

1 September 2017

Topic Three: **Monocots and Dicots.**

A “cotyledon” is contained in the seed of a flowering plant and emerges as a new shoot grows from a seed. As the seedling starts to grow, the cotyledon or “seed leaf” is visible on the stem before the true leaves appear. Some flowering plants, the monocotyledons or monocots, have one seed leaf and the dicotyledons or dicots have two seed leaves.

Let’s start with monocots. The grass family, *Poaceae*, is the most familiar group of monocots. Here are some grass categories with which you are probably familiar: bamboo, sugarcane, maize (corn), sorghum, wheat, oats, barley, milo, rye, rice, millet, hay, pasture grasses, turf, ornamental grasses, prairie grasses, pampas grasses, weed grasses, arctic grasses, and alpine grasses. A pretty extensive family, no? It occurs in many habitats in almost every region of the world.

Besides the grass family, here are some other monocots: sedges (including papyrus), rushes, pondweed, coconuts (palm family), philodendrons, spiderworts, pineapples (bromeliad family), asparagus, onions, chives, garlic, leeks, shallots, ginger, bananas, lilies, daylilies, hostas, irises, flowering bulbs, and orchids.

Dicots are an even more extensive group, there are gazillions of dicots:

Here are some familiar dicots that represent different families: magnolias, water lilies, buttercups, poppies, elms, walnuts, oaks and chestnuts, hazelnuts (birch family), cacti, pigweeds, pinks, buckwheat, mallows, squashes and cucumbers and melons, willows, cabbages, rhododendrons, hydrangeas, apples and pears and cherries (rose family), beans and peas, maples, cashews, oranges and lemons and grapefruit (citrus family), carrots and parsley, milkweeds, tomatoes and potatoes (nightshade family), sunflowers (aster or composite family), grapes, mints, and olives. And that is just an abbreviated selection!

Group inquiry:

So, which evolved first — monocots or dicots? The monocots seem to be simple plants, so maybe the dicots evolved from monocot ancestors. Or, maybe the dicots were already going strong and the monocots diverged as an off-shoot of the dicots. Don’t forget that both monocots and dicots came from the gymnosperms that preceded them.

Let’s take a vote. Take a slip of paper, write your vote, and fold it in half. If you think monocots came first, write “monocot.” If you think dicots came first, write “dicot.” Don’t put your name. If you had botany in college, don’t whisper the answer to your neighbor.

At the end of the class, we will count the votes. When the voting is finished, we will proceed.

Ready? One of the chief differences between monocots and dicots is that dicots have a cambium, and sometimes a “cork cambium” as well. In the stem of a monocot, the xylem and phloem (covered in Topic 2) are grouped into “vascular bundles,” but in a dicot plant the phloem and the xylem are concentric rings on either side of the cambium (not always, but generally speaking). The cork cambium is the layer that produces the bark on the outside of the stem in dicots. Monocots are never woody, but they can still be very strong and sturdy.

Look at figures XX and XX of monocot stems. The vessels are grouped into bundles, right? Then look at figures XX and XX of dicot stems and you see the concentric arrangement, no? Also, monocots have parallel veins on their leaves, and dicots have branching veins (see figures XX and XX).

Now here’s the thing. Gymnosperms have cambia (plural of cambium). We’ve already learned that monocots do not have cambia, and that dicots do have cambia. If gymnosperms developed into monocots and monocots developed into dicots, then did the plants forget how to make cambia and then remember again? (The next time you have ten minutes to spare, look up “Ockham’s Razor” in Wikipedia.)

It turns out that monocots are specialized dicots that split off on their own. The early dicots came first, and both dicots and monocots are descended from them. This split came early in the development of dicots, possibly the Early Cretaceous period. If you voted for monocots, don’t despair — you will have a chance to vote for monocots again in Topic Six when we each choose our favorite group of plants. There are about 60,000 species of monocots, including plants that grow in fresh water.

So, we have established that gymnosperms and dicots can be woody, and monocots cannot. If you are stacking firewood, the gymnosperms such as pine and hemlock look similar to the dicots such as maple, oak, birch, and beech. On a microscopic level, however, the structure of the wood is very different.

Which member of the Plant Kingdom is structurally the strongest? Douglas fir and western hemlock are the lords of the lumber industry, or perhaps it is the mighty oak or a titan of the tropical rainforest. Those trees must be strong to hold up such massive weight, no?

Actually, the strongest plant is bamboo. Bamboo? Yes, I kid you not. Bamboo is not a plant but a group of plants — 1,462 species in 115 genera, in fact. Bamboo has a higher specific compressive strength than wood, brick, or concrete, and a specific tensile

strength that rivals steel. Asian contractors use bamboo for scaffolding. And, guess what? Bamboo is a kind of grass, a monocot. Wow!

Since Topics 4, 5, and 6 are mostly about dicots, let's explore the monocots a bit.

Further details about monocots:

In the textbook *Integrative Plant Anatomy*, Professor Dickison relates the following:

“J. C. Schleip was an active piano maker in Berlin between 1816 and 1850. Schleip used woods of as many as 10 species in the construction of a single piano....Especially interesting is Schleip's use of rattan palm (*Calamus*) “wood” for his hammer shanks. This is the earliest known instance of a Southeast Asia/Pacific Rim forest product being used in a Western musical instrument and is an almost unique use of monocotyledonous material.”

The monocotyledons get around, no? As with all monocots, palm trees do not have “wood” and “bark” in the usual sense, but they do have means of thickening and strengthening their stems.

The world's largest crop by quantity is sugarcane (a group of related species used commercially to produce sugar, molasses, ethanol, paper, and many other things). And sugarcane is, you guessed it, a member of the grass family (hurray for monocots).

The sedges are also monocots — they look like grasses but belong to a different family. The most famous of the sedges is the genus *Cyperus*, consisting of 700 species including the papyrus used in Ancient Egypt and common indoor plants such as umbrella plant and dwarf umbrella-sedge. Purple nutsedge, sometimes called “the world's most noxious weed,” belongs to this genus, as well as its cousin yellow nutsedge which is common in lawns and gardens in North America. You can spot this weed easily because it has a triangular stem.

Once I was exploring a wild meadow in Connecticut and noticed that the thorny vine “greenbrier” has parallel veins on the leaves. Sure enough, greenbriers are monocots (even though they look like dicots).

The largest monocot family is the orchid family with about 20,000 species.

The monocots are pretty impressive, no?

Intergenerational activity:

Senior Citizen: tell a story from your past about a kind of monocot or dicot plant. Take time to think of a really good story. (Monocot Examples: you saw forty kinds of palm tree in a botanic garden in Florida, you remember reading about Laura and Mary Ingalls jumping on haystacks on the banks of Plum Creek, or you wore a leek in your hat in a Shakespeare play in college. Anything goes.)

Here is a story about a dicot plant from *The Voyage of the Beagle* by Charles Darwin (the dates of the voyage were 1832-1836). Here is a brief excerpt from Chapter VII about a rural region of Argentina:

“When the thistles are full grown, the great beds are impenetrable, except by a few tracts, as intricate as those in a labyrinth. These are only known to the robbers, who at this season inhabit them, and sally forth at night to rob with impunity. Upon asking at a house whether robbers were numerous, I was answered, ‘The thistles are not up yet’ — the meaning of which reply was not at first obvious. There is little interest in passing over these tracts, for they are inhabited by few animals or birds, excepting the bizcacha and its friend the little owl.”

Here is a monocot story. In 1969, I worked on a dairy farm in Delaware County in the Catskills of New York State. The farmer wanted to grow some sweet corn for his family, but he knew that raccoons love sweet corn. So, he planted a row of sweet corn in the middle of a field of silage corn (he called it “cow corn”). It didn’t fool the raccoons one bit. The raccoons came out of the woods, walked past twenty rows of cow corn, stripped every ear of sweet corn, and went back to the woods again!

Young Person and Senior Citizen together: Let’s play a game: Monocots vs. Dicots. Take a sheet of paper and make a column of edible monocots down the left side and a column of edible dicots down the right side. Copy from the paragraphs above at the beginning of Topic 3 (if two or three words are connected by “and” you can list them separately in the column). Look at the list of monocot plants and circle the ones you like to eat (both the grass family and the other monocots). Then look at the list of dicot plants and circle the ones you like to eat. If you like raisins or grape juice, be sure to circle “grapes.” Which do you like the best — monocots or dicots? You can do the same with the plants you do NOT like to eat (underline rather than circle). What is the verdict? If you are good at arithmetic, you can assign a “score” to each plant — scale of one to five: positive for like and negative for dislike. The number five is for the ones you like or dislike the most. For example, sweet corn could be +3 and parsley could be -3. Add up the totals and compare the numeric score of monocots and dicots! Who wins? Compare scores with your friends.

Experiment #3: Dicots and Monocots

Part One: Dicots

Propagation of mint plants

Background about the mint genus:

Mints (the genus *Mentha*): This large group of plants has been used for cooking, beverages, candy, and as a strewing herb for centuries. There are two that are especially good for growing indoors: American apple mint *Mentha gentilis* var. *variegata* and Corsican mint *Mentha requienii*. The former is good for the usual cooking use of mint and the latter is a conversation piece with a strong aroma similar to peppermint. A rare mint that does well in containers is Ginger Mint, *Mentha x gracilis* 'Variegata.' When the author lived in central Michigan in the 1970s, he found peppermint growing wild adjacent to the fields where it had formerly been grown commercially on a large scale. With the invention of artificial peppermint flavor, peppermint ceased to be a crop, but one can still find it escaped from cultivation in the windbreaks and streambanks nearby.

Plant mint in a rich, peaty potting soil, water weekly, and give plant food every two months. Mint is more shade-tolerant than other herbs and will do well with indirect light. Once a year, repot mint by dividing the roots — saving only the best vigorous roots. Repot the healthy roots and your mint will last for years.

Instructions for propagation of mint cuttings:

Here is a specific technique that I have used with easy-to-root plants such as mint, wax plant, and tip cuttings of geranium.

- 1) Take cuttings about five to six inches in length and remove the leaves from the bottom half of the cutting.
- 2) Take plain vermiculite and put it in a gallon plastic zipper-top bag, about three or four inches deep.
- 3) Add water to the vermiculite so that it is moist but not saturated. When you squeeze a fistful of moist vermiculite, a few drops of water should come out. That is the right amount of water.
- 4) Put the cuttings in the vermiculite (about three inches apart — do not overcrowd).
- 5) Blow air into the bag and zip it shut. This makes more space available for the cuttings. I also explain to participants that the carbon dioxide that we breathe out is good for the cuttings.
- 6) Put the bag in indirect light, such as a north window, for four to five weeks. It is not necessary to open the bag or add water during that time.
- 7) Remove the rooted cuttings and pot them up right away. For leaf cuttings of African violet, the time will be

two or three weeks. This same technique will work for germinating lily seeds, but shorten the time span to three weeks.

Mint cuttings will also root in water, but the roots will be weak and easily damaged.

Part Two: Monocots

Option 1: Growing papyrus

Dwarf Egyptian Papyrus, *Cyperus papyrus*: a monocot plant, a sedge (with a triangular stem), that grows in the Nile Delta and in Sudan. The pith of the plant was made into writing-paper by the ancient Egyptians, but papyrus was also used for making reed boats, mats, rope, sandals, and baskets. It can be grown in a dishpan of water in a high-light location.

Option 2: Forcing paperwhite narcissus

Paperwhite narcissus: Put 2-4 inches of attractive stones in the bottom of a tall clear glass or plastic “hurricane vase.” Put narcissus bulbs on top of the stones, so close that they almost touch each other. Add more stones so that the tops of the bulbs are showing. Add water so that the level of the water is just at the bottom of the bulbs — keep this water level by adding more as water evaporates. For the first two or three weeks, keep the bulbs in a cool place away from direct sunlight (50-60 degrees F). After the bulbs sprout, move the bulbs to a sunny window. Keep an eye on the water level, since bulbs in active growth can dry out in a day or two. When blooming is finished, put the bulbs in the compost — they will not bloom again after being forced indoors.

Option 3: Growing a pot of chives

Follow the instructions on the seed packet.

Option 4: Planting a ginger root purchased in a grocery store

Instructions:

Topic Three Drawing Lesson:

Topic Three Video Materials: