

TITLE: TREES OF NORTH AMERICA: The Angiosperms--Part I
AUTHOR: Edward C. Jensen, Dendrologist, Dept. of Forest Management
PRODUCER: Forestry Media Center, Oregon State University, Corvallis, OR 97331
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OPERATING INSTRUCTIONS: Begin this program with slide "1" on the screen and the tape advanced through the clear leader.

The following slides are in vertical format: none.

NOTE: Genera within the following families are included in this slide-tape: Willow--Salicaceae; Birch--Betulaceae; Beech--Fagaceae

SLIDE 1: series title

In the next three slide-tape programs we'll look at the principal broadleaved trees of North America. In more technical language, these are referred to as angiosperms-- plants that bear their seeds inside ripened ovaries. Remember that the conifers, or gymnosperms, bear naked seeds, although they're often enclosed in a woody cone. But before we look at the angiosperms, let's refresh our memories about the structure of the plant kingdom.

SLIDE 2: taxonomic chart

You'll remember from the first slide-tape in this series that the plant kingdom is divided into three major groups: the algae and fungi, the vascular plants, and the bryophytes (the mosses, liverworts, and hornworts).

SLIDE 3: taxonomic chart

Further, the vascular plants are divided into ferns, horsetails, seed plants, club mosses, and psilotums.

SLIDE 4: taxonomic chart

The seed plants may again be divided--into the angiosperms and the gymnosperms. Angiosperms are the most common, most complex, and most widely distributed plant group on earth. They number approximately 250,000 species, compared with only about 600 species of gymnosperms. They include all the flowering plants in the world, regardless of whether they're trees, shrubs, vines, or herbs. They span the globe-- from the tropical rain forests, to the dryest deserts, to the arctic tundra. Some complete their life cycles in weeks, while others live thousands of years. The angiosperms can be further divided into two classes, the monocots and dicots. However, since there are no commercially important monocots native to North America, the remainder of these slide-tapes will focus exclusively on the dicots, a large and diverse group in itself.

SLIDE 5: family title

The dicots can also be divided into a number of smaller units. One of these consists of families whose flowers are borne in aments or catkins. This is the first group that we'll look at--and the first family that we'll consider is Willow, Salicaceae, sometimes called Poplar. Although the Willow family includes only two genera, it contains some 350 species of deciduous trees and shrubs widely distributed throughout the world. North America alone contains approximately 120 species in these two genera.

SLIDE 6: genus title

The first genus is the Willow family we'll look at is willow, *Salix*.

SLIDE 7: map--worldwide distribution of genus

Over 300 species of willows are scattered throughout the world, but most are concentrated in the cooler regions of the Northern Hemisphere. About 70 species are native to North America, but only half of these reach tree size. It's difficult to pinpoint the exact number of willow species since many of them hybridize and rehybridize, making accurate classification extremely difficult.

SLIDE 8: willows along water (*Salix* spp.)

One of the best ways to identify willows is by the habitat in which they grow.

Willows generally occur along water--either running water, as in streams or rivers, or standing water, as in lakes or bogs. They also occur on wet, cold, rocky sites near the limits of tree growth, both on mountain tops and in the Arctic tundra.

SLIDE 9: fruit/seed split (*Salix* spp.)

The fruits of willows are 2-valved capsules containing a number of cottony or silky-haired seeds. In spring, the air and water near slow moving streams and lakes are often covered with these cottony tufts.

SLIDE 10: leaves (*Salix* spp.)

The leaves of willows are quite variable because of the vast number of species, but they're always simple, alternate, and deciduous. In shape they're mostly elliptical to lanceolate with margins that are entire, or sometimes toothed.

SLIDE 11: flowers (*Salix* spp.)

Willow flowers occur in aments that may either be elongated or compact. It's the compact type that most of us learn to identify as pussy willows when we're 5 or 6 years old. Willows are dioecious, so you'll only find fruits on female plants.

SLIDE 12: tree (*Salix* spp.)/list of products

Because of their generally small, shrubby growth forms, willows have historically had little value commercially. In recent years, however, scientists have been experimenting with willows as a source of bio-energy. Because of their fast growth rates and vegetative propagation, willows can be cultivated on fast, highly productive rotations, furnishing fuels to produce electricity. When it does reach merchantable size, the wood of willow is tough and springy, so it is often converted into manufactured products like polo balls, cricket bats, and steamer paddles. Wicker furniture and baskets are often made from the long, stringy twigs. Willows are also an important source of food and shelter for a variety of wildlife, and play a very important role in limiting erosion along streams.

SLIDE 13: map--distribution of principal species in North America

Black willow, *Salix nigra*, is the only important willow in North America that reaches tree size. It grows on wet sites across the eastern half of the United States.

SLIDE 14: genus title

The second genus in the Willow family that we'll consider is *Populus*. Two common names are used interchangeably: poplar and cottonwood. Some members of the genus are also called aspens.

SLIDE 15: map--worldwide distribution of genus

Like the willows, cottonwoods occupy most of the Northern Hemisphere, with approximately 35 species scattered across the hemisphere. About 10 species are native to North America and a number of others have been introduced, especially for use in shelterbelts and as ornamentals. Unlike the willows, nearly all the cottonwoods are fast-growing trees capable of reaching very large sizes. Like the willows, cottonwoods are most commonly found along stream banks, especially in the arid West, where they may be the only trees for miles around.

SLIDE 16: fruit (*P. trichocarpa*)

One of the best identifying characteristics of cottonwoods is their fruit, which are small, round or tear-shaped capsules, each containing a number of tufted seeds. In spring when they ripen, these seeds literally fill the air with cottony puffs, giving rise to the name "cottonwood". Like the willows, cottonwoods are dioecious, and bear male and female flowers on separate plants.

SLIDE 17: bark (*P. tremuloides*/*P. trichocarpa*)

Bark is also a good clue to the cottonwoods, although it's not fool-proof. At an early age the bark is generally smooth in texture, and cream, tan, or light green in color. As the bark ages, it's often broken by numerous lenticels and dark lesions, finally giving way to a more normal blocky appearance. Some species, however, never exhibit the initial smooth bark phase.

SLIDE 18: leaves (various species)

The leaves of the cottonwoods are simple, alternate, and deciduous. Generally they're triangular or egg-shaped, and their margins range from entire to coarsely toothed to lobed.

SLIDE 19: back of leaves (*P. trichocarpa*)

Often the leaves will be white or bronze colored on the back, and will have long, flattened petioles. Together these characteristics make it very apparent when wind is moving through the crowns of cottonwoods, often giving the appearance of trembling or quaking.

SLIDE 20: tree (*P. trichocarpa*)/list

Cottonwoods are generally large, fast-growing, short-lived trees. Their wood is soft, lightweight, and high in water content, so it has little commercial value except for minor manufactured products. It is, however, very important for pulpwood. In addition, cottonwoods are important ornamentals, especially in shelterbelts where their fast growth and uniform size are advantages.

SLIDE 21: map--distribution of principal species in North America

There are a number of important cottonwoods in North America, each with large and overlapping ranges. Black cottonwood, *Populus trichocarpa* occupies stream banks and moist sites throughout western North America. Eastern cottonwood, *Populus deltoides*, does the same throughout the eastern United States. Quaking aspen, *Populus tremuloides*, and balsam poplar, *Populus balsamifera* share ranges across the northern United States and Canada--with quaking aspen dropping farthest south through much of the mountainous West.

SLIDE 22: family title

The next family we'll consider is Birch, *Betulaceae*, which contains 6 genera and approximately 100 species of deciduous trees and shrubs scattered widely throughout the cooler regions of the Northern Hemisphere. Five genera are represented in North America, but only the birches and alders contain tree-sized species. Like the willows and cottonwoods, all members of the Birch family bear their flowers in aments.

SLIDE 23: genus title

The first member of the Birch family that we'll look at is birch, *Betula*.

SLIDE 24: map--worldwide distribution of genus

There are approximately 40 species of birch scattered across most of the Northern Hemisphere above the Tropics. About 15 species occur in North America alone. Most are early successional species, invading sites after disturbances like fire or logging.

SLIDE 25: bark (*B. alleghaniensis*/*B. papyrifera*)

Bark is perhaps the best clue to the birches. It varies in color from pure white to yellow or orange, to dark brown or black. Generally it's very thin and smooth, and often it exfoliates in paper-thin sheets. Often it has prominent horizontal lenticels.

SLIDE 26: fruit (*Betula* spp.)

The fruits of birches are elongated semi-woody strobiles with deciduous scales. When mature, these strobiles fall apart at a touch, as opposed to those of their close relatives the alders, which remain intact, often for a year or more. The seeds of birches are tiny, laterally-winged nutlets, capable of flying great distances or floating on the water.

SLIDE 27: tree with drooping form (*Betula* spp.)

The terminal twigs of birches are long, thin, and floppy, which often gives the trees a drooping or weeping appearance.

SLIDE 28: leaves (*Betula* spp.)

The leaves of all birches are alternate, simple, and deciduous. In shape, they're generally ovate to rectangular, with long, tapering tips. Their margins may be either singly or doubly serrate.

SLIDE 29: tree (*Betula* spp.)/list

Birches are trees of many uses. Although too soft for general construction use, the wood is excellent for manufactured products such as furniture, spoons, wooden barrels and clog shoes. In the northern part of their range, where they're the principal hardwoods, they're an important source of firewood for humans and a primary source of food for wildlife. Because of their handsome bark, birches are very important ornamental and shade trees throughout the world, and of course, the native American Indians of the Lake States and New England used the waterproof bark in making their famous birch bark canoes.

SLIDE 30: map--distribution of principal species in North America

In North America there are two principal species of birch: paper birch, *Betula papyrifera*, which spans Canada and the northern United States, and yellow birch, *Betula alleghaniensis*, which grows throughout northeastern United States and southeastern Canada. Their ranges overlap significantly in the area shown in brown. Both are valued commercially and for the great beauty they add to the mixed conifer-hardwood forests in which they grow.

SLIDE 31: genus title

Next we'll look at the other North American genus in the Birch family: alder, *Alnus*.

SLIDE 32: map--worldwide distribution of genus

There are about 40 species of alder scattered throughout the world, making it similar in size to the birch genus although alders are far less important commercially. Most species are concentrated in the cool, temperate regions of the Northern Hemisphere, but several occur throughout the Andes of South America. About 15 species are native to North America, but most of these are shrubs rather than trees.

SLIDE 33: fruit (*A. rubra*)

The woody strobiles of alders are perhaps their most distinguishing characteristic. These tiny, egg-shaped strobiles look for all the world like miniature pine cones, and because they persist throughout most of the year, often prove a great help in identifying the alders. The seeds themselves are small, brown, laterally-winged nutlets, like those of the birches, and are capable of flying great distances.

SLIDE 34: flowers (*A. rubra*)

Like the birches, both male and female flowers are borne in drooping aments, which generally form in the fall and release pollen very early in the spring.

SLIDE 35: twigs (*A. rubra*)

The twigs of alders are slender to moderately stout, and tend to be reddish in color. Most species have stalked buds covered by 2 or 3 valve-like scales.

SLIDE 36: leaves (*A. rubra*)

The leaves of alders are simple, alternate and deciduous. They're oval or ovate in shape, and generally have serrate or doubly serrate margins. The leaves of most species would fit nicely in the palm of your hand, although some grow up to 9" long.

SLIDE 37: tree (*A. rubra*)/list

With the exception of a few species, alders seldom reach commercial size. Locally they're used for a number of minor manufactured products, especially toys and novelties, and they're seeing increased use as the structural component in furniture. Alders also are valuable for firewood, and because their roots house a nitrogen-fixing bacteria, are important site improvers. Alders have relatively little value horticulturally.

SLIDE 38: map--distribution of principal species in North America

Red alder, *Alnus rubra*, is the only tree-sized alder native to North America, growing in great abundance on cut-over and burned lands along the West Coast of the continent.

SLIDE 39: family title

The next family we'll look at is Beech, Fagaceae. There are only 8 genera within the Beech family, but nearly 900 species, widely scattered throughout the temperate and tropical regions of the world. Five of these genera contain tree-sized members in North America: oak, beech, chestnut, chinkapin, and tanoak. Again, all members of this family bear their flowers in aments.

SLIDE 40: genus title

The largest and most important genus in the Beech family is oak, *Quercus*.

SLIDE 41: map--worldwide distribution of genus

Oak is one of the largest and most diverse genera of trees in the entire world, and is far-and-away the most important group of hardwoods found in the Northern Hemisphere. It's generally accepted that there are 200-300 species of oak, but some put the upper limit as high as 700 when all hybrids are included. Oaks occur primarily in the temperate regions of the Northern Hemisphere, but there are outlying populations in South America, Australia, and New Zealand. In North America alone there are 60-70 species, with an additional 70 or so if hybrids are included.

SLIDE 42: variety of leaves and acorns

Although there's much diversity in the genus, all oaks share several characteristics. Their leaves are always simple and alternate, and their fruits are always acorns. Beyond that, however, their leaves may be deciduous or persistent--and as you can see, their margins vary considerably. In addition, their acorns differ widely--in size, shape, and the type of cap they have.

SLIDE 43: chart

Two subgenera are commonly used to help classify the North American oaks: the white oak subgenus, and the red or black oak subgenus. Although there's little disagreement about the concept of subgroups, there's much controversy over which species go where. No matter which features are chosen to split the groups, there are always a few species that defy categorization.

SLIDE 44: wood cross section (white oak/red oak)

The most accurate way of dividing the oaks into these two groups seems to be by a cross section of their wood. In the white oaks, shown on the left, the small summerwood pores are thin-walled and slightly angular in the cross section. In the red or black oak groups shown on the right, the summerwood pores have thicker walls and are round.

SLIDE 45: variety of red oak leaves

There are a number of more easily observable characteristics that can generally put us in the right category, but they're not as reliable as wood anatomy. For example, members of the red or black oak subgenus generally have lobed leaves, in which each lobe is tipped by one or several bristle-like hairs. If the leaves are unlobed, then the bristles occur along the outer margins of the leaves.

SLIDE 46: variety of white oak leaves

The white oaks, on the other hand, do not have bristles--but again the leaves may be lobed or unlobed.

SLIDE 47: white oak/red oak characteristics

Acorns can also be used to separate the two groups. The red oak/black oak acorns take two seasons to mature, have fuzzy inner caps, and have bitter tasting seeds--while the acorns of white oaks mature in one season, have smooth inner caps, and have sweet-tasting seeds.

SLIDE 48: tree (*Quercus* spp.)/list split

Oaks are used for an amazing variety of purposes. They furnish more lumber than any other group of hardwoods in North America. Their wood is hard and durable, but also has beautiful grain and color, making it useful for everything from pallets to fine furniture and hardwood flooring. Oak also makes excellent firewood. Lesser products include cork, which comes from the bark of two Mediterranean species, tannins for curing leather, and acorns, some of which are suitable for both human and animal consumption. In addition, the acorns are a very important food source for many wildlife species.

SLIDE 49: eastern oak forest

The oaks of eastern North America frequently form dense stands, stretching as far as the eye can see. White oaks and red oaks grow side-by-side, mixed with hickories and a variety of other species, depending on location. These forests comprise the single largest forest type in the United States, occupying over 20% of the commercial forest land.

SLIDE 50: western oak forest (*Q. garryana*)

The oaks of western North America most often grow in open, park-like stands, interspersed with grasses and low growing shrubs. Compared with the eastern oaks, they're much smaller, and therefore less highly valued for wood products. Many of the western species have shrubby growth forms, small evergreen leaves, and scattered, narrow ranges confined to the arid Southwest.

SLIDE 51: map--distribution of principal species in North America

There are many species of white oak native to North America. Most occur east of the Great Plains and share nearly identical ranges. Eastern white oak, *Quercus alba*, shown in brown, is one of the most widespread and important of these eastern oaks. Oregon white oak, *Quercus garryana*, is the principal western white oak, but its range is much smaller than any of its eastern counterparts.

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

There are also many important species of red and black oak in North America, again mostly occurring east of the Great Plains. Ranging across much of the eastern U.S. are northern red oak, *Quercus rubra*, black oak, *Quercus velutina*, scarlet oak, *Quercus coccinea*, and pin oak, *Quercus palustris*. Particularly important in the southeastern United States are southern red oak, *Quercus falcata*, Shumard oak, *Quercus shumardii*, willow oak, *Quercus phellos*, and water oak, *Quercus nigra*. West of the Rockies, California black oak, *Quercus kelloggii* is the principal oak in this group but 15 or 20 other species occupy scattered sites throughout the arid southwest. Although not important individually, these species play a major role in watershed protection and in providing wildlife habitat.

SLIDE 53: genus title

The second genus we'll look at in the Beech family bears the family name: beech, *Fagus*.

SLIDE 54: map--worldwide distribution of genus

There are approximately 10 species of beech scattered throughout the temperate regions of the Northern Hemisphere. Only one of these species is native to North America.

SLIDE 55: beechnuts (*F. grandiflora*)

Once again, fruits are probably the single best identifying characteristic for the beeches. Beechnuts, as they're called, are small triangular nuts borne in spiny burrs. These nuts come two or three to the burr and are eaten not only by humans, but in Europe are used to fatten hogs and are converted to vegetable oil. Because they're unwinged, and heavy, beechnuts seldom fall far from the parent tree, and must depend on animals for long-distance dispersal.

SLIDE 56: bark/twig split (both *F. grandiflora*)

Both the bark and twigs of beeches are distinctive. Their bark is smooth, thin and bluish-grey in color. In some individuals it has long, raised striations that resemble human muscles. The terminal buds of beeches are also good identifying characteristics. They're very long, thin, and tapered--some would say cigar-shaped--and have prominent shingle-like scales.

SLIDE 57 leaves (*Fagus* spp.)

The leaves of beeches are simple, alternate, and deciduous. In shape they're normally ovate to elliptical, and the margins may be entire or toothed, often tipped with soft spines. Their size is generally smaller than a human hand. Although their color is normally deep, lustrous green, several varieties have deep red or purple leaves.

SLIDE 58: tree (*F. grandiflora*)/list

Beech wood, which is slow growing and quite dense, has many uses. Its strength and toughness make it prized for manufactured products such as wedges, plane blocks, furniture, and flooring. It's an important ornamental tree throughout its native range, and it's valued for nut production.

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

American beech, *Fagus grandiflora*, is the only beech native to North America and is found on well-drained bottomlands throughout the eastern United States and southeastern Canada.

SLIDE 60: genus title

The third genus in the Beech family we'll look at is chestnut, *Castanea*.

SLIDE 61: map--worldwide distribution of genus

Chestnut is a small genus comprised of about 10 species scattered throughout the temperate Northern Hemisphere. Only one of these species is native to North America.

SLIDE 62: fruit (on branch/close-up) (both *C. dentata*)

The fruits of the chestnuts are the best clue to their identity. From the outside you see a golden brown burr covered with hundreds of needle-like spines. On the inside, you'll find from one to three lustrous brown nuts. These nuts are edible and are considered delicacies by many. In fact, each Christmas we hear the popular song about "chestnuts roasting on an open fire. "

SLIDE 63: leaves (*C. dentata*)

The leaves of chestnuts are much like the leaves of beech--they're simple, alternate, and deciduous. Their shape is elliptical to lanceolate, and their margins are coarsely serrate, often tipped with soft spines.

SLIDE 64: tree (*C. dentata*)

Chestnuts are fast-growing trees, often reaching 75-100 feet tall and up to 7 feet in diameter. Their wood is highly prized as lumber because of its natural durability and straight grain. Earlier in this century, when it was more available, it was used in almost every conceivable way--including shingles and siding for homes, doors and paneling, poles, ship masts and railroad ties. Chestnuts are also highly prized as ornamental shade trees and for the nuts they produce.

SLIDE 65: map--distribution of principal species in North America

American chestnut, *Castanea dentata*, is the only chestnut native to North America, and once ranged throughout most of the eastern United States. Up until the early 1900's American chestnuts comprised 25 percent of the eastern hardwood forest.

SLIDE 66: dead trees (*C. dentata*)

Unfortunately, in 1904 a shipment of logs from eastern Asia introduced a fungal blight into the United States that attacked our native chestnut. Within a span of 50 years, American chestnuts were virtually eliminated from both our forests and our cities. The gray snags in this slide are the remnants of a stand once dominated by chestnuts. Several research programs in prominent North American universities are actively seeking a solution to this devastating blight. Two of the most promising avenues currently under investigation include selective breeding and the introduction into infected trees of a sick form of the fungus itself, which causes the disease to die a natural death before it kills the tree.

SLIDE 67: genus title

The fourth genus in the Beech family we'll look at is chinkapin, *Castanopsis*.

SLIDE 68: tree (*C. chrysophylla*)/word

Chinkapin is another of those genera currently in a taxonomic limbo. It, along with the tanoaks, is commonly regarded as an evolutionary link between the oaks and the chestnuts--and as such, it shares characteristics with both those genera. Depending on which author one chooses to accept, chinkapin includes somewhere between 30 and 120 species of evergreen trees and shrubs, most of which are located in China and southeast Asia. Only one or two species are native to North America.

SLIDE 69: fruit and seed (both *C. chrysophylla*)

The fruit of the chinkapins is similar to that of the chestnuts--golden brown, spiny burrs enclosing from 1-3 shiny brown nuts.

SLIDE 70: flowers (*C. chrysophylla*)

In most species the male and female flowers occur separately on the same tree. In such cases, the male flowers most often occur in long, up curved aments, while the female flowers occur singly or in small clusters.

SLIDE 71: upper and lower leaf surface (*C. chrysophylla*)

The leaves are simple, alternate, and persistent. In the North American species, they're lanceolate, have margins that are entire and revolute, and have golden- colored undersides.

SLIDE 72: map--distribution of principal species in North America

The principal North American species, golden chinkapin, *Castanopsis chrysophylla*, grows along the coasts of Washington, Oregon, and California, where it ranges from a shrub to a large tree, depending on where you happen to encounter it. Regardless, it has little commercial value other than as a nuisance to foresters who need to control it in order to grow more desirable species.

SLIDE 73: genus title

The fifth and final genus that we'll look at in the Beech family is tanoak, *Lithocarpus*.

SLIDE 74: tree (*L. densiflorus*)/word

Like the chinkapins, the tanoaks are considered a link between the oaks and the chestnuts. The number of species in the genus ranges from 100-300, again depending on author, and consists of evergreen trees and shrubs concentrated almost exclusively in southeast Asia. In fact, only one species, *Lithocarpus densiflorus*, grows outside this region, and it's native to Oregon and California.

SLIDE 75: acorn (*L. densiflorus*)

The fruit of the tanoaks is an acorn that is partially or wholly surrounded by a fuzzy cap.

SLIDE 76: flowers (*L. densiflorus*)

The flowers are similar to those of the chestnuts and chinkapins--male flowers occur in long upright aments, while female flowers occur singly or in small clusters. In some flowers, the sexes are mixed together.

SLIDE 77: top and bottom leaf surface (*L. densiflorus*)

The leaves of the North American species, *Lithocarpus densiflorus*, are simple, alternate, and persistent. Their margins are normally toothed but may be entire, their shape is oblong, and their color is light green above and bluish white below.

SLIDE 78: tree (*L. densiflorus*)/list

Tanoak has little commercial value in North America, although its bark contains appreciable amounts of tannins and therefore once played a major role in the leather industry. It's also a problem for reforestation foresters on the West Coast of North America because of its shade tolerance and ability to sprout vigorously and repeatedly.

SLIDE 79: Author Credit (no narration)

Dendrologist: Edward C. Jensen

Media Specialist: Dale Conley

Artist: Don Poole

SLIDE 80: FMC Credit (no narration)

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