100 Trees Initiative

Tree Guild

January 13, 2024

AGENDA

Forum

New Tech in Urban Forestry.....AI in Urban Forestry

Urban Forestry Around the World.....Vertical Forests

Local Species Highlight.....Bitternut Hickory

Tree Biology 101

Introduction to Young Tree Pruning

Volunteering Opportunity

Pruning New Trees on Transfer Road

ARTIFICIAL INTELLGENCE (AI) IN URBAN FORESTRY

What is it?

Oxford Languages

“The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision making, and translation between languages

IBM

A field which combines computer science and robust datasets, to enable problem-solving. It also encompasses sub-fields of machine learning and deep learning, which are frequently mentioned in conjunction with artificial intelligence. These disciplines are comprised of AI algorithms which seek to create expert systems which make predictions or classifications based on input data.

How can it help Urban foresters?

Tree Data Management

Internet of things (Sensors, apps, smartphones, etc.)

Data needs to be interpreted/understood

Landscape Analysis (canopy cover classification)

Data needs to be up-to-date

Data needs to be accurate

Tree Inventory (Species classification, management needs)

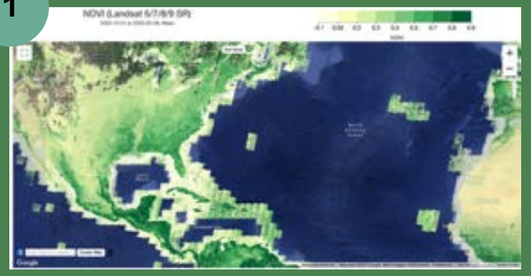
AI Algorithms + Machine learning = fast & efficient data processing

AI IN URBAN FORESTRY

Top down canopy assessment

Satellite imagery

1



Lidar (Light Detection & Ranging)

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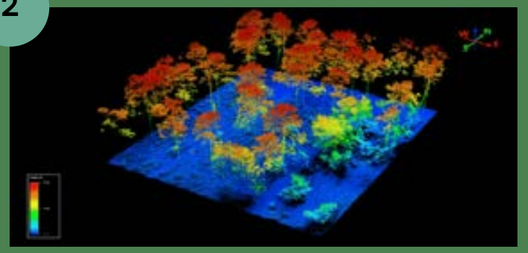


Before AI/ML algorithms, it took many years to release new datasets with more recent information

Machine learning/AI have improved accuracy of canopy information from satellite and LiDAR data and allowed increased frequency of updates.

Earth Define has created a nationwide high resolution (60cm) canopy map and produced individual tree point datasets from for certain cities. Higher resolution datasets can pick up younger trees with small canopies.

3

Tree crowns (canopy cover) identified from satellite imagery

AI IN URBAN FORESTRY

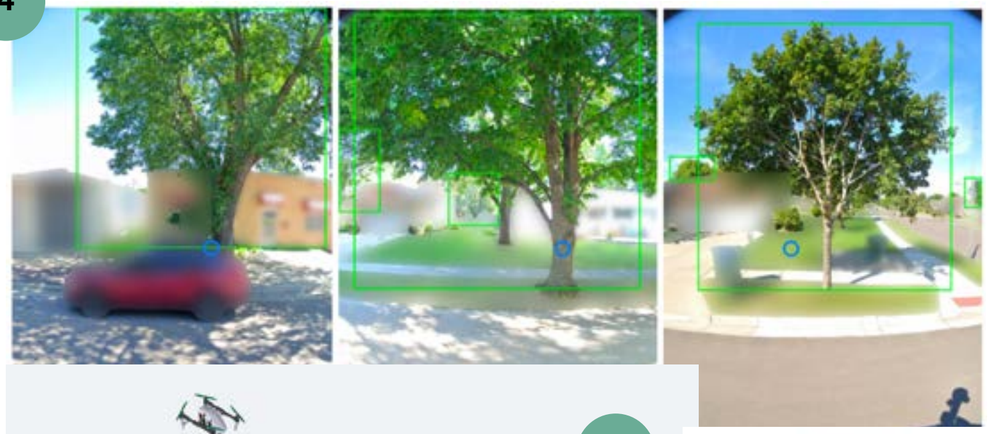
Ground-level tree inventory

Vehicle-mounted street-level imagery + LiDAR Point Clouds

Machine learning models and predictive analytics

Species specific city-wide tree inventory datasets!

4



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New York

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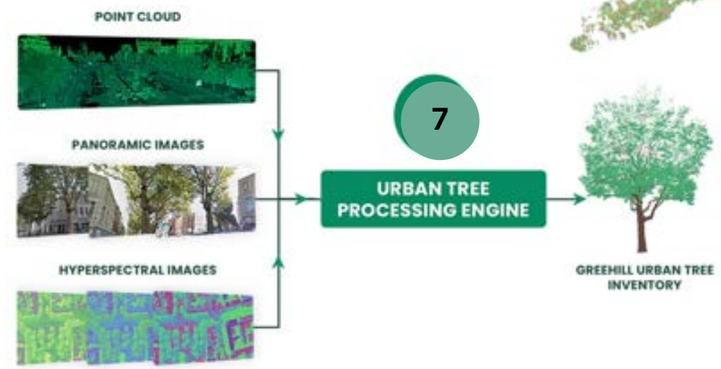


AI and ML models have been able to identify tree species from street-level imagery when “Trained” on city-wide, region-wide, and world-wide datasets.

Auto Arborist Dataset (Open Source)

Traditional approaches to inventory can be time and money intensive...

More about AI based tree inventory here

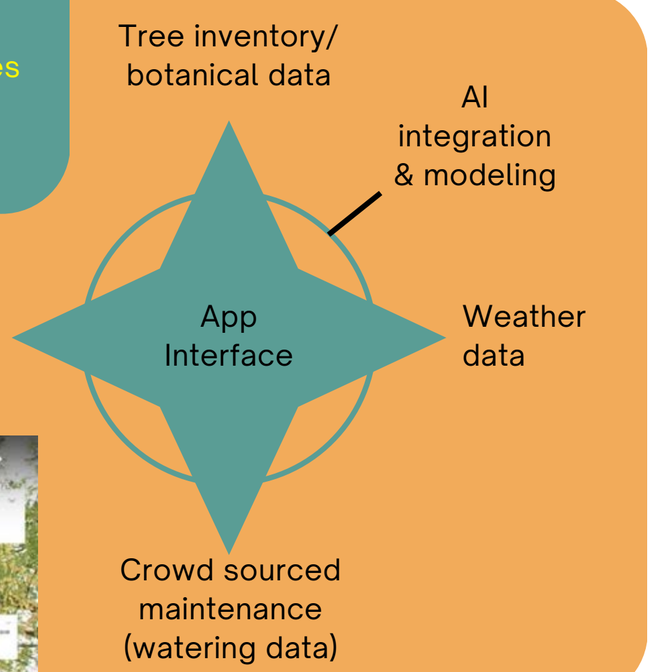
AI IN URBAN FORESTRY

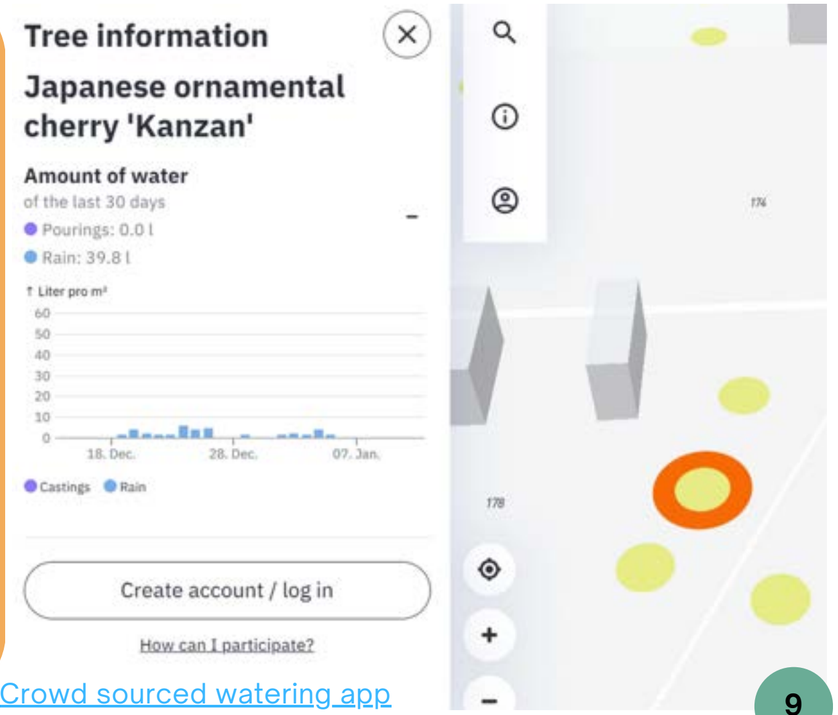
Internet of Things (IOT)

Amazon:

“the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.”

Use of AI to predict tree watering needs





Crowd sourced watering app

Q Trees Consortium

Baumblick app - Shows trees color-coded by AI Predicted watering needs (up to 2 weeks in advance)

TALKING TREES?

Soil moisture sensors and other sensors have been used to allow trees to “Talk” to us via Tweets!

https://www.youtube.com/watch?v=YY0PpRKbmXw&t=81s

Internet of Nature Podcast

The internet of things allows people to more directly understand and interact with the urban forest.

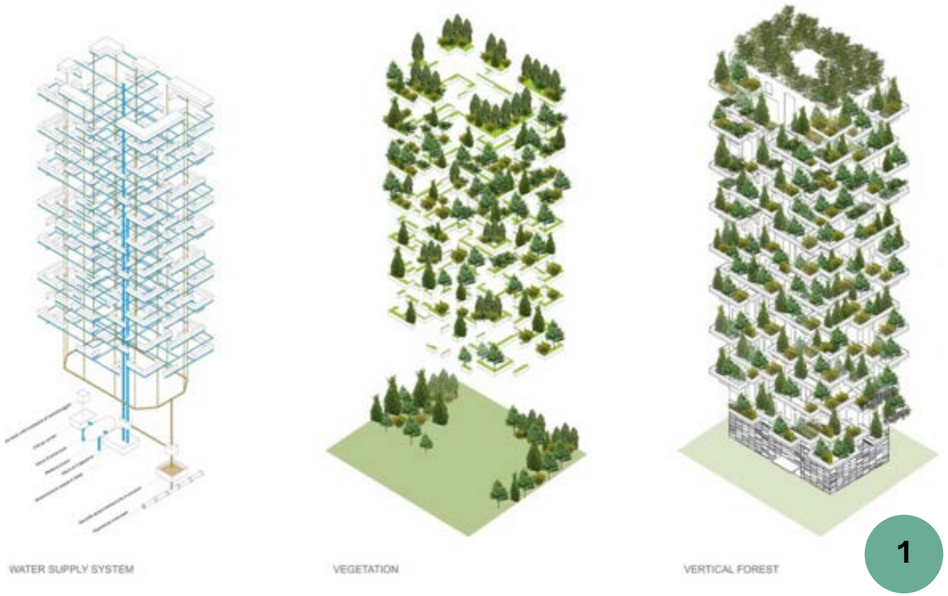
AI IN URBAN FORESTRY

Closer to home: UMN is home to the
AI Institute for climate-land interactions, mitigation, adaption, tradeoffs, and economy

Pic Credits:

1. https://support.climateengine.org/article/69-landsat
2. https://www.researchgate.net/figure/An-example-portion-of-the-LiDAR-point-cloud-used-for-this-project-which-was-acquired-at_fig2_348036382
3. https://www.earthdefine.com/treemap/
4. https://google.github.io/auto-arborist/
5. https://www.greehill.com/technology
6. https://google.github.io/auto-arborist/
7. https://www.greehill.com/technology
8. https://google.github.io/auto-arborist/
9. https://www.giessdenkiez.de/

VERTICAL FORESTS



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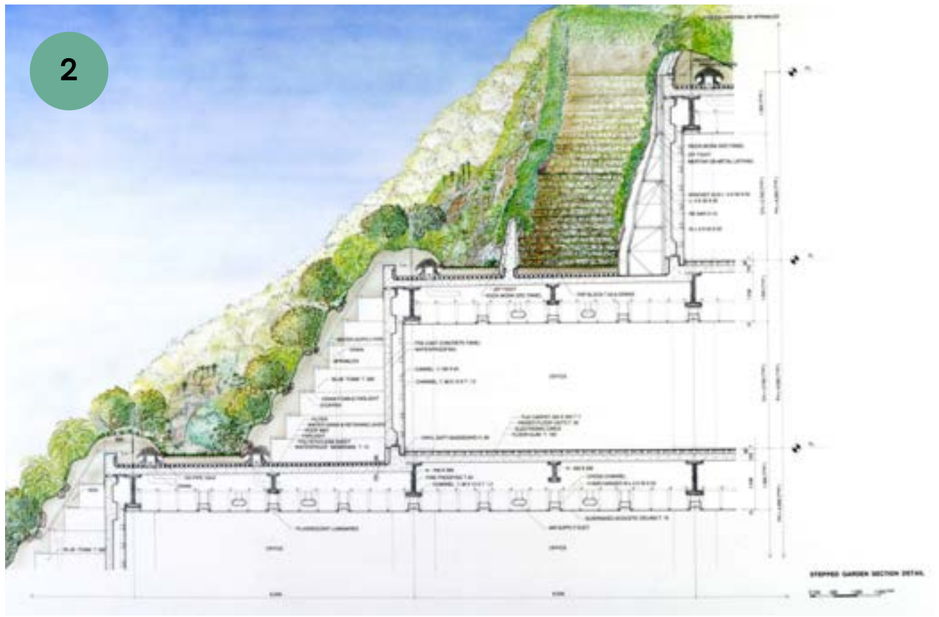

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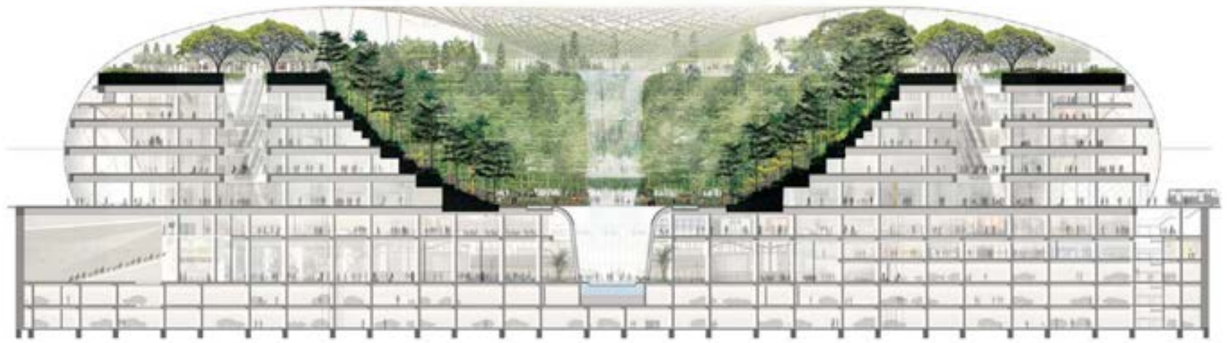

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VERTICAL FORESTS

Recent concept in Green Architecture
Term coined by architect
Stefano Boeri (pictured left)

What it represents according to the him:

“a new format of architectural biodiversity”

“a device for limiting the sprawl of cities brought about through a quest for greenery”

in 2014, the prototype “Bosco Verticale” was completed in Milan

Architecturally ambitious?

Irrigation requirements

Maintenance access

Long term structural stability

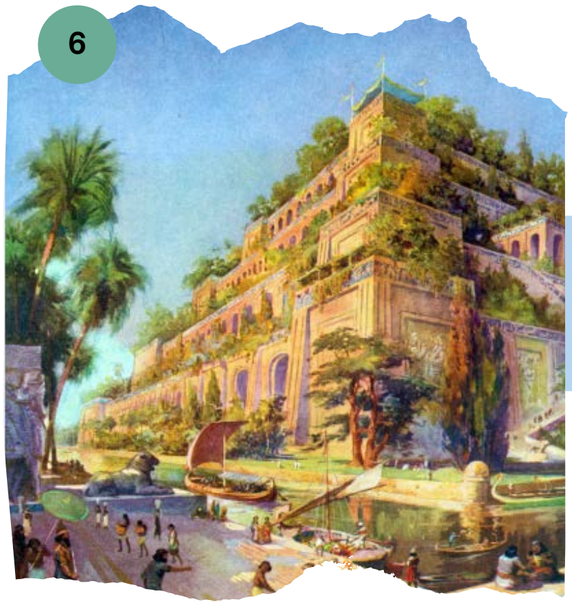
In Concept: a “home for trees that also houses humans and birds”

VERTICAL FORESTS

Precedents

Mesopotamia

6



Hanging Gardens of Babylonia
600 B.C. ?

Italy

7

Guinigi Tower Garden
~1600

Before Boeri “popularized” them

Japan

Fukuoka Prefectural International Hall
Emilio Ambasz 1990

8

Germany

9

The Forest Spiral of Darmstadt
Andreas Bodi 2000

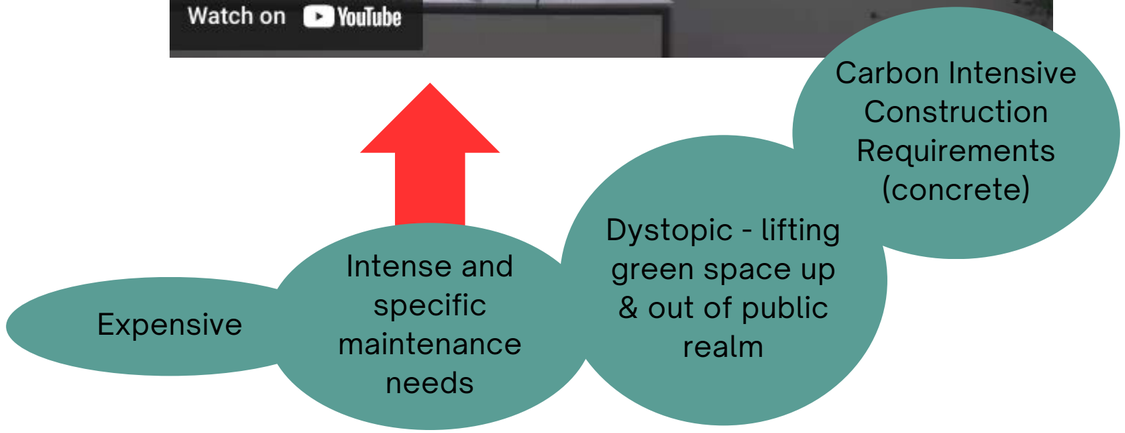
VERTICAL FORESTS

Examples around the world

2:20-6:16 https://www.youtube.com/watch?v=Af97oE1qktE&t=377s

Bosco Verticale
reimagined what's possible, but
ultimately was an experiment

https://www.youtube.com/watch?v=kPVlKV9Nh2A



Skepticism of the Vertical Forest

VERTICAL FORESTS

Looking ahead

Timber and high-density timber
(Instead of concrete)

Toronto Tree Tower (render)

Stefano Boeri on his work 12:25, 23:30

Forest Cities?

Boeri has plans, but
there are cautionary tales...

Forest City, Malaysia (vision versus reality)

Is the vertical forest truly feasible?
Alternatives to trees in green architecture

Green roofs

https://www.youtube.com/watch?v=FlJoBhLnqko

Green facades

Oasia Hotel Downtown - WOHA 2016

No solution is a substitute for forest conservation!

More Green Architecture: Urban Nature Atlas

VERTICAL FORESTS

Pic Credits:

1. https://www.archdaily.com/777498/bosco-verticale-stefano-boeri-architetti
2. https://www.stirworld.com/think-columns-acros-fukuoka-prefectural-international-hall-by-emilio-ambasz-turns-25
3. https://www.safdiearchitects.com/projects/jewel-changi-airport
4. https://www.alainelkanninterviews.com/stefano-boeri/
5. https://www.iconmagazine.it/design/non-solo-milano-il-bosco-verticale-diventa-un-modello-globale/
6. https://www.britannica.com/place/Hanging-Gardens-of-Babylon
7. https://www.atlasobscura.com/places/torre-guinigi-guinigi-tower
8. https://www.stirworld.com/think-columns-acros-fukuoka-prefectural-international-hall-by-emilio-ambasz-turns-25
9. https://hundertwasser.com/en/architecture/arch120_die_wald-spirale_von_darmstadt_1547
10. https://www.dezeen.com/2017/08/02/toronto-tree-tower-penda-cross-laminated-timber-construction/
11. https://www.eco-business.com/news/malaysias-forest-city-primed-for-green-development/
12. https://woha.net/project/oasia-hotel-downtown/

Local Species Highlight

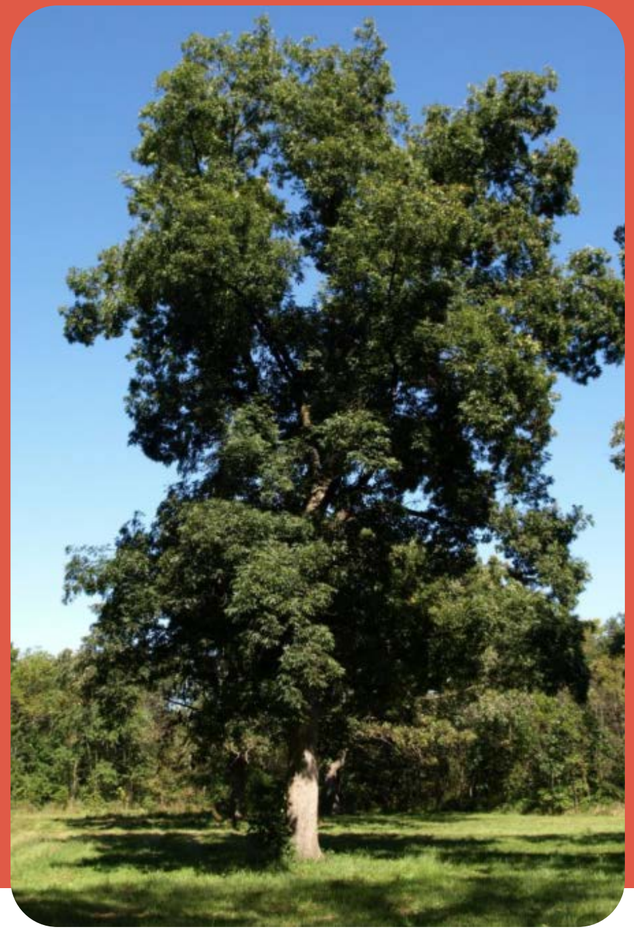
Bitternut Hickory (Carya cordiformis)

50-70 ft. Height
40-50 ft. Spread

Fairly low maintenance

Part Shade - Full Sun

7-9 leaflets per stalk



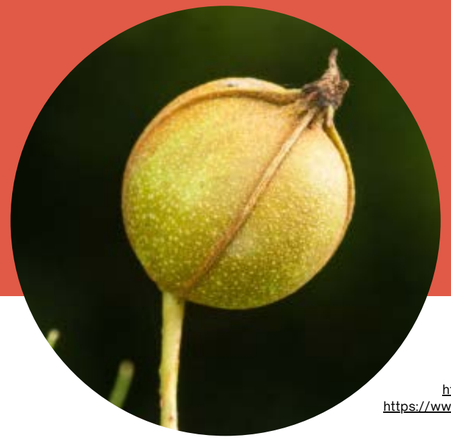
Best for larger yard spaces

Minnesota Native

Difficult to find in nurseries, taproot makes transplant difficult

Yellowish, soft buds

Greenish nut with raised “sutures”



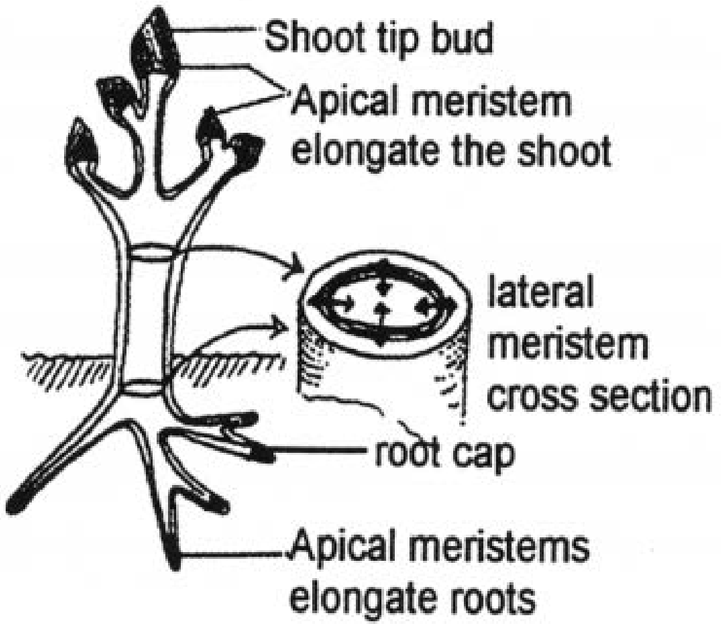
https://mortonarb.org/plant-and-protect/trees-and-plants/bitternut-hickory/
https://www.riceswcdonlinestore.com/product-page/hickory-bitternut-carya-cordiformis-bundles-of-10
https://www.tallahassee.com/story/life/home-garden/2018/11/09/bitternut-hickory-adds-leaf-pile/1834190002/
https://www.birdsoutsidemywindow.org/2023/11/08/bitternuts-butternuts/
https://www.ontario.ca/page/bitternut-hickory

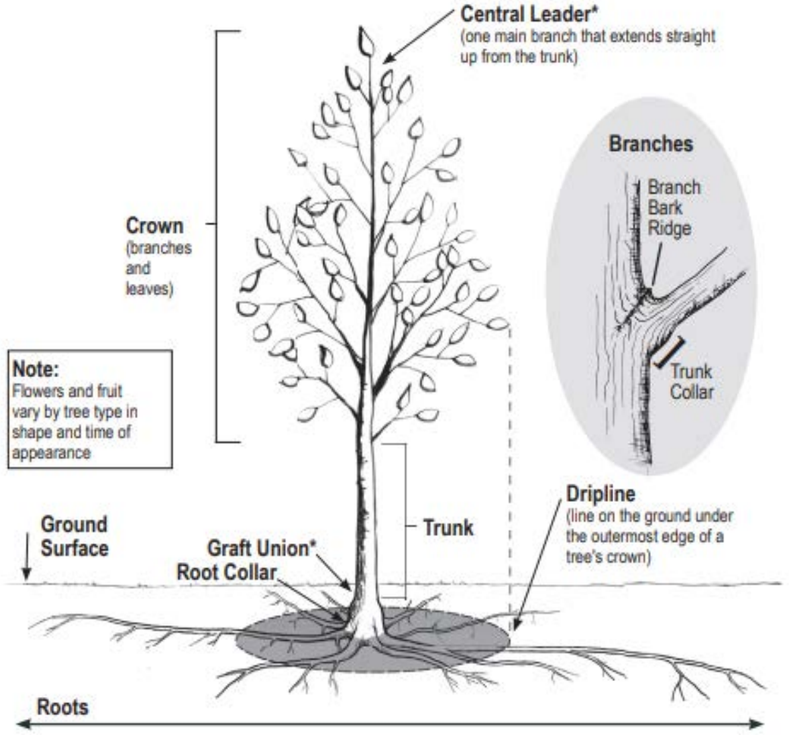
Tree Biology 101:

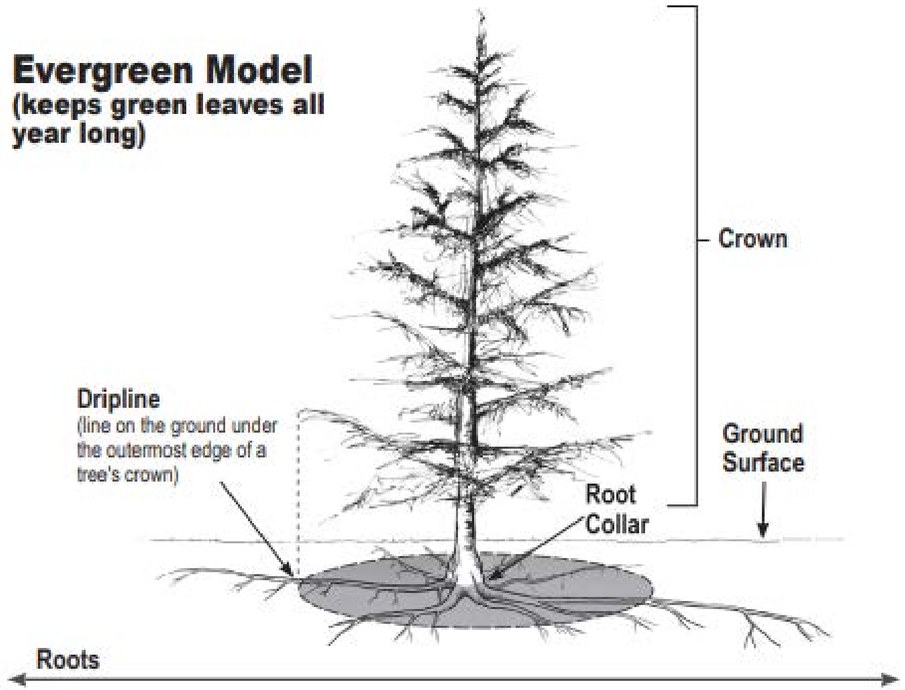
What is a tree?

Trees are ***Angiosperms*** (flowering) or ***Gymnosperms*** (non-flowering)

MERISTEM TISSUES







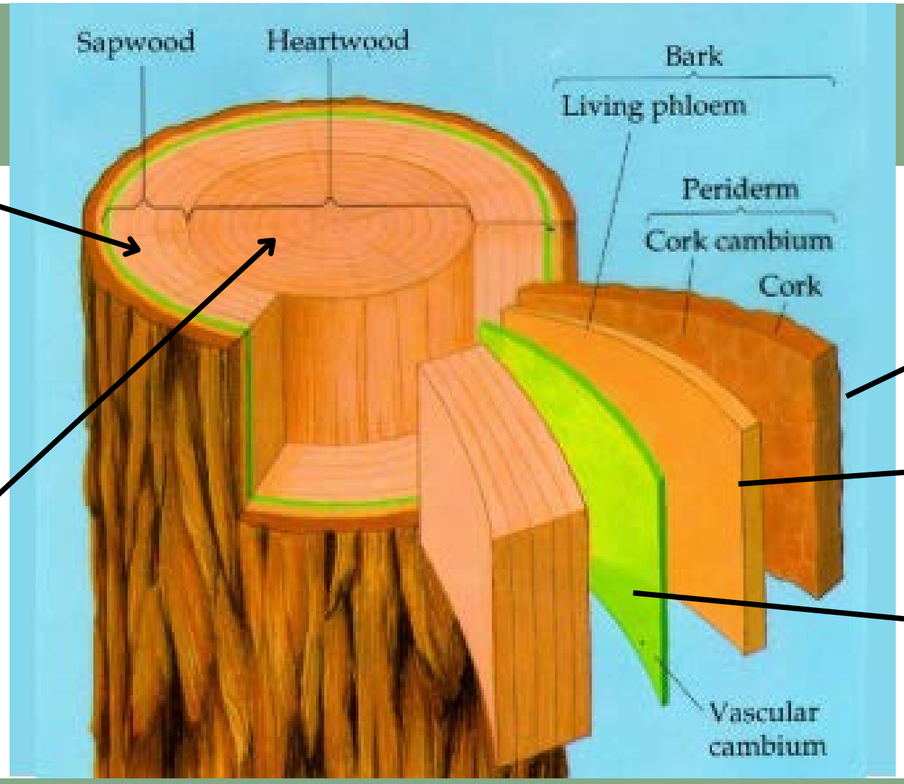
Trees are ***"woody" plants*** (producing secondary growth) and distinct from shrubs due to their height
Some plants are inclined to be "multi-stemmed shrubs" but can be pruned to be small trees

Growth occurs at the tips (shoots and roots) and laterally in the cambial zone

Tree Biology 101:
Wood (Trunk)

The ***sapwood (xylem)*** contains living (10%) and dead cells which conduct water and nutrients to crown

Sapwood becomes ***heartwood*** which is composed of strengthened dead cells of lignin and cellulose



The living and conductive tissues of sapwood, cambium, and phloem are protected by the ***outer bark (periderm)***

The soft ***inner bark (phloem)*** transports sugars from the crown to the roots

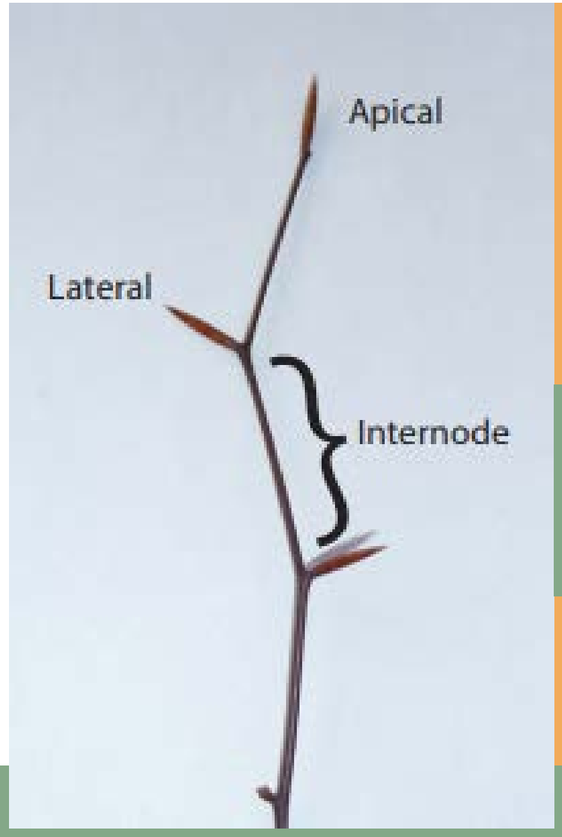
The ***vascular cambium*** produces new sapwood and bark

***Common misconception: A message carved in a tree will not move upward over time.

Tree Biology 101:

Nodes, Shoots, Branches, & Leaves (Crown)

Leaves photosynthesize creating sugars from sunlight, oxygen, and water



Tree twig with apical/lateral buds

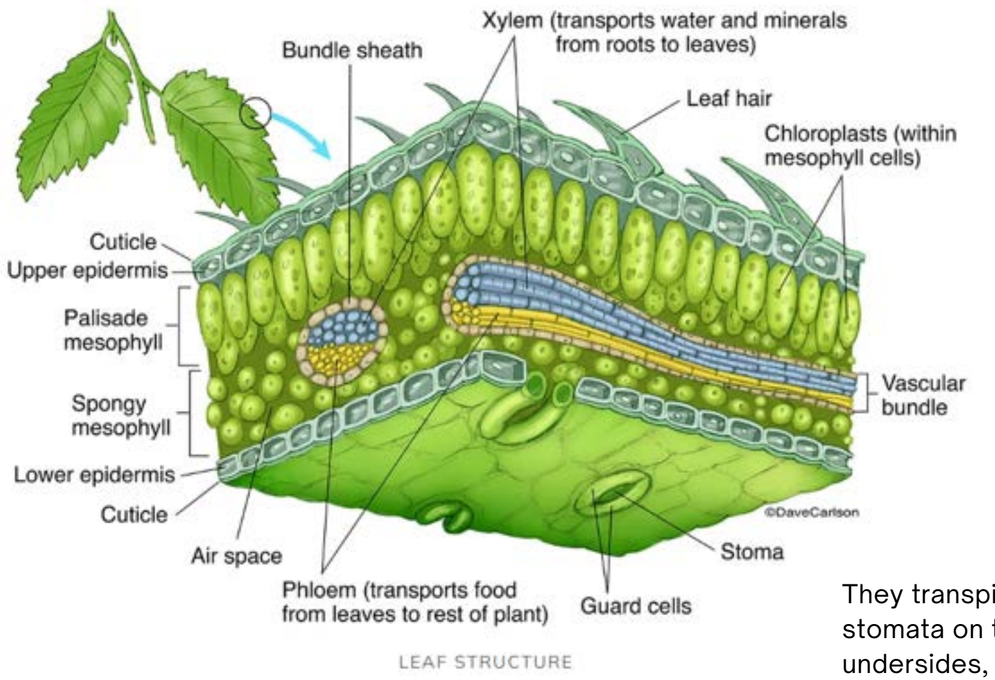
Buds, leaves, and flowers emerge from **nodes** on twigs.

Shoots are young stems will become branches.

Shoot growth is typically fastest from Apical (terminal) buds

Growth from Lateral (axillary) buds is typically surpressed by growth hormones until the apical bud is removed

Dormant buds exist along the stem and trunk and may be activated when damage occurs



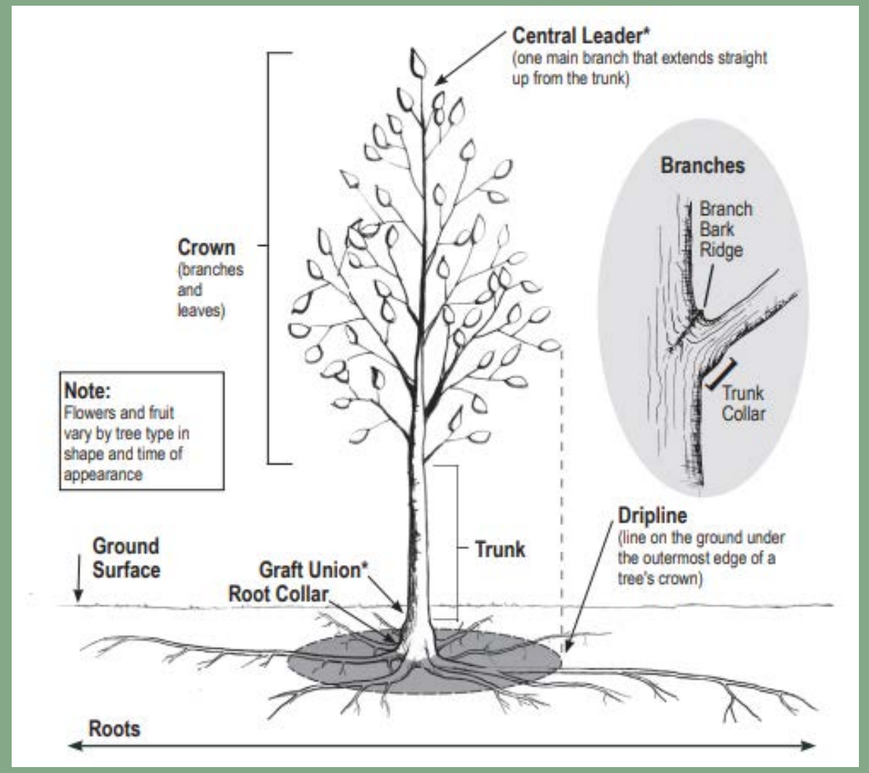
They transpirate through stomata on their undersides, releasing water vapor and oxygen

They produce a waxy coating called the cuticle in order to retain moisture.

PC: https://www.carlsonstockart.com/photo/leaf-structure-anatomy-illustration/

Tree Biology 101:

Roots



Roots grow mostly within the top 18 inches of soil

There are ***woody (structural)*** and ***non-woody (Fine absorbing)*** roots.

Root networks are often partner with ***mycorrhizal (fungal) networks*** to expand their nutrient uptake

Roots provide structural support & water/ nutrient uptake

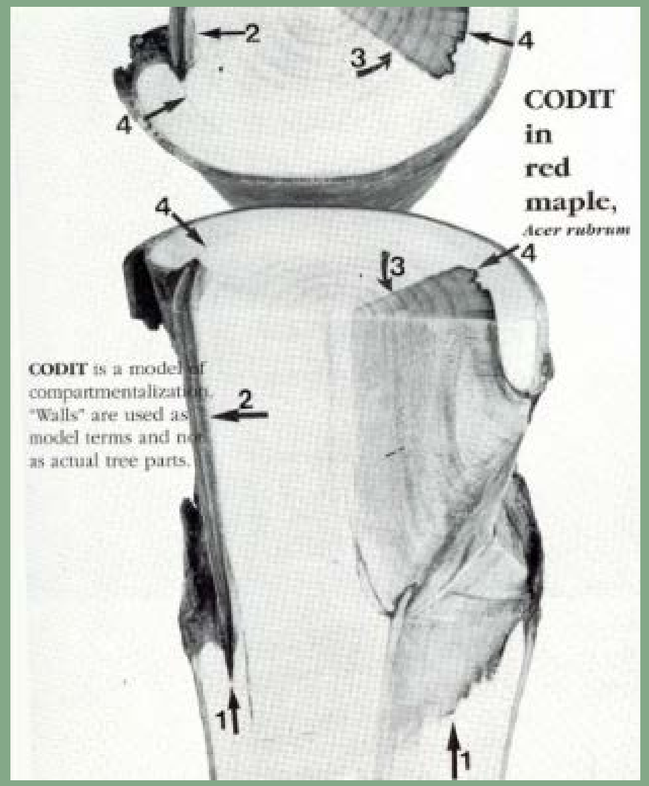
Tree Biology 101:

How a tree fights infection (CODIT)

Trees don't have an immune system.

Instead of fighting infection, they have biological mechanisms to slow it down.

Some trees do this better than others: Listed Here



PC: Dr. Alex Shigo,"Tree Basics" p.11

The model of Compartmentalization of Decay in Trees (CODIT):

Trees "wall up" immediately following injury as best they can.

Cells surrounding the wound area and new growth become chemically altered.

There are 4 walls:

Wall 1 (weakest) - Slows spread vertically
Wall 2 ---------- Slows spread inward
Wall 3 ---------- Slows spread circumferentially
Wall 4 (strongest) - Slows spread to new growth

Because of Wall 4, decay *may* be contained to the size of the tree at time of injury.

Tree Biology 101: Takeaways

1.Trees are tall “woody” plants growing from both apical meristem and lateral meristem tissue

2. A nail in the trunk won’t move up over time

3.Trees compartmentalize (they slow, seal off, and prevent infection but cannot heal)

4.Trees conduct nutrients and water in a very thin layer called the cambial zone. It must be protected.

5.Tree roots typically grow 3-4 x the width of the crown in the top 18 in. of soil. Protect this area.

Tree Pruning - Long Term

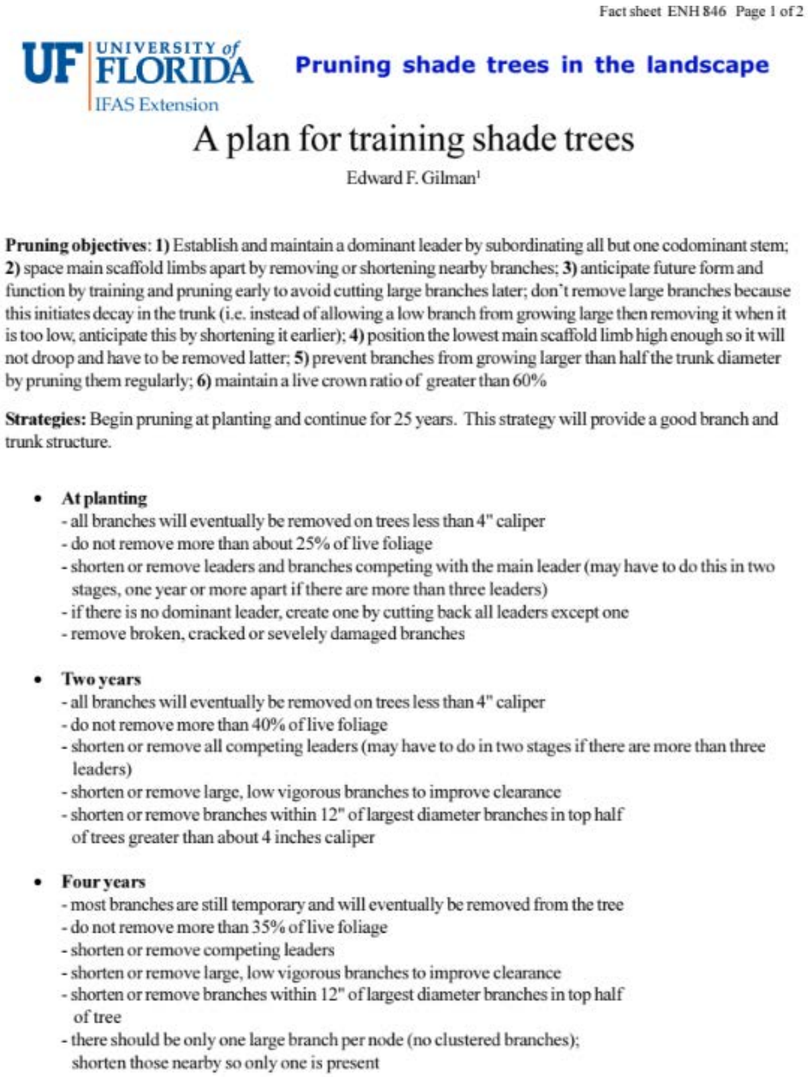
Most urban trees don't naturally grow to have good form. The structurally sound, upright form needed must be created by trained professionals through multiple pruning cycles in the first 25 or so years after planting.

To read more about this practice, consult Dr. Ed Gilman's "Plan for training shade trees" (pictured right), or

Read more HERE

Always remember to consult an ISA Certified Arborist before any tree work is to be done

Find an Arborist HERE



UF UNIVERSITY of FLORIDA IFAS Extension

Pruning shade trees in the landscape

A plan for training shade trees

Edward F. Gilman[1]

Pruning objectives: **1)** Establish and maintain a dominant leader by subordinating all but one codominant stem; **2)** space main scaffold limbs apart by removing or shortening nearby branches; **3)** anticipate future form and function by training and pruning early to avoid cutting large branches later; don't remove large branches because this initiates decay in the trunk (i.e. instead of allowing a low branch from growing large then removing it when it is too low, anticipate this by shortening it earlier); **4)** position the lowest main scaffold limb high enough so it will not droop and have to be removed latter; **5)** prevent branches from growing larger than half the trunk diameter by pruning them regularly; **6)** maintain a live crown ratio of greater than 60%

Strategies: Begin pruning at planting and continue for 25 years. This strategy will provide a good branch and trunk structure.

- **At planting**
  - all branches will eventually be removed on trees less than 4" caliper
  - do not remove more than about 25% of live foliage
  - shorten or remove leaders and branches competing with the main leader (may have to do this in two stages, one year or more apart if there are more than three leaders)
  - if there is no dominant leader, create one by cutting back all leaders except one
  - remove broken, cracked or sevelely damaged branches

- **Two years**
  - all branches will eventually be removed on trees less than 4" caliper
  - do not remove more than 40% of live foliage
  - shorten or remove all competing leaders (may have to do in two stages if there are more than three leaders)
  - shorten or remove large, low vigorous branches to improve clearance
  - shorten or remove branches within 12" of largest diameter branches in top half of trees greater than about 4 inches caliper

- **Four years**
  - most branches are still temporary and will eventually be removed from the tree
  - do not remove more than 35% of live foliage
  - shorten or remove competing leaders
  - shorten or remove large, low vigorous branches to improve clearance
  - shorten or remove branches within 12" of largest diameter branches in top half of tree
  - there should be only one large branch per node (no clustered branches); shorten those nearby so only one is present

- **Eight years**
  - shorten or remove competing leaders
  - do not remove more than 25 to 35% of foliage
  - determine where you want the lowest permanent scaffold limb and shorten all large or vigorous branches lower than this limb
  - shorten branches within 12-18" of largest diameter branches (there should be only one large branch per node (no clustered branches)
  - shorten low branches that will have to be removed later so they do not become large

- **Fourteen years**
  - shorten or remove competing leaders
  - identify several permanent scaffold limbs
  - shorten vigorous branches within 18-36" of permanent scaffold limbs
  - shorten or remove large branches lower (on the trunk) than the lowest permanent scaffold limb
  - there should be only one large branch per node (no clustered branches)
  - shorten low branches that will have to be removed latter

- **Twenty years**
  - shorten or remove competing leaders
  - identify 5 to 10 permanent scaffold limbs
  - shorten aggressive branches within 18-36" of permanent scaffold limbs
  - shorten or remove large branches lower (on the trunk) than the first permanent branch
  - there should be only one large branch per node (no clustered branches)
  - shorten low branches that will have to be removed latter

- **Twenty-five years**
  - shorten or remove competing leaders
  - continue to develop and space permanent scaffold limbs
  - shorten branches within 36" of permanent scaffold limbs
  - shorten or remove large branches lower (on the trunk) than the first permanent branch
  - there should be only one large branch per node (no clustered branches)
  - shorten low branches that will have to be removed latter

With seven prunings in the first 25 years after planting, a good structure can be developed that can place the tree on the road to becoming a permanent fixture in the landscape. Less frequent pruning may be acceptable if good quality nursery trees were planted with a dominant leader, and trees were irrigated appropriately until established.

[1] Professor, Environmental Horticulture Department, 1245 Fifield Hall, Gainesville, FL 32611

Newly-Planted Tree Pruning 101

You can generally remove 3 types of branches and twigs year-round (the 3 D's)

Dead

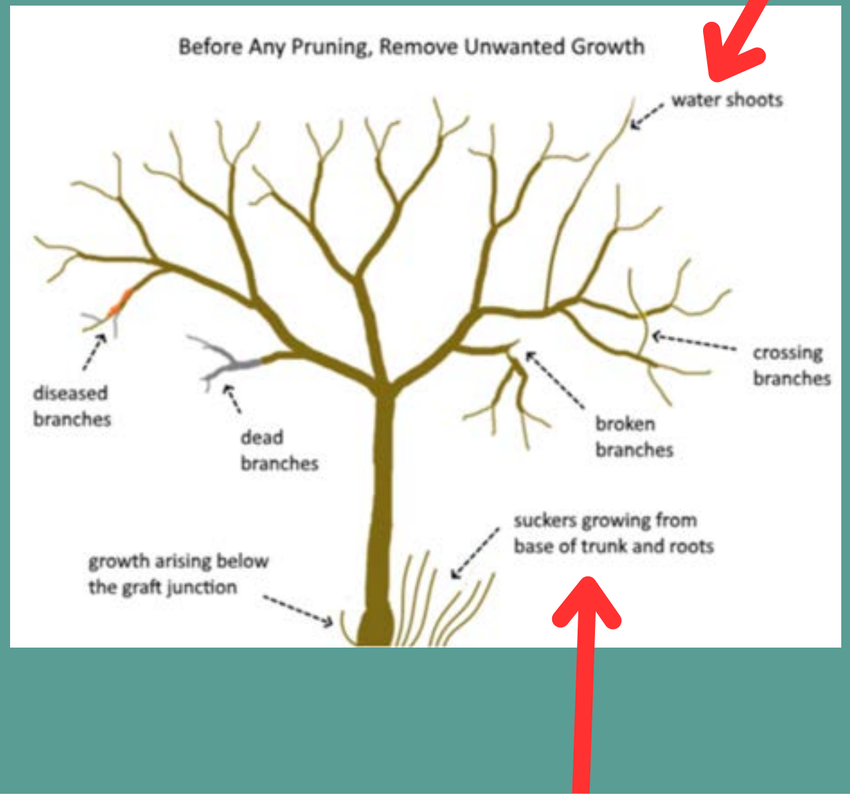
**Give the branch a tiny scratch,
if underlying wood is still green, it's alive.
If it bends, instead of snaps, that's another sign
it's still living.**

Diseased

**Typically discolored, or deformed
Consult a field guide such as the
Purdue Tree Doctor**

Damaged/dying

**Broken
Severe bark or cambium wound**



Newly-Planted Tree Pruning 101

Consider pruning objectives & parameters

1. Find the Central Leader

You want the tree to put most of its energy into one main trunk
This will prevent the development of weak branch unions and attachments, which are prone to failure during extreme weather events and over time

Central leader

All branches temporary, remove when aspect ratio reaches 1:3

Consider limiting the pruning dose until after the first or second growing season

2. Determine the lowest permanent branch

For newly planted trees, generally all existing branches will eventually be removed
You will still want to preserve lower branches in the first few years in order to encourage trunk growth

3. Consider the pruning dose

Never remove more than 25% or 30% of the live crown
Within that, you may consider lighter or more aggressive pruning doses depending on how fast the tree grows or how often you will come back to it

4. Consider the pruning objective

For newly planted trees this is subjugating competing leads and removing the 3 Ds

2/3 Crown, 1/3 trunk: Don't remove more than 25-30% canopy at any one time

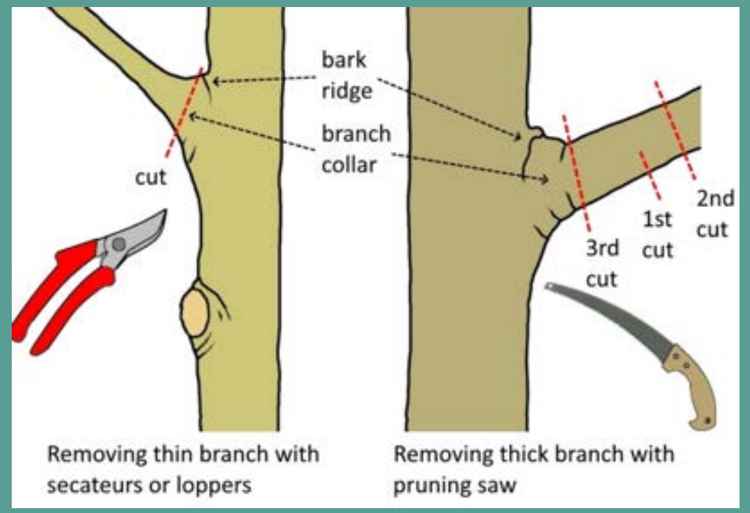
*****Unsure what is competing? Consider the <u>aspect ratio!</u>**
Healthy branch unions are 1/3 the size of the trunk or less***

Newly-Planted Tree Pruning 101

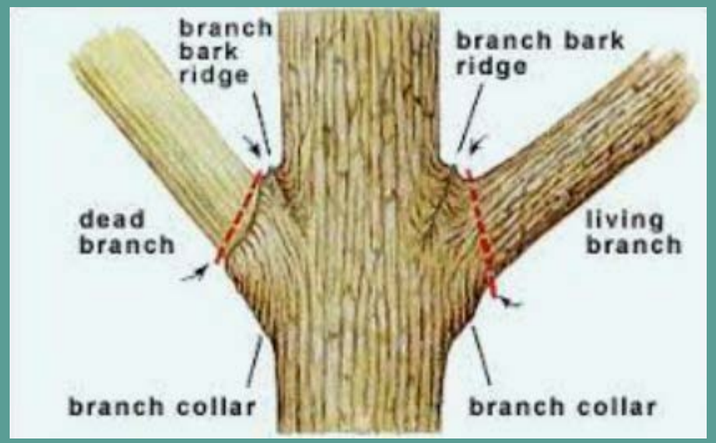
The 3-Cut method must be followed for larger branches

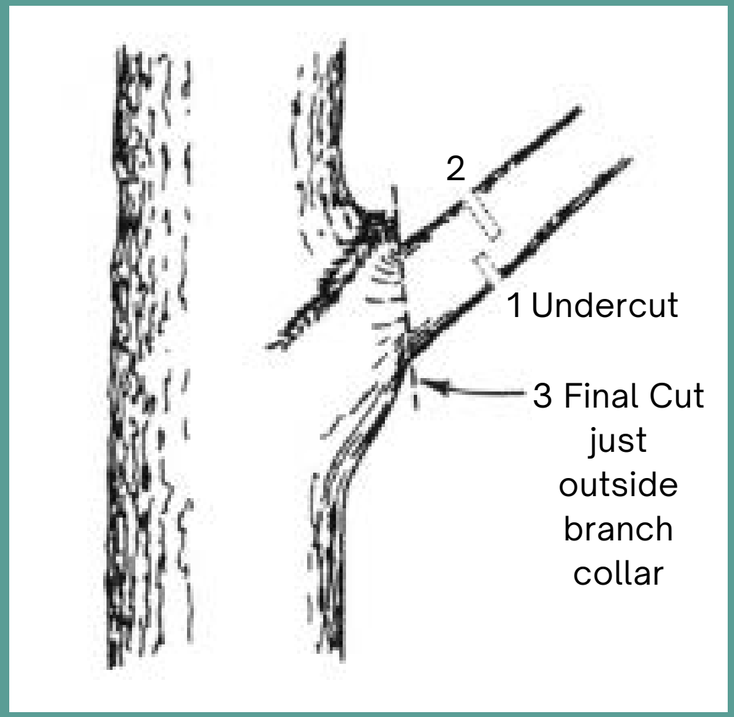
3-Cut Method

Avoid the weight of the branch stripping bark to the trunk



https://youtu.be/1CrSDQSJuAc





Newly-Planted Tree Pruning 101

There are 3 types of pruning cuts for young trees

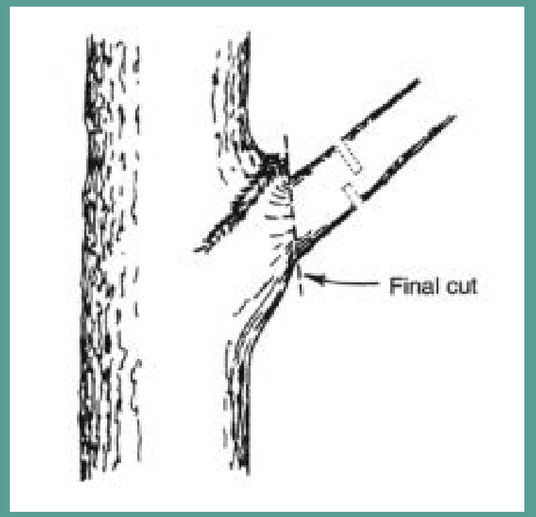
Branch Removal Cuts

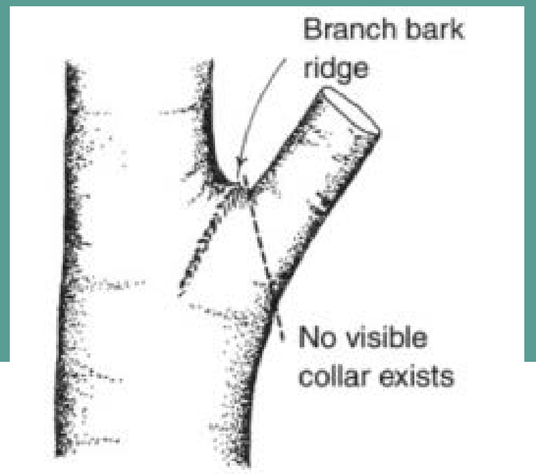
- Cut back to the main trunk or leader
- Diverts growth/energy into main trunk
- Forces growth upward

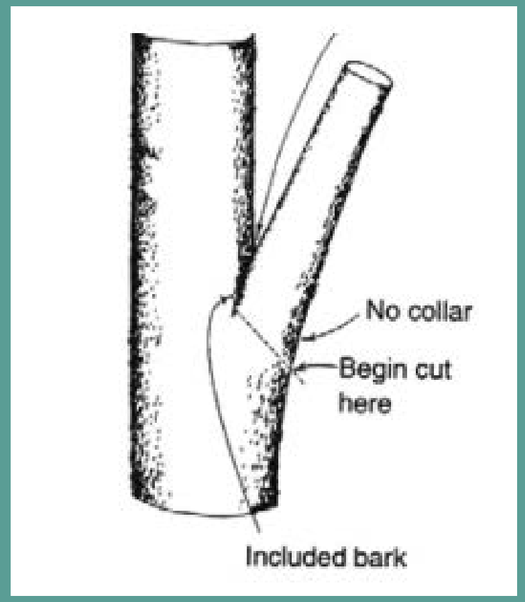
Similar to “Thinning cuts” - removing smaller branch at a union

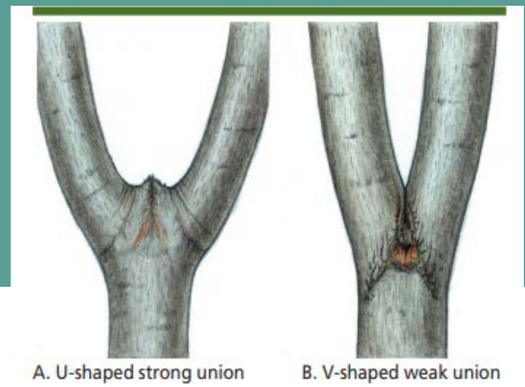
- Avoid over use, can cause “lions tailing”

https://youtu.be/rf0-trrla1c









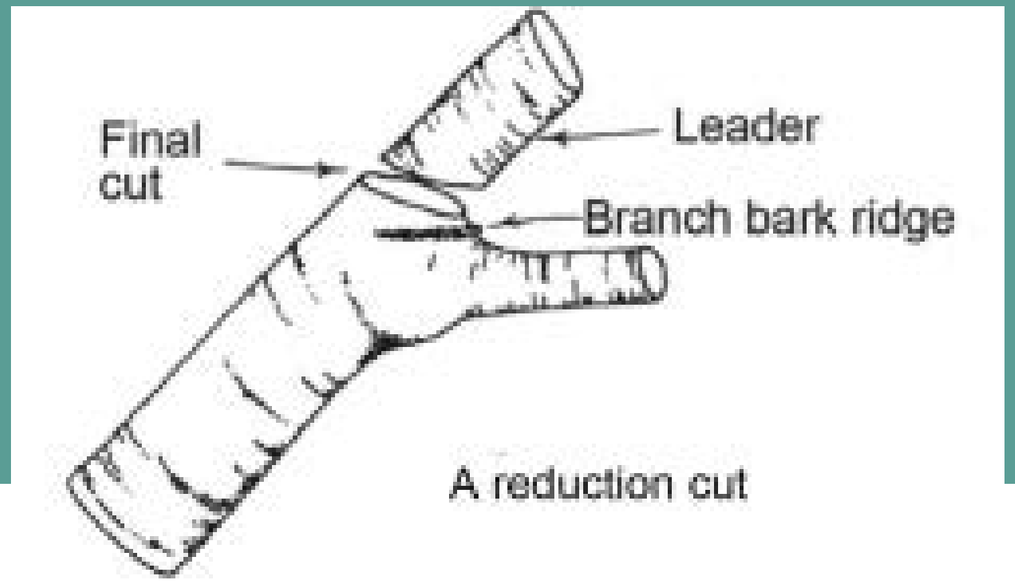
Newly-Planted Tree Pruning 101

There are 3 types of pruning cuts for young trees

Reduction Cuts

- Most frequent pruning cut on young trees
- Cut back to a lateral branch
- Subjugate competing leaders/large aspect ratio temporary branches
- Best used on smaller branches

https://youtu.be/vHDoxyv9jns



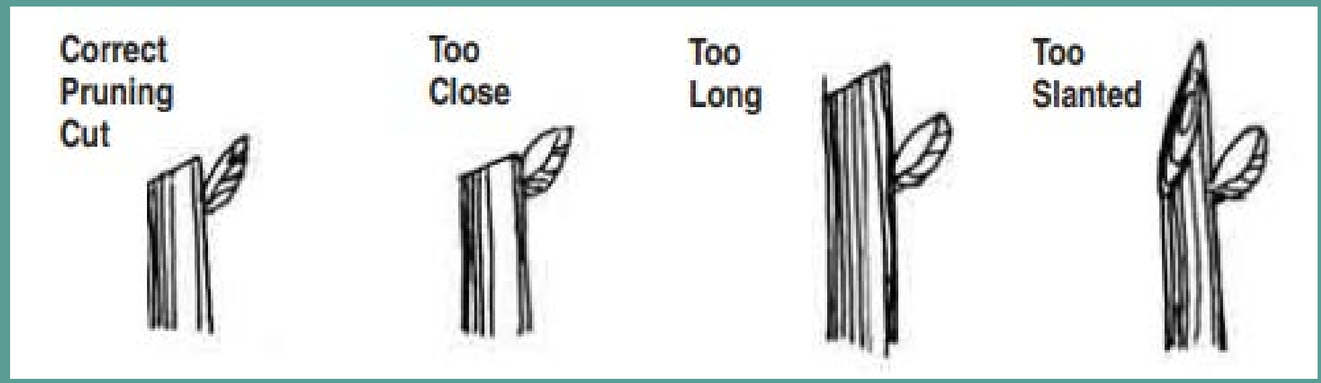
Newly-Planted Tree Pruning 101

There are 3 types of pruning cuts for young trees

Heading Cuts

- Cutting between the nodes
- Causes high sprouting
- Used in tree nurseries to generate lower branching and miniature “tree-like” form

https://youtu.be/SYrhG6ZBvi0



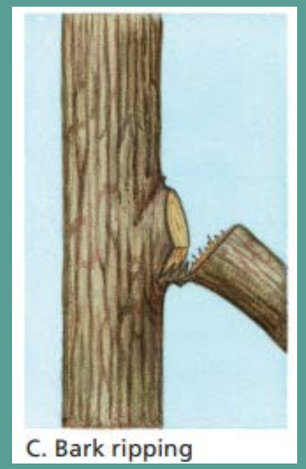
Newly-Planted Tree Pruning 101

Word of Caution

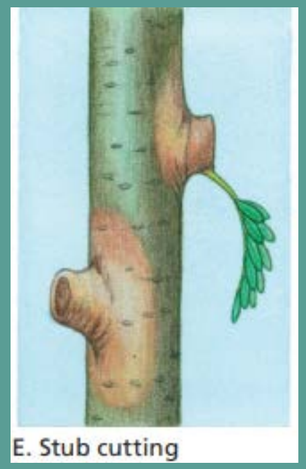
Pruning is best done in late winter/early spring to reduce the time wounds are exposed.

Avoid pruning oaks April - October to prevent Oak Wilt Spread
More information

AVOID:


C. Bark ripping


D. Flush cutting


E. Stub cutting


B. Tipping

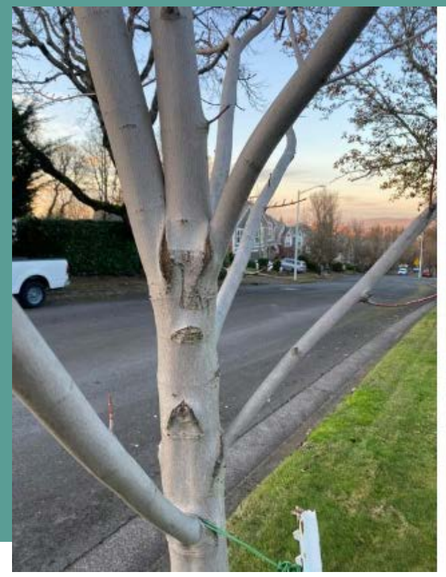

A. Topping

https://files.dnr.state.mn.us/assistance/backyard/treecare/how-to-prune-trees.pdf

Newly-Planted Tree Pruning 101

Why Prune?

Young trees are more vigorous
Pruning early results in smaller wounds which can be easily sealed up
Pruning early results in better tree architecture
Better tree architecture responds better under severe pressure





Tree Pruning Tools

Never prune on a ladder

Bypass pruners

Branches less than 1/4 inch diameter

Foldable hand saw

Branches 1/2 inch in diameter and larger

fine teeth, small cuts

Fixed hand saw

Branches 1/2 inch in diameter and larger

medium teeth, larger branch removal/reduction cuts

Pole saw/pruner

Pruner - reduction cuts less than 1/2 inch in diameter

Tree Pruning: Sanitation

70-90% isopropyl acohol, undiluted

- Dip, wipe or spray hand pruner blades with alcohol before moving from one plant to the next.

10% Bleach solution

- Mixing one part bleach with 9 parts of water in a plastic container large enough to immerse all or part of the item
- Clean all visual dirt and debris from tools.
- Dip, douse or spray tools with the 10% bleach solution. This will kill fungi, bacteria, and viruses within seconds.
- Turn taller items over in the bucket to make sure all parts are treated.
- Allow tools and equipment to dry completely.
- Rub metal items with a few drops of linseed oil, Tung oil or mineral oil. Do not use motor oil as it may transfer to plants. If rust does develop, use steel wool or wire brush to remove and re-oil.

More on disinfecting tools here

Newly-Planted Tree Pruning 101

TAKEAWAYS

1. Routinely remove 3Ds, suckers, & sprouts
2. Consider pruning objectives & dose
3. Use the 3-Cut method
4. Branch removals/thinning - Avoid until necessary - establish central leader, raise canopy
5. Reduction cuts - Most common, slow growth of competing leaders until they can be removed
6. Heading cuts - suppress upward growth of fast growing shoots, promote lateral branch growth
7. Be careful when and how you prune, avoid unnecessary injury/infection
8. Sanitize tools when possible

Review pruning cuts here: https://marinmg.ucanr.edu/CARE/HOWTOPRUNE/Cuts/

More about Trees & Pruning

Next Meetings

New Events/Volunteer Hub ----------->
Sign up to attend there

Saturday, February 17 2024
11am-1pm

Pruning, Species selection

Pic Credits:
https://hortnews.extension.iastate.edu/decline-newly-planted-trees.,
https://ipm.missouri.edu/MEG/2021/8/leafScorch-DT/
https://www.ecolandscaping.org/05/designing-ecological-landscapes/trees/how-and-why-trees-die-after-planting/
https://northernpecans.blogspot.com/2013/10/broken-twigs-caused-by-long-horned.html
https://notfarfromthetree.org/tree-health/pruning/
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https://trellatrees.com/2022/11/tree-training/