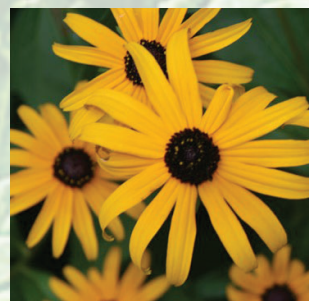
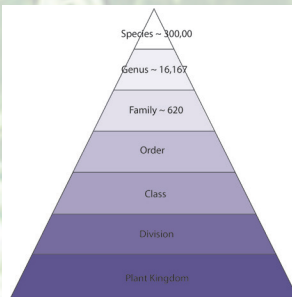




Classification and Naming of Plants

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Classifying organisms based on similarities helps provide order to the thousands of living organisms on earth. By understanding the classification system, gardeners and professional landscape managers can make appropriate decisions for propagating, controlling, or managing landscape plants. Properly naming plants through careful classification allows professionals and gardeners to easily communicate with each other and with others across the world without being confused by common names (Figure 1).

Classification of Plants

Taxonomy is the science of identifying, classifying, and naming organisms. In 1735, Carl Linnaeus created a hierarchical classification system that places all organisms into successively smaller groups that assume organisms within a specific group resemble one another more than organisms within a different group. His system classified plants based on sexual reproductive parts. Other plant classification systems used different morphological characteristics, such as leaf and stem qualities, to classify plants. Linnaeus' basic classification method is still used today. The classification system groups, in order from largest to smallest, are kingdom, phylum or division, class, order, family, genus, and species (Figure 2).

Linnaeus also described a **binomial naming system**. All organisms were given two names — the genus



Figure 1. Common names are frequently used when talking about plants. Unfortunately, confusion occurs when multiple common names are used for the same plant or a common name is used for more than one plant. Geranium is a common example. Most people think of the well-known annual (*Pelargonium X hortum*) that often has large clusters of red, pink or white flowers as geranium (a). But *Geranium* is also the genus for a lesser-known perennial which has smaller, single flowers in shades of pink and purple and different foliage characteristics (b). Using scientific names eliminates the potential confusion that occurs when communicating about plants.

and specific epithet, which together define the species. Before the binomial system was adopted, plants could have very long scientific names that could be easily changed. With the binomial system, there can be several common names for a single plant, but there is only one official scientific Latin name. The scientific binomial naming system is governed by the International Code of Nomenclature.

Systematics is an emerging science that uses today's technology to classify plants based on evolutionary relationships that can be identified through molecular sciences. With this new technology, plant classification

continues to evolve. Plants are occasionally moved from one classification to another or names are slightly changed to reflect new knowledge. These changes can be observed in textbooks.

Kingdoms

Kingdom is the broadest division of organisms. Linnaeus originally divided all organisms into two kingdoms — the Plant Kingdom and the Animal Kingdom. With new knowledge and discovery, this classification system was expanded to five kingdoms

in the 1900s, and more recently into six kingdoms. Organisms are differentiated into kingdoms based on various characteristics including the number of cells (one to multicellular), cell type (complex or simple), presence or absence of cell walls and/or organelles, and the ability to make their own food. The six kingdoms recognized today are described below.

- Plant Kingdom.** Plants are multicellular, have complex cell walls, are primarily immotile, and make their own food. Organisms that make their own food are called autotrophs. More information about the processes plants use to create food can be found in EC1268, *Plant Growth Processes: Transpiration, Photosynthesis, and Respiration*. Without plants, life on earth would not exist. Humans and other heterotrophs (organisms that cannot use atmospheric CO₂ to create complex organic molecules) rely on plants for their food. The plant kingdom is the second largest kingdom and contains an estimated 300,000 plant species. Within the plant kingdom, plants are further categorized into non-vascular and vascular plants. **Non-vascular plants** do not contain water-conducting tissues or true roots, leaves, or stems. Plants with non-vascular systems include mosses and liverworts. **Vascular plant systems** contain water and nutrient conducting tissues called xylem and phloem. Vascular plants have true roots, stems, and leaves (Figure 3).
- Animal Kingdom.** Animals are multicellular, consist of complex cells, and rely on plants for their food. The animal kingdom is the largest kingdom. It has more than a million species, with more than three-fourths of all species being arthropods (primarily insects). In landscapes, wildlife and insects are the primary animals of interest, and many insects found in

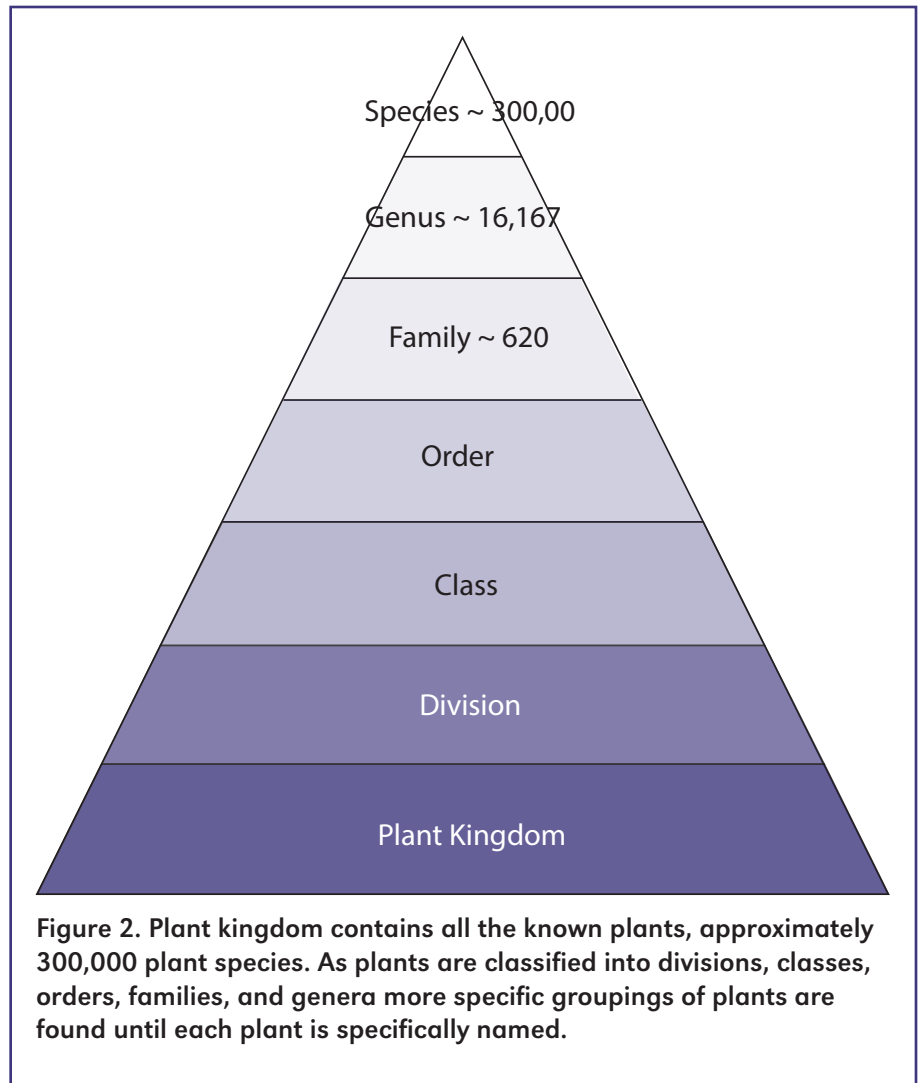


Figure 2. Plant kingdom contains all the known plants, approximately 300,000 plant species. As plants are classified into divisions, classes, orders, families, and genera more specific groupings of plants are found until each plant is specifically named.

landscapes are beneficial because of their pollination or predatory activities. For more detailed information about insect classification see EC1588, *Introduction to Entomology*. EC1260, *Landscape Diagnostic Guide for Problems Affecting Woody Ornamentals and Herbaceous Perennials* provides information on signs and symptoms of common vertebrate pests in home landscapes.

- Fungi Kingdom.** Fungi are primarily multicellular, complex cells, but they do not make their own food. They usually obtain food from decaying organisms. Fungi are often the causal agent of many plant diseases. However, many fungi, including morels, are

considered delicacies. For more detailed information about plant diseases, see EC1273, *Introduction to Plant Diseases*.

- Protista Kingdom.** Most Protista are unicellular, complex cells that acquire nutrients through photosynthesis or by eating other organisms. This kingdom includes a variety of microscopic organisms that vary quite a bit from one another, unlike organisms in the other five kingdoms. Slime molds and algae are in the Protista kingdom.
- Eubacteria Kingdom.** Eubacteria are complex, unicellular organisms. Most bacteria are in this kingdom. Bacteria have various

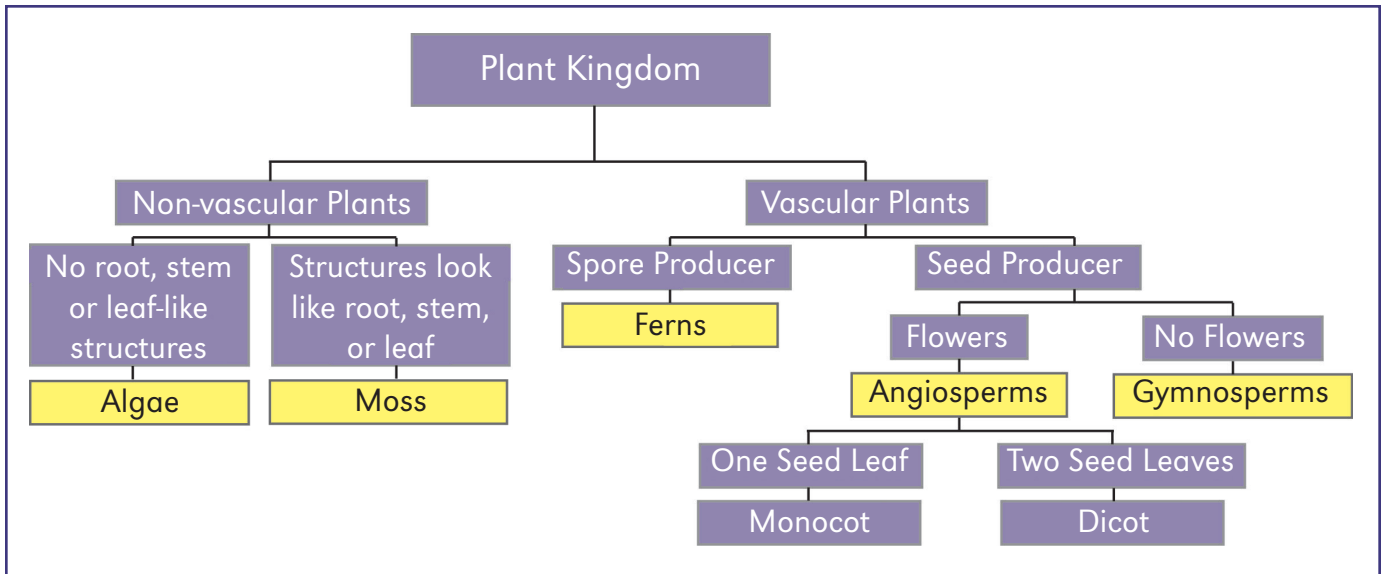


Figure 3. All members of the plant kingdom can be classified based on their morphological differences. Some biologists classify algae in the Protista kingdom, while other plant biologists would classify them as the simplest member of the plant kingdom.

functions, including being causal agents for some plant diseases, biological control agents for some pests, nitrogen fixers in some plant species (legumes), and serving as the primary organic matter decomposers in the soil. Bacteria can live in environments that have (aerobic) or lack (anaerobic) oxygen for respiration.

- **Archaea Kingdom.** Archaea are unicellular organisms found in extreme environments, such as very hot springs or highly acidic or alkaline waters. Archaea is the last kingdom discovered and new knowledge about where these organisms live is still being discovered.

Plant Classification and Naming

All kingdoms are divided into divisions, which are then further divided into classes, orders, families, genera, and species. Each species represents a specific plant. Plants can be further described by using variety,

cultivar, hybrid, and authority notations.

- **Plant Division.** Plant divisions classify plants based on whether they reproduce by spores or seeds. Spore-bearing plants include ferns, club mosses, and horsetail. Seed-bearing plants are divided into gymnosperms and angiosperms.
 - **Gymnosperms** are non-flowering plants that produce naked seeds. Cycads, ginkgo, and conifers, such as pines and spruce, are examples of gymnosperms. There are 700 estimated gymnosperm species in existence today.
 - **Angiosperms** are flowering plants that have their seeds enclosed in a fruit. There are 250,000 estimated angiosperm species in existence today.

- **Plant Class.** The two plant classes under the angiosperm division are valuable classification tools due to differences in their growth characteristics. Angiosperm plants are placed into one of two classes —

monocotyledons or dicotyledons (Figure 4).

- **Monocotyledons (monocots)** include grasses, iris, lilies, orchids, and yuccas. Distinguishing characteristics include one seed leaf, a vascular system in paired bundles throughout the stem, floral parts in multiples of three, and parallel leaf veins. Meristematic regions, areas of plant growth, are low in the plant until vegetative growth changes to reproductive growth.
- **Dicotyledons (dicots)** have distinguishing characteristics including two seed leaves, vascular systems arranged in continuous rings around the inside of the stem, floral parts in multiples of four or five, and netted leaf venation. Plant growth occurs from meristem regions above the ground.

- **Plant Order.** Plant order is not commonly used as a way to distinguish plants for gardeners, but is used to group similar families when learning or teaching about

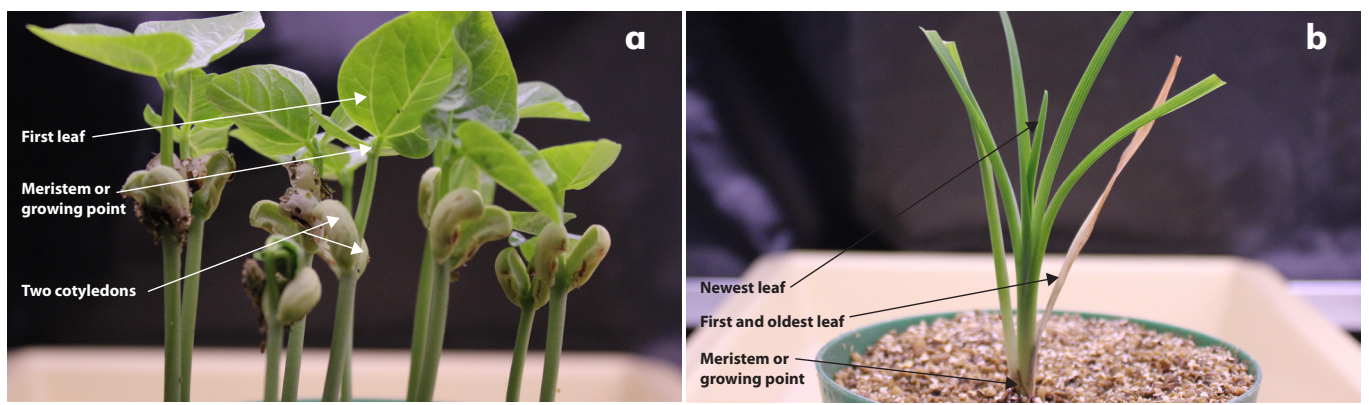


Figure 4. One of the key differences in dicot growth versus monocot growth is the location of the growing point or meristems. In dicots, the first true leaves emerge above the cotyledons and the plant's meristems continue to grow aboveground (a). Monocots grow from meristems low in the plant, near the soil surface, until the plant moves from vegetative growth to reproductive (flowering) growth. Understanding where the growing point is located is important for making management decisions, such as where to prune and how low to mow.



Figure 5. Plants are grouped into families because of similar morphological characteristics. Even with vastly different visual appearances, the presence of legumes on plants easily places them into Fabaceae family; blue false indigo has round legumes; Kentucky coffeetree has thick, leathery legumes; and Illinois bundleflower has ball-like clusters of small, wavy legumes.

plants. Most plant order names end in “-ales,” such as Rosales which has 24 families.

- **Plant Family.** Plants in the same family have similar flower, fruit, and seed structures. Most families in the plant kingdom are angiosperms. The family name is often the first level of plant classification discussed when talking about specific plants, as pest problems and management practices within a family may be similar. The three largest plant families are Asteraceae (sunflower family), Orchidaceae (orchid family), and Fabaceae (bean family) with an estimated 24,000, 20,000, and 18,000 plants within each. Family names always end in “-aceae” (Figure 5).
 - **Genus.** Plants within a family that have more characteristics in common with one another than other plants of the same family are placed in a genus. The genus name is the first part of the scientific or Latin name for a specific plant. The first letter of the genus name is always capitalized and the word is always italicized or underlined, as in *Quercus* or Quercus. *Quercus* is the oak genus. There are thousands of genera (plural of genus) in the plant kingdom.
 - **Specific epithet.** Specific epithet is the second part of the scientific name. The specific epithet may describe a plant characteristic, the location where it was found, or the person who discovered it. For example, *repens* means creeping and is the specific epithet for many plants that have a creeping growth habit. The specific epithet may be used with any number of different genera names, as in *Tilia americana* or *Fraxinus americana*. It is never used without

a genus name preceding it. The specific epithet is always written in lowercase, even if the name is a proper noun commemorating a person or place that would normally be capitalized, and is either underlined or italicized.

- **Species.** Species is the name of a specific plant. The genus and specific epithet are combined to name the species. When related species in a particular genus are listed, they can be written as *Tilia cordata*, *T. americana*, and *T. tomentosa*, with the genus spelled out for only the first item in the list. If the species is unknown, the plant can be written as *Tilia sp.* or *Tilia spp.* for multiple species.

Some plants are further distinguished through the use of variety, cultivar, hybrid, or authority designations. These items are added after the specific epithet.

- **Variety.** Variety is used to subdivide a species and is written as the third name in a species designation. Varieties are naturally occurring variations that have inheritable differences from the straight species. For example, *Gleditsia triacanthos*, common honeylocust, contains branched thorns and is not used very often in the landscape industry. Conversely, *Gleditsia triacanthos* var. *inermis*, a thornless honeylocust, is used quite often. Subspecies (ssp.) is sometimes used instead of variety, but the distinction between these terms is not always clear. Subspecies may be used when a plant is geographically isolated. Varieties should either be underlined or italicized. The abbreviation var. is not italicized or underlined.

- **Cultivars.** Cultivar designates a cultivated variety. Botanical varieties are naturally occurring; cultivars are purposely bred and propagated. Although some cultivars can be propagated by seed, asexual reproduction (divisions, grafting, tissue culture) should be used with cultivars to ensure offspring that are true to type. For cultivars of annual plants (such as tomatoes, marigolds, and petunias), sexual reproduction is controlled so that the desired seed is produced. Cultivars are always capitalized and indicated by putting a single quotation mark around the name or by abbreviating it as cv. Both of the following are correct designations of a cultivar: *Acer platanoides* ‘Crimson King’ or *Acer platanoides* cv. *Crimson King* (Figure 6).
- **Hybrids.** Hybrids are typically crosses between two varieties, species, or two distinct parent lines. A hybrid is identified by placing an “×” before the specific epithet, as in *Viburnum ×burkwoodii*. *Viburnum ×burkwoodii* can also be written as *Viburnum carlesii* × *Viburnum utile* to show parentage. The “×” is not italicized.
- **Authority.** The authority is used in some references to indicate the first person who described the species. The authority follows the species name and is usually abbreviated, such as *Quercus rubra* L. The “L.” stands for Carl Linnaeus.

Knowing how to classify and name plants in a landscape is important for successful plant management and placement in landscapes. Some plants are known for quick growth and weak wood (*Populus* genus), high potential for diseases (Rosaceae family),

preferred growing conditions (*Salix* in moist conditions), or brilliant fall color (*Acer* genus). Knowing the name of specific plants will help gardeners and landscape managers identify those general characteristics and become better managers of the landscape.

Summary

All organisms are classified into one of six kingdoms. The plant kingdom, the second largest kingdom, contains an estimated 300,000 species. Most of the plant species found in managed landscapes are classified as angiosperms or plants that have true flowers. Naming of plants is done in a systematic method to allow professionals and gardeners to easily communicate with each other and with others across the world without being confused by common names.

Additional information

Detailed information about plant classification can be found at the two websites listed below.

The Plant List, <http://www.theplantlist.org>.

USDA Plants, <http://plants.usda.gov>.

Asteraceae → First letter capitalized
Family Name NOT italicized

Rudbeckia → First letter capitalized
Genus Italicized

fulgida → All letters lowercase
Specific Epithet Italicized

Genus + Specific Epithet = Species

var. *sullivantii* → All letters lowercase
Variety var. NOT italicized
Other letters italicized

'Goldsturm' → First letter capitalized
Cultivar NOT italicized
In single quotes

***Rudbeckia fulgida* var. *sullivantii* 'Goldsturm'**

Common Name: Goldsturm rudbeckia



Figure 6. Landscape management and design often focus on classifying plants from the family level down to the specific plant name. Effective communication relies on following the proper writing format for plant names.

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