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Chapter 1 : 5 Ways to Kill Tree Roots - wikiHow

TREE ROOT PROBLEMS. Root systems are vital to the health and longevity of trees. All plants need water, oxygen, and nutrients. These are most readily available near the soil surface where precipitation infiltrates the soil and oxygen from the atmosphere diffuses into the porous soil.

Its roots also help prevent soil erosion, especially along riparian areas that are prone to flooding. A tree depends on its roots to reach deep into the soil to search for the water and nutrients that it requires to survive. Oak trees do not tolerate transplanting well because of their deep root systems. Tree Types and Their Roots White oak, hickory, black gum, sassafras, sweet gum, Japanese pagoda, butternut and some pines develop deep taproots. During their first years of life, the trees display remarkably little top growth because all of their energy is focused on creating a deep and diverse root system. The American basswood, American hornbeam, boxelder, chestnut oak and the swampbay magnolia develop deep lateral roots. The lateral roots firmly anchor the tree to the ground. Trees that develop deep taproots require well-draining soil. In areas that suffer from compacted soil, the tree is often unable to develop a deep root system. Its weak root growth renders the tree unstable. Taproot Most trees require soil with adequate nutrients and soil. Trees that have evolved to produce a deep taproot can withstand soil conditions that other trees often fail in. They can tolerate drought and will survive in locations that other tree types often perish in. The taproot grows deep and strong. It does not always grow straight down but may grow in varying directions. The taproot forms small lateral roots off its length. Planting Site Effects A tree will adjust its root system to exist in the environment it is planted within. If the soil is rich and moist, the tree will not require a deep root system. In planting locations that often suffer drought conditions, the tree will produce a deep root system as it searches for the water it requires to survive. A tree with a deep taproot does not withstand transplanting well. Any damage to the tap root often causes the tree to die. Tree types that produce deep lateral roots will withstand transplanting well.

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Chapter 2 : Tree without Roots | The University Press Limited

Fruit, Shade and Curbside Trees with Non-Invasive Root Systems May 2, Walking through the local nursery and seeing all the flowering, fruiting and shaded treasures you can choose is pure joy. As you're picking the right tree for the right place, think about how big that tree will get-and how far its roots will spread.

Home Fruit, Shade and Curbside Trees with Non-Invasive Root Systems May 2, Walking through the local nursery and seeing all the flowering, fruiting and shaded treasures you can choose is pure joy. If there are obstacles, like sidewalks, close to your planting site, pick a tree with a non-invasive, small root system. Below, learn the benefits of these trees and discover which tree is best for you! Sometimes that causes trees to prod underground structures, like water tanks and sewer lines. Homes, sidewalks and driveways are also in danger of becoming puckered or injured when roots tunnel under them. Luckily, non-invasive root systems are less likely to interfere with sidewalks, sewers or your home. Plant a tree with non-invasive roots to solve problems brought on by protruding roots. Choose a plant in your zone for best results , and plant at the right time of year. Fruit trees with non-invasive root systems Zones 4, 5, 6, 7, 8 Adams crabapple zones A slow-growing plant that can be grown as a small tree or large shrub and has bunches of delicate yellow flowers Pawpaw zones A tropical tree with large green fruit that tastes like banana or peach Kousa dogwood zones An ornamental tree that produces pinkish-red fruits and grows clusters of white leaves in spring that look like flower petals Shade trees with small root systems Zones 3, 4, 5, 6, 7, 8, 9 Amur maple zones A small shade tree with fiery red fall color American hornbeam zones A mid-size plant with dark green leaves and small flowers that grows well in drought conditions Southern sugar maple zones A short-spreading maple tree with yellow fall color and clusters of small hanging flowers Red tip photinia zones 8 and 9: A red-leafed shade tree with a shapely round canopy and white flowers that also tolerates heat and dryness Shrubs and curbside trees with non-invasive roots Zones 3, 4, 5, 6, 7, 8, 9 Crape myrtle zones A brilliant pink flower tree commonly found in the South â€” which can be grown as a small curbside tree or large shrub Skyrocket juniper zones A popular scarlet-red maple that will grow in shade or sunlight and is ideal for a patio or curbside location Hollywood juniper zones A fast-growing evergreen shrub that is tolerant of salt, drought, wind and cold Fraser photinia zones 8 and 9: A full, busy shrub with apple-red leaves.

Chapter 3 : Tree Without Roots by Syed Waliullah

One of the problems associated with growing trees in the lawn is that when you water your lawn you encourage surface roots. Deep watering will encourage deep root systems so if you make a special effort to deeply soak the tree when it is young, the roots will continue to grow down and out as opposed to up and towards the surface.

All plants need water, oxygen, and nutrients. These are most readily available near the soil surface where precipitation infiltrates the soil and oxygen from the atmosphere diffuses into the porous soil. Most roots, therefore, especially the important, tiny, absorbing roots, proliferate near the soil surface. When space is available, roots can spread two to three times further than the branches. Tree roots are often associated with situations that cause damage to structures, pavements, and utilities. In almost every case, roots are not the cause of the problem. As roots enlarge, they may occasionally break the pipes and enter the cracks. More commonly, the pipes fail especially at the joints due to age or slight movement of the soil, allowing roots to invade. Moisture and nutrients released from ruptures can stimulate root growth toward the break in the pipe. Once a root enters a sewer pipe, the conditions of aeration, moisture, and nutrients are quite favorable for rapid growth. Species that are naturally found in wet areas such as poplars, willows, and silver maples, are commonly associated with clogged pipes. Blocked sewers usually must be cleared mechanically. Mechanical routing may be needed on an annual basis. Registered chemical treatments are available. The main advantage of these products is that they can be placed into the sewer as a foam for more effective contact with roots; however, it is essential to follow label directions. The only permanent solution to the problem, however, is to replace ruptured pipes. Modern materials and joints should prevent most problems in the future. When roots encounter a paved area, the only entry is often a gap between the soil and pavement. Future problems can be prevented at the time of planting by using smaller plants, providing a minimum distance of 4 feet between the tree and the pavement, or using mechanical barriers to prevent roots from growing under the pavement. Remedies for lifted pavements around mature trees often involve either moving the pavement away from the tree or pruning off the problem roots. Barriers are often installed after the roots are cut to prevent re-growth of the roots and recurrence of the pavement lifting. Cutting off the problem roots often causes stress and instability. Trees without sufficient root support can be blown over more easily in a storm. In reality, roots are rarely the cause of the problem. Though small roots may penetrate existing cracks in foundations, they are incapable of causing mechanical damage through their growth. Soil subsidence can result in damage to structures. Under very special circumstances roots can contribute to this problem. When soils are prone to shrinking substantially during periods of drought, and if foundations are shallow, roots can contribute to depletion of soil moisture under the foundation, causing it to subside. Some species, such as maples, grow roots particularly close to the surface. Alternate freezing and thawing causes frost-heaving, which can expose roots that would otherwise remain below the soil surface. On slopes, soil erosion may also expose roots. These surface roots could become a foot hazard or cause difficulty in mowing, and are easily injured. Removing these roots may disrupt the moisture supply to the tree, causing serious stress. Covering them with soil could cut off the oxygen supply to the fine roots in the soil below. Both situations could lead to decline. These materials are porous enough to allow sufficient oxygen supply to the soil and may actually encourage fine root growth. Acting as an insulator, the mulch will minimize further frost-heaving and erosion. Another benefit is the replacement of highly competitive turf grass with mulch, which supplies nutrients as it decomposes. Grass removal is not necessary before the mulch is applied. An additional 2 inches can be added each year as necessary to raise the soil level sufficiently to cover the roots. The lawn can then be replanted, but the tree roots may reappear on the surface within a few years. Norway maples are most susceptible to damage from girdling roots, but they can occur in most trees. When roots circling inside of a pot in the nursery cause the problem, the tree seldom survives more than a decade in the landscape. To prevent girdling roots in nursery stock, make sure that all circling roots on the outside of the root ball are eliminated at time of planting. Research shows that moderate disruption of the container root system does not increase stress. For large girdling roots on established trees, correcting the problem can be difficult. Removal of the girdling roots may

cause enough damage to the root system to hasten the decline. Several roots may be intertwined, making it even more difficult. It is difficult to predict if removing the roots will be more damaging than leaving them alone. Since roots are near the surface and depend on oxygen, raising the soil level around an established tree can have serious impact. This new soil will drastically reduce the oxygen supply to roots. When grade changes are necessary, avoid changing the grade within the dripline of the tree. The fewer roots that are impacted, the better the chances that the tree will survive. Another alternative would be to construct a retaining wall outside the dripline to accomplish the grade change. If the grade change is necessary to improve site drainage, be sure to divert the excess water away from the tree.

Chapter 4 : Tree - Wikipedia

A tree with well developed deep roots can withstand a great wind storm without falling over. We watched many trees with shallow root systems topple over in heavy wind and over moist ground in Oregon. A tree depends on a strong root system to reach down into the ground and receive nourishment and water to live a long strong live.

I revere them when they live in tribes and families, in forests and groves. And even more I revere them when they stand alone. They are like lonely persons. Not like hermits who have stolen away out of some weakness, but like great, solitary men, like Beethoven and Nietzsche. In their highest boughs the world rustles, their roots rest in infinity; but they do not lose themselves there, they struggle with all the force of their lives for one thing only: Nothing is holier, nothing is more exemplary than a beautiful, strong tree. When a tree is cut down and reveals its naked death-wound to the sun, one can read its whole history in the luminous, inscribed disk of its trunk: And every young farmboy knows that the hardest and noblest wood has the narrowest rings, that high on the mountains and in continuing danger the most indestructible, the strongest, the ideal trees grow. Whoever knows how to speak to them, whoever knows how to listen to them, can learn the truth. They do not preach learning and precepts, they preach, undeterred by particulars, the ancient law of life. A kernel is hidden in me, a spark, a thought, I am life from eternal life. The attempt and the risk that the eternal mother took with me is unique, unique the form and veins of my skin, unique the smallest play of leaves in my branches and the smallest scar on my bark. I was made to form and reveal the eternal in my smallest special detail. My strength is trust. I know nothing about my fathers, I know nothing about the thousand children that every year spring out of me. I live out the secret of my seed to the very end, and I care for nothing else. I trust that God is in me. I trust that my labor is holy. Out of this trust I live. When we are stricken and cannot bear our lives any longer, then a tree has something to say to us: Life is not easy, life is not difficult. Those are childish thoughts. Let God speak within you, and your thoughts will grow silent. You are anxious because your path leads away from mother and home. But every step and every day lead you back again to the mother. Home is neither here nor there. Home is within you, or home is nowhere at all. A longing to wander tears my heart when I hear trees rustling in the wind at evening. If one listens to them silently for a long time, this longing reveals its kernel, its meaning. It is a longing for home, for a memory of the mother, for new metaphors for life. Every path leads homeward, every step is birth, every step is death, every grave is mother. So the tree rustles in the evening, when we stand uneasy before our own childish thoughts: Trees have long thoughts, long-breathing and restful, just as they have longer lives than ours. They are wiser than we are, as long as we do not listen to them. But when we have learned how to listen to trees, then the brevity and the quickness and the childlike hastiness of our thoughts achieve an incomparable joy. Whoever has learned how to listen to trees no longer wants to be a tree. He wants to be nothing except what he is.

Chapter 5 : Lawn trees without surface roots - Knowledgebase Question - calendrierdelascience.com

Tree root problems are not always solved by the removal of the tree, as the stump or remaining roots may continue to grow. It is best to look at the type of tree and the suckering ability of its roots beforehand and then deal with the issue on a case-by-case basis.

Question by wildlfe May 18, Currently we have a silver dollar and a eucalyptus tree. The surface roots are ruining our lawn and look terrible. We were going to cut the roots but we think the trees may blow over with the strong wind we get here in the High Desert of So. What are the best lawn trees for our area? Thank you, Carol May 18, 0 One of the problems associated with growing trees in the lawn is that when you water your lawn you encourage surface roots. Deep watering will encourage deep root systems so if you make a special effort to deeply soak the tree when it is young, the roots will continue to grow down and out as opposed to up and towards the surface. I agree that cutting the surface roots from your eucalyptus trees will compromise their health. It might be better to remove them and choose deep rooted trees as replacements. Here are some of the best: Celtis sinensis; a deciduous shade tree, similar to Elm, but smaller. Glossy, scallop-toothed, dark green leaves. Deep-rooted, tolerates heat, wind, drought, alkaline soil. Shapely deciduous tree to 40ft. Small leaflets, reddish new growth. Large, purplish-pink showy flowers, prolonged bloom. Platanus racemosa; Large tree to ft. Large, light green leaves, lobed like maple. Mottled, multi-colored trunks due to bark shedding in patches. Tolerates heat, wind, likes deep watering in summer. Alnus rhombifolia; Fast-growing, very tolerant of heat and wind. Prefers plenty of water. Alnus cordata; Reaches ft. Four-inch dark green leaves, very attractive tree. Decorative woody cones in winter. Hope these suggestions are helpful. You must be signed in before you can post questions or answers. Click here to join!

Chapter 6 : Removing Tree Roots Above Ground: Will It Kill the Tree? | Davey Blog

"A people without the knowledge of their past history, origin, and culture is like a tree without roots" -Marcus Garvey A significant issue in the lives of African Americans is a subtle, yet.

As a bonus, many also have branches that resist breakage and are thus less likely to fall and pulverize your patio railing, trellis or garden fence. Keep in mind that to encourage maximum growth from your tree, you must provide the right environment for it, including an optimal location and the proper amounts of light, water and nutrients. Choose this tree, also called basswood, for sunny or partially shaded areas in U. Department of Agriculture plant hardiness zones 3 through 8. On the downside, this species can succumb to a number of pest and disease problems, including aphids, borers, scales, anthracnose, canker, powdery mildew and rust. Turkey Oak Quercus cerris has distinctive, deeply lobed leaves of dark, glossy green that turns yellow in fall. Growing up to 36 inches a year in USDA zones 7 through 10, turkey oak thrives in full sun to partial shade and can reach a height and width between 30 and 50 feet. The tree has strong branches and a low probability for root damage, but its acorns and leaves can pose a litter problem so avoid planting it where this could be an issue. Evergreen Trees If you like to see leaves all year, some evergreens provide shade, quick growth and low potential for hardscape destruction. Even though evergreens keep their foliage year-round, however, they periodically shed needles that require cleanup if you like a tidy-looking yard or driveway. Japanese Evergreen Oak Quercus acuta , USDA zones 9 through 11, likes full sun and grows up to 30 feet tall and 20 feet wide at the rate of up to 36 inches each year. Its branches also resist breaking, it provides dense to very dense shade and the probability of damage from its roots growing near the surface of the soil is low. Wildlife like to visit Japanese evergreen oak to eat its acorns, which may be a joy or a nuisance to you, depending on your perspective. The tree can grow 36 inches per year, reaching up to 35 feet tall with a foot spread. Buttonwood has attractive blue-green or silver leaves, grows well in a variety of soils and is salinity tolerant. On the downside, this species is prone to developing sooty mold. The tree can grow up to 60 feet tall and 50 feet wide in USDA zones 7 through 9, where it prefers full sun. On the plus side, the tree bears clusters of small, white flowers in summer with brilliant orange leaves and green encapsulated fruits following in fall. Texas Madrone Arbutus xalapensis , which grows in USDA zones 7 through 8, gives you fragrant, white flowers in spring, masses of orange or red berries in summer or fall, and interesting peeling bark in shades of red and brown. Although Texas madrone may litter the ground with its fruit and bark, it has a high fire-resistance rating.

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Chapter 7 : Trees With Strong, Deep Roots | Home Guides | SF Gate

Syed Waliullah's Tree Without Roots () is a transcreation (a recreation in another language), rather than a literal translation, of his first novel Lal Shalu (). Waliullah made a number of.

A Tree Without Roots We love trees. We recently read an article about trees. A tree with well developed deep roots can withstand a great wind storm without falling over. We watched many trees with shallow root systems topple over in heavy wind and over moist ground in Oregon. A tree depends on a strong root system to reach down into the ground and receive nourishment and water to live a long strong live. Some trees develop a long deep tap root with smaller roots coming off that main root. As they grow, there is very little visible growth above ground for the first few years as the growth takes place below the surface, deep in the ground. Taproots Some trees develop deep lateral roots that anchor them firmly to the ground. Trees that produce a deep taproot can handle most any soil conditions while other trees may fail. They can take drought, cold, heat, or dry. The taproot keeps them upright and strong. The tree adjusts where ever it is planted. Same kind of different as me This week we watched an amazing movie. Same kind of different as me. We highly recommend this true story movie. The subject of homelessness is a focus. In this next section, please do not think we are callus or showing disrespect for the people in the world who are homeless. We are not comparing our rich full life to those who have no home. We are simply using the word as a metaphor. As we went to bed that night after watching the movie, we had the weight of the decisions we are making about a place to live. We have no place that is ours. No place where the roots are deep. We have no tap root. We both have moved our entire lives. Prior to our marriage and after the Air Force we continued to move with no roots, anchor, or grounded purpose. We swayed where the job might be. We moved where family was. We moved when we got tired of the stress of the job. We had no tap root in our life, so we had no reason to stay put. Unfortunately our children were also never allowed to have roots. Thankfully, They have made their own roots and for this we are grateful, even though their roots are scattered over five different states, but we still find ourselves a tree without roots. This time, we choose a place where we can learn how to grow a taproot deep within the earth. Not because we are changing to something better. Not because we are moving because of a family member. It has been five months since we left Oregon. We have looked, thought, prayed, searched, settled on, become unsettled, looked, and looked and looked. We are getting closer to knowing. We have discovered that no place is perfect. We actually knew that all along. We also know that we need to find a place where we can drive in and feel good each time we do. We felt that way in Oregon, but it was not our place. This is where we are taking ourselves. We are really good gardeners. It is time that we allow the Master Gardener to lead us to our last garden where we will put our tap room deep into the ground. We no longer want to be homeless. We desire to stay put, sway in the wind, withstand the drought, the cold, heat, and obstacles that come our way. We think we will make fine trees with deep roots in a place to call home until the Master Gardener calls us Home.

Chapter 8 : Fruit, Shade and Curbside Trees with Non-Invasive Root Systems

From evergreens to trees with showy flowers or bright fall color, you have lots of options when choosing fast-growing shade trees. A number of these trees have noninvasive roots that won't wreck.

Will It Harm or Kill the Tree? September 29, Roots stretch far and wide to give our trees a stable foundation. Read on to learn if you can prune above-ground tree roots, how many tree roots you can cut at once and how to safely prune tree roots at the best time. It all depends on the size and location of the tree root. As a guideline, avoid pruning roots more than 2 inches wide. Removing large tree roots can make the tree unstable or unhealthy later on. If large roots are removed, the tree may not be able to get enough nutrients and water. If you choose to cut or remove tree roots, winter and early spring are the best time of year to do so. How many tree roots can I cut? Never remove more than 20 percent of above-ground tree roots at once. Then, wait two to three years to make sure your tree fully recovers. Only then can you safely consider cutting more tree roots. How can I cut tree roots without killing the tree? We only recommend removing tree roots when they are damaging or infringing on a nearby structure â€" not for aesthetic reasons. For the best chance of your tree surviving, consult with your local arborist before removing tree roots. Or see if your arborist can prune the roots for you. For DIY root cutting, use this step-by-step guide. Find the root posing an issue and trace it back to the base of your tree. If it turns out to be part of a large root, ask your arborist before pruning or cutting. For a smaller root, move to step 2. Measure the diameter of your tree. Then, divide that number by 3. Generally, you can safely prune roots that are times the diameter away from your tree. So, if your tree has a diameter of 3 feet, only cut tree roots feet away from the tree. Use a root saw to prune the tree. Carefully pull the root up and away from the tree until it comes out. Be sure to refill the hole with soil from the same area afterward. Keep an eye on your tree for a few weeks after pruning.

Chapter 9 : Tree root problems | The Morton Arboretum

A compromised basement wall, septic system or sewer connection might be the expensive consequence of buying and planting an ornamental tree without checking to find out how deep its roots will.

A new layer of wood is added in each growing season, thickening the stem, existing branches and roots. Although "tree" is a term of common parlance, there is no universally recognised precise definition of what a tree is, either botanically or in common language. Certain monocots may be considered trees under a slightly looser definition; [8] while the Joshua tree , bamboos and palms do not have secondary growth and never produce true wood with growth rings, [9] [10] they may produce "pseudo-wood" by lignifying cells formed by primary growth. They differ from shrubs , which have a similar growth form, by usually growing larger and having a single main stem; [5] but there is no consistent distinction between a tree and a shrub, [17] made more confusing by the fact that trees may be reduced in size under harsher environmental conditions such as on mountains and subarctic areas. The tree form has evolved separately in unrelated classes of plants in response to similar environmental challenges, making it a classic example of parallel evolution. With an estimated 60,, species, the number of trees worldwide might total twenty-five per cent of all living plant species. The majority of tree species are angiosperms. There are about species of gymnosperm trees, [21] including conifers , cycads , ginkgophytes and gnetales ; they produce seeds which are not enclosed in fruits, but in open structures such as pine cones , and many have tough waxy leaves, such as pine needles. There are also some trees among the old lineages of flowering plants called basal angiosperms or paleodicots ; these include Amborella , Magnolia , nutmeg and avocado, [23] while trees such as bamboo, palms and bananas are monocots. Wood gives structural strength to the trunk of most types of tree; this supports the plant as it grows larger. The vascular system of trees allows water, nutrients and other chemicals to be distributed around the plant, and without it trees would not be able to grow as large as they do. Trees, as relatively tall plants, need to draw water up the stem through the xylem from the roots by the suction produced as water evaporates from the leaves. If insufficient water is available the leaves will die. In trees and other plants that develop wood, the vascular cambium allows the expansion of vascular tissue that produces woody growth. Because this growth ruptures the epidermis of the stem, woody plants also have a cork cambium that develops among the phloem. The cork cambium gives rise to thickened cork cells to protect the surface of the plant and reduce water loss. Both the production of wood and the production of cork are forms of secondary growth. Forest The number of trees in the world, according to a estimate, is 3. The estimate is about eight times higher than previous estimates, and is based on tree densities measured on over , plots. It remains subject to a wide margin of error, not least because the samples are mainly from Europe and North America. The estimate suggests that about 15 billion trees are cut down annually and about 5 billion are planted. Light is very limited under their dense cover and there may be little plant life on the forest floor, although fungi may abound. Acacia and baobab are well adapted to living in such areas. Root The roots of a tree serve to anchor it to the ground and gather water and nutrients to transfer to all parts of the tree. They are also used for reproduction, defence, survival, energy storage and many other purposes. The radicle or embryonic root is the first part of a seedling to emerge from the seed during the process of germination. This develops into a taproot which goes straight downwards. Within a few weeks lateral roots branch out of the side of this and grow horizontally through the upper layers of the soil. In most trees, the taproot eventually withers away and the wide-spreading laterals remain. Near the tip of the finer roots are single cell root hairs. These are in immediate contact with the soil particles and can absorb water and nutrients such as potassium in solution. The roots require oxygen to respire and only a few species such as the mangrove and the pond cypress Taxodium ascendens can live in permanently waterlogged soil. Many of these are known as mycorrhiza and form a mutualistic relationship with the tree roots. Some are specific to a single tree species, which will not flourish in the absence of its mycorrhizal associate. Others are generalists and associate with many species. The tree acquires minerals such as phosphorus from the fungus while it obtains the carbohydrate products of photosynthesis from the tree. The fungus promotes growth of the roots and helps protect the trees against predators and pathogens. It can also limit damage done to a tree by

pollution as the fungus accumulate heavy metals within its tissues. They have actinorhizal root nodules on their roots in which the bacteria live. This process enables the tree to live in low nitrogen habitats where they would otherwise be unable to thrive. The interconnections are made by the inosculation process, a kind of natural grafting or welding of vegetal tissues. The tests to demonstrate this networking are performed by injecting chemicals, sometimes radioactive , into a tree, and then checking for its presence in neighbouring trees. The common purposes for aerial roots may be of two kinds, to contribute to the mechanical stability of the tree, and to obtain oxygen from air. An instance of mechanical stability enhancement is the red mangrove that develops prop roots that loop out of the trunk and branches and descend vertically into the mud. These brace the tree rather like angle brackets and provide stability, reducing sway in high winds. They are particularly prevalent in tropical rainforests where the soil is poor and the roots are close to the surface. These root extensions are called pneumatophores , and are present, among others, in black mangrove and pond cypress. Trunk botany The main purpose of the trunk is to raise the leaves above the ground, enabling the tree to overtop other plants and outcompete them for light. It protects the trunk against the elements, disease, animal attack and fire. It is perforated by a large number of fine breathing pores called lenticels , through which oxygen diffuses. Bark is continually replaced by a living layer of cells called the cork cambium or phellogen. Similarly, the bark of the silver birch Betula pendula peels off in strips. In some trees such as the pine Pinus species the bark exudes sticky resin which deters attackers whereas in rubber trees Hevea brasiliensis it is a milky latex that oozes out. The quinine bark tree Cinchona officinalis contains bitter substances to make the bark unpalatable. These lay their eggs in crevices and the larvae chew their way through the cellulose tissues leaving a gallery of tunnels. This may allow fungal spores to gain admittance and attack the tree. Dutch elm disease is caused by a fungus Ophiostoma species carried from one elm tree to another by various beetles. The tree reacts to the growth of the fungus by blocking off the xylem tissue carrying sap upwards and the branch above, and eventually the whole tree, is deprived of nourishment and dies. In Britain in the s, 25 million elm trees were killed by this disease. It is a soft spongy layer of living cells, some of which are arranged end to end to form tubes. These are supported by parenchyma cells which provide padding and include fibres for strengthening the tissue. The cells are continually dividing, creating phloem cells on the outside and wood cells known as xylem on the inside. It is composed of water-conducting cells and associated cells which are often living, and is usually pale in colour. It transports water and minerals from the roots to the upper parts of the tree. The oldest, inner part of the sapwood is progressively converted into heartwood as new sapwood is formed at the cambium. The conductive cells of the heartwood are blocked in some species, and the surrounding cells are more often dead. Heartwood is usually darker in colour than the sapwood. It is the dense central core of the trunk giving it rigidity. Three quarters of the dry mass of the xylem is cellulose , a polysaccharide , and most of the remainder is lignin, a complex polymer. A transverse section through a tree trunk or a horizontal core will show concentric circles or lighter or darker wood - tree rings. These rings are the annual growth rings [64] There may also be rays running at right angles to growth rings. These are vascular rays which are thin sheets of living tissue permeating the wood. This pattern of growth is related to climatic conditions; growth normally ceases when conditions are either too cold or too dry. In readiness for the inactive period, trees form buds to protect the meristem , the zone of active growth. Before the period of dormancy, the last few leaves produced at the tip of a twig form scales. These are thick, small and closely wrapped and enclose the growing point in a waterproof sheath. Inside this bud there is a rudimentary stalk and neatly folded miniature leaves, ready to expand when the next growing season arrives. Buds also form in the axils of the leaves ready to produce new side shoots. The expanding shoot pushes its way out, shedding the scales in the process. These leave behind scars on the surface of the twig. The new stem is unlignified at first and may be green and downy. The Arecaceae palms have their leaves spirally arranged on an unbranched trunk. Secondary growth consists of a progressive thickening and strengthening of the tissues as the outer layer of the epidermis is converted into bark and the cambium layer creates new phloem and xylem cells. The bark is inelastic. If damage occurs the tree may in time become hollow. Leaf Leaves are structures specialised for photosynthesis and are arranged on the tree in such a way as to maximise their exposure to light without shading each other. Trees have evolved leaves in a wide range of shapes and sizes, in

response to environmental pressures including climate and predation. They can be broad or needle-like, simple or compound, lobed or entire, smooth or hairy, delicate or tough, deciduous or evergreen. The needles of coniferous trees are compact but are structurally similar to those of broad-leaved trees. They are adapted for life in environments where resources are low or water is scarce. Frozen ground may limit water availability and conifers are often found in colder places at higher altitudes and higher latitudes than broad leaved trees. In conifers such as fir trees, the branches hang down at an angle to the trunk, enabling them to shed snow. In contrast, broad leaved trees in temperate regions deal with winter weather by shedding their leaves. When the days get shorter and the temperature begins to decrease, the leaves no longer make new chlorophyll and the red and yellow pigments already present in the blades become apparent. This causes the cells at the junction of the petiole and the twig to weaken until the joint breaks and the leaf floats to the ground. In tropical and subtropical regions, many trees keep their leaves all year round. Individual leaves may fall intermittently and be replaced by new growth but most leaves remain intact for some time. Other tropical species and those in arid regions may shed all their leaves annually, such as at the start of the dry season. Plant reproduction , Pollination , and Seed dispersal Trees can be pollinated either by wind or by animals, mostly insects.