PLANT FUNCTION: PHOTOSYNTHESIS AND FOOD

Photosynthesis is an energy trapping process. Chlorophyll traps the light energy of the sun. The energy is first used to run processes that use carbon dioxide and water to form glucose. The sun’s energy is then stored in glucose. Oxygen is given off in the process of glucose formation.

ELEMENTS ARE THE BUILDING BLOCKS OF LIFE

About 98% of trees is made up of six elements: carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur.

Other essential elements include potassium, calcium, magnesium, iron, zinc, boron, copper, manganese, molybdenum, nickel, and chlorine.

Fertilizers provide elements, not energy

When essential elements are low or lacking in soils, the addition of fertilizers are very beneficial for healthy growth.

Water and food - energy source, elements - are essential for life

GROWTH

Growth is a process that increases mass. Energy and elements are required for growth.

CONDUCTING TISSUES

Phloem

- Transports food and nutrients such as sugars & amino acids from leaves to storage organs & growing parts of plants
  - Active, under plant’s control where sugars are moved (up or down)
  - To the outside of vascular bundle

Xylem

- Transports water & minerals from the roots up to the aerial parts of plant
  - “Dead” cells, passive transport, moved based on water potential (up)
  - Wood is primarily xylem tissue
  - Inside of vascular bundle

CONDUCTING TISSUES

- Water and food
  - Cells have end walls with perforations
  - Two-way flow
  - Walls contain lignin
  - No end walls between cells
**BARK**
- **BARK** is the protective covering of trees
  - Made up of living and dead cells
  - Keeps moisture and gases in and resists attack by insects and microorganisms
- **PHLOEM**, or inner bark is the transport tissue
  - Transports energy-containing substances made in leaves toward non-woody absorbing roots
- **CAMBIAL ZONE** is a cell generator that is between the wood and inner bark (meristem)
  - Cells on its outer side mature to form phloem
  - Cells on its inner side mature to form xylem
  - Sometimes called the vascular cambium (it is not green)
  - It is rarely made up of a single layer of cells
- **MERISTEMS** are groups of cells that have the ability to divide and produce more cells
  - Apical meristems increase the length of stems & roots, and produce flowers
  - Vascular meristem, or the cambial zone, increases the girth or circumference of the plant

**WOOD**
- **WOOD** is a highly ordered arrangement of living, dying, and dead cells
- **XYLEM** is a transport tissue
  - Transports free water and substances dissolved in it, from absorbing non-woody roots to leaves
- **SAPWOOD** is wood that contains living cells
- **PROTECTION WOOD** is wood that no longer has any living cells, and has been altered to a state that is more protective than the sapwood
  - When wounded, sapwood has a dynamic response because of living cells
  - When protection wood is wounded, chemically altered substances in the cells and cell walls resist the spread of infections
- **HEARTWOOD** is a type of protection wood where protection substances form as a result of normal genetically controlled aging processes as cells die
  - Substances often, but not always, impart a color to the wood darker than the sapwood

**WOODY ROOTS**
1. Anchor the tree
2. Transport free water and substances dissolved in it
3. Store energy reserves and hold water
4. Make substances essential for the life of the tree
Codominant leaders

Watersprout

Leader

Lateral

Topping – Failing Health
LEAVES AND NEEDLES

Leaves and needles have cells that contain chlorophyll which traps the energy of the sun to make a molecule called glucose.

When leaves and needles die they fall and provide protection and food for soil organisms.

BUDS

Buds are organs made up of small preformed parts and an apical meristem. There are leaf buds, flower buds - male alone, female alone, male and female - and mixed buds that have leaves and stems and flowers.

Apical meristems start in buds and continue in tips of twigs. Roots do not form from buds. Apical meristems are active in tips of roots.

Why Do We Prune?

- Remove dead, damaged, diseased or broken branches
- Remove rubbing, crossing, inwardly growing branches
- For visibility & safety considerations
- Train young plants
- Control plant size
- Rejuvenation of plants
- Increase flowering, fruiting and vigor

Pruning Cuts

Compartmentalization

Branch Bark Ridge

VS

Branch Bark Collar

Compartmentalization

- the tree’s defense process after injuries
- resists the spread of infections
- protects systems involving water, air, energy storage, and mechanical support
- the boundaries are like an inside bark
Always look for the branch collar before making any final cut.
We Prune Trees:

- To remove dead, damaged, diseased and broken branches

Always have a good reason to prune!
We Prune Trees:

- For visibility & safety considerations:
  - To avoid signage
  - Clearance
  - Reduce hazards
  - Reduce liability

*Always have a good reason to prune!*
To train young trees
- Remove defects
- Remove co-dominant leaders
- Avoid weak branch unions and included bark
- Provide for well spaced scaffold branching pattern
- Reduce future maintenance and problems

Always have a good reason to prune!
What is Included Bark?

- Bark that gets enclosed in the crotch of a tree as the branches and trunks develop
- It weakens the branch attachment
- The tree is more prone to storm damage
**We Prune Trees:**

- Rejuvenation of plants

*Always have a good reason to prune!*

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**The 3-Cut Method of Removing Large Branches**

Use when removing large or heavy branches to prevent the weight of the branch from tearing the bark below the cut.

1. Make an undercut approximately 12” from trunk and ¼ of the way through branch

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**The 3-Cut Method of Removing Large Branches**

1. Make an undercut approximately 12” from trunk and ¼ of the way through branch
2. Make second cut within 1” of the undercut (away from first cut) and through the branch
The 3-Cut Method of Removing Large Branches

1. Make an undercut approximately 12” from trunk and ¼ of the way through branch
2. Make second cut within 1” of the undercut (away from the first cut) and through the branch
3. Remove remainder of branch just beyond the shoulder and the branch bark ridge
What's Wrong with Topping Trees?

1. It is a source of invasion by decay-causing organisms
2. It reduces the food-manufacturing capacity of trees
3. New limbs that originate near the cuts are weakly attached and break easily in the wind (A re-grown limb never has the structural integrity of the original limb)
This branch was topped and the new growth is poorly attached to the original limb

Note parallel grain and lack of branch collar

Trunk beginning to rot

What’s Wrong with Topping Trees?

4. Thick re-growth of suckers or sprouts has greater wind resistance leading to more storm and wind damage

5. Topping does not help in keeping a tree smaller or lower in height

6. It’s expensive to have the tree re-topped every few years due to rapid, thick re-growth of branches

7. It’s ugly! The re-growth of a mass of straight suckers and shoots

8. Topping presents a dangerous situation because branches are weakly attached and presents a potential for trunk rot and tree failure

9. It makes you and your employer look bad: Informed people know that topping is not an accepted procedure
Topping can also destroy the natural growth form of some trees, like this bottle tree.

- Topping does not reduce the size of the tree
- Re-growth as a result of the topping encourages rapid, weakly-attached new growth

**How Can You Reduce the Size of a Tree?**

- Use a technique called ‘crown reduction’
  - Cut limbs back to laterals that are at least 1/3 the size of the parent limb

*Crown reduction* pruning offers an alternative to topping.
**Young Tree Pruning**

1. For new plantings, wait a full growing season before fertilizing or pruning
2. Always use clean, sharp tools
3. Only prune if you have a good reason to prune

**VERY IMPORTANT!**

Visualize what the plant will look like with the branch removed

Remove no more than 25-30% of the old branches annually
**Young Tree Pruning**

4. Leave the low, side branches on young trees
5. Don’t over-prune either the crown or branches
6. Don’t use tree wound dressing or paint

**Pruning Young or Newly Planted Trees**

- Remove only dead, damaged, diseased, rubbing or inwardly growing branches
- Leave thin side shoots on the trunk and trim back to about 4-6”
- Don’t ‘elevate’ the crown on newly planted trees drastically

**Young Tree Pruning**

7. Prune to eliminate weak growth or poor branch locations
8. Prune just outside the branch collar
9. Prune to open the canopy
10. NEVER TOP A TREE
11. NEVER ‘LION TAIL’ a trunk or branch

**Crown excessively raised**

**Weak branch angle**

**Excessively raised crowns**
**Pruning Palms**

1. Remove dead and old fronds
   1. Remove the sheath first and then cut the frond
2. Remove fruiting clusters
   1. Pull down and remove as close to the base as possible

3. Make two cuts:
   1. Remove the brown fronds and leave a small portion of the petiole
   2. The following year remove the petiole

*Fronds on some palms (i.e. queen palm) turn brown and are easily pulled off the tree*
Pruning Palms

- Avoid cutting into immature green tissue
- Avoid using tree spikes: trunk damage does not heal
- Frost damaged palms
  - Remove all but the three innermost fronds
  - Wait 6 months to see if the tree will recover

Overpruning

Just Right

Phoenix canariensis  
Phoenix dactylifera

ANSI A300 (Part 1) 2008 Standard Practices (Pruning)
Considerations When Working with Shrubs

1. Maintenance begins at planting
2. Shrub maintenance should begin before the plant reaches the desired size
3. Slow growing shrubs normally have a well defined branch structure
4. They should never be sheared
5. Fast growing shrubs generally have many shoots originating at the base of the plant and require regular pruning

VERY IMPORTANT!

- Visualize what the plant will look like with the branch in question removed
- Remove about 25-30% of the old branches annually

Shrub Pruning

- If the plant must be drastically reduced in size, reduce it over a 3-4 year period (know your species – some can take a more sudden cut-back)
- Make cuts on shrubs at varying lengths in order to leave the shrub with a textured natural look
- During the first growing season, shrubs should be thinned out to reduce the number of stems and to help develop stem girth
Converting Shrubs to Trees

1. Remove lower branches that do not carry into the top of the plant
2. You may have to remove several of the main branches
3. Then prune as you would prune any small tree

Maintaining Hedges

1. Choose evergreen plants with small leaves, short internodes, dense branching and that are able to sprout from old wood
2. Keep the number of hedges to a minimum because they are labor intensive

How to Prune Shrubs

1. Know the flowering period for the shrub
   1. Prune after bloom period
2. Try not to remove major branches which will open up the plant to sunburn
3. Keep pruning to a minimum
4. If you find that the shrub requires continual pruning, consider removing the plant and replacing with a slower growing species
Why Not Shear Shrubs?

- It looks unnatural
- Flower production is decreased
- It is very labor intensive
- Plants soon become woody on the interior
- Height is more difficult to control
- Design intent is lost

How to Avoid Shearing

1. NEVER use hedge shears
2. Selectively cut branches out of the plants; make the cut just above a bud or side shoot
3. Removed stems should be cut from throughout the plant
4. Cuts can be as severe as you desire
1. Cut shrubs to 6-18" above the ground
2. The ‘stumps’ will re-sprout in several months
3. Thin out the number of shoots the second year and reduce the overall height by half

4. The result will be a full, vigorous, rejuvenated shrub
5. Not all species respond positively to this treatment
6. Typically, fast growing plants respond to this radical pruning

Rejuvenation Pruning of Shrubs

These fast growing plants can be pruned to within 12-18 inches of the ground and will re-sprout rapidly:

- Texas ranger (Leucophyllum spp.)
- Jasmine
- Oleander
- Acacia redolens
- Grasses
- Lantana spp.
- Bougainvillea spp.
- Yellow bells – (Tecoma spp.)
- Cordia spp.

**Always consider age and species when planning drastic cut-backs**
**Shrub Pruning Calendar**

<table>
<thead>
<tr>
<th>Month</th>
<th>Action</th>
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<tbody>
<tr>
<td>Jan</td>
<td>Winter pruning only.</td>
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<tr>
<td>Feb</td>
<td>Winter pruning only.</td>
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<tr>
<td>Mar</td>
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<tr>
<td>Dec</td>
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</tbody>
</table>

*Shrub Pruning Calendar* (Table)

**Freeze Damage**

Wait until new growth starts in spring. If you have to remove damaged growth before new growth starts, keep pruning to an absolute minimum.

**Tools of the trade**

**Scabbard**

Used to store and protect your pruners. Keep your pruners in scabbard when not being used.

**Hand Pruners**

Used for selectively pruning of shrubs, branches ½” or smaller.

- 1” Bypass Hand Pruner
- ¾” Bypass Hand Pruner

**Loppers**

- 27” Lopper can cut up to 2” limb, 27” handles
- 32” Lopper can cut up to 2 ½” limb, 32” handles

**Scabbard**

Used to store and protect your pruners. Keep your pruners in scabbard when not being used.
**Pole Saw**
Used to remove tree limbs, above 6’
13” saw blade can cut up to 1 ¼” limb, Extends 7-14’

**Hand Saw**
For medium to large limbs
Keep protected in sleeve to prevent damage to toothed edge

**Hedge Shears**
Only used for formal hedges

**Blade Maintenance**
- File the bevel edge from the pivot toward the tip four or five times and check the edge
- File the flat side of the blade once, with the file against the blade, to remove burrs caused by sharpening

**Climbing vs. Ladder**
Pruning Near Power Lines

From the SRP website:

Your trees and overhead power lines
You should never attempt to trim trees near power lines or hire a tree-trimming contractor to work within 10 feet of an energized power line. Arizona law places restrictions on this work to protect public safety.

The Bad and the Ugly

Note what’s happening at base of these shrubs
Same place, different pruning
Resources

Thank you to Glenn Fahringer for class material. Some photos and text provided by Jack Kelly of Pima County Cooperative Extension and Dr. Alex Shigo of Shigo and Trees Associates.