Saturday, February 22, 2020

# How to think about plants if you want to prune well

## How trees grow

Each growth bud contains the “blueprint” for a whole stem.

Each spring, each growth bud shoots out like an arrow, building a long slender stem behind it in one single direction — “axially”. The bud itself is made out of stem cells. The precise term is “apical meristem”. Apex means the tip of the arrow. These stem cells in the bud divide behind themselves to give birth to “daughter cells”, which make up the growing stem we see. The stem cells in the bud are like mitosis-fueled cellular rockets, together growing a long row of daughter cells in a tight central area, laying down the central pattern of the stem as they climb. A growth bud is like a group of highly organized cranes building a skyscraper from each new top floor, always remaining at the very tip as they go, creating the capacity for all that is to emerge next. This arrow-growth is called “primary growth”.

After this initial spurt, this laid-down section of stem permanently stops growing longer.* Once primary growth ends, the growth direction shifts perpendicular to the axis. But now, this “secondary growth” happens outward in a whole plane, not just forward in one axis. Now our heroes are dividing themselves radially, alongside one other, making all the kinds of cells that form the mature branch. They also have to keep making more of themselves to fill in the gaps developing in-between each other as their circle expands outwards. Like the ripples in a pond after you plunk a rock in, they radiate out to develop the structure of the wood and bark. To radiate, some stem cells reproduce themselves on the inside of their circle each year, building a ring of wood, pushing the circle of stem cells outward, expanding the circle. Meantime, some of the cells divide on the outside of the circle, making bark. This way, all up and down the arrow-like shoot of primary growth, secondary growth stem cells are propelling themselves radially outward *at every level in a ring.* This ring is called the cambium, which makes xylem on the inside and phloem on the outside. Wood and bark.

Back when the primary growth laid down the blueprint of the stem, it also initiated new sideways-facing buds, which will make their own stems by repeating the above process themselves: first they’ll shoot out in a new direction with axial primary growth, then they’ll fatten radially with secondary growth. Get it? As time continues to go by, both the main stem, and the sideways-facing stems continue to develop radially. Both keep growing fatter. They grow into each other. This really is how plants are made.

These places where main and sideways-facing stems meet, each expanding their systems of wood and bark, are simply fascinating. Exploring them is the secret to understanding the tree’s strength and vulnerability. Once you do the work of imagination to get this idea visually, it becomes intuitive. It just makes so much sense when you think it all through. Then you just know how to prune! No kidding. It’s really quite exciting.

Each annual pulse of radial secondary growth is fueled by the glucose generated in the new crop of leaves. This means that annual growth rings cascade down each stem from the tip (where the leaves are) to the base, as the river of new fuel from the leaves flows down the stem, to (and beyond) where it attaches to the parent stem.

OK here is the secret: Where the stems meet, their two vascular systems, made by the secondary growth stem cells, actually intertwine, each year. This intertwining makes the attachment between the two branches very very strong. And basically when you prune, you want to make your cut so you leave that intertwined part ON the plant. Fortunately it has a distinctive look to it.

Hands on 1: we each “grow” (i.e. draw) our own tree through successive growing seasons. To draw primary growth spurts realistically in our drawings, we learn how tree hormones interact to grow the shape of the plant. Drawing plants like this is your window for imagining what will happen on your plant *after* you’ve made your pruning cuts.

Pruning is recognizing that whatever buds remain when you’re done, are going to continue to grow and compete for “apical dominance”, just like before you made your cuts. Some types of cuts result in styles of plant response that are healthier and more attractive than others. When pondering your cut selections, ask yourself what the plant’s remaining buds are going to do in response. This is how you see with the pruner’s eye.

Hands on 2: We each draw each new year’s secondary growth on our drawings. Soon we’re seeing how branch attachments form and develop through successive growing seasons. We focus on one by making a close-up of our first drawing.

Hands on 3: Using an actual branch attachment, see if you can draw the cut you want to make on your branch. Once you can visualize how to make that cut you want, try to make your cut exactly on your drawn line. You’ll learn a lot about how blades and saws work by trying to cut very smoothly and very precisely. Explore how to adjust your muscles to facilitate the cut you have in your mind.

Bring 7 colors you can draw with, and if you can, please bring some larger-format paper to draw on. Bring your hand pruners and hand saw too if you like.

*Next growing season, another “terminal” bud will emerge to continue the axial progression from the tip top of this year’s laid-down, fixed-length stem. This is why a nail doesn’t move up a tree trunk with age: once laid down, axial growth is over on that section of the stem.

Next:

**How Trees Rot**

- Plants don't heal, they *compartmentalize*.
- How do plants respond to the three different kinds of cuts?
  - Thinning cut
  - Co-dominant cut
  - Heading cut

**Roots: That glucose keeps on going and going down those stems!**

- Trees use twice the glucose to make their roots as for *all* their above-ground stems!
- Soil ecology: Trees give around 40% of their glucose to the organisms in the soil!
- How trees drink: Water siphons up from the roots to a leaf every time a leaf converts H2O & CO2 into glucose. Water molecules stick strongly together. Whenever a leaf makes glucose, water molecules "disappear" into the glucose. This disappearing water creates suction, pulling up more water, like a straw. This is why trees need to compartmentalize: to keep the suction strong so the leaves get fed.
- Which roots water & are fed glucose by which stems?