



CMG GardenNotes #122

Taxonomic Classification

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The most universal classification system of plants is plant taxonomy, or systematics. Taxonomy is the science of systematically naming and classifying organisms into groups that reflect their relatedness to other organisms. Plant systematics is an old science that uses the gross morphology (physical characteristics, [i.e., flower form, leaf shape, fruit form, etc.]) and, more recently, genetic information to understand their relationships and heritage. The science of classifying organisms to understand their relationships and evolutionary history is also known as *Phylogenetics*. Characteristics that distinguish organisms sometimes become a part of their name, though not always unambiguously. For example, *Quercus alba* means “white oak”, and is so named because the underside of the leaf is white, and *Pinus contorta*, lodgepole pine, translates to “twisted pine”, named for twisted seeds rather than its characteristically straight trunks.

Plant taxonomic classification changes with continuing research, so inconsistencies in nomenclature will be found among references. Knowing the currently accepted names is important, but do not get caught-up in which is “correct”, as it can be a moving target. Rather focus on “are you communicating?”

An overview of plant taxonomy helps the gardener understand the basis of many cultural practices. For example, fire blight is a disease of the rose family; therefore, it is helpful to recognize members of the rose family to diagnose this disease.

Common Taxonomic Divisions

The scientific system of classification divides all living things into groups called **taxa** (singular, **taxon**). Taxa are arranged in hierarchy, ranging from Kingdom to Subspecies, with each taxonomic division “nested” into the group above. A phylogenetic Kingdom is usually the largest recognized taxonomic group. Every living thing can be classified into taxonomic groups according to this system.

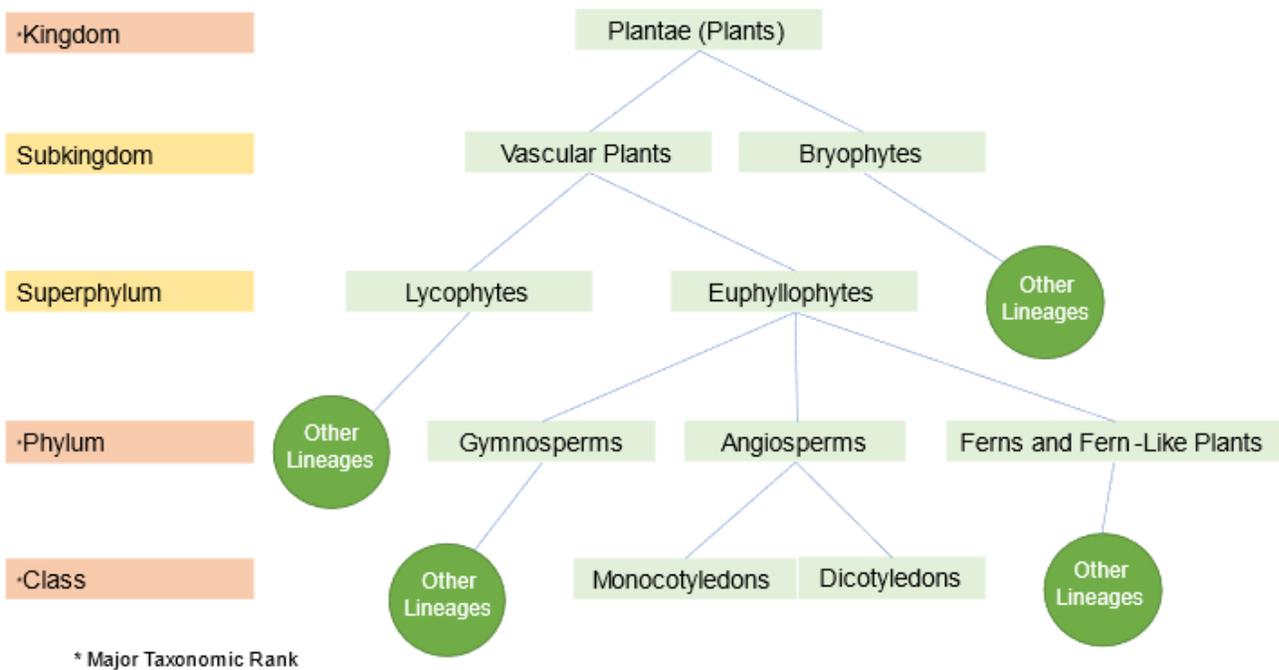
The seven major taxonomic groupings are, in order:

- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species

Plants are in the kingdom of **Plantae**. Other kingdoms include **Fungi**, **Protista** (one-celled organisms including yeasts, bacteria, and protozoans), and **Animalia** (animals). [Figure 1]

The plant kingdom is divided between **bryophytes**, or **non-vascular plants**, (including true mosses and liverworts) and **tracheophytes** or **vascular plants** (plants with a vascular system that includes *tracheids*, a type of xylem cell).

Figure 1. The Upper Portion of the Plant “Family Tree”



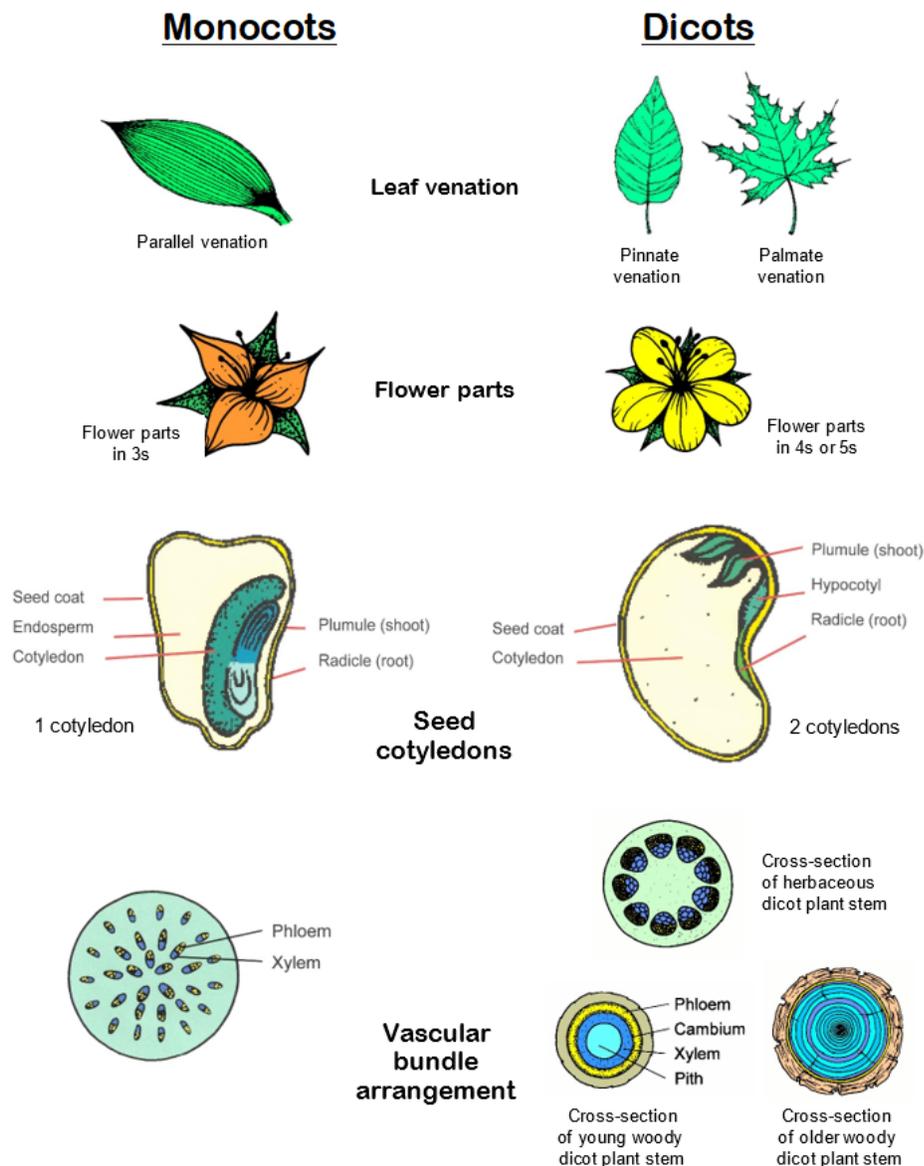
Vascular plants are further divided into two subgroups: lycophytes (plants with very simple vascular systems, like *Selaginella* and club-mosses) and *euphylllophytes* (plants with complex vascular systems and overtopping branches, like ferns, conifers, and flowering plants). One sub-group of the Euphylllophytes is the **spermatophyta**, or **seed plants**, so named because they produce seeds rather than spores or free-swimming gametes. The seed plants include five phyla, Cycads, Ginkgos, Conifers, and Gnetophytes (commonly referred to as a group as **Gymnospermae** or Gymnosperms) and flowering, **Magnoliaphyta** (Angiosperms). Plants from these groups make up most of the plants in the landscape (the most notable exception being ferns, which reproduce from spores rather than from seeds).

Gymnosperms do not produce flowers, but rather “naked seeds” (the translation of Gymnosperm) on or in specialized structures, such as pinecones. Cycads are common landscape plants in tropical and sub-tropical areas and may be grown as houseplants in Colorado. *Ginkgo biloba* is the only existing species in the Ginkgoales, but the fossil record includes many other members. Arborvitae,

junipers, Douglas-fir, fir, pine, and spruce are examples of conifers (or literally, “cone-bearers”). The Gnetophytes are another small group, with only a few dozen species, the most well known in our area being *Ephedra*.

Angiosperms or phylum Magnoliophyta, are flowering plants, and with nearly 260,000 existing species make up most of the diversity of plants. Angiosperms have more complicated vascular systems than other plant groups and a highly modified reproductive system compared to older lineages. Angiosperm seeds are enclosed in a fruit (i.e., not naked). The angiosperm phylum is divided into several classes: two important groups for landscape maintenance are **monocotyledons (monocots)** and **dicotyledons (dicots)**. (Note that “dicots” are not themselves an individual taxonomic “class,” but rather the term refers to several variously related classes of flowering plants that are distinct from monocots). Distinguishing between monocots and dicots is a common practice in landscape management. For example, some of our common herbicides are selective against one group or another. Lawn weed sprays (such as 2,4-D and dicamba) kill dicots (broadleaf plants like dandelions) but not monocots (the grass). Other herbicides will kill monocots but not dicots, allowing the gardener to kill grass (a monocot) in the shrub or flowerbed (dicots). [Figure 2]

Figure 2. Monocots versus Dicots



Orders and Families

Plant Orders and Families are separated from one another by characteristics inherent in their reproductive structures (flowers, fruit, and seed). Many family members have obvious morphological similarities, but the resemblances can be less plain too. As with higher taxonomic groups, orders and families share common traits that reflect a shared heritage.

Family names end in ‘*aceae*’. Examples of common families include the following:

- ***Caprifoliaceae*** – Honeysuckle family, including elders, honeysuckle, snowberry, and viburnum.
- ***Fabaceae*** – Pea family, including Pagoda tree, locust and Siberian peashrub.
- ***Oleaceae*** – Olive family, including ash, forsythia, lilac, and privet.
- ***Rosaceae*** – Rose family, including apple, cotoneaster, crabapple, potentilla, peach, plum, mountain ash and 250 common landscape plants.

Genus and Species

The taxonomic divisions beneath the family level are genus and species. Plant species are named using a binomial system that was standardized by Carolus Linnaeus (1707-1778), a Swedish biologist who is known as the father of modern taxonomy thanks to his efforts. The binomial system assigns each living thing two names: a genus and specific epithet, which together make up the species name. The genus name comes first and is analogous to a person’s last name (like Smith). The specific epithet names follow as a more specific identifier. It would be analogous to a person’s first name (like John). Plant names are regulated internationally by the International Code of Botanical Nomenclature (ICBN), <https://www.iapt-taxon.org/nomen/main.php>. The goal of the ICBN is to provide only one, internationally recognized, correct name for each taxonomic group within a stable system of names (i.e., a “classification”), and is officially updated every six years by the International Botanical Congress.

Genus	Specific Epithet
Smith	John
<i>Catalpa</i>	<i>speciosa</i>

The common names of plants typically apply to a genus (plural **genera**). For example, *Acer* is the genus of maples, *Fraxinus* of the ash, and *Juniperus* of the junipers. Many genus names have become ‘generic’ common names. For example: anemone, rhododendron, crocus, and viburnum, are all common names that are identical to the genus name. Genus names are always nouns in the singular.

The specific epithet classifies a member of a genus as a unique species. The specific epithet is always used in conjunction with the genus, never alone, and is an adjective, noun in apposition, or possessive noun that modifies the generic name. The specific epithet must grammatically agree with the genus (according to the rules of Latin).

When genus name and specific epithet are written, they are italicized. The genus name is always capitalized, but the specific epithet is not.

In writing, the abbreviation “sp.” following the genus indicates a single unidentified species and “spp.” indicates multiple species. For example, “*Acer* sp.” would indicate an unidentified species of maple, and “*Acer* spp.” refers to multiple species in the maple genus. The “sp.” or “spp.” is not italicized.

In technical papers, the person who first described the species, called the **Authority**, follows the specific epithet. For example, Japanese maple would be written *Acer palmatum* Thunberg or *Acer palmatum* T. The potato would be written *Solanum tuberosum* Linnaeus or *Solanum tuberosum* L.

Variety and Cultivar

The taxonomic divisions beyond the genus and species level include subspecies, variety, and form (forma).

Variety, form, or subspecies is a sub-grouping of species assigned to individuals displaying unique differences in natural populations. The differences are inheritable and reproduce true-to-type in each generation. For example, cauliflower and cabbage are varieties of the same species, *Brassica oleracea*, and our local native maple, *Acer saccharum* subsp. *grandidentatum* is a subspecies of sugar maple, *Acer saccharum*.

In technical writing, variety and subspecies names must be denoted with 'var.' or 'ssp/subsp.' when following a species name. The names themselves are italicized, while var. or ssp. is not. For example, the thornless variety of honeylocust would be written *Gleditsia triacanthos* var. *inermis*. The bigfruit evening primrose would be written *Oenothera macrocarpa* ssp. *incana*.

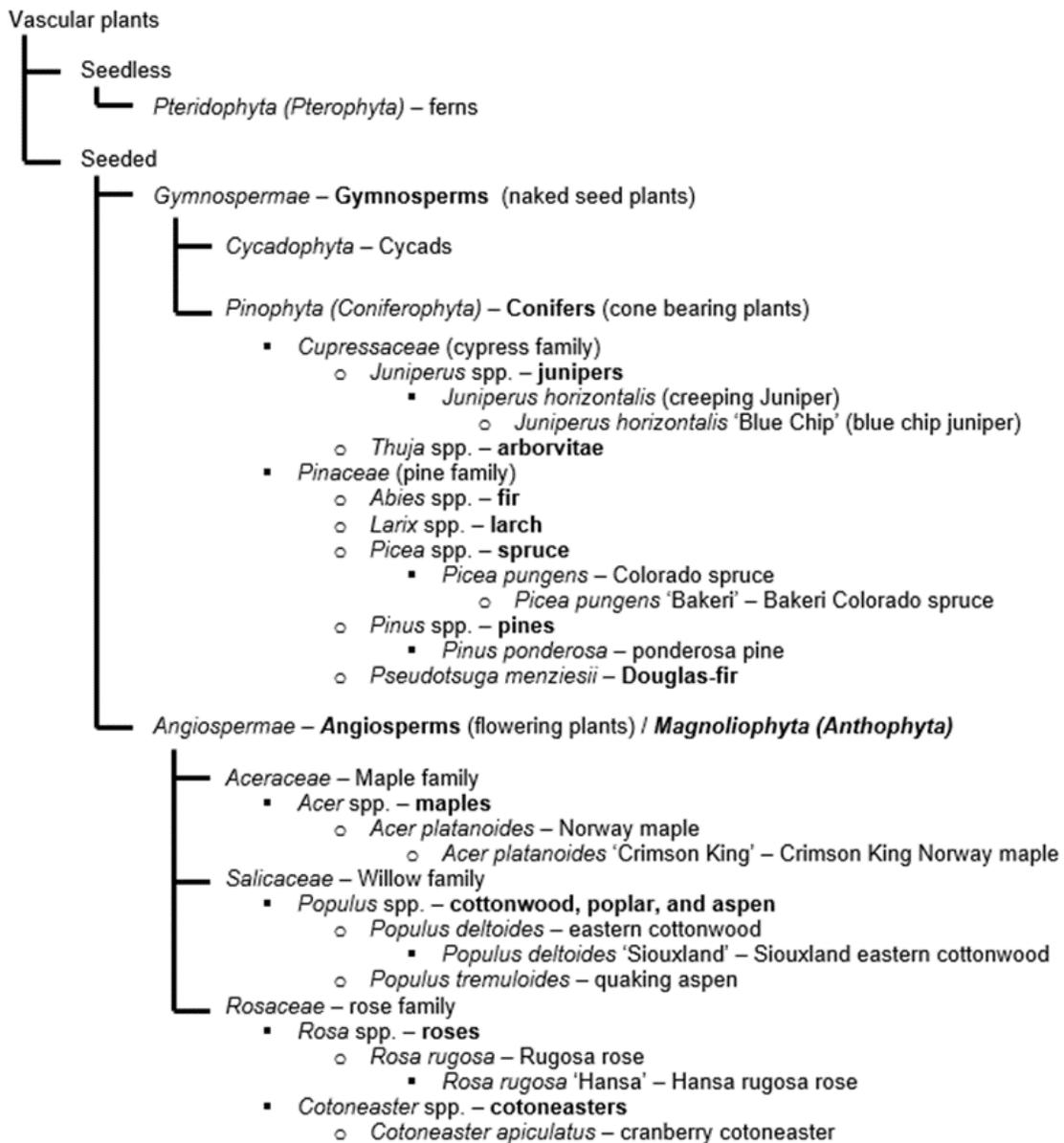
A cultivar ("cultivated variety") is a man-made variety of plant that displays unique characteristics, typically of gardening importance. Some cultivars can be reproduced by seed; others need to be propagated vegetatively because they derive from a single plant. Vegetatively propagated cultivars are genetic clones. Cultivar names are not italicized, rather they are placed in 'single quotes'. Often, a grower will introduce a trademarked marketing name for plants that is different from the recognized cultivar name - a marketing name has no taxonomic value. For example, October Glory Red Maple is *Acer rubrum* 'October Glory', whereas the real name of Autumn Blaze® Maple is *Acer* 'Jeffersred'.

It is possible to have a cultivar of a variety. For example, *Cornus florida* var. *rubra* 'Cherokee Chief'. Cultivars of native plants are sometimes called "Nativars".

Examples of Taxonomic Classification chart on next page.

Examples of Taxonomic Classification:

Examples of Taxonomic Classification



Why Are Scientific Names “in Latin”?

When Linnaeus published *Species Plantarum* in 1753, he consistently used and established modern binomial classification. Because Latin was used in Western Europe at that time as the language of state and science, scientific names of plants are Latinized - that is, they take the form of Latin words, while they themselves are not necessarily Latin. (Even Linnaeus' own name is Latinized, from the Swedish Karl von Linne). Today, Linnaeus' system continues to provide consistent naming across the globe, allowing scientists from anywhere, speaking any language, to communicate with one another with confidence.

Pronouncing Scientific Names

Botanic names are universal in **spelling** (that is, each plant has a single genus and specific epithet, **spelled the same** worldwide). By using botanic names, plants can be positively identified from over 380,000 known plant species.

However, pronunciation of scientific names is not universal and will vary based on the local language. (You say 'toe-may-toe' and I say 'toe-mah-toe'.) Based on the native language and local dialect of the user, scientific names sound rather different in various countries.

Here are a few basic guidelines for American English:

- Botanic names, like Latin, are entirely phonetic. Silent letters are rare and occur only in names derived from languages other than Latin (e.g. Greek) or when a botanic name is based on a person's name. In general, what you see is what you say.
- Consonants are pronounced as in English. The letters 'c' and 'g' are normally hard in front of the vowels 'a', 'o' and 'u'. When in front of 'i' and 'e', the sound can be soft in American parlance (think "circle" and "gentle").
- The letters "ch" are usually pronounced like "k" because they are usually derived from the Greek letter χ ("chi") in botanic names.
- Vowels are usually long in an accent syllable. For example, *Acer* becomes AY-ser and *Pinus* become PIE-nus.
- Adjacent vowels may be marked with a dieresis or double dot, to indicate that they are to be pronounced separately. For example, the cycad genus *Dioöñ* is pronounced in three syllables: "dye-oh-on", not in two syllables: "dye-oon". The vowel pair "ae" is pronounced as a diphthong (i.e., not separately) as in "Julius Caesar". When in doubt, pronounce vowels separately.
- Examples:
 - *Quercus macrocarpa* (bur oak) – KWER-kus MAC-row-CAR-pah.
 - *Elaeagnus angustifolia* (Russian olive) – Ell-ee-AG-nus an-GUS-tih-FOL-ee-auh.
 - *Ptelea trifoliata* (hoptree/wafer ash) – TEA-lee-ah.
 - try-FOAL-ee-AH-tah (note the Greek-derived "pt").
 - *Kalanchoe pinnata* – KAL-an-COE-ee pin-NAH-ta (note the Greek-derived "ch" and separately pronounced vowels "oe").

Botanic Names Add Meaning

Botanic names often reflect something about the plant's description since the specific epithet is an adjective or noun modifying the genus name. For example:

- **americana** = of America – *Fraxinus americana* (white ash).
- **-ensis** = from a particular area (e.g. *texensis* for "from Texas") – *Clematis texensis* (scarlet leatherflower)
- **baccata** = berry bearing – *Taxus baccata* (common yew).
- **micro** = little, small – *Antennaria microphylla* (littleleaf pussytoes).
- **officinalis** = medicinal – *Rosmarinus officinalis* (rosemary).
- **repens** = creeping, crawling – *Berberis repens* (creeping Oregon grape).
- **undulata** = wavy – *Quercus undulata* (wavyleaf oak).
- **variegatus** = variegated – *Miscanthus sinensis* 'Variegatus' (variegated maiden grass).
- **vulgaris** = common – *Syringa vulgaris* (common purple lilac).
- **alba** = white – *Quercus alba* (white oak).
- **niger** = black – *Pinus nigra* (black pine).
- **rubra** = red – *Acer rubrum* (red maple), *Quercus rubra* (red oak).

- *sanguineus* = blood-red – *Geranium sanguineum*.

Common Names

In contrast to scientific names, common names are local in use rather than global. For example, *Liriodendron tulipifera* is known as the tulip tree in the northern USA and as yellow poplar in the south. *Carpinus caroliniana* goes by American hornbeam, blue beech, muscledwood, water beech and ironwood. The European white lily, *Nymphaea alba*, has fifteen English common names, forty-four French common names, one-hundred-five German common names, and eighty-one Dutch common names. More problematic still, the same common name can often refer to more than one plant, for example, “bluebell” refers to several dozen plants across different genera and families. Common names can lead to confusion about taxonomy, (“poison oak” is not an oak at all), and huge numbers of plants do not have common names. **The use of scientific names is absolutely essential to ensure efficient, accurate communication about plants, particularly on a worldwide basis.**

References on Plant Taxonomy

Some suggested sources of scientific names and taxonomic information include the following:

- World Flora Online <http://www.worldfloraonline.org/>.
- Missouri Botanical Garden Angiosperm Phylogeny <http://www.mobot.org/MOBOT/research/APweb/>.
- USDA Plant Data Base at <http://plants.usda.gov/>.
- Published *Florae* of Geographic Areas, for example, *Flora of Colorado* by J. Ackerfield (Brit Press, 2015).

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