Looking Ahead

Understanding and Caring for Your New Tree

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Introduction

Purpose

The purpose of this guide is to offer a basic foundational knowledge of trees and the requirements for their care; as well as a brief outline of their benefits. This guide is not meant to be a complete description of all topics nor material that qualifies one as a professional; instead it is meant to be a guide of tips, tricks, and bits of information. Urban forestry is a very broad and complex topic. If you are interested in learning more, sources worth reading are the USFS Tree Owner's Manual, ABC's Field Guide to Young & Small Tree Pruning, ANSI A300 BMP's, ISA Certified Arborist Study Guide, and ReGreen Springfield's Greenskills Course Resource Material. The material in this guide was sourced from the aforementioned sources and many more.

This guide is geared towards maintenance on new trees homeowners may have received through the GGCP Springfield.

Greening the Gateway Cities Program – Springfield

Greening the Gateway Cities is a partnership between the Executive Office of Energy and Environmental Affairs (EEA), the Department of Conservation and Recreation (DCR) Urban & Community Forestry Program, the Department of Energy Resources (DOER) and the Department of Housing and Community Development (DHCD), along with Gateway Cities and local grassroots organizations.

The Springfield branch of the program operates in McKnight, Old Hill and parts of Upper Hill that have been chosen by the state due to their low canopy cover with respect to the rest of the city. Our goal is to plant 2,400 trees over the course of 3 years with 80% of those trees planted on private property.

Planting trees on private property allows the homeowner or renter autonomy over their plant care after the first two years. We hope this guide is helpful to you in learning proper ways to take care of your new trees. Trees will not only benefit you as an individual but will benefit your neighborhood and city as a whole. A healthy urban forest improves the quality of the *water we drink*, the *air we breathe*, the *stability of our neighborhoods,* and our *sense of community*.

For any questions, please contact Emmalin Coates or Joe Pellegrino from the GGCP Springfield Team at ECoates@SpringfieldCityHall.com or JPellegrino@SpringfieldCityHall.com. Our mailing address is 200 Trafton Road, Springfield, MA 01108.

Tree Growth

Introduction

A tree is defined as a woody perennial plant, typically having a single stem or trunk growing to at least 12 to 15 feet tall, having branches, and a distinct head some distance from the ground. Trees come in many different shapes, sizes and forms (Figure 1). They can be either *deciduous*, meaning they lose leaves annually in a cycle that is impacted by climate (for us, the cold season), or *coniferous*. Coniferous trees hold their leaves, which are typically needles or scales, and these leaves retain their green color.

Trees have many important parts that play a large role in multiple tree functions. The diagram below outlines tree parts from bottom to top. We will discuss each of the important parts in length.

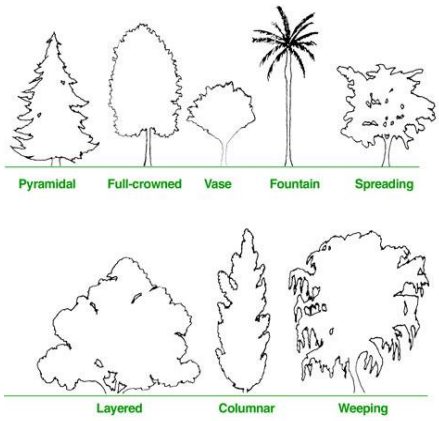

Figure 1: Brief illustration of tree shape, size and form differences.

Roots

Roots provide anchorage, support, food storage, and the movement of materials throughout the tree. Roots grow outwards from the tree and can be found only in the upper 2-6' of soil (Figure 2). Any further down and there would not be sufficient oxygen and nutrients for the tree to survive. The large woody roots that you sometimes see growing through grass are the roots that hold the tree in its place. The fine roots underground are what absorb water and nutrients for the tree to use.

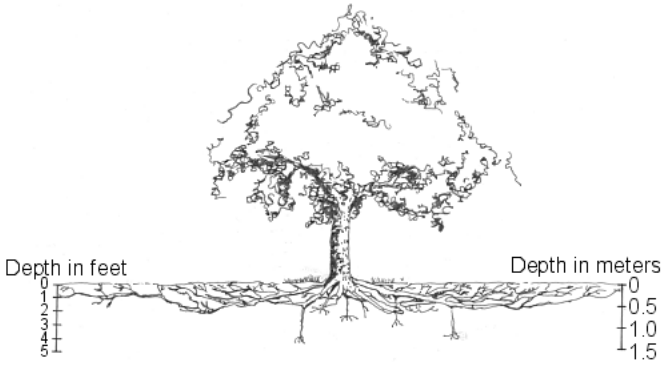

Figure 2: It is a common misconception that tree roots grow straight down into the soil. Instead, they grow outwards in the upper 2-6' of soil and can spread 3 times the size of the crown diameter.

Roots are actively growing. They, like the rest of the woody parts of the tree, are made up of meristematic cells; meaning they are actively growing as these cells divide. The apical meristem is located at the tip of every root just under the bark and is what causes roots to grow outwards.

Stems and Branches

Stems and branches have apical meristems at their tips as well. Stems and branches are responsible for the movement of water and nutrients, providing support, and maximizing photosynthesis by reaching out and creating a canopy.

Stems and branches have a vascular system just under their bark, almost like the system of veins under our skin. But instead of moving blood and oxygen, these move food and water. Plant vascular systems are made up of xylem and phloem.

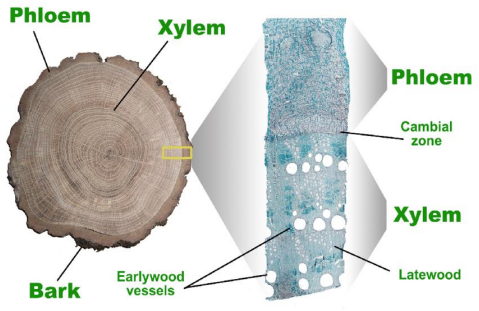

Figure 3: cross section of trunk showing active tissue just under the bark. The outermost layer consists of phloem, followed by cambium, and finally xylem. The first layer of xylem remains active, as it gets replaced in growth, the old xylem becomes inactive and serves as structural support.

Phloem carries food (carbohydrates) produced from photosynthesis in the leaves, down to the roots for storage or use.

Xylem carry water and nutrients up from the roots and out to the leaves. The layer between the xylem and phloem which is responsible for outward growth is called the cambium. Parts that are essential for a tree's biological functions and growth, the xylem, phloem and cambium, are located just underneath the bark. The bark protects the layers inside the tree from injury and stress.

Leaves

Leaves come in many different shapes, sizes, arrangements and colors (Figure 4). The most important function of the leaves is conducting photosynthesis. Different tree species produce different kinds of leaves that will tolerate more or less shade. This is why some trees grow better in full sun whereas others fare better in partial shade. Example: sugar maple tolerates partial shade.

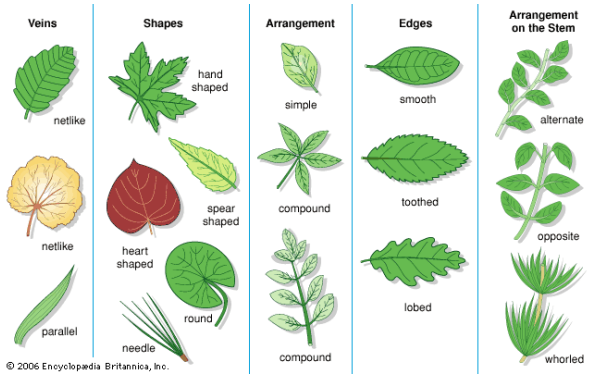

Figure 4: Illustration of leaf morphology. Leaves are great identifiers of tree species.

Photosynthesis

Photosynthesis is the process in which green plants use sunlight to make food from carbon dioxide and water. The byproduct of this process is oxygen which we need to survive. The temperature, amount of light, carbon dioxide and water, as well as the amount of nutrients all can affect the rate of photosynthesis in a tree.

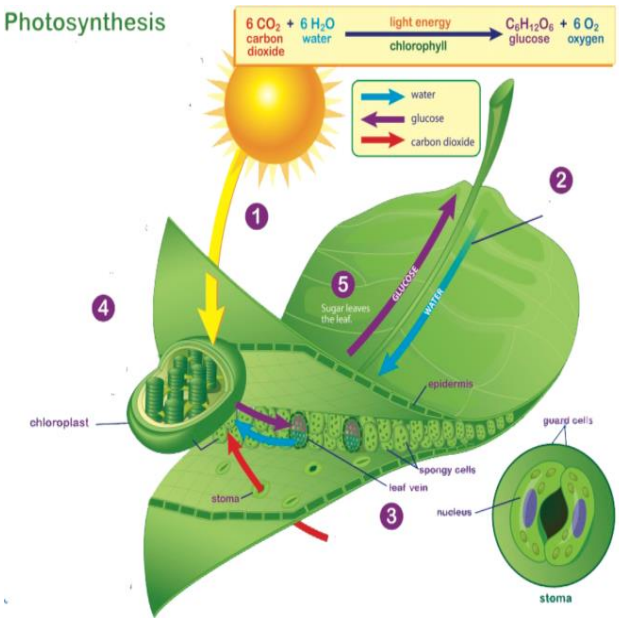

Figure 5: Demonstration of the process of photosynthesis. Carbon Dioxide enters the leaf through the stomata while sunlight penetrates the leaf surface. Both travel to the chloroplast where they interact with water carried up by the xylem to create glucose. Glucose is carried down by the phloem while oxygen is released back out through the stomata.

This process happens in a structure called a "chloroplast". The chloroplast contains chlorophyll which is where chemical reactions occur and create oxygen. Chlorophyll absorbs all light except green and yellow which is what reflects back to us and is what we see, giving leaves their green color. Chlorophyll absorbs light energy from the sun. Then, using this energy, the chloroplast combines water and Co2 to produce glucose and oxygen. Glucose, or carbohydrates, are needed to maintain cell function and for growth.

The byproduct, oxygen, is released from the leaves though tiny openings called "stomata". These openings are used for gas exchange both in and out of the leaf. They cool the leaf surface by releasing water vapor in a process called transpiration and they have the ability to close in order to conserve water in times of stress. They close at night and open during the day when the plant resumes its normal function.

The carbohydrates then travel, by way of the phloem, to be used in a process called respiration. Respiration is the process of releasing energy stored in sugars during photosynthesis. This energy is used for various biological functions such as growth, reproduction, and healing. All living things respire, including us. The speed in which carbohydrates are produced directly affects growth. If not enough sugars are produced quickly enough, they cannot be used in respiration.

Conclusion

Moisture, air, nutrients, temperature, and light are required factors for growth of healthy leaves, roots and stems. There are many interconnected processes in fine balance both in and around plants. Changing environmental factors can greatly affect these processes. When plants become stressed they become more susceptible to lasting injury and disease which, in turn, could cause an untimely death. It is important to understand and respect these biological functions so you can better help your tree live a healthy and happy life.

After-Care: Tree Health & Maintenance Considerations

Introduction

Successfully adding trees to your landscape requires an understanding of the care and maintenance required to keep plants in good health. Trees are living organisms and so their lives will come to an unavoidable end, that being said, proper care and maintenance can keep a tree around for many years – sometimes centuries. Some of the most important aspects of maintenance for a new tree are watering, mulching and pruning amongst other things.

We will not be discussing species selection and planting as processes; GGCP foresters will go through these steps with you on site.

Watering

As discussed, water plays an important role in photosynthesis and therefore is one of the main components driving tree function. The first three years of a newly planted tree's life are essential when it comes to watering. Establishing a good watering routine, especially in the summer when high heat evaporates water quickly, is crucial. The most common question GGCP Foresters receive is, "How often and how much do I water my tree?" Frequency depends on rainfall amounts and the drainage speed of your soil.

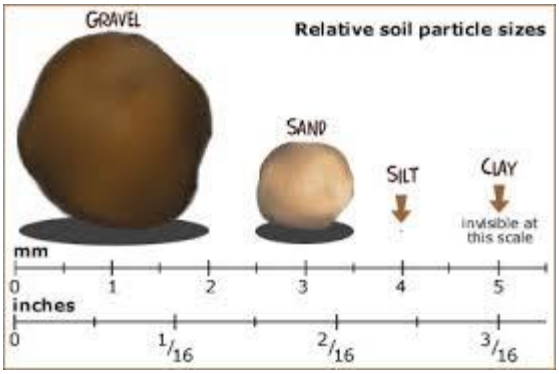

Figure 6: Illustration of soil particle size. Each particle type gives a soil a specific texture which, in turn, affects its ability to hold water for plant use.

All soils are made up of sand, silt and clay particles (Figure 6). Sandy soils have big particles – the large amount of space between each particle allows water to pass through quickly without leaving much behind for plants to use. Silty soils are between clay and sand in particle size making drainage average. Clay soils have very fine particles which, as opposed to sand, leave no space between granules, so water cannot pass through much at all. This is why sand on the beach does not stay wet for long and why clay soils create puddles.

A mix of all three is better for most plants – though it must be noted that different species of trees prefer different kinds of soil. For example: A Ginkgo tree (*Ginkgo biloba*) grows best in sandy soils, whereas a Cornelian Cherry Dogwood (*Cornus mas*) prefers clay soils. You can determine what kind of soil your tree likes by researching their specifications. It is best to know your soil type before you pick a tree.

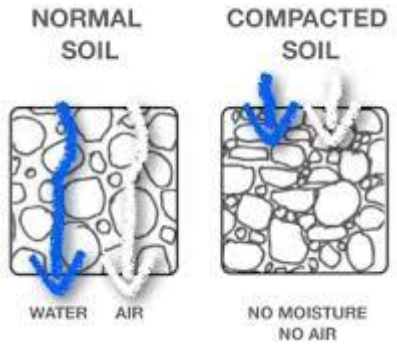

Figure 7: Compacted soil has no open space between soil particles; making it nearly impossible for necessary air and water to exist in the root zone.

Your soils texture also affects its ability to become compacted. When a soil becomes compact, there is no space for water to penetrate down to the roots or for oxygen to exist in the soil (Figure 7). This is one of the worst things for a tree's survival. Without oxygen and water, the tree roots will suffocate. So, be sure to keep all foot and mechanical traffic (lawn mowers, weed whackers, cars, etc.) away from the base of your trees.

While fast draining soils do require more frequent watering than slow draining soils, overall, a less frequent, deep watering is better than an infrequent light watering. For example, if you try to water a tree with sprinklers it will not penetrate deep enough into the soil to be used by your tree. This is partially due to competition for water. Grass roots are much finer and shallower than tree roots so they are able to use up water first. If you water lightly, water still might not reach deep enough to reach your tree's roots. Slow watering with drip irrigation or a watering bag is the best method to water your new trees.

Trees planted through the GGC Springfield program will come with a free watering bag, also referred to by its tradename, *Gatorbag* (Figure 8). These can be filled up for easier watering and allow the water to slowly drip through the soil and reach your tree roots. New trees need 20 gallons of water a week, or 1-$^1/_5$ gallons of water per diameter inch.

Figure 8: These green watering bags can be seen all throughout the city. They aid in better watering practices.

While both over watering and under-watering can be a detriment to your trees health, overwatering is much harder to correct. This can be avoided by being diligent about sticking to your routine and checking your soil before watering. To check if your tree needs water, feel the top 6 inches of soil to determine if it is dry. If it is, then it's certainly time to water. If your soil is saturated, stop watering. When tree roots remain saturated for more than 24 hours the tree cannot use oxygen to respire causing it to drown. Begin watering your tree by ensuring your gator bag is full every day. Start all watering operations in the spring when the ground thaws and continue watering until the ground freezes in the winter.

Be sure to keep track of the weather so you can avoid overwatering your tree after a large rain event. Please visit our website, www.springfield-ma.gov/ggcp, for more detailed instructions on watering your tree with the GGCP Gatorbag.

Mulching

Maintaining the mulch ring around your newly planted tree not only looks nice but can actually be extremely beneficial to your tree's health. Mulch helps to insulate the soil, providing a buffer from extreme hot and cold temperatures. Mulch also retains water to help keep roots moist and prevent compaction. Using mulch can reduce damage to trees from mowers, string trimmers, and weed whackers. As discussed, live tissue that is responsible for important biological processes in the tree is positioned just underneath the bark so it is easy to damage these tissues with lawn tools if one is not careful. Grass and other plants around a tree can be competition for water, so, mulching around a tree prevents other plants from growing and using up potential water sources.

Figure 9: Illustration of proper mulching practices

To maintain your mulch ring, place a 2-4 inch thick layer of bark mulch (shredded can form a hard crust that prevents water from getting to the soil) in a 3 foot ring, 3 inches away from the base of the tree. Be sure to keep mulch away from the base of the tree, as covering this can prevent roots from getting oxygen or can cause rot in vital parts of the trunk. Do not make "mulch volcanoes" – a cone of mulch around the tree base (Figure 10).

Instead, create a saucer, also referred to as a berm, to help retain water, build organic matter for nutrients, and keep down weeds. Be sure to clean around the base of your tree every year and replace the mulch as needed.

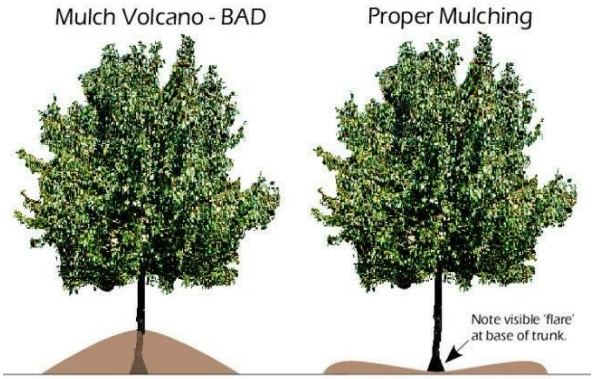

Figure 10: It is common to see improper mulching practices – it is important to keep mulch away from the trunk of your tree and keep the root flare visible. Mulch volcanoes can be detrimental to tree health.

Tree Stakes

Staking a tree is the process of placing additional support into the ground to hold a tree in the proper upright position (Figure 11). Not all trees need stakes, in fact, it is typically better *not* to use stakes. Trees develop what is called "reaction wood" at their base, this occurs when trees experience outside forces such as wind, which causes a tree to sway. This swaying triggers trees to grow a wider, stronger trunk base. With the use of stakes, especially if they are too tight, a tree cannot sway and therefore cannot build up as strong of a base, potentially shortening the lifespan of your tree. However, if a tree's root system is too fine to hold the tree up before it can establish, stakes can be beneficial.

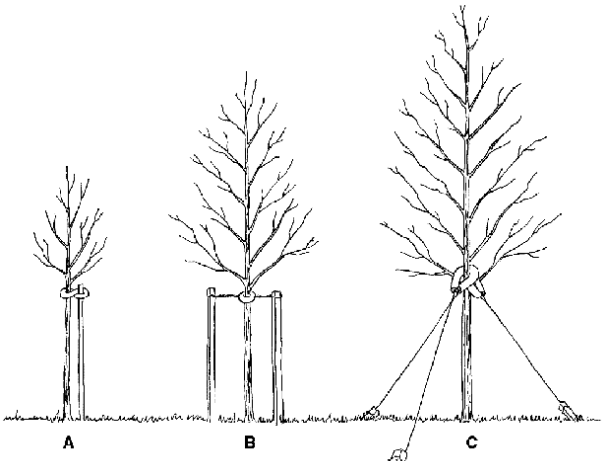

Figure 11: Illustration of multiple ways to stake a new tree. GGCP typically stakes following picture B.

If you have received a GGCP tree with stakes please note that the ties are adjustable and the stakes MUST be removed after 2 years, though the sooner they can be removed the better. The program will monitor tree stakes annually with you to be sure they are not harming the tree in any way.

If you choose to stake your tree on your own, please leave stake ties just taut so the tree has room to move. Put stakes in the ground just outside the mulch ring, and then attach your ties. Do not tie ropes, chains, leashes, wires or other materials around the tree. If any material cuts through the bark as the tree grows, this could girdle your tree, and compromise the vascular tissue just below the bark (Figure 12). It is best to use a tie with a flat, broad, and flexible surface. If you use wire, put a section of hose between the wire and the trunk.

Figure 12: When left on a tree too long, ties can begin to constrict the tree as it grows around the material. This cuts off flow of water and nutrients in the trunk in a process called girdling.

The best materials to use to stake trees are industry made arbortie or arborlock. GGCP Springfield trees with stakes will have arborlock.

To adjust the arborlock on your tree:

1. Gently remove the "basket" created around the trunk of the tree and put it somewhere safe to be repositioned afterwards

Figure 13: The basket is made up of a separate piece of arborlock placed around the trunk

2. Unlock one end of your arborlock and unwrap it from around the stake
3. Pull gently until just taut and rewrap the strand around the stake, taking care to place it above the notch in the stake

Figure 14: Note the small notch made on the stake. This helps keep the tie from sliding.

4. Pull the free end of the lock through the other side and twist to "lock" in place
5. Feed the remainder through in the opposite direction and "lock" to ensure it is sturdy

Figure 15: Demonstrates the end result of steps 4-5

6. Replace the "basket" gently around the trunk. Be sure it is loose enough for the trunk to move freely a few centimeters in all directions

*If you have any questions please call your local GGCP forester to assist you

Plant Healthcare

Plant healthcare (PHC) is the preventative process of maintaining plants so they may remain less susceptible to problems such as insect pests and diseases. Plant healthcare includes all of the aforementioned care processes, as well as fertilization and pest and disease management.

It is a common misconception that all plants need fertilization. However, new trees should not be fertilized while they are trying to establish in a new place. Fertilizer should only be applied following a soil test that determines if your soil is lacking proper nutrients for your plant. If you do decide to fertilize your plants at a later date, be sure to follow the instructions on the bag and be careful not to overdose. Fertilizer can cause problems such as burn and chlorosis when improperly applied.

Figure 16: Example of herbicide damage to leaves. This can look very similar to other stress responses or diseases

On this note, "weed and feed", or herbicides that kill weeds and fertilize your lawn can severely harm your tree (Figure 16). If a fertilizer label says "will kill broadleaf weeds", this means it will have a negative effect on trees since they are woody broadleaf plants. As previously stated, be sure to read all labels and follow them accordingly.

Proper plant healthcare requires checking your trees health on a regular basis. This includes inspecting for insect pests and plant diseases. There are a large number of insect pests that effect plants as well as a large number of fungi and bacteria related diseases that affect trees. Some signs and symptoms you may notice if you have pests and diseases are discolored spots on leaves, mushrooms and other fruiting bodies on branches and stems, discoloration, missing portions of leaves (i.e. leaves look as if they have been eaten), nests and insect egg masses (Figure 17).

Figure 17: (left to right) leaf damage from Japanese Beetle pests feeding, Rust disease causing discolored patches on leaves, mushrooms growing from a tree trunk signifying internal decay. All of these are signs and symptoms of pest and disease problems

If you believe you are seeing pests or diseases make sure you gather as much information as possible and call your local arborist. Information to gather includes:

1. Date and time you noticed the problem
2. Weather factors such as wind speed and rain
3. Signs and symptoms – take photos when possible
4. Samples of affected material

The more information you provide your arborist with, the easier it will be for them to identify your problem.

Conclusion

Trees are living things – we cannot completely control and predict the process of life. Therefore, following each of these steps doesn't guarantee the survival of your tree; they do give you a better chance at being a successful tree owner. Closely monitoring and caring for your tree from the beginning are some of the most important steps you can take. Diligence in reporting problems and asking questions are extremely beneficial to ensuring your tree grows healthy and strong. In addition to proper watering, mulching and other plant healthcare practices, pruning plays a large role in tree health.

After-Care: Tree Pruning

Introduction

Pruning is the process of removing select parts of a tree in order to reach an objective that enhances safety, health and aesthetics. To successfully prune a tree, one must set a goal before beginning so as to facilitate a methodical approach. This goal can be something such as encouraging the development of a strong central leader or increasing clearance over a roof. Pruning requires the understanding that no two trees are the same. They have different form, size, shape and ability to heal and therefore need to be pruned accordingly. Pruning is both an art and a science and takes years of practice to perfect. So, don't get discouraged along the way, and be sure to utilize your resources when you are in doubt. When your tree starts to become too large to prune on your own, reach out and hire a professional arborist to get the job done for you.

Figure 18: Springfield Forestry crew takes care of pruning a large city tree with a bucket truck. Large trees take years of experience to prune safely – only a certified professional should perform this work.

When pruning, be sure to prune first for safety, then for health, and lastly for looks. Pruning for safety refers to removing branches that have potential to cause injury or damage, removing branches that obstruct line of sight and removing branches by utility wires. Pruning for health is removing dead or dying branches, crossing or rubbing branches, or thinning the canopy to increase air flow. Lastly, pruning for aesthetics refers to pruning to enhance natural beauty and pruning for bud and flower stimulation.

This does *not* refer to pruning trees into shapes, or topiary pruning, with disregard for their biological functions.

Newly planted trees generally take 3 years to put out substantial growth. As a saying goes, "first it sleeps, then it creeps, then it leaps." This means: the first year of a new trees life it takes time to recover from the shock of being planted – it sleeps. Then, the second year, it begins to better establish and put out new roots for anchorage and absorption – it creeps. Finally, in the third year, your tree will begin to resume its normal functions – it leaps!

A healthy tree should have well attached branches with good spacing between each branch, one central leader or stem (this could change as a tree grows into its natural form), good clearance between branches and surrounding objects, and a good crown height that is at least 60% of the total tree height (Figure 19). Pruning can help maintain these features.

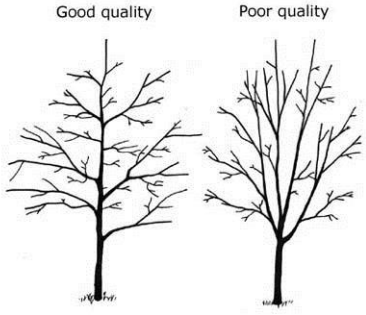

Figure 19: Demonstrates features of a healthy tree of good quality compared to one of poor quality

When to Prune

Knowing when to prune requires an understanding of "pruning intervals", or the number of years between each time the tree is pruned. Any initial pruning needed on your new tree will be done by the GGCP Springfield team. For those who are not able to participate in our program: pruning done on newly planted trees should *ONLY* be the removal of broken or dead branches and, if truly necessary, the removal of codominant stems to help establish a single central leader.

The general rule of thumb is to not prune until after the first 2 years of planting. New trees are using most of their energy to put out new roots and establish in the soil. Pruning forces your tree to use precious energy to heal over new wounds. After the first 2 years, your tree would only need to be pruned every other year or every 3 years at your discretion or an arborist's discretion. Vigorously growing trees can be pruned less than every 3 years. When your tree reaches maturity pruning can be done every 4-7 years. Though, removal of sprouts, dead, broken, or rubbing branches is recommended every year. No tree shall be pruned more than once in a growing season, as this will cause your plant to become stressed and pruning will no longer be beneficial.

Figure 20: Before (left) and after (right) of a pruning event. Since this is a larger tree, the pruning interval will be longer – closer to 4-7 years between pruning events

It is typically easier for beginners to prune in the winter time. This is because it is easier to see all of the branches. As an added bonus to winter pruning; trees are dormant in the wintertime and therefore there is reduced risk of sending your tree into stress or facilitating the spread of insect pests and diseases.

Tools for Pruning

There are a variety of tools to prune your tree with. There is no one universal tool that is effective for all pruning situations. Instead, different tools are best suited for different situations based on their attributes. Please keep equipment sharp and maintained to ensure better pruning cuts and safety. Sharp tools make cleans cuts while dull tools make crushing cuts that a tree cannot heal over.

Figure 21: (left to right) bypass hand pruners are best for small branches on young trees. A hand saw is typically used for larger branches that are within arms-reach. Pole saws and pole clips can safely get to larger branches that may be out of reach.

When pruning it is in your best interest that you practice tree care safely. This includes wearing personal protective equipment (PPE). Though it may feel silly or unnecessary, anything can happen and your life is more important than an avoidable event. Personal protective equipment would include safety glasses, gloves, and, if you are using a chainsaw, protective chainsaw resistant pants or chaps**. Be aware of utility wires when pruning your trees. Keep at least 10 feet away from wires and refrain from touching any as they are to be considered energized at all times – this includes telephone and cable wires.

All tools and equipment can be purchased at your local garden store or hardware store. There are places where they are available for purchase online as well.

***Please note: if you need power tools such as a chainsaw to prune your tree, we recommend you hire a professional arborist that is aware of all the hazards and safety regulations surrounding tree pruning with power tools. It is not worth the potential risk for serious injury to care for your tree.*

How to Prune

Before pruning, it should be understood that the process of pruning is actually the process of intentionally injuring your tree. That being said, learning how trees heal from injury helps us to better comprehend the importance of making proper pruning cuts. Improper cuts, even made with good intentions, will end up harming your tree instead of benefiting its growth.

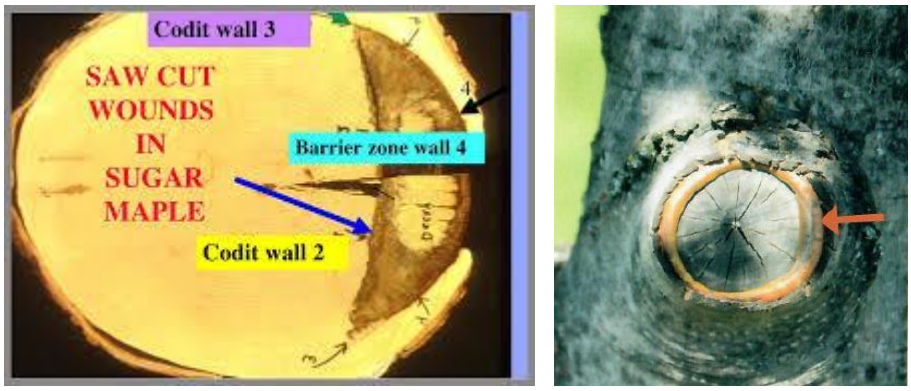

Figure 23: (Left) cross section of a trunk shows "walls" of chemical trees produce to compartmentalize decay. (Right) the tree develops wood from the branch collar that will grow over a wound to complete the CODIT process

Trees don't heal the same way humans do. While we have white blood cells to *heal* our wounds, trees go through a process known as CODIT, or Compartmentalization of Decay in Trees. Through this process, trees produce chemical compounds to contain decay and develop new tissue from the branch collar to seal over wounds (Figure 23). This is why it is extremely important to avoid damaging the branch collar when making **any** pruning cuts. Both species and tree vitality can affect the rate of compartmentalization, so these must be noted before deciding how much to prune.

The basic technique used to make cuts that respect CODIT is known as the "3 Cut Method." This method can be used when branches become big enough for multiple cuts on the same branch. This method will help to ensure your cut is clean and in the right place so the compartmentalization process can begin. The steps are:

1. Make an undercut part of the way through your branch a few inches away from where it is attached
2. Cut overhand all the way through the branch just beyond your undercut to remove the majority of the branch

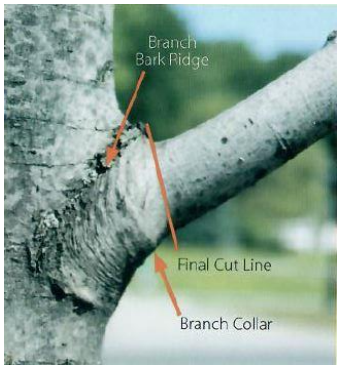

Figure 22: The branch collar contains interlocking layers of cells that will cover a wound. The branch bark ridge can be used to help identify the branch collar. Never cut past the branch bark ridge.

3. Make your final cut just outside the branch collar, avoiding the branch bark ridge. (If the stub is long enough, hold onto the stub with one hand and finish your cut with the other to ensure the bark doesn't rip. Ripping bark peels away the vascular tissue underneath, compromising biological processes for growth)

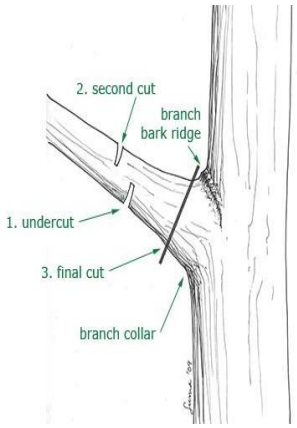

Figure 24: Illustrates the steps of the Three Cut Method. Note the final cut does not have to be parallel to the trunk but should still remain outside of the branch bark ridae and branch collar

Start the pruning process by assessing your tree. Take note of the species, its age, its specifications, and what its natural structure looks like. Then, determine your objective – no pruning cut should be made without a pruning objective. You could have multiple objectives, but, as a beginner, it is easier to focus on just one. Common objectives include: reducing, raising, cleaning and thinning (Figure 25).

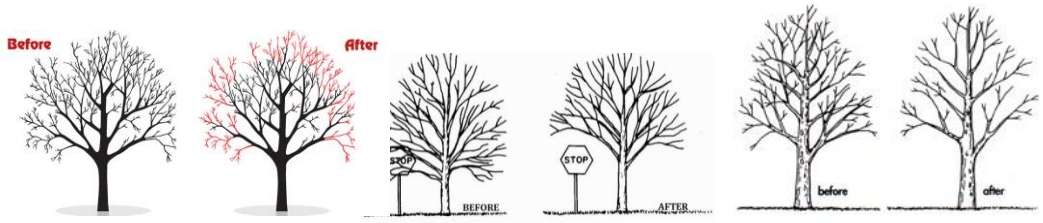

Figure 25: (left to right) examples of reducing, raising, and thinning. Cleaning refers to the removal of dead, dying or diseased branches – usually this objective would be included in any pruning event

A rule of thumb when pruning any tree is never to prune out more than 25% of the canopy at one time. As you now know, photosynthesis is one of the main drivers of keeping trees healthy and happy, so, removing too much of the material responsible for this process will send your tree into stress. On that note, there are three different types of pruning cuts that can be used to achieve any of the objectives listed above. These cuts are: the removal cut, the reduction cut, and the heading cut.

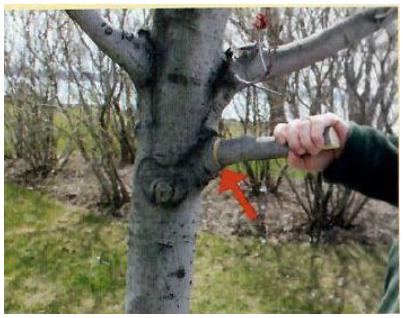

Figure 26: example of a removal cut – the branch is removed back to its origin which is the trunk

Removal cuts remove an entire branch to its point of origin (Figure 26). This cut can be used to meet objectives such as establishing a central leader (reducing), providing clearance (raising), improving spacing (thinning), and removing entire dead, diseased or broken branches (cleaning). To make a removal cut: follow the 3 cut method to take the branch back to its origin.

Reduction and heading cuts have some of the same objectives, but have different instructions. Reduction cuts are preferred over heading cuts for tree health. Both reduction and heading cuts can be used to suppress

branch growth by removing its terminal bud (thinning), direct branch growth in a desired direction by removing the terminal, and reducing the amount of pruning by removing less branch area than a removal cut (reducing).

Reduction cuts shorten a parent stem back to a lateral branch that must be at least $^1/_3$ the diameter or the parent stem (Figure 27). These should be made when the branch you are pruning is to remain on the tree or when removing the entire branch would be undesirable. To make this cut: determine a good lateral to cut back to that is growing in a desirable direction (i.e. out and away from the trunk or other branches) that is at least $^1/_3$ the diameter of its parent stem. Then follow your three cut method by drawing an imaginary line perpendicular to the branch bark ridge and making your final cut divided equally in the angle created by your perpendicular line.

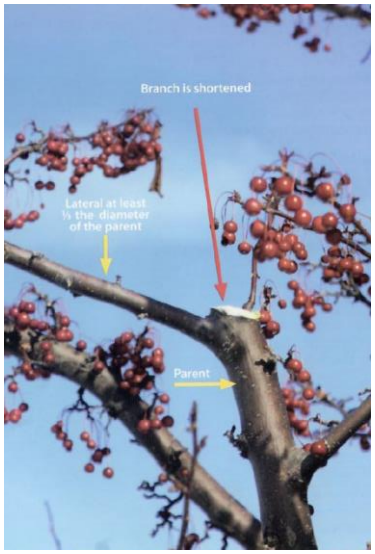

Figure 27: example of a reduction cut. This cut does not remove a whole branch; instead it shortens a desired section

Figure 28: example of a heading cut. This cut is only preferred when a branch will be removed at a later date. The cut compromises the integrity of the branch

The heading cut shortens the parent as well, but this cut brings the parent between two laterals or to a lateral that does not meet the $^1/_3$ diameter criteria (Figure 29). Heading cuts should *only be used on branches that will be removed at a later date* or on species that are experiencing extremely vigorous growth. These cuts are made by leaving a stub between two laterals or by cutting back to a branch that is too small (less than $^1/_3$ the diameter of the parent) and therefore cannot assume dominance. Topping is the process of making multiple heading cuts that they remove a branch between nodes. Topping can cause your tree to produce unhealthy sprouts and could lead to decreased vigor or even death.

Take note of these helpful tips while you are pruning:

<u>DO</u>

a. Remove branches in pieces before making a final cut for easier handling and to avoid injury to the tree or to yourself
b. Remove in small amounts and step back to assess your work. You can always take more off but you cannot put anything back on
c. Remove branches with narrow angles by cutting from the underside
d. Sanitize your tools between cuts if you are removing diseased branches

e. Have a sound method – start from the bottom and work your way to the top
f. Prune in wintertime when you can clearly see branches and their attachments
g. Light pruning more frequently is better than heavy pruning less often
h. If your tree is too big and would require you to leave the ground in order to maintain it, call an arborist

DON'T

a. Remove more than 25-30% of the canopy – this will cause your tree to go into stress and could have a negative effect on its growth
b. Dress wounds – research has proven that wound dressings have no effect on compartmentalization
c. Use ladders – using a ladder to prune is not a safe work practice
d. Flush cut – cut a branch flush with the trunk which removes important compartmentalization tissue
e. Damage trunk, stems, branch collar, branch bark ridge
f. Rip bark
g. Use dull tools
h. Leave stubs
i. Top your trees
j. Put yourself, others or your property in harm's way – ask a professional arborist for help

Hiring an Arborist

Professional arborists are very helpful when it comes to tree care. While they can be utilized at any stage in a trees life, it is highly recommended to hire an arborist any time power tools or large equipment and clean-up are required. It is better to be safe than sorry when it comes to tree care questions and operations. If your tree is getting too big to handle safely without leaving the ground, please call an arborist. If you would like to ask about or mitigate pests and diseases, please hire an arborist that has the proper experience and licensure to deal with these concerns.

When you are looking for an arborist that can help, be aware of companies that advertise as tree care companies, but have not had proper training. These companies can be a liability to have on your property. Look for the following qualifications when deciding who to hire:

a. Education – formal education in arboriculture, horticulture, or another related field
b. Membership in Professional Organizations – International Society of Arboriculture (ISA), Massachusetts Arborist Association (MAA), Tree Care Industry Association (TCIA)
c. ISA Certification or State Certification
d. Proof of insurance
e. Necessary permits and licenses
f. Follows or is aware of ANSI (American National Standards Institute) and OSHA (Occupational Safety and Health Administration) safety standards

Tips:

a. Ask for references or speak to former clients
b. Get at least 3 estimates
c. Don't automatically accept the lowest bid
d. Never pay in advance
e. Get it in writing – when work will be completed, who is responsible for cleanup, what is hourly rate for additional work

Conclusion

Professional arborists are here to keep you safe and to help you with your tree care needs. Understanding some of the basics as a tree owner and being able to take care of your young trees is of great benefit to you and even greater benefit to your community. Begin pruning your trees after the first two years of establishment is easier, safer and cheaper in the long run. Pruning trees when they are young develops strong attachments and good structure so your tree will need less maintenance as it ages. Pruning encourages trees to develop a strong structure from top to bottom and reduces the likelihood of damage from weaknesses that could develop in an unhealthy tree. In a bustling urban setting, such as the one here in Springfield, an urban forest made up of strong and healthy trees are vital to a strong and healthy city.

The Urban Forest

History

The urban forest refers to a collection of trees and other woody plants that grow within a city, town or suburb. The Urban Forestry field itself is an interdisciplinary field consisting of the research, care and management of single trees that make up an entire tree population within an urban setting for the purpose of improving many aspects of our urban environment. The canopy created by our urban trees provides a multitude of positive benefits that can, and should, be reaped by all. The history of our forests and urban forests is long standing.

Figure 29: (left to right) examples of urban green space and the urban forest in Downtown Springfield and West Springfield

North America was once densely covered with forest land. However, by the 18th century, American colonists had cut down millions of acres. Trees were cut primarily to make space for agriculture with wood being used for ships, homes, fences and fuel (figure 31). The forest was an important aspect of life as it was a renewable resource, though this was not yet recognized. Instead, it was viewed as more of a hindrance. As time passed, and with the rise of the industrial era in the 19th century, deforestation had taken off even further. Trees were hardly a part of urban landscapes at all. Those living in denser populated areas began to forget the significance of our natural world and cities slowly became bigger and less green.

Figure 30: Picture of an 1880's logging operation. These operations initially cleared large areas of land for farming and development

Furthermore, with the expansion of roadways in and out of major cities post WWII, even more of the urban canopy was decimated (Figure 32). In the 1950's, 30% of the country's population lived in smog filled cities. As our population continues to grow, by 2030 it is projected that the proportion of the population living in urban areas could increase up to 60%. With this initial increase in the 20th century came the renewed realization that we, as humans and animals, need nature. Removing ourselves from the natural world entirely is neither sustainable, nor positive. The presence of nature plays an important role in the development and vitality of all living things.

Figure 31: The Industrial Revolution and the period following WWII were detrimental to tree cover in densely populated areas leading to a drastic decrease in air quality among other deficits

It wasn't until the late 20th century that our forests were viewed as an asset. With the passing of the Cooperative Forestry Assistance Act in 1978, the life of our urban forests started to turn around. The CFA Act recognized that urban and community forests "improve the quality of life for residents; enhance the economic value of residential and commercial property; improve air quality; reduce the buildup of carbon dioxide; mitigate the heat island effect in urban areas; and contribute to the social well-being and sense of community". With this the US began to allocate federal funds to cultivate and maintain city trees. At the start of the 21st century, North American urban forestry was flourishing and remains on the rise. Many state and local organizations are working tirelessly to bring awareness to the importance of combining our natural environment and our built environment.

However, urban foresters still face great challenges today. Some of these challenges include limited space, poor soil quality, water and nutrient deficiency, pollution, mechanical damage to trees, and the mitigation of tree hazards (Figure 33). Management challenges include keeping up with a tree inventory, maximizing tree benefit, minimizing costs, maintaining and obtaining public support and funding, establishing laws and policies for both public and private trees and addressing social issues that arise from this maintenance.

Figure 32: challenges that city trees face such as limited space and poor soil, water, and nutrient availability (left) make it more difficult to mitigate hazards (right)

Many cities and their respective forestry departments have been working to implement environmental policies and practices that will lead to the rise of better, more equitable, green space and canopy cover. The urban forestry industry as a whole dedicates time and resources to research and development of new technologies and techniques that will allow for better growing conditions in cities. City officials and organizations also take care to work with residents to ensure they are hearing needs and providing the best, safest care for our city trees. They aim to maintain the health of the city, its trees, and its residents.

Trees can often still be seen as a hindrance, however, with communication and education urban foresters hope to better represent our urban canopies so people may begin to fully understand their importance – especially the importance of our older, larger trees. Though trees do come with some risk, it is important to understand that, like many things in life, one must be willing to accept some risk to experience benefit.

Benefits

Not only is our urban canopy is beautiful to look at, it provides real benefits as well. While some are still being researched, known benefits can be placed into three categories: environmental, economic and social benefits.

Figure 33: illustrates environmental benefits of trees including air quality control and climate control

The most well-known benefits fall into the "environmental" category (Figure 34). These include: reducing the effects of climate change and pollution, conserving water, improving air quality and providing habitat for wildlife. Trees help to stop climate change by removing harmful carbon dioxide and storing it in the soil, leaves and in branches. Trees improve air quality by absorbing pollutants such as ozone, carbon monoxide and sulfur dioxide. Their leaves filter the air we breathe and collect dust and other particulates on their surface which are then washed to the ground when it rains, thus stopping particles from entering our lungs.

Trees can reduce the "heat island" effect prominent in cities. This occurs when heat reflects off of impervious surfaces such as driveways, sidewalks and roads (Figure 35). The shade provided by trees can cool a street by 10 degrees – making them more enjoyable and safe for residents in the warmer summer months. Trees conserve water and reduce erosion. Their leaves, stems, and roots intercept water, therefore slowing it as it moves across the surface of

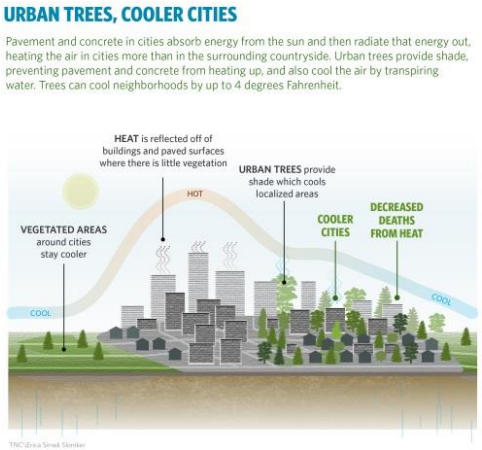

Figure 34: Illustrates how trees can cool cities and reduce the effects of "heat islands"

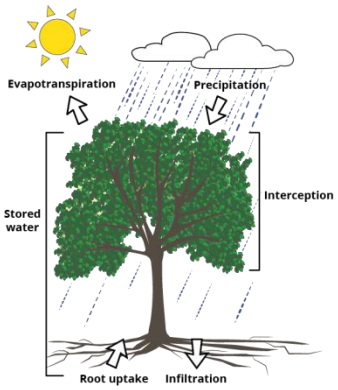

Figure 35: Illustrates the stormwater interception and storage capability of trees. Leaves, branches and roots slow the effects of stormwater runoff.

the earth, preventing erosion (Figure 36). The intercepted water is taken up by the roots to be used by the tree. This process helps to reduce runoff that occurs during storm events. Trees provide good habitat for native wildlife. While wildlife can sometimes be a nuisance to urban living, they provide many benefits of their own and help us to feel more connected to nature in our busy cities.

The economic benefits of trees can be either direct or indirect. Direct benefits are usually associated with energy costs. Savings in energy directly benefit the homeowner. The net cooling effect of a tree is equivalent to ten room sized air conditioners operating 20 hours a day. Large shade trees placed properly around a home or building can reduce air conditioning needs by 30% and can save 20-50% in energy used for heating (Figure 37).

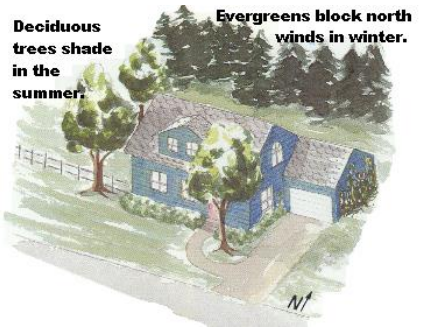

Figure 36: Illustrates the energy saving potential of trees planted near a home. Shade in the summer reduces cooling and windblocks in the winter reduce heating

In addition, trees directly benefit home value. Studies show that landscaped homes are "more valuable" than non-landscaped homes and can increase the overall value of a property by 20%. The tree itself also increases in value as it grows. A mature tree can be worth anywhere from $1,000 to $10,000.

The indirect benefits of trees, however, are arguably even greater. Benefits to each individual add up to a much larger benefit for a whole community, city, or region. Trees on your property may benefit your neighbor and vice versa; which creates a community of people working to save both money and the environment. Community savings can be in the thousands and even millions of dollars. In Springfield, the 30,000 trees that make up the city's urban canopy produce $4 million in ecosystem benefits a year. This can be seen in cost savings on energy use and water disposal, reduction in CO2 and air particulate matter, and an uptick in property value.

Figure 37: GGCP table at McKnight neighborhood event. This table provided information to the community on the many benefits of urban trees

A healthy urban canopy can provide benefits such as noise reduction, increased privacy, and screening of harsh scenery. Trees can stimulate economic development and attract new businesses, which could invite more tourism and revenue into your city.

The social benefits of urban trees are plentiful. At the moment, perhaps one of the most notable benefits is those related to public health. Trees are known to help ease the symptoms of asthma that can be prevalent in cities due to their ability to control particulate matter. In

fact, Springfield, Massachusetts (as of 2018) has some shockingly high ratings for asthma related hospital visits.

Moreover, trees can help to reduce cases of hospitalization due to heat related illness and can speed recovery time for medical patients all together. Trees are known to reduce stress and help those with attention disorders gain and maintain focus. Maintained green spaces encourage outdoor activity leading to a healthier lifestyle.

The contribution of trees to parks and greenspaces can contribute to larger policy objectives such as job opportunities, youth development and community building (Figure 39). Trees add character to cities and their neighborhood by providing natural color, shapes, forms and textures. Our urban canopy can bolster our sense of community and city pride when we take ownership over our trees and work together to better our environment.

Figure 38: Local organization and GGCP partner, ReGreen Springfield, host outdoor educational events for youth to introduce city children to the important curiosities of our natural world.

Conclusion

Trees are beautiful and complex organisms. They remain in place, sometimes for centuries, quietly preforming many biological functions. Through these functions they contribute to supplying products, such as oxygen, that are fundamental to human survival. Furthermore, trees offer both direct and indirect benefits to our social, economic and environmental settings. Trees and greenery are vital components of the urban fabric. With more people recognizing their importance and advocating for their care, we can instill ownership over our canopies and inspire each other to create a better world.

Figure 39: Local businesses and residents volunteer with ReGreen Springfield to give back to their community by planting more trees in Springfield. Pictured above (left), 30 trees were planted in Harriet Tubman Park following the 2011 tornado. (Right) Over 40 participants plant 35 trees in Gurdon Bill Park

Glossary

Aesthetics – concerned with the appreciation and nature of beauty. How something looks

American National Standards Institute (ANSI) – private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The Z1133 and A300 standards pertain to arboriculture

Apical – referring to the apex or tip

Apical Dominance – when the main central stem of a plant grows more strongly than other side stems. This is a preferred habit for young trees

Apical Meristem – meristem that causes a shoot or root to increase in length. Growth originating from this meristem is referred to as primary growth (see meristem)

Arboriculture – the cultivation, study and management of individual trees and shrubs

Arbortie & Arborlock – Products specially developed to stake trees. Arbortie is a flat polypropylene strip. Arborlock (also referred to as "Plastic Locking Tree Ties" is a polyethylene chain of locking ties

Bark – the hard, protective outer covering of a tree. Can be used to identify an individual tree

Berm – a raised saucer of dirt and mulch encircling the base of a tree to aide in drainage and provide aesthetic value

Biological Process – a process vital for a living organism to live

Branch Attachment – the point where a branch joins with the trunk or another branch. Bad attachments will appear very narrow with a sharp angle whereas good attachments will be more of a "U" shape

Branch Bark Ridge – raised strip of bark at the top of a branch attachment, where the growth and expansion of the trunk or parent stem and adjoining branch push the bark into a ridge. Branch bark ridges should be apparent on good branch attachments

Branch Collar – area where a branch joins another branch or trunk. Typically enlarged at the base of the branch. Compartmentalization occurs from this area

Bud – small protuberance on the stem of a plant that develops into a flower or shoot

Cambium – cellular plant tissue located between the xylem and phloem that is responsible for tree thickening

Canopy – layer of leaves, branches, and stems of trees that cover ground when viewed from above

Central Leader – the main stem of a tree

Chlorophyll – green pigment responsible for the absorption of light energy to be used in photosynthesis

Chloroplast – plastid containing chlorophyll in which photosynthesis takes place

Chlorosis – whitish or yellow leaf discoloration often caused by nutrient deficiency

Cleaning – the process of removing sprouts or dead, dying, or diseased branches from a tree crown

Clearance – Space between tree parts and structures such as rooves, sidewalks and signs

Climate Change – change in global or regional climate patterns largely attributed to increased levels of atmospheric carbon dioxide produced by fossil fuel use

Codominant Stem – two or more main stems that are of similar height and diameter and emerge from the same location. This is not desirable because both stems compete for nutrients and energy. If one is pruned out, the other will take control

Compartmentalization of Decay in Trees (CODIT) – the process by which trees produce chemical compounds to contain decay and develop new tissue from the branch collar to seal over wounds

Coniferous (conifer) – tree that bears cones and evergreen leaves

Crossing and/or Rubbing Branch – Branches that cross and rub or will rub when the wind blows. This can create rubbing injuries (open wounds) in tree branches exposing them to disease or pests

Crown – all of the branches, leaves and reproductive structures extending from the trunk or main stems

Deciduous – a tree that sheds its leaves annually

Drip Irrigation – a type of irrigation system that has potential to conserve water and nutrients by allowing water to drip slowly down to the roots of plants

Dripline – the area defined by the outermost circumference of a tree canopy

Establishment – period of time in which a tree focuses most of its energy on regrowth of its root system to a point where it is strong enough to support itself and withstand a range of harsh conditions throughout the rest of its life

Evergreen – a plant that retains its green leaves throughout the year

Flowers – showy seed bearing part of a plant that is responsible for reproduction

Flush Cut – process of cutting branch in line with tree trunk. This process cuts through the branch collar and therefore should never be used in proper tree care

Girdling – the complete removal of a strip of bark from around the entire circumference of either a branch or trunk of a woody plant

Heading Cut – a pruning process that shortens the parent and makes a final cut between laterals or to lateral less than $^1/_3$the diameter of parent. This method is only to be used on branches that are to be removed at a later date

Impervious Surface – artificial structures that do not allow water to penetrate through their surface

International Society of Arboriculture (ISA) – international non-profit organization promoting the professional practice of arboriculture

Internodes – space between nodes

Lateral Branch – secondary branches that emerge from parent stems

Lateral Bud – buds along the sides of branches

Leader – the vertical stem at the top of the trunk

Leaves – material responsible for photosynthesis. Leaves also aide in other processes such as transpiration

Massachusetts Arborists Association (MAA) – professional trade organization that serves the commercial arboriculture industry. Note that the Mass Certified Arborist credential is one of the most difficult certifications to get in the country. It is only rivaled by the Connecticut Arborist Certification.

Meristem – A region of plant tissue consisting of actively dividing cells that form new tissue

Mulch Volcano – the process of mulching around a tree in a way that builds mulch up around the tree trunk in the shape of a cone.

Nodes – critical areas from which leaves, branches, and roots grow out from the stem

Occupational Safety and Health Administration (OSHA) – agency of the United States Department of Labor that sets out to assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance. OSHA enforces the ANSI standards for tree care as well as their own

Parent Stem – a branch or stem that bears smaller branches

Particulate Matter (PM) – microscopic solid or liquid matter suspended in the atmosphere of Earth

Personal Protective Equipment (PPE) – protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. Tree care PPE consists of hard hats, ear protection, eye protection, and chainsaw resistant clothing

Phloem – vascular tissue in plants that conducts sugars and carbohydrates downward from the leaves

Photosynthesis – process by which green plants and some other organisms use sunlight to make foods from carbon dioxide and water

Plant Healthcare – proactive approach to maintaining tree, shrub and groundcover health through holistic cultural management and integrated treatments

Professional Arborist – accredited professional that performs tree care within the arboriculture scope

Prune – pruning is the process of removing select parts of a tree in order to reach an objective that enhances safety, health and aesthetics of a tree

Pruning Interval – time between pruning events

Pruning Objective – a set goal to be reached at the end of a pruning event

Public Health – the health of the population as a whole, typically monitored by the state

Raising – the process of removing lower branches from a tree to increase clearance between the tree canopy and the ground or an object

Reaction Wood – wood that grows in response to gravity and other outside forces; notably wind. Facilitates increased structural support

Reduction Cut – pruning process that shortens a parent stem back to lateral that is at least $^1/_3$ the diameter of the parent

Removal Cut – pruning process that removes and entire branch back to its origin

Root Flare – the area at the base of a tree trunk that flares out to become supportive roots entering the soil – also referred to as the root collar. The root flare should be level with or slightly higher than ground level

Roots – part of plant that attaches it to the ground, mostly underground, and is used for anchorage, absorption and storage

Runoff – the draining away of water from the surface of the land. Becomes a problem after large storm events – known as stormwater runoff

Sign – a pathogen or its parts present on a plant

Soil Compaction – process in which a stress applied to soil causes air to become displaced from pore spaces between particles

Soil Texture – classification of soils based on physical texture and characteristics. Made up of different measurements of sand, silt, and clay

Sprout – small, undesirable branch produced on the trunk or larger branches in response to branch removal, wounding, or other stress
Staking – the process of providing additional support for a newly planted tree
Stem – the main body or stalk of a plant. On trees these extend from the trunk
Stomata – structures on a leaf that open and close for gas exchange
Stress – a factor contributing to decline in tree health. A tree has to compensate for these factors, taking away energy from normal biological functions
Stub – remaining stem protruding from the branch collar at a distance that does not facilitate the CODIT process
Sucker – small, undesirable branch produced at the root flare
Symptom – the internal or external reactions of a plant as a result of disease
Terminal Bud – buds at the tips of a branch responsible for outward extension
Thinning – the practice of removing branch material from within a tree canopy to increase air flow and reduce the likelihood of crossing or rubbing branches while enhancing natural structure
Three Cut Method – method for making the proper pruning cuts. This method consists of a partial undercut, followed by a full cut from above a few inches out from the undercut, and is completed with removing the left over stub with a full cut just outside the branch collar
Topiary – the practice of clipping trees or shrubs into shapes
Topping – unacceptable practice of removing whole tops of trees or large branches and/or trunks from the tops of trees, leaving stubs or lateral branches that are too small to assume the role of a terminal leader. Also referred to as heading
Transpiration – process where plants absorb water through their roots and give off water in the form of water vapor through their leaves
Tree – woody perennial plant, typically having a single stem or trunk growing to at least 12 to 15 feet tall and having branches and a distinct head some distance from the ground
Tree Care Industry Association (TCIA) – trade association of over 2,300 tree care firms and affiliated companies. TCIA develops safety and education programs, standards of tree care practice and management information for tree and landscape firms around the world
Tree Stress – any condition that causes a decline in tree health

Trunk – stem and main wooden axis of a tree
Urban Forest – collection of trees and other woody plants that grow within a city, town or suburb
Urban Forestry – consists of the research, care and management of single trees that make up an entire tree population within an urban setting for the purpose of improving many aspects of our urban environment
Urban Heat Island – urban area that is significantly warmer than surrounding rural areas due to human activities and impervious surfaces
Vascular System – assemblage of conductive tissues and fibers. Consists of xylem and phloem
Watering Bag – a tool used as a form of drip irrigation to aid in the proper watering of newly planted trees. Also referred to by its tradename – Gatorbag
Xylem – vascular tissue in plants that conducts water and nutrients upward from the roots. Xylem also contributes to the woody inner portion of the stem

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