

Trees of North America: The Gymnosperms—Part I

(471.40 S-T)

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OPERATING PROCEDURES: Begin this program with slide "1" on the screen and the tape advanced through the clear leader.

The following slides are in vertical format and should be checked to see that they're properly oriented in your tray: 18.

NOTE: Genera within the following families are included in this slide-tape: Pine--*Pinaceae*.

SLIDE 1: series title

The intent of this slide-tape series is to focus on important or distinctive genera of North America. Individual species will be used to illustrate specific characteristics and to lend perspective to each genus, but your attention should remain on characteristics of the genera. Let's begin with the gymnosperms-- those woody plants commonly referred to as conifers. But before looking at individual genera, let's see where the gymnosperms fit into the larger scheme of things.

SLIDE 2: taxonomic chart

Although scientists differ slightly on how plants should be classified, and new information is uncovered almost daily, most would agree that the plant kingdom can be divided into three major groups: the algae and fungi, the vascular plants, and the bryophytes, which contain the mosses, liverworts, and hornworts.

SLIDE 3: taxonomic chart

Vascular plants, the group we're interested in in these slide-tapes, can be further divided into the ferns, the horsetails, the seed plants, the club mosses, and the psilotums.

SLIDE 4: taxonomic chart

The seed plants can again be divided--into the angiosperms, which bear their seed inside ovaries, and the gymnosperms, which bear naked seeds.

SLIDE 5: taxonomic chart

The gymnosperms, the focus of this program, can again be divided--into cycads, ginkgo, gnetales, conifers, and yews. It's the latter two groups that we'll be reviewing in this slide-tape series. Within the conifers are approximately 5 families, 50 genera, and 550 species, while within the yews are 1 family, 5 genera, and 10 species. In this series of slide-tapes, we'll look only at the principal genera found in the United States and Canada. To learn about other genera you'll need an appropriate dendrology textbook.

SLIDE 6: family title

The largest and most important conifer family is the Pine family, *Pinaceae*. It contains 9 genera and about 210 species, stretching throughout the Northern Hemisphere from the Tropics to beyond the Arctic Circle. North American representatives include the pines, larches, spruces, Douglas-firs, hemlocks, and true firs. The only major genus not native to North America is the true cedar genus, *Cedrus*, which occurs in the Middle East.

SLIDE 7: genus title

Of the genera native to North America, the first we'll look at is pine: *Pinus*.

SLIDE 8: map--worldwide distribution of genus

The pine genus is very large, with 90-100 species scattered throughout the forested regions of the Northern Hemisphere. About 35 species occur in North America alone. This genus comprises the largest and most diverse group of conifers in the world; a fact that has given rise to the tendency of many people to refer to all conifers--incorrectly--as "pine trees". Pines are also among the world's most important trees for timber and pulp production.

SLIDE 9: needles in fascicles (several species)

Perhaps the most distinguishing feature of the pines is that their needles are borne in tiny bundles, called "fascicles". Most species have a fixed number of needles per fascicle, usually two, three or five, although one species has only one per fascicle and another has four. Some species have fascicles containing different numbers of needles on the same tree, usually two and three per fascicle.

SLIDE 10: split slide--different sized needles/artwork of needle x-section

The shape of pine needles is always acicular, or needle-like, but the length varies greatly, from 1 to 18 inches. Because each fascicle has developed from a single round needle, it's possible to predict the shape of needle crosssections from the number of needles per fascicle. If a tree has one needle per fascicle it will be round, two will be hemispherical, and three or more will be triangular. The angles making up the triangular cross section will vary predictably depending on the number of needles per fascicle. Knowing this simple fact can aid tremendously when trying to identify a pine from a single needle.

SLIDE 11: cones (variety)

The cones of pines are also distinctive from those of other genera, but there's great variety even among the pines. As you can see, they differ widely in size, shape, and other characteristics. Some have thick scales, others thin. Some have sharp prickles, others none. Some open immediately at maturity; others remain closed on the tree for years, retaining viable seeds until conditions are right for germination. Regardless of their characteristics, most pine cones take two years to develop fully. Seeds vary in size and shape almost as much as the cones, and this greatly affects how and how far they're dispersed from the mother plant.

SLIDE 12: art

Because of the diversity in this genus, there are a number of ways to group the pines into smaller, more uniform units. The method most commonly used for the pines of North America combines morphological characteristics, or structure of the various parts, with geographic distribution.

SLIDE 13: art--hard pines vs. soft pines

The most common breakdown divides the genus into "hard" and "soft" pines. Although these categories refer to the hardness of the tree's wood, they're only partially accurate since the wood of some of the "hard" pines is softer than that of several of the "soft" pines. A second common breakdown uses the colors yellow and white in place of hard and soft. In this system the hard pines are referred to as yellow pines, and the soft pines, as white pines--to reflect the color of the freshly cut wood. Let's look first at the soft pines.

SLIDE 14: art--soft pine characteristics

The soft pines usually bear their needles in fascicles of five, although fascicles of one to four are also possible. The papery sheath that surrounds each fascicle is deciduous, that is it falls off at maturity. The cone scales are thin at the apex and usually have no prickles, so are said to be "unarmed". Their wood is relatively soft, with a gradual transition from early wood to late wood, and the heartwood is white in color.

SLIDE 15: art--soft pine breakdown

The soft pines can be further divided into the white pines, stone pines, pinyon or nut pines, and foxtail pines, each with distinctive characteristics. Of these, the white pines are far-and-away the most important forest trees.

SLIDE 16: needles/cones--(*P. monticola*)

The white pines of North America have needles 2 to 6 inches long and borne in fascicles of five. Their cones typically have long stalks and thin unarmed scales. Their seeds have terminal wings that are longer than the seeds--as a result they're good flyers, aiding greatly in wind dispersal of the seeds from the parent tree.

SLIDE 17: map--distribution of principal species in North America

The most prominent white pines of North America are: eastern white pine, *Pinus strobus*, common in New England and the Lake States, western white pine, *Pinus monticola*, which grows throughout the mountains of California and the Pacific Northwest, and sugar pine, *Pinus lambertiana*, which grows throughout the Sierra and Cascades of California and Oregon.

SLIDE 18: tree (*P. monticola*)

All three of these white pines are large, rapidly growing trees prized for their soft, easily worked lumber. When grown in stands they have tall, straight trunks devoid of bottom branches. This once made them a mainstay of the sailing industry for the construction of masts. The red branch on the lower right side of this western white pine is the first sign of white pine blister rust, a fungal infection responsible for dramatically decreasing the commercial importance of all white pines.

SLIDE 19: branch/cones and seeds

The next division within the soft pines consists of a minor group called the stone pines. Like the white pines, stone pines have five needles per fascicle, but stone pine needles are generally less than 3 1/2" long, and are clustered on the ends of branches. The cones have short stalks and thick, unarmed scales. The seeds are large, making them a favorite of squirrels, and they have small or no wings, making them poor flyers. Therefore most seedlings are found close to the parent tree, unless the seeds are carried away by flood waters or animals.

SLIDE 20: tree (*P. albicaulis*)/word

The two prominent North American stone pines are trees of the high mountains: limber pine, *Pinus flexilis*, grows throughout the mountainous West, while whitebark pine, *Pinus albicaulis*, is limited to the northern Rockies and Cascades. Both are small trees, not commercially important, but highly valued for the beauty they give to high, windswept slopes.

SLIDE 21: foliage/cone split

The next division of the soft pines is the pinyon or nut pine group. Pinyon pines have needles that are generally less than 2" long, occur in fascicles of one to five, and are clustered near the ends of twigs. The cones have very short stalks, thick twisted scales, and large, unwinged seeds that are a food source for humans as well as wildlife.

SLIDE 22: tree (*P. edulis*)/word split

Four species of pinyons, and several varieties and hybrids, dominate vast areas of the arid southwestern United States and northern Mexico. All are small trees that grow in scattered-to-dense woodlands with a variety of junipers. Although not important commercially, pinyons are extremely valuable for watershed protection and for the beauty they add to the harsh lands they inhabit. They're also a valuable source of food for wildlife, and once formed a primary staple of the American Indians who inhabited these desert lands.

SLIDE 23: foliage/cones (both *P. aristata*)

The final division of soft pines is another minor group--the foxtail pines, so named because of bushy foliage that's retained on the twigs for many years. The needles themselves are similar to those of the stone pines--generally less than 2" long, and arranged in fascicles of five; but foxtail pines hold their needles much longer--up to 17 years. The cones are short-stalked, and have thick, twisted scales like the stone pines, but foxtail cones are armed with prickles, and their seeds have long wings.

SLIDE 24: tree (*P. aristata*)/word split

The foxtail pines are shrubby, windswept trees of the highest elevations of the southwestern United States. The two principal species are foxtail pine, *Pinus balfouriana*, and bristlecone pine, *Pinus aristata*. Although neither are commercially important, they provide important watershed protection and add great beauty to a desolate landscape. Additionally, bristlecone pines are among the oldest living organisms on earth, with a number of individuals over 4000 years old, and at least one nearing 5000 years. Because of the long history captured within their rings, these trees are a valuable aid to scientists studying long-term climatic changes.

SLIDE 25: art--hard pine characteristics

Next, let's look at the hard pines of North America, a group comprising roughly 2/3 of all the pines on the continent. The hard pines generally bear their needles in fascicles of two or three, or in a combination of two and three. The papery sheath surrounding each fascicle generally persists for a number of years. The cone scales are thickened at the tips, and are often armed. Their wood is generally hard, with an abrupt transition from early to late wood, and the heartwood is yellow in color--a fact that results in this group often being called yellow pines.

SLIDE 26: art--hard pine divisions

The hard pines are the most commercially important of all North American pines, as well as containing the most species and covering the widest range. For ease of identification they're often divided into three groups based on geography: one for the northeastern United States and southeastern Canada, one for the southeastern United States, and one for the western United States and Canada. Unfortunately, these geographic divisions don't always lead to the neat morphologic distinctions found among the soft pines.

SLIDE 27: map--distribution of principal species in North America

The two principal northeastern hard pines are red, or Norway pine, *Pinus resinosa*, and jack pine, *Pinus banksiana*. Jack pine has the wider distribution of the two, growing throughout the Lake States of the U.S. and across Canada, making it one of the most common and widely distributed of North American pines. Red pine has a much smaller distribution, occupying the Lake States, New England, and southeastern Canada. Note that on this and many subsequent maps, areas in which species overlap will be shown in brown.

SLIDE 28: *P. resinosa*/*P. banksiana*

Red pine, shown on the left, is a tall and stately tree--valued for its timber; jack pine is small and scraggly, and finds its way into commercial markets primarily because of its abundance. Both have two needles per fascicle, but they're easy to tell apart by needle length: red pine needles are four to six inches long, while jack pine needles are generally under two inches.

SLIDE 29: map--distribution of principal species in North America

Approximately ten hard pines are native to the southeastern United States. Of these, four are especially important commercially, accounting for a high percentage of the lumber and pulpwood produced in North America each year. Loblolly and shortleaf pine are the most common, and occur farthest inland, while longleaf and slash pines dominate the low-lying plains of the Atlantic and Gulf coasts. Again, the area in brown indicates where the ranges of all four overlap.

SLIDE 30: *P. taeda* stand

Of these four principal species, loblolly pine, *Pinus taeda*, is the most important commercially. As well as being one of the leading lumber producing trees in North America, it's also one of the leading pulpwood species.

SLIDE 31: *P. palustris* needles

Longleaf pine, *Pinus palustris*, is probably the most distinctive southern pine, simply because of its needles, which may reach 18 inches. Longleaf pine is an important source of lumber, and also a leading source of naval stores such as turpentine, pitch, and rosin.

SLIDE 32: map--distribution of principal species in North America

Although there are approximately a dozen hard pines scattered throughout western North America, only three--Jeffrey, ponderosa, and lodgepole--are of commercial importance. Jeffrey pine has the smallest range of the three, for the most part confined to the Sierra Nevada Mountains of California. Ponderosa and lodgepole pines have extensive ranges that cover much of the mountainous West. Of the two, ponderosa extends farther south, dropping well into Mexico; lodgepole extends farther north, occupying early successional sites from Mexico to Alaska.

SLIDE 33: *P. ponderosa* stand

Ponderosa and Jeffrey pine are nearly identical in appearance and growth. Both have 5 to 10 inch long needles occurring primarily in fascicles of three. Both grow in open, park-like stands and have distinctive yellow or orange puzzle-like bark. Ponderosa is the more widespread of the two, occurring in commercial quantities in all states west of the Great Plains. It furnishes more lumber than any other American pine, and is second only to Douglas-fir in total volume. Jeffrey pine has a narrower range, but is slightly better adapted to extreme temperatures and drought. The stand pictured is ponderosa pine growing on the east flank of the Oregon Cascades.

SLIDE 34: *P. contorta* stand

Lodgepole pine is the other important western hard pine. Its three varieties grow over a wide latitude and elevation range, and have several distinctive growth forms. Along the Pacific Coast lodgepole is a small tree, often twisted and shrubby, but farther inland it grows tall and straight--in dense, even-aged stands that are suitable for lumber production. Of the western pines, lodgepole is the easiest to recognize because of its short needles occurring two per fascicle. Of the other pines, it most closely resembles jack pine of Canada and the northeastern United States. In fact, the two species hybridize where their ranges meet in the northern Rockies.

SLIDE 35: art--pine breakdown

Taken as a group, the pines are the most diverse and important set of conifers in the world. Although it's hard to tell them apart from such brief descriptions, you'll be surprised how easy it becomes when you see them on a daily basis.

SLIDE 36: genus title

The next genus in the Pine family we'll look at is larch: *Larix*. Notice that the common name tamarack is sometimes used for the genus.

SLIDE 37: map--worldwide distribution of genus

Larch is a small genus of about 10 species native to cool mountainous regions of the Northern Hemisphere. Only three species are found in North America.

SLIDE 38: *L. occidentalis* foliage

Without doubt, larch's foliage is its most distinctive feature. On new shoots soft, yellow-green needles are borne singly and spirally; on older shoots they're densely clustered in sets of from 12 to 40 on short, woody spurs. It's interesting to note that these woody spurs are actually stunted branchlets that fail to elongate in the typical fashion. The only other conifers to bear their needles in such fashion are the true cedars of the genus *Cedrus*, native to the middle eastern part of the world.

SLIDE 39: *L. lyallii* autumn colors

Perhaps most importantly, all larches have deciduous foliage. Although they aren't the only deciduous conifers in North America, they're the most common, and they're the only ones with needles borne on spur shoots.

SLIDE 40: cones (several *Larix* species)

Larch cones are also distinctive, and are often the best way to separate different species. Mature cones are small, egg-shaped, and erect. The scales are thin, and, in some species, are separated by distinctive bracts like the cone on the longest twig in the slide.

SLIDE 41: tree (*L. occidentalis*)/list

In spite of their deciduous foliage and the harsh climates in which they often occur, larches grow tall, fast, and straight--and their wood is strong and durable. These characteristics make larch a prized timber species, especially for poles, pilings, and posts. Their unique botanical characteristics also make them valued for landscaping and street plantings.

SLIDE 42: map--distribution of principal species in North America

Three species of larch are native to North America: eastern larch, or tamarack, *Larix laricina*, has far-and-away the largest range, growing throughout the northeastern United States and across Canada, especially on wet, boggy sites. Western larch, *Larix occidentalis*, occupies the Inland Empire of the Rocky Mountains and the Cascades of the Pacific Northwest. Subalpine larch, *Larix lyallii*, occupies a similar range, but occurs only at the highest elevations.

SLIDE 43: genus title

The next genus in the Pine family is spruce: *Picea*.

SLIDE 44: map--worldwide distribution of genus

The spruce genus contains 30 to 45 species, almost half of which are found exclusively in China. Spruces are confined mostly to cool or mountainous regions of the Northern Hemisphere, and form a very important group economically.

SLIDE 45: sterigmata (*P. sitchensis*)

Perhaps the best identifying characteristic of the spruces is that their needles are always borne singly, on distinct woody pegs called "sterigmata." Although not as easy to see as the woody spur shoots of larches or true cedars, these sterigmata are quite apparent on close examination.

SLIDE 46: needles on twig (*P. pungens*)

Spruce leaves are single, linear, and spirally arranged. Most are sharp-pointed, and are four angled in cross section rather than flat. Generally, they're about 1 inch long, and most emit a pungent odor when crushed.

SLIDE 47: several cones (*P. abies*, *P. breweriana*, *P. pungens*, *P. sitchensis*)

Spruce cones are distinctive of the genus. Although they range in size, they're all woody, and are composed of thin, spirally arranged, unarmed scales, that may have smooth or feathered edges.

SLIDE 48: pendent cones on trees (*P. abies*)

In several species, the cones hang heavily from the branches in dense terminal clusters, contributing greatly to the "weeping" appearance often associated with spruces.

SLIDE 49: bark (*P. engelmannii*)

The bark of the spruces is also distinctive. Generally, it's thin, scaly or flaky, and has a red or purple tinge when the outer bark is flaked off.

SLIDE 50: aphid gall (*P. sitchensis*)

Spruces are susceptible to a variety of damaging agents. The spruce gall aphid, whose infestations result in these cone-like structures, is one of the most apparent attackers, but there are a number of others as well. In addition, spruces may be substantially damaged by fire and wind because of their thin bark and shallow root systems.

SLIDE 51: tree (*P. pungens*)/list

Spruces are prized for a number of purposes. Although not often used for general construction lumber, spruce wood is light, strong, and easily worked. As a result, it sees extensive use as sounding boards in pianos and stringed instruments. In addition, the largest airplane ever built was constructed of spruce and was aptly named the "Spruce Goose". Economically, spruces are among the most important pulpwood species in the world. They're also widely planted for Christmas trees and for landscaping homes and streets.

SLIDE 52: map--distribution of principal species in North America

Six spruces are important in North America, three in the East and three in the West, although, as you can see, there's a good deal of overlap. In the East, red spruce, *Picea rubens*, occupies high elevations along the Appalachian Mountain chain, while black spruce, *Picea mariana* and white spruce, *Picea glauca*, span the northeastern United States and Canada. In the West, Engelmann spruce, *Picea engelmannii*, is the most widespread, occupying high elevations throughout most of the Rockies. Colorado blue spruce, *Picea pungens*, is limited to the central Rockies, while Sitka spruce, *Picea sitchensis*, hugs the coast from northern California to Anchorage, Alaska.

SLIDE 53: genus title

The next member of the pine family is Douglas-fir: *Pseudotsuga*. This genus has given botanists fits since its discovery in the late 1700's. Since then it's been classified as a true fir, a spruce, a pine, and a hemlock. Finally it's been placed in its own genus, but even that indicates contradiction, for the scientific name means "false hemlock" and the common name implies it's a fir.

SLIDE 54: map--worldwide distribution of genus

The Douglas-fir genus contains six species of trees scattered throughout western North America, southwestern China, Japan, and Taiwan. Two species are native to forests of western North America. In spite of what seems like a small range when compared with other genera, the Douglas-fir genus is extremely important commercially. Also, keep in mind that this map, and others in this series, indicate only the native ranges of the trees being discussed. Douglas-fir now grows over a much broader range due to planting by humans.

SLIDE 55: cone (*P. menziesii*)

Without doubt, Douglas-fir cones are their most characteristic feature. All members of the genus are easily identified by trident-shaped bracts protruding well beyond the thin, rounded cone scales. Douglas-fir cones hang down from the branches, and mature in one season.

SLIDE 56: buds (*P. menziesii*)

Douglas-fir buds are also characteristic of the genus. They're long, sharp-pointed, and covered with mahogany-colored, overlapping scales.

SLIDE 57: foliage/leaf scar (*P. menziesii*)

The needles of Douglas-firs are single, linear, and spirally arranged. Generally they're green above, with two rows of stomatal bloom on their undersides. Most often they're under 1 1/2" long. Their leaf scars are small and half-raised, resembling tiny ski-jumps.

SLIDE 58: young bark/old bark (both *P. menziesii*)

On young stems the bark is thin, tight, and smooth, except for frequent resin blisters. On mature trees, the bark is thick and deeply furrowed.

SLIDE 59: map--distribution of principal species in North America

The principal species of Douglas-fir in North America is *Pseudotsuga menziesii*, generally called Douglas-fir, but sometimes referred to as Oregon Douglas-fir to distinguish it from other species in the genus. This tree has one of the widest distributions of any in North America, stretching from northern British Columbia through Mexico, and from the Pacific Coast to the eastern slopes of the Rocky Mountains. The other North American species is bigcone Douglas-fir, *Pseudotsuga macrocarpa*. It grows in a limited range in southern California and is distinguished primarily by its large cones.

SLIDE 60: mature stand/old tree (both *P. menziesii*)

Douglas-fir is the premier timber species in North America, and one of the most important in the world. Individual trees are tall, straight, and fast growing. They're also capable of reaching immense sizes and old ages, commonly exceeding six feet in diameter and 750 years in age in old growth forests.

SLIDE 61: forest (*P. menziesii*)

In addition, they grow in vast, pure, relatively even-aged stands suitable for economical management. Historically many of these stands arose following large-scale disturbances such as wildfire and wind storms. Now, the ability to grow in even-aged stands is taken advantage of through clearcutting, the most common means of harvesting Douglas-fir.

SLIDE 62: stand (*P. menziesii*)/list

Douglas-fir trees are used in almost every imaginable way. The wood is used in all phases of construction from poles and pilings, to plywood and veneer, to dimensional lumber. In addition, Douglas-fir is far-and-away the leading Christmas tree in North America, and it's planted extensively as a lawn and street tree.

SLIDE 63: genus title

The next member of the Pine family is hemlock: *Tsuga*.

SLIDE 64: map--worldwide distribution of genus

Tsuga is a small genus of approximately 10 species located in cool, temperate regions of North America, China, and Japan. Four species are native to North America, two in the East and two in the West.

SLIDE 65: tree (*T. heterophylla*)

The growth form of hemlocks is perhaps their most distinguishing characteristic. The trees are broadly pyramidal, with branches that are horizontal but drooping. The terminal branch tips, and the leader of the main stem itself, often droop in a buggy-whip fashion. The main branches emerge irregularly from the trunk, rather than in a whorled pattern like the spruces, firs, and pines.

SLIDE 66: leaves on twig (*T. heterophylla*, *T. mertensiana*)/ leaf scars (*T. heterophylla*)

Hemlock leaves are single, linear, and spirally arranged, but often appear 2-ranked. They vary in length but are always less than 1 inch, and in most species alternate in a long-short pattern. The leaf scars are also distinctive, being small, diagonally raised bumps.

SLIDE 67: cones (*T. heterophylla*)

Hemlock cones are small, egg-shaped to oblong, and hang down from the twigs. The cone scales are thin, nearly round, and have smooth margins. They mature in one season.

SLIDE 68: map--distribution of principal species in North America

The principal hemlocks of North America are western hemlock, *Tsuga heterophylla*, which grows along the west coast of North America and in the Inland Empire of the Rocky Mountains, and eastern hemlock, *Tsuga canadensis*, which is widely distributed in the eastern United States. Mountain hemlock, *Tsuga mertensiana*, is a wide-ranging timberline species from California to Alaska. Although it's of little economic importance, it dominates vast areas of high elevation recreational land throughout the West.

SLIDE 69: trunks (*T. heterophylla*)/list

Hemlocks that reach sufficient size are used for general-purpose construction lumber, and for making high quality paper. Many species are used for landscaping, and the bark has long provided an important source of tannin for tanning leather.

SLIDE 70: genus title

The sixth, and final, member of the Pine family represented in North America is the fir genus: *Abies*. Note that members of *Abies* are often referred to as "true firs" to distinguish them from several other genera that are incorrectly called firs, such as Douglas-fir or Chinese fir.

SLIDE 71: map--worldwide distribution of genus

The genus *Abies* includes about 40 species of trees scattered widely throughout the cool, temperate regions of the Northern Hemisphere; nine are found in North America.

SLIDE 72: cone (*A. procera*, *A. concolor*)

The cones of true firs are probably their most distinctive feature. They're generally large--often 5 to 9 inches long and several inches in diameter--and they're borne upright near the tops of the trees. The cone scales are thin, but are often curved on the ends, giving the appearance of shoulders. In many species the bracts are longer than the scales, and have distinctive shapes.

SLIDE 73: cone spike (*A. procera*)

Both the cone scales and bracts are deciduous at maturity, leaving long, pointed spikes on the trees that often persist through winter. Having deciduous scales makes good sense, considering the difficulty seeds would otherwise have falling from an upright cone.

SLIDE 74: leaves (*A. procera*)/stomatal bloom (*A. Amabilis*)

The leaves of true firs are single, linear, and spirally arranged, although they may appear two-ranked or be massed on the upper surface of the twig in some species. Generally the needles are blunt at the tip, although on cone-bearing branches they may be sharply pointed. The location of the white stomatal bands on the needles is often a good clue for proper identification of species.

SLIDE 75: leaf scars (*Abies* spp.)

The leaf scars of all true firs are round and flat, a distinctive characteristic of the genus.

SLIDE 76: young bark with blisters (*A. amabilis*)/mature bark (*A. procera*)

The young bark on many species is thin, and dotted with blisters full of sticky, aromatic resin, an important defense mechanism used to repel burrowing insects and to wall off disease and infections within the tree. In addition, different types of resin emit different odors, a fact that greatly helps in distinguishing different species, varieties, and forms of true firs. Older bark varies by species, but ranges from thin to thick, and from blocky to deeply furrowed.

SLIDE 77: tree (*A. magnifica* var. *shastensis*)/word

Although the wood of true firs is soft, and therefore not extremely valuable for lumber, it is converted into lumber for many purposes. It's also important worldwide for pulpwood. Many products are made from leaf oils and from resin obtained from the bark--ranging from medicines to varnish to photographic cement for use in camera lenses and microscope slides. Because of their beautiful shapes and lush foliage, true firs are also prized for landscaping and as Christmas trees.

SLIDE 78: map--distribution of principal species in North America

Seven true firs are important in North America, although several more may be found here. As you can see, many of their ranges overlap; in addition, many of the species hybridize where they meet, making accurate identification a difficult proposition. The most widespread of the firs are found on the map on the left. The most important species native to the East is balsam fir, *Abies balsamea*, and it ranges all the way from the Atlantic to the Rockies. Subalpine fir, *Abies lasiocarpa*, has the widest range in the West, occupying high elevations throughout the Rockies. Grand fir, *Abies grandis*, shown in blue, grows throughout the Pacific Northwest and Inland Empire. White fir, *Abies concolor*, shown in yellow, occupies mountains of the arid Southwest. The map on the right shows three true firs that occupy smaller ranges along the West Coast. Pacific silver fir, *Abies amabilis*, ranges farthest north; noble fir, *Abies procera*, is confined to Oregon and Washington; and California red fir, *Abies magnifica*, spans the Sierra Nevada mountains of California.

SLIDE 79: Production Team Credit (no narration)

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SLIDE 80: FMC Credit (no narration)