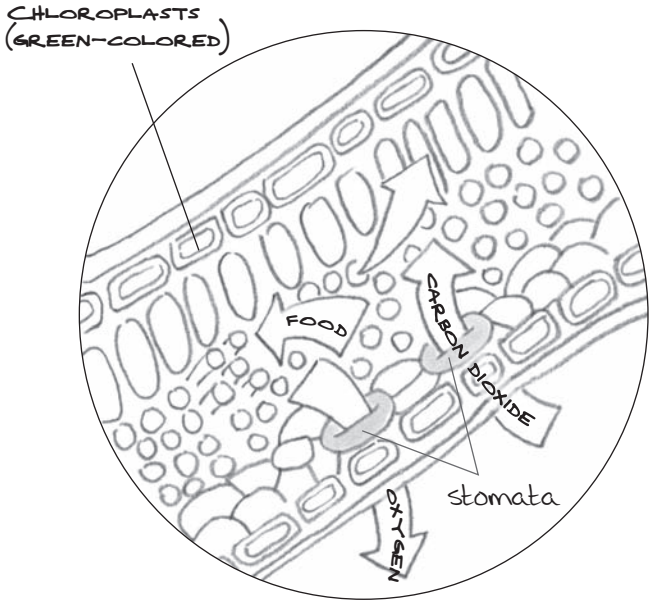
Photosynthesis

1. Chlorophyll and other pigments absorb energy from the sun and store it in green-colored, microscopic structures called chloroplasts.
2. The tree takes in carbon dioxide through small holes in its leaves called stomata.
3. Using the stored energy, the tree combines carbon dioxide with water drawn up from the roots to make sugar and oxygen.
4. The tree uses the sugar to grow. It releases the oxygen to the air. Trees help make the oxygen we need to stay alive.

BY FORMING NEW CELLS UNDER THE BARK AND AT THE TIPS OF THE BRANCHES AND ROOTS, A TREE GROWS IN DIAMETER, HEIGHT, AND EXTENT OF ROOT SYSTEM EACH YEAR.



LEAF CROSS SECTION



Tree Troubles

Trees face many threats in today's world.

Development

As houses, shopping malls, and other buildings spread across the landscape, trees often take a hit. Some are cut to make room for development. Others are left in place, but are damaged by construction and eventually die.

Harmful Non-Native Insects and Diseases

Insects and diseases can weaken and kill trees. Some of those imported from other parts of the world are among the most devastating.

Dutch Elm Disease

Dutch elm disease, which is native to Europe, swept through Minnesota in the 1960s and '70s, killing millions of elm trees. Once-shaded city streets were left bare. Trees that added beauty, comfort, and value to homes were destroyed. As urban foresters replaced dead elms with species that are not affected by the disease, the problem got better. But in recent years Dutch elm disease has reared its ugly head again.

Gypsy Moth

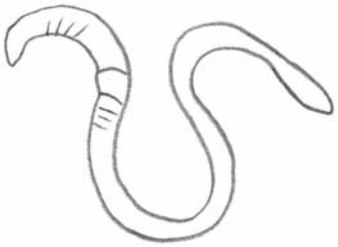
Gypsy moth is a non-native insect that eats leaves of deciduous trees, weakening them. It was imported to the United States in the late 1800s. Gypsy moths are spreading inland from the coasts.

Emerald Ash Borer

This Asian insect was found in Michigan in 2002. It can kill an ash tree within a year.

Eurasian Earthworms

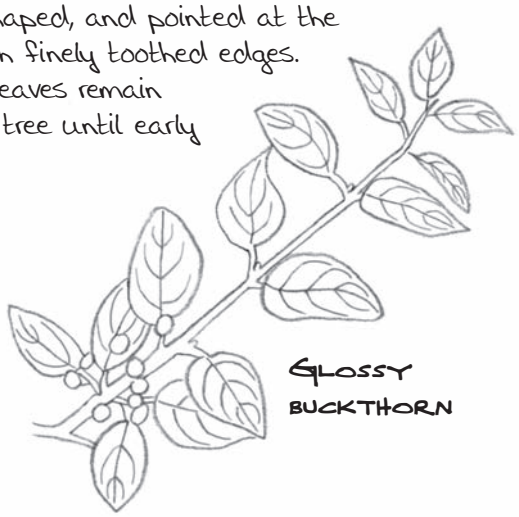
All earthworms, including angleworms and night crawlers, are non-native in Minnesota. Earthworms consume the leaf litter of the forest, causing tree seedlings, ferns, wildflowers, and potentially water quality to decline.



Common and Glossy Buckthorn

These European plants were introduced to Minnesota as landscaping shrubs. They spread rapidly, crowding out native plants and disturbing the woodland ecosystem. Many communities are working to eliminate buckthorn from public spaces and to encourage property owners to destroy it on their land so healthy native plants can thrive once again.

Keys to identification: Leaves are dark, egg-shaped, and pointed at the tip, with finely toothed edges. Green leaves remain on the tree until early winter.



Glossy buckthorn

Minnesota's Native Trees

Minnesota is home to 52 native tree species.

Deciduous

Northern red oak

- American basswood
- American elm
- American hornbeam (blue beech)
- American mountain ash
- Balsam poplar (balm-of-Gilead)
- Bigtooth aspen (largetooth aspen, poplar, popple)
- Bitternut hickory
- Black ash
- Black cherry
- Black maple
- Black oak
- Black walnut
- Box elder
- Bur oak
- Butternut
- Chinkapin oak (yellow chestnut oak)
- Eastern cottonwood
- Eastern hophornbeam (ironwood)
- Green ash (red ash)
- Hackberry
- Honeylocust
- Kentucky coffeetree
- Mountain maple
- Northern mountain ash (showy mountain ash)
- Northern pin oak (Jack oak, Hill oak)
- Northern red oak
- Paper birch
- Pin cherry

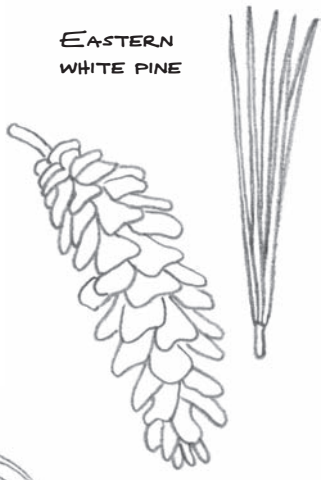
Green ash

- Quaking aspen (trembling aspen, poplar, popple)
- Red maple
- Red mulberry
- River birch
- Rock elm
- Shagbark hickory
- Silver maple
- Slippery elm (red elm)
- Sugar maple
- Swamp white oak
- White ash
- White oak
- Willow
- Yellow birch

Coniferous

- Balsam fir
- Black spruce
- Eastern hemlock
- Eastern red cedar (juniper)
- Eastern white pine
- Jack pine
- Northern white cedar

Eastern white pine



White spruce

- Red pine (Norway pine)
- Tamarack (eastern or American larch)
- White spruce

Different trees thrive under different conditions. When planting trees, native species are a good choice. Tree professionals can help choose species that are right for the site.

To learn more about Minnesota's native trees, check out the following:

- Trees of Minnesota. Minnesota's Bookstore, order number 9-1, phone: 800-657-3757, www.comm.media.state.mn.us
- Minnesota Trees. Minnesota Extension Service, order number BU-00486-GO, phone: 800-876-8636, www.extension.umn.edu
- Nature Snapshots: Trees & Shrubs, www.dnr.state.mn.us/trees_shrubs/index.html

Fall

In fall, trees undergo changes that help them survive winter.

Deciduous Trees

The cool nights and shorter days of autumn signal deciduous trees to shut down the food-making factories in their leaves. A membrane forms between the leaves and twigs. Chlorophyll production stops.

Carotenoids—yellow, orange, and brown pigments that were overshadowed by the green chlorophyll in summer—begin to show, making the leaves glow with autumn color. In some tree leaves, reds and purples appear when pigments called anthocyanins are produced. The leaves eventually fall off.

Carotenoids give color to carrots, corn, canaries, daffodils, egg yolks, rutabagas, buttercups, and bananas as well as tree leaves.

At the same time, the living tissue in the tree's trunk and branches goes through a process called hardening that prepares them for winter. Hardening enables a tree to survive colder weather. If a tree were suddenly exposed to winter temperatures in July, it would be injured or die. But after it's gone through the hardening process, a tree can survive temperatures far below freezing.

Coniferous Trees

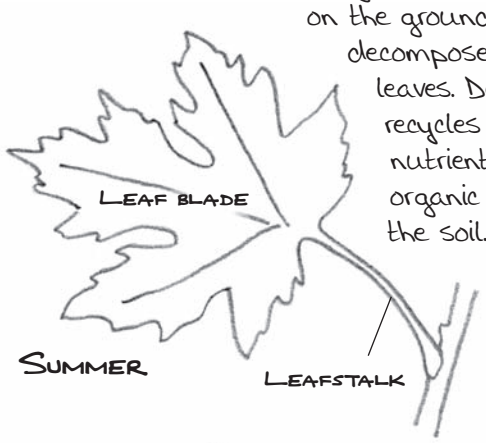
Coniferous trees also undergo hardening. But they don't lose all of their leaves in the fall. Instead, they shed them over time—much as a dog or cat sheds hair gradually, rather than going bald all at once.

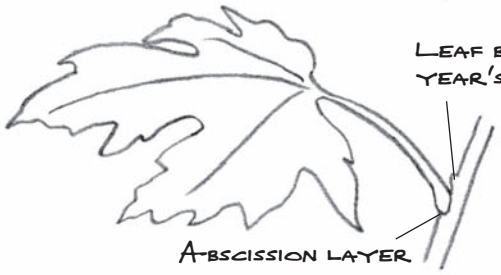
The needlelike shape and waxy coating of coniferous tree leaves prevent them from drying out in winter, when little if any liquid water is available to the tree.

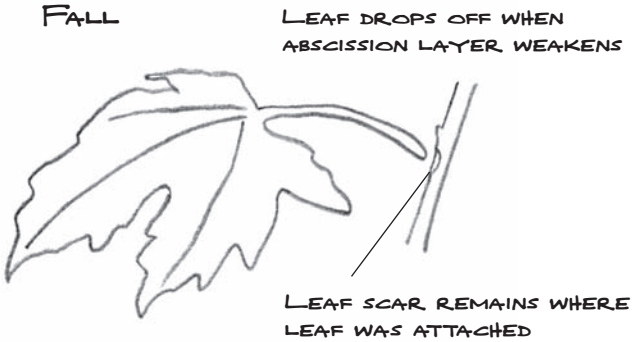
The pyramid shape of coniferous trees helps keep branches from breaking off from the weight of snow that accumulates on the needles.

Getting Ready for Winter

1. As days get shorter and the temperature drops, deciduous trees produce a hormone called abscisic acid. This hormone signals the tree to build a membrane, called the abscission layer, that cuts the leaf off from the rest of the tree.
2. The leaves stop photosynthesizing and the chlorophyll fades. The leaf turns color and falls to the ground.
3. The membranes surrounding the tree's cells become more permeable. This allows water to seep out so it won't burst the cell when it freezes.
4. Mammals, insects, fungi, and bacteria on the ground help decompose the fallen leaves. Decomposition recycles the leaves' nutrients and adds organic material to the soil.







Winter

Living trees contain water. Why don't they burst open in winter, since water expands when it freezes? The water inside cells contains lots of dissolved substances. These lower the freezing temperature. Insides of cells also lack structures that water needs to start freezing.

As the temperature drops, water in between the tree's cells freezes first. This draws water out of the cells, which became more permeable during the process of hardening in the fall. The concentration of dissolved substances in the water inside the cells increases, lowering its freezing point even further.

Cold Adaptations

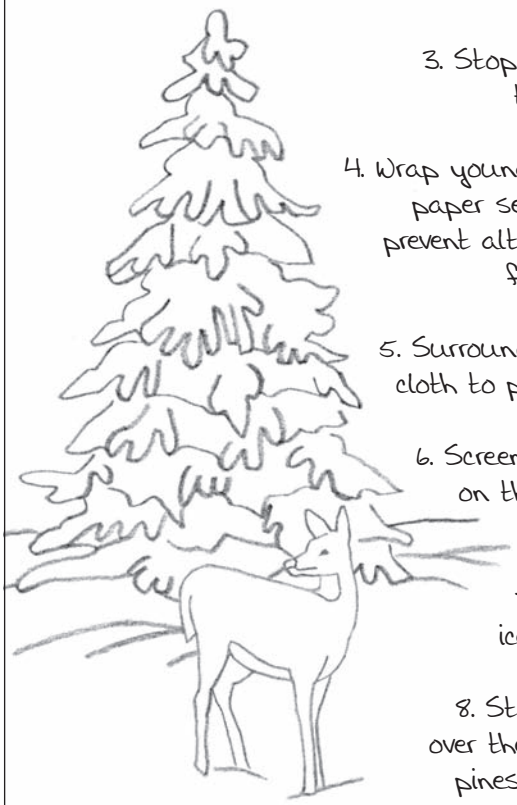
Different trees can survive different temperatures. After they have gone through hardening, red oaks can survive temperatures of -40°F. Spruces, balsam fir, quaking aspen, and other trees found in the far north can survive temperatures below -100°F!

Because they keep their leaves, coniferous trees can photosynthesize in winter and early spring. Some deciduous trees, such as aspen and cottonwood, can photosynthesize even without leaves because they have chlorophyll in their bark. This allows the trees to make sugar for themselves year-round.

Eight Tips to Help Trees in Winter

1. Plant only native trees.

2. Water coniferous trees thoroughly in autumn.



3. Stop using nitrogen fertilizer near trees in late summer.

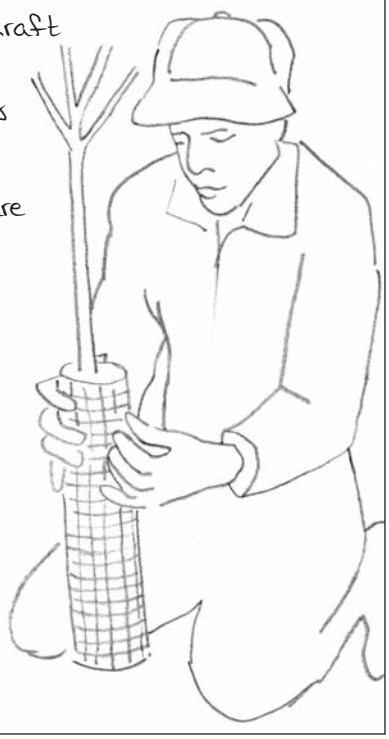
4. Wrap young smooth-barked trees with kraft paper secured with masking tape to prevent alternating freezing and thawing from damaging bark.

5. Surround the lower trunk with hardware cloth to protect from gnawing animals.

6. Screen coniferous trees with burlap on the south and west to prevent winter "browning."

7. Don't shake snow or ice from trees in winter.

8. Staple a folded index card over the top bud of young white pines to discourage deer from nibbling them.



The Value of Trees

Trees help humans and other living things in many ways. Among them, they:

- Remove carbon dioxide (a greenhouse gas) and other pollutants from the air
- Produce oxygen
- Provide food and shelter for wildlife
- Provide wood products
- Add beauty to the landscape
- Provide a pleasant environment for recreation
- Help reduce residential energy consumption by shading homes in summer and sheltering them from wind in winter
- Help protect streams and lakes by reducing runoff
- Reduce noise pollution by absorbing sound
- Increase property values.

CEDAR WAXWING

Research has shown that trees can provide up to $7 in benefits each year for every $1 invested in caring for them. Benefits include increased property values, pollution control, and energy savings.

Keep Trees a Healthy Part of Your World!

- Plant trees. Make sure they are right for the site.
- Help keep trees healthy. For example: Water trees during dry periods; avoid wounding bark with lawn mowers and weed whips; stake small-diameter, newly planted trees to give them added support; mulch trees to help retain moisture in the soil.
- Celebrate Arbor Day and Arbor Month. In Minnesota, Arbor Day is the last Friday in April and May is Arbor Month.
- Join—or establish—a local tree committee or board.
- Go to www.MNtrees.org, Minnesota's one-stop Web site for information on trees, tree care, and tree-related organizations.

How to Use the Back of This Poster With Students—

- Use the panels on the back of the poster with the front design to create a bulletin board.
- Distribute copies of the panels to students.
- Copy panels and have students paste them into a journal to which they add additional comments and drawings.

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Acknowledgements:

Meg Hanisch, Project Manager
Mary Hoff, Writing Services
Amy Beyer, Illustration

Printed on 50 percent recycled, elemental chlorine-free paper containing a minimum of 15 percent postconsumer waste and manufactured using an acid-free process.