

## GC 2008 Brainstorm on Theme

“What wrath, conflict, hostility and bitterness are found everywhere... Who are they that pursue what makes for peace and for mutual up-building? O God! How long? Even if the harvest has not yet arrived, become a part of the first fruits. Do you love your neighbor as yourself?” - *John Wesley, end of Discourse Two on the Sermon on the Mount*

“... it is grace, nothing but grace that we are allowed to live in community with Christian sisters and brothers... Only in Jesus Christ are we one, only through him are we bound together... [The communion] of the Lord’s Supper is the superlative fulfillment.” - Bonhoeffer, *Life Together*

(both the above quotes used by Bishop Weaver in his Council of Bishops address)

“Grace Place” - the place of theological and spiritual self-understanding

“Embrace Place” - the place of relational and covenantal understanding

“Run-the-Race Place” - the place of missional and Let’s-make-a-difference understanding

### *Global Gathering IV worship use of plants/trees*

**Bamboo** Bamboo provides many essential articles for people who live in tropical countries, especially Asian lands. It is used in the construction of shelter, for food, for boats, for paper, etc. Experts who compared the strength of laminated (layered) bamboo with soft steel found that the bamboo's breaking point nearly equaled that of the steel. We pray this morning for peace and for the resourcefulness and strength—like that of the bamboo we see in our midst—to accomplish this mission.

**Seeds** (people give each other seeds... “planting” them... children bring seedlings)

Pablo Picasso said, “Every act of creation is first of all an act of destruction.” Of course, this wasn’t a new thought, for Jesus said we must die to the old in order to be born anew. The symbol of the seed used in this morning’s worship expresses this need to break open and shed the old in order for a supple new plant to emerge. The “seeds” of hope, healing, wholeness and renewal are in our grasp but our mission together is to do that which is necessary to nurture those seeds.

The communities represented in “North America and Europe” - the region whose partnership we celebrate today are numerous and diverse. The churches of this region are flowering because of the immigration of peoples from all over the world. Being “together” in mission requires us to grow together without choking one another’s growth. We pray this morning for healing - confessing that not all have been nurtured and given room and resources to flourish. And we ask for wholeness - that we may become channels of God’s peace.

**Palms** To be in mission together is to journey paths of righteousness in the face of death and sorrow. How is that we move into an unknown future in an uncertain world? We do it together. We begin our Palm Sunday procession this morning at the Civil Rights Museum as a symbol of our solidarity with all those who have walked together for justice and peace through the ages and across geographies. Our pilgrimage is one with the saints, those who journeyed with Jesus and all pilgrims who have claimed the courage to “walk on” in the name of Jesus.

As well as being the plant which those early pilgrims waved along Jesus' journey, palms are one of the most ancient plants on earth. May the palm pins given to each person as a symbol of our dedication to service remind us of the enduring love and presence of Christ who accompanies us on the journey toward the reign of God.

**Rainforest and desert** Our common baptism is one of the most powerful signs of our mission together as the Body of Christ. Through our baptism we are empowered to bring about the reign of God. The power to do so is magnified when we come together. Together we can do more than we can think or imagine on our own. And so tonight we celebrate the fullness of who we are *together*. In remembering our baptism, we will remember that all things are possible through God who sustains us. We acknowledge that we share a Gospel vision—a vision enriched by the diversity of expressions of it. This is embodied in the cacophany of rhythms we will hear at the beginning of our worship which converge into one rhythm as they reach the center—the heartbeat of the Creator God.

We celebrate our partnership with the churches of Africa this night. Africa is a land of striking contrasts and great natural wonders. In the tropical rain forests of western and central Africa, the towering treetops form a thick green canopy. The world's largest desert, the Sahara, stretches across northern Africa, yielding sometimes far less than 7 inches of rain per year. Africa also has the world's longest river—the Nile. It flows more than 4,000 miles through northeastern Africa. And so we join our voices with those from a land where the possibility of extreme drought or flood exists—praising God for the living water of the Spirit which renews and restores the earth and all its people. We will dare the kind of over-flowing joy which is part of the rhythms of the churches of Africa.

**Flowering Lei's** As we gather this evening, we are joined by the “cloud of witnesses” in the images of people gathering projected on the screens. Whenever Christians gather, they are not alone in time or place but a part of the mystical Body of Christ which knows no bounds. Being together in mission this night is embodied in our gathering around the table of Jesus. We remember the radical nature of the hospitality and presence of Christ and we proclaim that this is how we shall be for each other and for the world. It is appropriate that we celebrate our partnership with the churches of the South Pacific with Holy Communion because, as anyone who has ever been blessed enough to visit them knows, hospitality in this region is manifest in the piling high of food for guests. May we know the abundance of God's love in our sharing this simple meal.

The flower lei's are a special traditional of many in this region. .... (etc.)

**[others...]**

*roots*

*mountain pines... shedding, cones*

*eucalyptus - fast-growing but not strong*

*redwoods - old, long-living*

*ginko - see ginko prayer*

*biblical refs:*

*“oaks of righteousness”*  
*“cedars of Lebanon”*  
*“oaks of Mamon”*  
*fruit trees*  
*palm tree*  
*apple tree*  
*almond tree*  
*sycamore tree*  
*oive tree*  
*(see biblical search below)*

Look at GTU “TREES”  
Eco-theology

### **Biblical passages**

**Isaiah 60: 19** The sun shall no longer be  
your light by day,  
nor for brightness shall the moon  
give light to you by night; †  
but the LORD will be your everlasting light,  
and your God will be your glory.  
20 Your sun shall no more go down,  
or your moon withdraw itself;  
for the LORD will be your everlasting light,  
and your days of mourning shall be ended.  
21 Your people shall all be righteous;  
they shall possess the land forever.  
**They are the shoot that I planted, the work of my hands,  
so that I might be glorified.**  
22 The least of them shall become a clan,  
and the smallest one a mighty nation;  
I am the LORD;  
in its time I will accomplish it quickly.

**Isaiah 61** The spirit of the Lord GOD is upon me,  
because the LORD has anointed me;  
he has sent me to bring good news to the oppressed,  
to bind up the brokenhearted,

to proclaim liberty to the captives,  
and release to the prisoners;  
2 to proclaim the year of the LORD's favor,  
and the day of vengeance of our God;  
to comfort all who mourn;  
3 to provide for those who mourn in Zion—  
to give them a garland instead of ashes,  
the oil of gladness instead of mourning,  
the mantle of praise instead of a faint spirit.  
They will be called **oaks of righteousness**,  
the planting of the LORD, to display his glory.  
4 They shall build up the ancient ruins,  
they shall raise up the former devastations;  
they shall repair the ruined cities,  
the devastations of many generations.

**Jeremiah 17: 7** Blessed are those who trust in the LORD,  
whose trust is the LORD.  
8 They shall be like a tree planted by water,  
sending out its roots by the stream.  
It shall not fear when heat comes,  
and its leaves shall stay green;  
in the year of drought it is not anxious,  
and it does not cease to bear fruit.

**Genesis 13:14** The LORD said to Abram, after Lot had separated from him, "Raise your eyes now, and look from the place where you are, northward and southward and eastward and westward; 15 for all the land that you see I will give to you and to your offspring † forever. 16 I will make your offspring like the dust of the earth; so that if one can count the dust of the earth, your offspring also can be counted. 17 Rise up, walk through the length and the breadth of the land, for I will give it to you." 18 So Abram moved his tent, and came and **settled by the oaks † of Mamre**, [*ancient sacred place associated with Abraham*] which are at Hebron; and there he built an altar to the LORD.

**Genesis 18** The LORD appeared to Abraham † by the **oaks † of Mamre**, as he sat at the entrance of his tent in the heat of the day. 2 He looked up and saw three men standing near him. When he saw them, he ran from the tent entrance to meet them, and bowed down to the ground. 3 He said, "My lord, if I find favor with you, do not pass by your servant. 4 Let a little water be brought, and wash your feet, and **rest yourselves under the tree**. 5 Let me bring a little bread, that you may refresh yourselves, and after that you may pass on—since you have come to your servant." So they said, "Do as you have said." 6 And Abraham hastened into the tent to Sarah, and said, "Make ready quickly three measures † of choice flour, knead it, and make cakes." 7 Abraham ran to the herd, and took a calf, tender and good, and gave it to the servant, who hastened to prepare it. 8 Then he took curds and milk and the calf that he had prepared, and set it before them; and he stood by them **under the tree while they ate**. [*continues... declaration of Sarah's pregnancy*]

**Zechariah 11** Open your doors, O Lebanon,  
so that fire may devour your **cedars!**

**2 Wail, O cypress, for the cedar has fallen,  
for the glorious trees are ruined!**

**Wail, oaks of Bashan,  
for the thick forest has been felled!**

3 Listen, the wail of the shepherds,  
for their glory is despoiled!

Listen, the roar of the lions,  
for the thickets of the Jordan are destroyed!

**11.1-3: The fall of the tyrants.** *Cedars, shepherds, and lions* refer to the rulers. **1:** Lebanon's cedars were proverbial symbols of strength (Ezek 31.2-9). **2:** *Oaks of Bashan*, Isa 2.13; Ezek 27.6; compare Ps 22.12; Am 4.1. **3:** *Thickets of the Jordan*, Jer 12.5 n.

**Psalm 80: 8** [*entire psalm is prayer for restoration*]

You brought a vine out of Egypt;  
you drove out the nations and planted it.

9 You cleared the ground for it;  
**it took deep root and filled the land.**

**10 The mountains were covered with its shade,  
the mighty cedars with its branches;**

**11 it sent out its branches to the sea,  
and its shoots to the River.**

12 Why then have you broken down its walls,  
so that all who pass along the way pluck its fruit?

13 The boar from the forest ravages it,  
and all that move in the field feed on it.

**Psalm 104: 14** [*entire psalm is celebration of the Creator God*]

You cause the grass to grow for the cattle,  
and plants for people to use, †

to bring forth food from the earth,  
15 and wine to gladden the human heart,  
oil to make the face shine,  
and bread to strengthen the human heart.

**16 The trees of the LORD are watered abundantly,  
the cedars of Lebanon that he planted.**

**17 In them the birds build their nests;  
the stork has its home in the fir trees....**

**Psalm 148: 7**

Praise the LORD from the earth,  
you sea monsters and all deeps,  
8 fire and hail, snow and frost,  
stormy wind fulfilling his command!

**9 Mountains and all hills,  
fruit trees and all cedars!**

10 Wild animals and all cattle,  
creeping things and flying birds!

11 Kings of the earth and all peoples,  
princes and all rulers of the earth!  
12 Young men and women alike,  
old and young together!

13 Let them praise the name of the LORD,  
for his name alone is exalted;  
his glory is above earth and heaven.  
14 He has raised up a horn for his people,  
praise for all his faithful,  
for the people of Israel who are close to him.  
Praise the LORD!

**Ezekiel 31.1-18: Allegory of the cedar** (compare ch 17). Date, June 21, 587 B.C. Ezekiel uses an ancient Babylonian myth to emphasize that, as with Tyre (28.1-5), the cause for Egypt's fall was pride (and political unreliability, 29.6-9). **4:** *The deep* (Hebrew "tehom;" compare Tiamat, the Babylonian dragon of the watery chaos; see Isa 51.9-11 n.), ancient mythological opponent of the gods, nourished the tree so that it reached into the heavens and sheltered all life. **7-9:** The splendor of the great cedar, Egypt, was incomparable (28.11-19), surpassing those *in the garden of God* (thus rivaling God, Gen 11.1-9). **31.10-18:** But God will cut it down; the life it sheltered will be dispersed, and it will go down to Sheol (28.8-10) where it will lie not with the honored dead, *the trees of Eden*, but with those who died untimely, violent, or dishonorable deaths. Later the great world tree, or tree of life, became a motif in Near Eastern (e.g. Persian) apocalypticism.

**Genesis 1: 29** God said, "See, I have given you every plant yielding seed that is upon the face of all the earth, and **every tree with seed in its fruit**; you shall have them for food. **30** And to every beast of the earth, and to every bird of the air, and to everything that creeps on the earth, everything that has the breath of life, I have given every green plant for food." And it was so. **31** God saw everything that he had made, and indeed, it was very good. And there was evening and there was morning, the sixth day.

**Genesis 3** Now the serpent was more crafty than any other wild animal that the LORD God had made. He said to the woman, "Did God say, 'You shall not eat from **any tree in the garden**'?" **2** The woman said to the serpent, "We may eat of the fruit of the trees in the garden; **3** but God said, 'You shall not eat of the fruit of the tree that is in the middle of the garden, nor shall you touch it, or you shall die.' " **4** But the serpent said to the woman, "You will not die; **5** for God knows that when you eat of it your eyes will be opened, and you will be like God, † knowing good and evil." **6** So when the woman saw that the tree was good for food, and that it was a delight to the eyes, and that the tree was to be desired to make one wise, she took of its fruit and ate; and she also gave some to her husband, who was with her, and he ate. **7** Then the eyes of both were opened, and they knew that they were naked; and they sewed fig leaves together and made loincloths for themselves.

### **Psalm 52: 8**

But I am like a **green olive tree**  
in the house of God.  
I trust in the steadfast love of God  
forever and ever.

9 I will thank you forever,  
because of what you have done.  
In the presence of the faithful  
I will proclaim † your name, for it is good.

**Psalm 92: 12** The righteous flourish like the palm tree,  
and grow like a cedar in Lebanon.

13 They are planted in the house of the LORD;  
they flourish in the courts of our God.

14 In old age they still produce fruit;  
they are always green and full of sap,

15 showing that the LORD is upright;  
he is my rock, and there is no unrighteousness in him.

### **Psalm 120**

1 In my distress I cry to the LORD,  
that he may answer me:

2 “Deliver me, O LORD,  
from lying lips,  
from a deceitful tongue.”

3 What shall be given to you?  
And what more shall be done to you,  
you deceitful tongue?

4 A warrior’s sharp arrows,  
with glowing coals of **the broom tree!** [*produces a specially hot long-buring fire*]

5 Woe is me, that I am an alien in Meshech,  
that I must live among the tents of Kedar.

6 Too long have I had my dwelling  
among those who hate peace.

7 I am for peace;  
but when I speak,  
they are for war.

### **Ecclesiastes 11**

Send out your bread upon the waters,  
for after many days you will get it back.

2 Divide your means seven ways, or even eight,  
for you do not know what disaster may happen on earth.

3 When clouds are full,  
they empty rain on the earth;

**whether a tree falls to the south or to the north,  
in the place where the tree falls, there it will lie.**

4 Whoever observes the wind will not sow;  
and whoever regards the clouds will not reap.

5 Just as you do not know how the breath comes to the bones in the mother’s womb, so you do not know the work of God, who makes everything.

6 In the morning sow your seed, and at evening do not let your hands be idle; for you do not know which will prosper, this or that, or whether both alike will be good.

### **Song of Solomon 7**

6 How fair and pleasant you are,  
O loved one, delectable maiden! †

7 You are stately † as a palm tree,  
and your breasts are like its clusters.

**8 I say I will climb the palm tree  
and lay hold of its branches.**

Oh, may your breasts be like clusters of the vine,  
and the scent of your breath like apples,

9 and your kisses † like the best wine  
that goes down † smoothly,  
gliding over lips and teeth. †

### **Hosea 14: 4**

I will heal their disloyalty;  
I will love them freely,  
for my anger has turned from them.

5 I will be like the dew to Israel;  
he shall blossom like the lily,  
he shall **strike root like the forests of Lebanon.** †

**6 His shoots shall spread out;  
his beauty shall be like the olive tree,  
and his fragrance like that of Lebanon.**

7 They shall again live beneath my † shadow,  
they shall flourish as a garden; †  
they shall blossom like the vine,  
their fragrance shall be like the wine of Lebanon.

### **Matthew 3: 7** *[proclamation of John the Baptist]*

But when he saw many Pharisees and Sadducees coming for baptism, he said to them, “You brood of vipers! Who warned you to flee from the wrath to come? 8 Bear fruit worthy of repentance. 9 Do not presume to say to yourselves, ‘We have Abraham as our ancestor’; for I tell you, God is able from these stones to raise up children to Abraham. 10 Even now the ax is lying at the root of the trees; every tree therefore that does not bear good fruit is cut down and thrown into the fire.

11 “I baptize you with † water for repentance, but one who is more powerful than I is coming after me; I am not worthy to carry his sandals. He will baptize you with † the Holy Spirit and fire. 12 His winnowing fork is in his hand, and he will clear his threshing floor and will gather his wheat into the granary; but the chaff he will burn with unquenchable fire.”

**Matthew 7: 15** “Beware of false prophets, who come to you in sheep’s clothing but inwardly are ravenous wolves. 16 You will know them by their fruits. Are grapes gathered from thorns, or figs from thistles? 17 In the same way, every good tree bears good fruit, but the bad tree bears bad fruit. 18 A good tree cannot bear bad fruit, nor can a bad tree bear good fruit. 19 Every tree that



does not bear good fruit is cut down and thrown into the fire. (Lk 13.6-9; Jas 3.10-12) 20 Thus you will know them by their fruits.

**Matthew 12: 33** “Either make the tree good, and its fruit good; or make the tree bad, and its fruit bad; for the tree is known by its fruit. 34 You brood of vipers! How can you speak good things, when you are evil? For out of the abundance of the heart the mouth speaks. 35 The good person brings good things out of a good treasure, and the evil person brings evil things out of an evil treasure. 36 I tell you, on the day of judgment you will have to give an account for every careless word you utter; 37 for by your words you will be justified, and by your words you will be condemned.” (Mk 7.14-23; Lk 6.43-45)

**Matthew 13: 31** He put before them another parable: “The kingdom of heaven is like a mustard seed that someone took and sowed in his field; 32 it is the smallest of all the seeds, but when it has grown it is the greatest of shrubs and becomes a tree, so that the birds of the air come and make nests in its branches.” (Lk 13.18-19)

**Matthew 21: 18** In the morning, when he returned to the city, he was hungry. 19 And seeing a fig tree by the side of the road, he went to it and found nothing at all on it but leaves. Then he said to it, “May no fruit ever come from you again!” And the fig tree withered at once. 20 When the disciples saw it, they were amazed, saying, “How did the fig tree wither at once?” 21 Jesus answered them, “Truly I tell you, if you have faith and do not doubt, not only will you do what has been done to the fig tree, but even if you say to this mountain, ‘Be lifted up and thrown into the sea,’ it will be done. 22 Whatever you ask for in prayer with faith, you will receive.” (Mk 11.12-14, 20-25)

**Luke 21: 29** Then he told them a parable: “Look at the fig tree and all the trees; 30 as soon as they sprout leaves you can see for yourselves and know that summer is already near. 31 So also, when you see these things taking place, you know that the kingdom of God is near. 32 Truly I tell you, this generation will not pass away until all things have taken place. 33 Heaven and earth will pass away, but my words will not pass away.

**Luke 19** He entered Jericho and was passing through it. 2 A man was there named Zacchaeus; he was a chief tax collector and was rich. 3 He was trying to see who Jesus was, but on account of the crowd he could not, because he was short in stature. 4 So he ran ahead and climbed a sycamore tree to see him, because he was going to pass that way. 5 When Jesus came to the place, he looked up and said to him, “Zacchaeus, hurry and come down; for I must stay at your house today.” 6 So he hurried down and was happy to welcome him. 7 All who saw it began to grumble...

**Acts 5: 30** The God of our ancestors raised up Jesus, whom you had **killed by hanging him on a tree**. 31 God exalted him at his right hand as Leader and Savior that he might give repentance to Israel and forgiveness of sins. 32 And we are witnesses to these things, and so is the Holy Spirit whom God has given to those who obey him.”

**Romans 11: 13** Now I am speaking to you Gentiles. Inasmuch then as I am an apostle to the Gentiles, I glorify my ministry 14 in order to make my own people † jealous, and thus save some of them. 15 For if their rejection is the reconciliation of the world, what will their acceptance be

but life from the dead! 16 If the part of the dough offered as first fruits is holy, then the whole batch is holy; and if the root is holy, then the branches also are holy.

17 But if some of the branches were broken off, and you, a wild olive shoot, were grafted in their place to share the rich root † of the olive tree, 18 do not boast over the branches. If you do boast, remember that it is not you that support the root, but the root that supports you. 19 You will say, “Branches were broken off so that I might be grafted in.” 20 That is true. They were broken off because of their unbelief, but you stand only through faith. So do not become proud, but stand in awe. 21 For if God did not spare the natural branches, perhaps he will not spare you. † 22 Note then the kindness and the severity of God: severity toward those who have fallen, but God’s kindness toward you, provided you continue in his kindness; otherwise you also will be cut off. 23 And even those of Israel, † if they do not persist in unbelief, will be grafted in, for God has the power to graft them in again. 24 For if you have been cut from what is by nature a wild olive tree and grafted, contrary to nature, into a cultivated olive tree, how much more will these natural branches be grafted back into their own olive tree.

**James 3: 5b** How great a forest is set ablaze by a small fire! 6 And the tongue is a fire. The tongue is placed among our members as a world of iniquity; it stains the whole body, sets on fire the cycle of nature, † and is itself set on fire by hell. † 7 For every species of beast and bird, of reptile and sea creature, can be tamed and has been tamed by the human species, 8 but no one can tame the tongue—a restless evil, full of deadly poison. 9 With it we bless the Lord and Father, and with it we curse those who are made in the likeness of God. 10 From the same mouth come blessing and cursing. My brothers and sisters, † this ought not to be so. 11 Does a spring pour forth from the same opening both fresh and brackish water? 12 Can a fig tree, my brothers and sisters, † yield olives, or a grapevine figs? No more can salt water yield fresh.

**Revelation 2: 7** Let anyone who has an ear listen to what the Spirit is saying to the churches. To everyone who conquers, I will give permission to eat from the tree of life that is in the paradise of God.

**Psalms 1: 1** Happy are those  
who do not follow the advice of the wicked,  
or take the path that sinners tread,  
or sit in the seat of scoffers;  
2 but their delight is in the law of the LORD,  
and on his law they meditate day and night.  
3 They are like trees  
planted by streams of water,  
which yield their fruit in its season,  
and their leaves do not wither.  
In all that they do, they prosper.

**Psalms 96: 10** Say among the nations, “The LORD is king!  
The world is firmly established; it shall never be moved.  
He will judge the peoples with equity.”  
11 Let the heavens be glad, and let the earth rejoice;  
let the sea roar, and all that fills it;  
12 let the field exult, and everything in it.  
Then shall all the trees of the forest sing for joy

13 before the LORD; for he is coming,  
for he is coming to judge the earth.  
He will judge the world with righteousness,  
and the peoples with his truth.

### **Thesaurus search**

Future

fu·ture n

1. time that has yet to come
2. events that have not yet happened
3. an expected or projected state
4. the tense or form of a verb used to refer to events that are going to happen or have not yet happened.

Also called future tense

Prospect

Outlook

Potential

Expectations

Opportunity

hope

upcoming

forthcoming

coming

imminent

yet to come

impending

(impending)

looming

in the near future

awaiting

approaching

just around the corner

on the horizon

at hand

(forthcoming)

available

ready

offered

supplied

on offer

in the offing

(potential)

budding

prospective

(potential: promise)

promise  
capability  
ability  
the makings  
possibility  
**Hope**

Expect  
Expectation  
Desire  
Chance  
Trust  
Anticipate  
Wish  
Look forward to  
Wait for  
Long for  
(Yearn)

*yearn vi*

1. *to want somebody or something very much, often with a feeling of sadness because of the difficulty or impossibility of fulfilling the desire*
2. *to feel affection, tenderness, or compassion*

crave  
ache  
hanker  
want very much  
covet  
hunger  
(crave)  
hunger after  
pine for  
require  
(ask humbly for)  
pray  
request  
implore  
entreat  
beseech  
(hope: expectation)  
optimism  
anticipation  
faith  
hopefulness  
(antonym: despair)

## Tree

Tree diagram

Tree farm

Tree fern

Tree frog

Tree house

Tree line

Tree of knowledge (Eden)

Tree of life (Eden)

Tree ring (growth ring)

Tree shrew

Tree sparrow

Tree spiking

*tree spik-ing n*

*the act of hammering long nails into trees as a form of environmental protest, making it dangerous to cut down the trees using a chainsaw*

Tree surgeon

*tree sur-geon n*

*somebody trained in pruning trees or treating diseased or damaged trees, for example, by cutting off branches or filling cavities*

Tree tomato

Treehopper

Treen

*tre-en n*

*tableware and other household utensils **made of wood***

[Northaven's furniture! Claremont's furniture! Bill's roundtable!]

treenail

*tree-nail or tre-nail or trun-nel n*

*a large cylindrical peg made of dry wood that expands to give a tight fit when it is wet and is used to fasten timbers together, for example, in ships*

Tree-of-heaven

*tree-of-heav-en n*

*a deciduous tree, originally Chinese but now cultivated elsewhere, that grows rapidly and has foul-smelling flowers. Latin name: Ailanthus altissima Ailanthus glandulosa*

treetop

## Grow

*grow v*

1. *vi to become larger in size through natural development*
2. *vi to expand or become larger in any way*
3. *vi to increase in degree*
4. *vi to be capable of developing naturally and remaining in a naturally healthy state*
5. *vi to develop from something else*
6. *vi to move from one condition to another, especially gradually*
7. *vt to make something, especially plants, grow and develop*
8. *vt to produce something as part of a natural process, or allow it to be produced*

9. *vt to develop, expand, and stimulate something, especially a business, a line of business, or an economic market*

(grow:produce)

cultivate

raise

breed

nurture

(grow:develop)

grow up

mature

get bigger

get taller

become adult

(grow: expand)

enlarge

swell

extend

spread

increase

get bigger

(antonym: shrink)

(grow: increase)

multiply

intensify

escalate

strengthen

develop

(anyonym: decrease)

grow into

*grow into vt*

*to develop in size, maturity, or capability to suit something*

grow light

*grow light n*

*a fluorescent lamp giving out light similar to sunlight and used to grow plants indoors*

grow on

*grow on vt*

1. *to become gradually more acceptable or pleasing to somebody*

2. *to become gradually more apparent or powerful to somebody*

grow out of

growing pains

growing point

*grow-ing point n*

*the area in a plant where the cells are actively dividing to produce new tissue in the stems and roots*

growing season

## Prune

*prune*<sup>2</sup> v

1. *vt to cut branches away from a plant to encourage fuller growth*
2. *vt to reduce something by removing whatever is unnecessary or unwanted*
3. *vt to remove something considered unnecessary or unwanted*

clip

trim

snip

cut back

cut

prune back

(prune: reduce)

shorten

tighten up

condense

abridge

*prun·ing hook* n

*a tool with a hooked blade and sometimes a long handle, used to prune trees and bushes*

*fer·til·i·za·tion* n

1. *the act or process of enabling reproduction by insemination or pollination*
2. *the union of male and female reproductive cells (gametes) to produce a fertilized reproductive cell (zygote)*
3. *the act or process of applying fertilizer to soil*

*plant* v

1. *vt to put something such as a seed, plant, or tuber into the ground to enable it to grow, or to take part in this activity*
2. *vt to place young plants or sow seeds in an area of ground*
3. *vt to put something down or take a position firmly or decisively*
4. *vt to introduce an idea into another person's mind*
5. *vt to place something such as an explosive or listening device where it will not be easily found by others*
6. *vt to put something secretly where it can be discovered later, for example, by the police, to incriminate somebody (informal)*
7. *vt to introduce somebody into an organization in order to spy on it or to influence the behaviour of its members (informal)*
8. *vt to land a blow on somebody (informal)*
9. *vt to place spawn, young fish, or shellfish into an area of water so that they will develop there*
10. *vt to establish a colony or settlement in a place, or send people to a place as colonists or settlers*

(plant: place)

fix  
stand  
deposit  
set  
lodge  
(plant: place in the ground)  
sow  
transplant  
pot

## **branch**

*branch* n

1. *a woody limb of a tree that grows out from a larger limb or from the trunk*
2. *a subdivision of the stem, root, or flower cluster of a plant*
3. *something that resembles a branch of a tree in structure*
4. *a store, bank, or another organization that is part of a larger group and is located in a different part of a geographical area from the parent organization*
5. *a subdivision of a large organization, usually with a specialized mission*
6. *one part of a large area of study or subject*
7. *one line of a family that is descended from a common ancestor*
8. *a river or stream flowing into another river*
9. *Southern U.S. a small stream or a creek*
10. *a distinctive part of a curve that is separated from the rest of the curve, for example, by discontinuities or extreme points*
11. *branch or branch wa-ter Southern U.S. drinking water, especially from a clean spring or stream, and used particularly for mixing with bourbon*
12. *any one of several alternative sequences of computer program instructions that are activated according to certain specific conditions, for example, the value of a variable*

v

1. *vti to divide or cause something to divide into lesser parts*
2. *vi to grow branches*
3. *vi to become involved in something new, especially as a way of extending or expanding personal interests or business activities*
4. *vi to execute an alternative sequence of computer program instructions as a result of the detection of a specific condition*

bough

limb

stem

twig

*branch out* vi

*to do something different, often involving an element of risk*

*fo·li·age* n

1. *the leaves of a plant or tree*
2. *decoration consisting of, or like, plant leaves*
3. *architectural ornamentation based on leaves and stems*



plant life  
flora  
undergrowth  
shrubbery

*flo·ra n*

1. *plant life, especially all the plants found in a particular country, region, or time regarded as a group (formal)*

*See also fauna*

2. *a systematic set of descriptions of all the plants of a particular place or time*

3. *all the usually harmless bacteria inhabiting an area or part of the body, regarded as a group or population*

*brush·wood n*

1. *a dense undergrowth of small trees and bushes*

*kin·dling n*

1. *something such as a bunch of small dry twigs used to start a fire because it burns easily*

2. *the act of making something start to burn*

3. *the arousal of somebody's interest or feelings*

logs, kindling. Wood, fuel

*bon·fire n*

*a large fire built outside for burning garbage, as part of a celebration, or as a signal*

## **World Book: Tree**

Tree is the largest of all plants. The tallest trees grow higher than 30-story buildings. Many trees also live longer than other plants. Some trees live for thousands of years. They are the oldest known living things.

People do not think of trees the way they think of other plants, most of which grow only a short time and then die. People think of trees as permanent parts of the landscape. Year after year, large, old trees shade houses and streets from the sun. Their buds and flowers are a sign of spring each year, and their colorful leaves brighten in autumn in many areas.

Trees continue to grow as long as they live. A tree's leaves make food that keeps the tree alive and helps it grow. Where winters are cold, many trees lose their leaves in autumn. Other trees keep their leaves during the winter and so stay green all year long. Trees that shed their leaves in autumn rest during the winter. In spring, they grow new leaves and flowers. The flowers grow into fruits, which contain seeds for making new trees. Some tree fruits, such as apples and oranges, taste good. Fruit growers raise large amounts of these fruits for sale. Trees also make new wood each year when the weather turns warmer. Wood is one of the most valuable parts of a tree. Mills and factories use wood to manufacture lumber, paper, and many other products.

A tree differs from other plants in four main ways. (1) Most trees grow at least 15 to 20 feet (4.6 to 6.1 meters) tall. (2) They have one woody stem, which is called a trunk. (3) The stem grows at least 3 to 4 inches (8 to 10 centimeters) thick. (4) A tree's stem can stand by itself. All other plants differ from trees in at least one of these ways. For example, no plant with a soft, juicy stem is a tree. Most of these plants, called herbs, are much shorter than most trees. Shrubs, like trees, have woody stems. But most shrubs have more than one stem, and none of the stems grows so thick or so tall as a tree trunk. Some jungle vines grow more than 200 feet (61 meters) long and have a woody stem. But the stems of most vines cannot support themselves.

There are thousands of kinds of trees. But most trees belong to one of two main groups—the broadleaf trees and the needleleaf trees. These two types of trees grow in Europe, North America, and many other parts of the world. Most other types of trees, such as palms and tree ferns, grow mainly in warm regions.

This article discusses TREE (Scientific classification of trees).

### Tree/The importance of trees

For thousands of years, trees have provided people with foods, fibers, and medicines. Above all, they have provided people with wood. Prehistoric people used wood to make the first spear, the first boat, and the first wheel. Throughout history, people have used wood to make tools, construct buildings, and create works of art. They have also used it for fuel. Living trees are as valuable to humankind as are tree products because they help conserve natural resources.

**Wood products.** Each year, loggers cut down millions of trees in the world's forests. Logs from these trees are shipped to sawmills and pulp mills. Sawmills cut the logs into lumber, which the building industry uses for many types of construction work. Manufacturers use lumber to make everything from furniture to baseball bats. Pulp mills break down the logs into wood pulp, the main raw material for making paper. The chemical industry uses wood pulp to make alcohol, plastics, and other products. See FOREST PRODUCTS; LUMBER.

**Food products.** People throughout the world eat fruits, nuts, and other tree products. The greatest variety of fruit trees grow in tropical and subtropical regions. These trees produce such fruits as avocados, grapefruits, mangoes, and oranges. A number of these fruits serve as basic foods in some tropical lands. Cooler, temperate regions—such as most of the United States and Europe—have fewer kinds of fruit trees. But several kinds are widely grown. For example, orchards in the United States produce vast amounts of apples, cherries, and peaches. The most important nut tree of warm regions is the coconut palm, which produces coconuts. Nut trees of temperate regions include almonds, pecans, and walnuts. Trees also supply chocolate, coffee, maple syrup, olives, and such spices as cinnamon and cloves. See FRUIT; NUT.

Other tree products are used by people in a variety of ways. The rubber tree produces latex, a milky fluid used to make natural rubber. Pine trees produce a sticky resin, used in making turpentine. The bark of oak and some other trees contains a compound called tannic acid. The tanning industry uses this compound to change animal hides into leather. The spongy bark of a type of oak that grows in Mediterranean countries provides cork. Some trees produce substances used as medicines. For example, the bark of the cinchona tree contains quinine, which doctors use to treat malaria and other diseases.

Trees in conservation. Trees help conserve soil and water. In open country, trees act as windbreaks and keep the wind from blowing away topsoil. Their roots prevent soil from being washed away by heavy rains. Tree roots also help store water in the ground. In mountain regions, forests prevent sliding snow from causing avalanches. Forests also provide shelter for wildlife and recreation areas for vacationists. See CONSERVATION.

Trees help preserve the balance of gases in the atmosphere. A tree's leaves absorb carbon dioxide from the air. They also produce oxygen and release it into the atmosphere. These two processes are necessary for people to live. People could not survive if the air had too much carbon dioxide or too little oxygen.

#### Tree/Kinds of trees

There are about 20,000 kinds of trees. More than 1,000 kinds grow in the United States. They range from mighty forest trees to fragile ornamentals. The greatest variety of trees grow in wet tropical regions.

Scientists who study plants divide plants with similar characteristics into various groups (see PLANT (Kinds of plants)). These scientists, called botanists, do not put trees in a separate group of plants. Instead, each kind of tree is grouped with other plants that have certain features in common with it. Therefore, a group of plants may include certain trees, certain shrubs or vines, and certain herbs. For example, locust trees, broom plants, and clover all belong to the same family. These plants are grouped together because they reproduce in the same way and have similar flowers. On the other hand, some trees that look much alike, such as tree ferns and palms, belong to different groups of plants.

Trees also can be divided into six groups according to various features they have in common. These six groups are: (1) broadleaf trees; (2) needleleaf trees; (3) palm, pandanus, and lily trees; (4) cycad trees; (5) tree ferns; and (6) ginkgo trees.

Broadleaf trees are the most numerous and varied of the world's trees. They include ashes, elms, maples, oaks, walnuts, willows, and many other familiar trees of the United States and Canada. They also include most trees of the tropics, such as mahogany trees and mangrove trees.

In addition to their broad, flat leaves, broadleaf trees have other features in common. Almost all broadleaf trees of temperate regions are deciduous-that is, they lose their leaves each autumn. A few kinds of broadleaf trees in temperate regions do not lose their leaves in the fall. These broadleaf evergreens include the holly trees and live oaks of the Southeastern United States. Some tropical broadleaf trees are deciduous, but most are evergreen. See DECIDUOUS TREE; EVERGREEN.

Foresters call broadleaf trees hardwoods because many of these trees, such as beeches, maples, and oaks, have tough, hard wood. Such wood makes excellent furniture. Some broadleaf trees, including basswoods and cottonwoods, have soft, lightweight wood.

Broadleaf trees belong to a large group of plants called angiosperms. These plants have flowers which develop into fruits that completely surround the seeds. Fruits are the seed or seeds of a

plant together with the parts in which they are enclosed. Botanists divide angiosperms into two classes-Monocotyledonae (monocotyledons) and Dicotyledonae (dicotyledons). Monocotyledons produce seeds that have one leafy structure called a cotyledon. These plants include palm, pandanus, and lily trees. Dicotyledons produce seeds that have two cotyledons. These plants include broadleaf trees. A few kinds of trees that do not have broad, flat leaves belong to the dicotyledon group. An example is the saguaro cactus of the Southwestern United States, which has prickly spines. See ANGIOSPERM; COTYLEDON.

Needleleaf trees include such familiar trees as firs, hemlocks, pines, redwoods, and spruces. There are about 500 species of needleleaf trees. Most of these trees have narrow, pointed, needlelike leaves. But a few types, such as cedars and junipers, have narrow, scalelike leaves.

Most needleleaf trees are evergreen, though they produce new needles each year. The oldest needles turn yellow or brown and drop, but the youngest needles remain green and do not fall. A few species of needleleaf trees are deciduous. One kind is the larch, which grows in northern forests throughout the world. Another deciduous needleleaf tree is the baldcypress that grows in swamps of the Southeastern United States.

Foresters call needleleaf trees softwoods because most of them have softer wood than broadleaf trees have. But the wood of Douglas-firs, yews, and some other needleleaf trees is hard.

Needleleaf trees belong to a group of plants called gymnosperms. Gymnosperms do not have flowers and their seeds are not enclosed to form fruits. Most gymnosperm trees bear their seeds in cones composed of hard scales. The seeds lie open on the surface of the scales. Botanists call such trees conifers. See CONIFER; GYMNOSPERM.

Most conifers grow north of the equator. The conifers belong to four families-the pine, yew, cypress, and taxodium families. The pine family is by far the largest. It includes not only pines, but also such trees as firs, hemlocks, larches, and spruces. Pine trees make up a large genus (group of species) within the pine family. Loblolly pines, ponderosa pines, and white pines are a few North American members of this genus. The yew family includes such well-known ornamental trees as English yews and Japanese yews. Although yews are classified as conifers, they do not produce cones but cup-shaped "berries." Many members of the cypress family, such as arborvitae and junipers, have scalelike leaves and give off a spicy fragrance. The taxodium family includes baldcypresses and the largest of all living trees-the redwoods and giant sequoias.

Two conifer families-the podocarpus family and the araucaria family--grow mainly south of the equator. Podocarpus trees are tall evergreens with broader leaves than those of most needleleaf trees. The araucaria family includes the Chile pine. This strange-looking tree has snakelike branches covered with sharp, scaly leaves. It is sometimes called the monkey puzzle tree because its sharp leaves make it difficult to climb.

Palm, pandanus, and lily trees belong to the large group of flowering plants called monocotyledons. These trees grow mainly in warm climates. Of the three types of trees in this group, palms are the most important.

There are about 2,500 kinds of palm trees. They range from the coconut palms of tropical islands to the date palms of desert oases. Most palm trees have no branches. The trunk has a crown of enormous leaves. The leaves are either feather-shaped or fan-shaped. See PALM.

Unlike most palms, pandanus and lily trees have branches. Each branch has a crown of sword-shaped leaves. Most pandanus trees have tall stilt roots that extend into the ground from high on the trunk or branches. Lily trees are closely related to the garden flowers called lilies, and many of the trees have attractive, fragrant flowers. The yucca trees of Mexico and the far Southern United States are lily trees. The best-known yucca is the colorful Joshua tree found in the deserts of the Southwestern United States.

Cycad trees look much like palm trees. They have a trunk without branches and a crown of long, feathery leaves. But cycads are more closely related to pine trees than to palms. They produce seeds in cones that look like large pine cones. Millions of years ago, cycads grew in nearly every part of the world. Today, they grow mainly in a few warm, moist sections of Africa, Asia, and Central America. See CYCAD.

Tree ferns. Ferns are best known as rather short plants with feathery, green fronds (leaves). But in the tropics and some areas with mild climates, many relatives of these plants are trees. Tree ferns look much like palm trees, but they belong to a different group of plants. Tree ferns do not have flowers or cones and so do not reproduce by seeds. They reproduce by means of tiny bodies called spores, which develop on the undersides of their fronds. See FERN.

Ginkgo trees are an extremely old species of tree. Millions of years ago, various kinds of ginkgoes existed. Only one species survives today. The ginkgo, like needleleaf trees, is a gymnosperm. But unlike other gymnosperm trees, the ginkgo has fan-shaped leaves. These leaves look like the fronds of a fern called the maidenhair. Ginkgoes are sometimes called maidenhair trees. They are natives of Asia, but many are grown in the United States and Europe.

Fossil trees. About 300 million years ago, there were whole forests of trees unlike most of the trees that grow today. Huge club-moss trees and horsetail trees grew along with tree ferns in steaming hot swamps. Over millions of years, the trees and other plant life in the swamps died, became buried, and turned into coal. In other places, buried forests became petrified (turned into stone). Coal deposits and petrified forests contain fossils of many trees that died out more than 100 million years ago (see FOSSIL). Two of these extinct trees are the club moss tree and horsetail tree of the coal-forming swamps. The club mosses and horsetails living today are herbs.

#### Tree/The parts of a tree

A tree has three main parts: (1) the trunk and branches; (2) the leaves; and (3) the roots. The branches and leaves together are called the crown. The trunk supports the crown and holds it up to the sunlight. Tree ferns, cycads, and most palms have no branches. Their crowns consist only of leaves. The roots of most trees are hidden in the ground, but they may take up as much space as the trunk and crown do above the ground. Other important parts of a tree include the seeds and the seed-forming structures.

Trunk and branches give a tree its shape. The trunks of most needleleaf trees grow straight up to the top of the tree. The branches grow out from the trunk. On most needleleaf trees, the branches

near the top are shorter than those farther down, which gives the crown a spirelike shape. The trunks of most broadleaf trees do not reach to the top of the tree. Instead, the trunk divides into spreading branches near the base of the crown, giving the crown a rounded shape. The trunks of a few broadleaf trees, such as black willows and white poplars, sometimes divide so close to the ground that the trees seem to have more than one trunk.

The trunks, branches, and roots of broadleaf and needleleaf trees consist of four layers of plant tissue wrapped around one another. These layers, from innermost to outermost, are: (1) the xylem, (2) the cambium, (3) the phloem, and (4) the cork.

The xylem is the woody, central part of the trunk. It has tiny pipelines that carry water with a small amount of dissolved minerals from the roots to the leaves. This water is called sap. The cambium, which surrounds the xylem, is a thin layer of growing tissue. Its job is to make the trunk, branches, and roots grow thicker. The phloem, also called the inner bark, is a layer of soft tissue surrounding the cambium. Like the xylem, the phloem has tiny pipelines. The food made by the leaves moves through the phloem to the other parts of a tree. In palms and tree ferns, the xylem and phloem are not separate layers. Instead, bits of xylem and phloem are connected and form small double pipelines scattered throughout the trunk.

The cork layer is the outer bark of a tree. It forms a "skin" of hard, dead tissue that protects the living inner parts from injury. The bark stretches to let the trunk and branches grow thicker. The bark of some trees, such as beeches and birches, is smooth because it stretches easily. But the bark of most other trees does not stretch so well. As the trunk and branches grow thicker, they push against the bark. It finally cracks and dries and so becomes grooved and rough. Most trees replace old bark from time to time with a new layer.

Leaves of various species of trees differ greatly in size and shape. Palms have leaves over 20 feet (6 meters) long. The leaves of some needleleaf trees are less than 1/2 inch (13 millimeters) long. Some broadleaf trees have compound leaves made up of small leaflets.

The main job of the leaves is to make food for the tree. Every leaf has one or more veins, which consist of xylem and phloem tissue. The tissue that surrounds the veins contains tiny green bodies called chloroplasts. Water from the roots passes through the xylem of the trunk, branches, and leaves to the chloroplasts, which use the water to make food sugar. Only a small amount of the water carried to the leaves is used to make sugar. The leaves lose most of the water to the atmosphere through transpiration (evaporation). Like the water and dissolved minerals carried from the roots, the food made by the leaves is also called sap. It travels through the phloem of the leaves, branches, and trunk to parts of the tree where it is needed. See SAP.

Almost all leaves are green in the spring and summer. Their color comes from chlorophyll, a green substance in the chloroplasts. Most trees also have reds and yellows in their leaves. But the green conceals these colors. In late summer and early autumn, the chlorophyll in the leaves of many broadleaf trees breaks down. The leaves then die. But before the leaves fall, they reveal their hidden reds and yellows. After the chlorophyll breaks down, the leaves of many trees also develop scarlets and purples. See LEAF (The leaf changes color).

Roots are long, underground branches of the trunk. They have the same layers of tissue as the trunk. The roots anchor a tree in the ground and absorb water with dissolved minerals from the

soil. The main roots branch out into small roots, which, in turn, branch out into still smaller roots. The main roots of most trees begin to branch out 1 or 2 feet (30 or 61 centimeters) under the ground. Some trees have one main root larger than the others. This root, called a taproot, extends straight down 15 feet (5 meters) or more.

A tree develops millions of small roots. Each root grows longer at its tip, which is as small as a thread. As a root tip grows, it pushes through particles of soil. Thousands of fine, white root hairs grow just back of the root tip. When the tip comes in contact with drops of water in the soil, the hairs soak up the water and dissolved minerals. The xylem layer of the roots, trunk, and branches carries this sap to the leaves.

Fungi grow on the roots of most trees in a helpful relationship called mycorrhiza. The fungi aid the roots in absorbing water and mineral nutrients. They also protect the roots from some diseases.

Seeds are the means by which all trees except tree ferns reproduce. Tree ferns reproduce by spores.

Angiosperms-broadleaf trees and palm, pandanus, and lily trees-produce seeds by means of flowers. Some broadleaf trees, such as horsechestnuts and magnolias, produce large, showy flowers. Many others have small, plain-looking flowers. Most palm, pandanus, and lily trees have small flowers that grow in bunches. Sometimes these are brightly colored and fragrant.

The seeds of angiosperms are enclosed to form a fruit. The fruits of some broadleaf trees, such as apples and cherries, have a fleshy outer covering. The fruits of other broadleaf trees, including acorns and beechnuts, are hard nuts. Ashes, elms, and maples have thin, winged fruits. Palm, pandanus, and lily trees have a variety of fruits, ranging from nuts to berries.

Gymnosperms-needleleaf trees, cycads, and ginkgoes-do not have flowers or fruits. Their seeds are produced in cones or similar structures. The seeds of needleleaf trees and cycads have no protective coverings. Ginkgo seeds have a fleshy outer covering, but the covering is not a true fruit.

#### Tree/How a tree grows

Most trees begin life as a seed. The young tree that develops from this seed is called a seedling. After a tree reaches a height of 6 feet (1.8 meters) or more and its trunk becomes 1 to 2 inches (2.5 to 5 centimeters) thick, it is called a sapling. Many trees reach a height of more than 100 feet (30 meters). Some old trees have trunks more than 10 feet (3 meters) in diameter.

Trees need great amounts of water. A large apple tree in full leaf may absorb 95 gallons (360 liters) from the soil daily. Most of the water goes to the leaves. On a sunny summer day, some trees move water up through their trunks at the rate of 3 feet (91 centimeters) per minute. A tree's wood is about half water.

How seeds sprout into trees. A seed contains parts that develop into the trunk and roots of a tree. It also has one or more cotyledons and a supply of plant food. After a seed has left the parent tree, it rests for a while on the ground. Water, air, and sunshine help the seed germinate (begin to

grow). The part of the seed that develops into the trunk points upward toward the sunlight. As the seed absorbs water, the root part swells and bursts through the seed's shell. As the root grows, it pushes down into the soil. The food stored in the seed nourishes the tree. As the root begins to soak up water from the soil, the trunk begins to develop leaves.

How leaves make plant food. As a leaf develops, it gets sap from the roots. It also absorbs carbon dioxide from the air. The leaf uses the energy of sunlight to change the sap and carbon dioxide into sugar, a process called photosynthesis. The sugar provides food for the trunk, branches, and roots. During photosynthesis, the leaves also produce oxygen and release it into the atmosphere. See LEAF (How a leaf makes food).

How trees grow taller. Trees grow taller only at the tips of their trunk and branches. Each year, the tips of the trunk and of each branch develop a bud. The bud contains a tiny leafy green stem called a shoot. The bud is wrapped in a protective covering of bud scales. After a period of rest, the buds swell and open. The shoots that were inside the buds begin to grow and so make the trunk and branches taller. Another type of bud grows on the sides of the trunk and branches. These buds contain a shoot that develops into a leaf-bearing twig after the bud opens. As a twig grows larger, it becomes another branch of the tree. Some tree buds develop into flowers. Still others develop into twigs that bear both leaves and flowers. In warm climates, trees produce buds frequently during the year or continue to grow without forming buds. In colder climates, trees produce buds only in the summer. These buds rest in winter and open after warm weather arrives in spring.

Trees without branches-cycads, most palms, and tree ferns-grow somewhat differently. For example, a young palm tree does not grow taller for a number of years. Its short trunk thickens and produces more and larger leaves each year. After the trunk and crown reach adult size, the tree begins to grow taller. The trunk stays about the same thickness for the rest of the tree's life.

How trunks and branches grow thicker. The trunk and branches of a broadleaf or needleleaf tree grow thicker as long as the tree lives. The cambium tissue just underneath the inner bark causes this thickening. It uses the sugar produced by the leaves to make new plant tissue. On its outside, the cambium makes new phloem, or inner bark, and on its inside, new xylem, or wood.

Wood consists largely of cellulose, a tough substance made from sugar. The xylem has two kinds of wood--sapwood and heartwood. The wood nearest the cambium is the sapwood. It is living wood and contains the tiny pipelines that carry sap. In tropical climates, the sapwood thickens all year. In cooler climates, a new layer of sapwood usually forms only in early summer. As a tree ages, the wood nearest the center dies. This dead wood is the heartwood. It helps support the tree.

In regions where trees make a new layer of wood once a year, the layers form a series of annual rings. Each ring represents one year's growth. After such a tree has been cut down, a person can count the rings to determine the tree's age. Scientists have also found that slight changes in the composition of a tree's cellulose reveal the kind of weather that a tree experienced.

How trees reproduce. Most trees reproduce sexually. That is, seeds are produced only after sperm unite with eggs. Sperm are produced by pollen, which forms in the tree's male reproductive parts-either the male part of the flower or the male cone. Eggs form in the female



part of the flower or in the female cone. Among many angiosperm species, the flowers have both male and female parts. The pollen from the male part can simply drop onto the female part. Other angiosperms and all gymnosperms have separate male and female flowers or cones, which may grow on the same tree or on separate trees. The pollen of these species is carried to the female flower or cone by insects, the wind, or other means. After contacting the female flower or cone, pollen produces sperm. The sperm then unite with eggs, and one or more seeds develop within a fruit or cone.

When the fruit or cone has ripened, the seeds are ready to leave the tree. The wind scatters the seeds of needleleaf trees and the winglike seeds or fruits of such broadleaf trees as ashes, maples, poplars, and willows. Birds, squirrels, and other animals scatter seeds contained in nuts or fleshy fruits. Ocean currents sometimes carry the seeds of coconut palms and mangroves.

Trees can also reproduce by a process called vegetative reproduction. After a tree has been cut or blown down, the stump may develop green sprouts. In time, one or several of these sprouts can grow into trees. A clump of birches or yellow-poplars may be produced in this way. The roots of apple trees, aspens, and some other trees sometimes develop shoots called suckers that may also grow into trees. Some spruces found in bogs grow roots from their branches. This method of reproduction is called layering. In addition, nursery workers often grow trees from cuttings—that is, twigs cut from older trees. The twigs are planted and develop roots.

#### Tree/Broadleaf and needleleaf trees

This section illustrates some of the chief characteristics of various broadleaf and needleleaf trees around the world. The drawings show the summer and winter appearance of each species. They also illustrate the leaf; the fruit or other seed-bearing structure; and, in most cases, the bark. For some species, the flower is shown. Each set of illustrations includes information about the tree's native geographic range—that is, the part of the world where the tree is most likely to be found. But a number of the species shown have spread or have been planted outside their native range. The average height of adult trees of each species is given in feet and in meters alongside the illustration of the tree's shape.

The drawings and other information in this section can help in identifying trees. For example, if the leaf and bark of a tree match the leaf and bark of one of the trees shown here, the tree should be fairly easy to identify. Tree guidebooks can provide additional help in identifying trees. Several guidebooks are listed in the Study aids at the end of this article.

#### Tree/Trees around the world

In some parts of the world, trees grow in thick forests. In other regions, they do not grow at all. To grow, trees need a period of more than two months without frost each year. The few trees that grow in the Arctic never reach full tree size. No trees can grow in the ice and bitter cold of Antarctica. Most trees also need at least 15 to 20 inches (38 to 51 centimeters) of rainfall a year. Only a few trees, such as the Joshua tree and some types of palms, can survive in deserts.

Most broadleaf trees grow best in regions that are warm and moist at least three or four months of the year. Colder, dryer climates are better suited to most needleleaf trees. But some broadleaf trees, such as birches and willows, grow well in cool climates. Some needleleaf trees, including

baldcypresses and various types of pines, need fairly warm climates. Palm trees grow in warm areas throughout the world, especially the wet and the dry tropics. Pandanus trees, cycads, and tree ferns grow mainly in the wet tropics and other warm, moist regions. Lily trees also thrive in warm areas, but they do not need so much moisture as do pandanus trees, cycads, and tree ferns.

Different kinds of trees also require different soils. Many needleleaf trees grow well in poor, sandy soil. But most broadleaf trees need more fertile soil.

Some trees grow alone or in small groups. Where moisture is scarce, trees may grow only along riverbanks. Tree seeds carried by ocean currents may take root along shorelines. People plant individual trees in such places as parks and gardens. But most trees by far grow in forests. The world's forest regions consist chiefly of broadleaf and needleleaf trees.

Broadleaf forests grow in regions that have a fairly long growing season and plentiful rainfall. Every continent except Antarctica has broadleaf forests, which are also called hardwood forests. In areas with cold, snowy winters, almost all the trees in broadleaf forests lose their leaves each autumn. In tropical areas, most broadleaf trees are evergreen.

Before the 1800's, broadleaf forests covered much of the Eastern United States. They included such trees as ashes, birches, maples, and oaks. During the 1800's, most of the trees in these forests were cut down to provide lumber and fuel and to make room for farms and cities. Today, only a few parts of the Eastern United States have large broadleaf forests. Western Europe also had great forests of broadleaf trees, including ashes, beeches, and oaks. But most of these forests have been cut down.

Broadleaf forests that consist largely of quaking aspens and balsam poplars cover parts of southern Canada and large areas of southern Siberia. Forests of birches and oaks grow in eastern Europe and along the Yellow Sea coast of China and Korea. Southeastern Australia has valuable forests of eucalyptus trees. These broadleaf trees grow nearly as tall as California's needleleaf giants, the redwoods. Some eucalyptus trees stand more than 300 feet (91 meters) tall. About 600 kinds of eucalyptus trees grow in Australia. Almost all of these trees are evergreen.

In many areas, mixed forests of broadleaf and needleleaf trees grow alongside broadleaf or needleleaf forests. Central Canada, the Eastern United States, central and southern Europe, and eastern Asia all have large mixed forests.

Remarkable broadleaf forests grow in tropical regions where the weather is always hot and rain falls regularly every month of the year. In these tropical rain forests, many of the trees look alike. They are tall, and many tower more than 150 feet (46 meters). The trees have leathery, dark-green leaves. Because the trees receive plenty of moisture throughout the year, most of them are evergreen. The trees may thus look alike, but they belong to many species. Many palms grow among the broadleaf trees in the tropical rain forests. The largest rain forests are in South and Central America, central Africa, and Southeast Asia.

Needleleaf forests grow mainly in regions that have long, cold winters. These forests, which are also called softwood forests, stretch across Canada, northern Europe, and Siberia. Many firs, larches, and spruces grow in these northern forests, along with a few broadleaf trees, such as birches and willows. Some willows grow even farther north than needleleaf trees do. But they

seldom reach more than shrub size. Needleleaf forests also blanket slopes in such mountain ranges as the Alps and the Rocky Mountains.

The Canadian needleleaf forests extend southward into the Western United States, where they include many of the world's largest trees. Many California redwoods tower over 300 feet (91 meters). Tall Douglas-firs also grow in the Western United States.

A few needleleaf forests grow in warmer regions. For example, the Southeastern United States has large forests of pines, such as loblolly pines and longleaf pines. These forests provide great quantities of wood for lumber and wood pulp.

How forests spread. Many forests did not always grow where they are growing now. These forests have spread from other areas. For example, broadleaf forests grow today in parts of the Northeastern United States where only needleleaf forests grew several thousand years ago. The spread of forests from one area to another is called migration. The wind helps trees migrate by carrying their seeds beyond the forests. Animals also help spread the seeds. Trees that grow from these seeds produce their own seeds, which may be spread in the same ways. Over hundreds or thousands of years, a particular kind of tree may thus spread to surrounding areas if the climate and soil are suitable.

Several hundred thousand years ago, glaciers moved down across much of North America and Europe. These glaciers caused the forests of needleleaf and broadleaf trees to migrate south. Thousands of years passed, and the ice began to melt. As the glaciers retreated northward, forests of needleleaf trees grew up again on the land that the glaciers had covered. The glaciers moved still farther north, and the climate became warm enough for broadleaf trees. Broadleaf trees usually crowd out needleleaf trees in areas where both are able to grow. As a result, broadleaf forests replaced needleleaf forests in many regions.

Forests can migrate over fairly level land but not across oceans or mountain ranges. Yet similar types of forest trees grow in areas separated by oceans or mountains. For example, the United States has oak trees much like those that grow in Europe. Most scientists believe that many millions of years ago, all the continents were connected. Needleleaf trees developed and spread across much of the earth. Broadleaf trees developed next and also spread. Over millions of years, the continents became separated--along with their trees and other forms of life--by the oceans. Mountain ranges rose up on the continents and separated the trees on each side of the mountains. In time, many of the trees on each continent and on each side of the mountain ranges developed into different species.

How people help trees spread. People have transplanted many species of trees across oceans and mountain ranges. Transplanted trees may grow well in a new region with a climate like that of their native lands. In time, these introduced species may spread and become native trees in their new surroundings. A kind of rubber tree that once grew only in Brazil was introduced into the Far East during the late 1800's. Today, whole forests of these trees grow in the Far East. About 100 years ago, Australian eucalyptus trees were planted in California. Today, many thousands of eucalyptuses shade streets and parks in several Western states. Monterey pines originally grew only in a small area of California. They now cover large areas in Australia and other countries south of the equator.

## Tree/Planting and caring for trees

Homeowners plant various kinds of trees on their property. They plant shade trees for protection from the sun and ornamental trees for beauty. They may also plant trees as windbreaks. Many people enjoy having fruit trees in their yard or garden to provide shade and beauty as well as fruit.

**Selecting the right tree.** To grow well, a tree must be suited to the region where it is planted. Trees from faraway places should be planted only in regions with similar climates. A tree's special characteristics must also be considered. For example, trees with wide-reaching roots should not be planted near houses because the roots may damage drains and foundations, or plug sewage pipes.

Trees with full, leafy crowns make the best shade trees. These trees include ashes, basswoods, maples, and oaks, all of which are popular in the Eastern United States. Trees with showy flowers, such as the catalpa and the crab apple, are popular ornamental trees in the Eastern United States. In fairly warm areas west of the Rocky Mountains, such trees as acacias and pepper trees are planted as both shade and ornamental trees. Needleleaf trees are grown as ornamentals in many parts of the United States and Canada. They also make good windbreaks. Various broadleaf trees, including cottonwoods and Lombardy poplars, are also planted as windbreaks. Apple and cherry trees are popular fruit trees in temperate climates. In warm climates, many people grow citrus trees.

**Planting the tree.** A tree should be planted where it will have enough room when fully grown. The soil should be fertile and should drain well so that water does not collect and drown the roots.

It takes much time and effort to grow a tree from seed. Most people prefer to buy a tree at a nursery. If a nursery tree is taller than 15 feet (4.6 meters) or if its trunk is thicker than 3 inches (8 centimeters), special transplanting equipment may be needed.

The best time to transplant a tree is when it is resting—that is, in the fall, winter, or early spring. The roots of a deciduous tree can be dug up without a covering of soil. But they must be kept moist while out of the ground. The roots of an evergreen should be dug up with a ball of soil around them. The hole for any new tree should provide room for all the roots below ground level. A small tree may need to be supported by stakes to keep the wind from blowing it over.

**Caring for the tree.** A young tree should be kept moderately watered until it is well rooted. It usually takes about a year for a tree to become firmly rooted.

Pruning improves the shape of trees. Cutting off some of a young shade tree's lower buds will keep it from developing many low branches. But enough buds should be left so that the tree has a full, leafy crown. As the tree develops upper branches, more lower branches may be removed. See PRUNING.

Insects and diseases may attack a tree. With normal care, it can overcome most minor attacks. But if a tree fails to develop as many leaves as usual or if the leaves look pale, the tree may

require the professional care of a tree surgeon. In some areas, air pollution threatens the health of trees.

### Tree/Scientific classification of trees

Trees belong to three classes (groups) within the plant kingdom. Botanists further classify the plants in each class into subclasses, orders, and families. Plants are grouped according to the various characteristics they have in common. A few plant families consist largely of trees or shrubs, but some families have no trees at all. The table A classification of trees lists the families with the most species of trees or with one or more outstanding species. The families are arranged in the probable order of evolutionary development.

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### Questions

What is sapwood? Heartwood?

What is the main job of a tree's leaves?

In what climate do most needleleaf forests grow?

What do root hairs do?

How do forests spread?

How do deciduous trees differ from evergreen trees?

When is the best time of year to transplant a tree?

How do trees help conserve soil and water?

In what four ways do trees differ from all other plants?

How do trees grow taller?

### Additional resources

#### Level I

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### **Africa**

Forests cover less than a fifth of Africa. Many people outside the continent think that much of Africa is a jungle, which must be hacked through with an ax or knife. But true jungle is rare in Africa. Most of the forests are tropical rain forests. These forests, with their many kinds of broadleaf evergreen trees, grow in the Congo Basin and in parts of western Africa and Madagascar. The floors of the forests tend to be fairly open and clear. Pockets of dense and tangled mangrove swamps fringe some coastal areas in the west and east and in Madagascar. Other forests grow in the highlands of eastern Africa, in the mountains of the northwest, and in parts of the south.