Humans are born taxonomists. We instinctively classify nearly everything in our lives. For instance, we divide music into classical, rock, jazz, etc. We even divide it hierarchically: rock may be pop, heavy metal, or hip-hop. We do this because we are so overwhelmed by the vast array of information bombarding us that we must subdivide it to understand it. We also have an innate need to arrange information so that we can better communicate.

For the same reasons, we classify plants. Early humans (and most modern ones) classified plants by their uses. Some might be used as medicines to treat stomach ailments or headaches, some to season soups, others to build structures or to soften the lines of foundations. Plants can also be classified by their relationships to each other. In the past this has been based on the morphology, or forms of the various plant parts. While this is still the case, classifications are increasingly being formed by genetic analysis of DNA. For the nonscientist, however, observation and knowledge of plant morphology are the common tools used for plant identification.

Learning to identify the plants around you can be fun—as you take a walk you can greet plants as old friends and impress your family with your knowledge of the natural world. Knowing the species of plants growing in your garden or larger environment is essential to understanding their cultural needs. Two species in the same family or genus may have very different growth requirements and if you do not use the appropriate cultural techniques the plant might die. Using the basic information presented here you will be able to understand scientific names and begin accumulating the terminology needed.

**Nomenclature**

Nomenclature is the system used in the naming of plants. While scientific names may seem confusing at first, these names provide a lot of information about plants; common names in English, meanwhile, offer an easy way to communicate about plants.

**Common names**

Most species have “common” names. These names usually have been given to the plants to describe their appearance or use. So, for instance, the spiny-stemmed native *Oplopanax horridus* becomes the “devil’s walking stick” or “devil’s club” and *Oemleria cerasiformis* is called “Indian plum” for its small edible fruits used by Native Americans. Common names are preferred by some people because they are generally easy to pronounce and their descriptive nature makes them easy to remember. However, caution is advised when using them since the same species may be known by several common names and many different species may be categorized under the same common name. For instance, *Chamaecyparis lawsoniana* is known as both Port Orford cedar and Lawson’s cypress. However,
it is neither a cedar (in the genus *Cedrus*) nor a cypress (in the genus *Cupressus*). “Red cedar” is a name given to *Juniperus virginiana* in eastern North America and to *Thuja plicata* in the West (note that neither is a true cedar!). Therefore, common names can be very misleading and are generally best used in combination with a scientific name.

Unlike scientific names, common names generally are not capitalized unless they refer to a proper noun, such as a person or place. Some prefer to capitalize them to call attention to them and distinguish the common name as something special, but doing so is not the standard.

**Hierarchy of scientific names**

Scientific names, sometimes incorrectly called “Latin names” (while many are based on Latin or are Latinized, many are of other origins such as Greek), are the preferred way to communicate about plants. Scientific names are preferred because each form gets a unique name agreed upon by scientists. These names convey information about each plant’s relationship to other species, as well as its unique attributes. Based on these relationships, scientists place each species in a hierarchy. Examples of such hierarchies are in Table 1.

The endings of these scientific names indicate which level the name represents. Families always end in “aceae,” which is pronounced as if spelling out the word “ace.” There are a few families that also have another name that ends in “ae.” An example is the sunflower family, the Asteraceae, which has an older name of Compositae. In these cases, both names are correct, but the more modern ending of “aceae” is generally preferred.

The genus and species together are referred to as a binomial. This binomial system was developed by a Swedish doctor named Carl von Linné. As you might expect from someone who developed this system, he gave himself a “Latin name” by which he is better known: Carolus Linnaeus. Linnaeus is considered to be the father of the naming system of plants and animals which we continue to use to this day. Prior to his work, names were a long string of descriptive Latin terms—pretty unwieldy! Linnaeus published *Species Plantarum* on May 1, 1753; since then all species have been given binomial names and placed in a hierarchy.

There are certain rules for crafting scientific names. Note that the “genus” and “species” of each organism are always either italicized or underlined. There are some who will also do this for the family, but that is unusual and optional. Genus is always capitalized and species is usually not capitalized, although it may be if the name reflects a proper noun such as a person or place. If a genus has already been referred to in a paper, it

<table>
<thead>
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<th>Table 1</th>
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<tr>
<td><strong>Hierarchy of scientific names</strong></td>
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<td>Common name: western red cedar</td>
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<td>Division (Phylum)</td>
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<th>Common name: tomato</th>
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<tr>
<td>Kingdom</td>
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<td>Division (Phylum)</td>
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| Species | *lycopersicum*

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1. Phylum is the equivalent name used in classifying animals; it is not generally used for plant classification.
2. The plural of genus is genera.
may be abbreviated thereafter to the first initial of the genus followed by the species name. Thus our earlier example, *Thuja plicata*, would be written as *T. plicata* in its next mention.

Occasionally, you may find a name or initials following the species name. These refer to the person or persons who first described the species and they help us maintain a connection to the original description. Linnaeus described many species for the first time, so "L." is commonly found, as in *Hypericum perforatum L.* If there is an initial or name in parentheses, followed by another initial or name, it means that the person represented in the parentheses named an earlier synonym and the later initial represents the person who gave it the current name. These names and initials must be used in formal publications, but do not need to be included in more casual communications.

Sometimes you will also encounter varieties, subspecies, hybrids and cultivars. Varieties and subspecies are variations of the species that are found in nature and are essentially interchangeable terms. The name of the variety or subspecies must always be preceded by var., subsp., or sp.—whichever is appropriate. Neglecting to precede the name with one of these creates a trinomial and although this is appropriate for animal taxonomy, it is not for plants. Examples include *Pseudotsuga menziesii* var. *glauca*, *Asplenium trichomanes* subsp. *trichomanes*, and *Viburnum plicatum* var. *tomentosum*. If there is formal recognition of a taxonomic level below species, but not including cultivars, the names are referred to as infraspecific. Note that infraspecific names are italicized while var. and subsp. are not.1

Plants have fairly open development systems and it is not uncommon for hybrids of two different species to be produced. These hybrids are usually produced by two species in the same genus. When a hybrid is known to be a hybrid between two species, it is written with an "x" before the species name, such as *Photinia x fraseri*. Less commonly, there may be a hybrid between two genera, such as in the Leyland cypress, *x Cupressocyparis leylandii*.

Cultivars are short for cultivated variety. Cultivars may be selections of wild forms that are propagated for commercial use, or they may have been bred to have special colors, forms, or other characteristics. According to the International Code of Nomenclature of Cultivated Plants, all cultivars named since 1959 have to have "fancy" names in modern languages, such as *Kalmia latifolia* `Olympic Fire’ or *Rhododendron* `Elizabeth.'

In the past, however, the cultivar names could be Latin, such as *Picea pungens* ‘Pendula.’ Note that cultivar names are not italicized. Alternatively to their being denoted with single quotation marks, these names may instead be preceded by cv. as in *Kalmia latifolia* cv. *Olympic Fire*, but should not have both cv. and quotation marks.

**What do the names mean?**

While it may seem that scientific names are harder to remember than common names, if you understand a little Greek and Latin you will realize that many of them are just as descriptive. For instance, *Juniperus horizontalis* means that it is a juniper with a horizontal growth form, *Pinus albicaulis* is a pine with a white stem or trunk, while *Silene acaulis* is a campion whose flowers have no stem.

Some species names reflect the first place that a species was found and described. Such names end in "ensis," such as *Picea sitchensis* (Sitka spruce), which was first found in Sitka, Alaska. This can give you an idea of what conditions the species prefers for growth. Many species names are intended to honor an individual. In the Pacific Northwest we have several species with the name "douglasii," honoring David Douglas, the early and brilliant British plant explorer in this region. Examples of Douglas-inspired names include *Spiraea douglasii* (hardhack), *Brodiaea douglasii* (wild hyacinth), and *Olsynium douglasii* (Douglas blue-eyed grass).

**Why do names keep changing?**

One of the greatest frustrations that people have with scientific names is that many seem to keep changing! No sooner have you mastered a name than you are told the species has a new name. Name changes are made for many reasons, but it is generally because systematists (scientists who study evolutionary relationships among plants) have found that either the old name does not accurately reflect plant relationships or an older name is found to have greater validity than a newer name. For example, the Alaskan yellow cypress, *Chamaecyparis nootkatensis*, was recently reclassified to *Xanthocyparis nootkatensis*. Originally it was placed in the genus *Cupressus* (it crosses with *Cupressus macrocarpa* to form the hybrid *x Cupressocyparis leylandii*), but was later found to have a greater affinity with *Chamaecyparis* and was transferred into that genus. In 2001, a new species was discovered in Vietnam and given the name *Xanthocyparis vietnamensis*. The Alaskan yellow cypress was then found to be more closely related to it, hence the changes in genera.

Another vexing example is the common weed, Himalayan blackberry. Older texts list it as *Rubus procerus*. This name is not valid not only because it is not the

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1 Occasionally you will see reference to a “forma,” which is usually a minor variation like a slight change in flower color. Forms are rarely used today and are noted with an “f.” before the forma name.
species found here, but because that name is a synonym of the name of *R. praecox*, which was published first. In nomenclature, the name attached to the first publication of a species description in a scientific publication is considered to be the correct one. More current texts refer to it as *R. discolor*, which is also incorrect because that taxon is a really a synonym of *R. ulmifolius*, another species. Furthermore, according to botanists, all of these names are incorrect because these plants are not the species found in Washington! Instead, our invader is *R. armeniacus*. On top of everything else, the common name is incorrect too—our invaders are from Armenia, not the Himalayas!

While all these changes may seem trivial at best, or inconvenient at worst, it is important to recognize that they are done to help people understand the relationships among plant species and to help us communicate more accurately about them.

**The big picture**

In the previous examples of hierarchy, the Kingdom for both is listed as Plantae, indicating the primary separation in biology. The division of *Thuja plicata* is given as Coniferophyta, while that of *Solanum* is Magnoliophyta. Coniferophyta are nonflowering, cone-bearing plants including pines, spruces, cedars, and cypress; Magnoliophyta are the flower-bearing species—everything from pansies to oaks.

The next level, and one that is critical to learn to distinguish, is the family. Families are groups of genera that are closely related and share core characteristics. These might be important characteristics of fruit type (e.g., the legume family, Fabaceae, is distinguished by pod-like fruits) or flower type (e.g., the sunflower family, Asteraceae, has distinctive *inflorescences* with two types of flowers, ray and disk). Sometimes, the traits used to distinguish families may be less obvious ones, such as chemistry.

**Monocots & dicots**

Flowering plants can be further divided into monocotyledons and dicotyledons, more commonly referred to as monocots and dicots. Cotyledons are the small leaves that emerge first from seeds. Monocotyledonous plants have just one seed leaf and are primarily herbaceous (not woody). In addition, they have parallel *venation* in the leaves and flower parts produced in multiples of three (Figure 1). Dicotyledonous plants have two seed leaves, can be herbaceous or woody, have variable leaf venation, and usually have flower parts in groups of fours and fives (Figure 2). Monocots include the grass, lily, and iris families. Dicots include all other flowering plants, from small herbaceous plants like violets to large trees like maples.

**Using keys**

It can be very hard to identify a plant if you have no idea what it is. Botanists have therefore created a tool called a *dichotomous key*, which is a series of paired plant descriptions, to aid in the identification process. You choose a key most appropriate to the characteristics of your sample and move down through the paired choices, which become increasingly specific until you arrive at an identity, which you then verify by reading a complete description. Keying is not difficult with most keys, but it does require knowledge of plant terminology and often a microscope or hand lens. Keying is an acquired skill and while frustrating at first, it will become easier and more satisfying.
with practice. There are many good keys, both in print and on-line, including those listed on the Oregon State University landscape plant materials web page, located at http://oregonstate.edu/deptld/plants/.

While systematists today principally use DNA to study plant relationships, we still describe and recognize plants based on their morphology, or form. The wide variety of plant forms means that there is a bewildering array of terms used. These terms are used in dichotomous keys, and understanding them can help you key out an unknown species. Some of the more common morphological terms are below, but for a complete description of terms, consult Harris and Harris (2001).

**Leaves**

Morphologically, a leaf seems like a straightforward thing, but it is infinite in its variation. Some of the terms you will need to know are categorized and illustrated in Figures 3 through 10:

**Arrangement on stems**
- **Alternate**—leaves alternate their positions on the stem (Figure 3a)
- **Opposite**—leaves originate opposite each other (Figure 3b)
- **Whorled**—three or more leaves originate from the same position on the stem (Figure 3c)

**Form**
- **Simple**—a leaf blade that is not divided, though the margins may be serrated (Figure 4)
- **Compound**—a leaf that is divided into smaller leaflets. There are two types of compound leaves:
  - **pinnately** compound, with all leaflets originating from a main stem (Figure 5a)
  - **palmately** compound, with leaflets originating from a common point (Figure 5b)

**Anatomy**
- **Blade**—the broad part of a leaf (Figure 6a)
- **Apex**—the tip of the leaf; this may be very narrow or broad (Figure 6b)
- **Base**—the part of the leaf that connects to the petiole (Figure 6c)
- **Petiole**—the small stem that attaches the leaf to the stem (Figure 6d)
- **Margin**—the edges of the leaves; these may be smooth (entire) or serrated (Figure 6e)

**Shape**
- **Cordate**—heart-shaped, with a notch at the base (Figure 7a)
- **Elliptic**—a narrow oval, with the broadest part in the middle (Figure 7b)
- **Lanceolate**—longer than wide, with the widest point in the lower 1/3 of the blade (Figure 7c)
- **Obovate**—shaped like an egg, but with the broadest part of the leaf in the upper 1/3 of the blade (Figure 7d)
- **Ovate**—egg-shaped (ova) with the broadest part of the leaf in the lower 1/3 of the blade (Figure 7e)
- **Palmate**—lobes radiating out from a common point, like fingers from a palm (Figure 7f)
Apex

**Acute**—tapering to a narrow point, with more or less straight sides (Figure 8a)

**Acuminate**—gradually tapering to a sharp point and forming concave sides along the tip (Figure 8b)

**Emarginate**—with a notch at the end (Figure 8c)

**Obtuse**—rounded, with the sides approaching the apex at an angle greater than 90 degrees (Figure 8d)

Base

**Attenuate**—gradually tapering at the base (Figure 9a)

**Cuneate**—wedge-shaped, forming a triangular base (Figure 9b)

**Cordate**—heart-shaped, with lobes on either side of the petiole (Figure 9c)

**Decurrent**—extended downward from the point of insertion (Figure 9d)

**Sheathing**—continuing down to form a sheath around the stem (Figure 9e)

Margin

**Entire**—completely smooth (Figure 10a)

**Serrate**—toothed, with the ends of the teeth pointing to the apex of the leaf (Figure 10b)

**Crenate**—toothed, with rounded teeth (Figure 10c)

**Dentate**—toothed, with the ends of the teeth pointing outward rather than forward (Figure 10d)

**Lobed**—rounded divisions that cut less than ½ way to the base or midvein (Figure 10e)

Flowers and fruits

Flowers are intended for plant reproduction. Their fragrance and colorful appearance may please us, but plants evolved such traits to attract **pollinators**, not humans. Unlike leaves, flowers do not change in traits such as size or color in response to the environment, making them important to taxonomy.
Not all flowers are pollinated by insects and other animals; many are pollinated by wind or water. Such flowers usually lack petals and scent. In fact, they may be minimal and contain only reproductive parts.

Wind-pollinated species are often unisexual, which means that they have only male or only female parts in each flower. If both male (staminate) and female (pistillate) unisexual flowers are housed on the same plant it is called monoecious, which literally means “one house.”

If male flowers are on a different plant from the female flowers, it is called dioecious, or two houses. English holly (Ilex aquifolium) is an example of a dioecious species—fruit is only formed on the female plants.

Most pine trees are monoecious; they have the woody female cones and on the same plant there are small male pollen cones. Flowers with petals and scent may also be monoecious or dioecious, but it is less common than among wind-pollinated species. If flowers have both male and female parts, they are called perfect or complete.

**Parts of a flower**

- **Receptacle**—the “platform” that all the other flower parts sit upon (Figure 11a)
- **Sepals**—leaf-like structures that surround and protect the flower bud; collectively called the calyx (Figure 11b)
- **Petals**—leaf-like, often colorful structures that surround the reproductive parts of the flower and serve to attract pollinators, collectively called the corolla (Figure 11c)
- **Stamens**—the pollen-bearing male structures of the flower, consisting of the filament and anther (Figure 11d)
- **Pistil**—the female part of the flower, consisting of the stigma, style, and ovary (Figure 11e)
- **Ovary**—the basal part of the pistil that contains the ovules.
The ovary becomes the fruit (Figure 11f)

**Ovules**—enclosed in the ovary, the “egg cells” which mature after pollination to become the seeds (Figure 11g)

**Inflorescences**

Flowers may be solitary, or may be grouped into inflorescences at the end of a branch or at leaf axils. A flower in an inflorescence is called a floret. Common types of inflorescences include:

- **Cyme**—the terminal flower opens first, then others open below (Figure 12a)
- **Raceme**—leaves on the flowering stem are reduced to bracts under the flowers (Figure 12b)
- **Corymb**—a flat-topped raceme (Figure 12c)
- **Umbel**—a flat-topped raceme on a very short stem, so that all secondary stems appear to branch from a single point, typical of the carrot family (Figure 12d)
- **Catkin**—a dense spike or raceme of apetalous unisexual flowers, found in the willow and birch families, also called an ament (Figure 12e)

**Types of fruit**

Fruits are matured ovaries of flowers and the seeds are fertilized ovules. Some things that we call fruits, like the fleshy parts of strawberries or apple, are actually other parts of the flower, such as the receptacle.

Fruits may be divided into dry fruits (usually wind, water, and gravity dispersed) and those with have fleshy coverings over the seeds. The latter are usually attractive to animals so that they will be consumed and therefore dispersed.

Terminology of some common fruit is described below:

- **Simple fruit**—fruit derived from a single pistil; most fruits are simple fruits (Figure 13a)
Aggregate fruit—fruit derived from multiple pistils of the same flower (e.g., raspberries [Rubus spp.], Magnolia spp.) (Figure 13b)
Multiple fruit—fruit derived from multiple flowers (e.g., pineapple [Ananas comosus]) (Figure 13c)
Dehiscent—a fruit that remains attached to the plant while shedding its seeds
Indehiscent—a fruit that retains its seeds after it has fallen from the plant
Berry—a fleshy fruit derived from a single pistil, but with several seeds (e.g., tomato, grape [Vitis spp.]) (Figure 13d)
Drupe—a fleshy fruit with a single hard seed inside (e.g., cherry [Prunus spp.], peach [Prunus spp.]) (Figure 13e)
Pome—a fleshy fruit derived from a compound ovary, consisting of a modified floral tube surrounding a core (e.g., apple [Malus spp.], pear [Pyrus spp.]) (Figure 13f)
Follicle—a dry dehiscent fruit with many seeds, opening along one side (e.g., milkweed [Asclepias spp.], columbine [Aquilegia spp.]) (Figure 13g)
Capsule—a dry dehiscent fruit composed of more than one pistil that releases seeds through a variety of opening types (e.g., Rhododendron spp., fireweed [Chamerion angustifolium]) (Figure 13h)
Legume—a dry dehiscent fruit usually opening along two lines, associated with the Fabaceae (e.g., pea [Pisum spp.], black locust [Robinia pseudoacacia]) (Figure 13i)
Achene—a small dry indehiscent fruit with a single chamber containing a single seed (e.g., sunflower [Helianthus spp.], the small seeds on the outside of a strawberry [Fragaria spp.]) (Figure 13j)
Samara—a dry indehiscent winged fruit (e.g., maple [Acer spp.], true ash trees [Fraxinus spp.]) (Figure 13k)
Nut—a hard dry indehiscent fruit usually with a single seed (e.g., acorn, hazelnut) (Figure 13l)

Seeds
Seeds are fertilized, mature ovules, composed of a seed coat, which serves to protect the enclosed embryo and endosperm (nutritive tissue that feeds the embryo) (Figure 14). Both gymnosperms (conifers) and angiosperms (flowering plants) have seeds, giving them a huge evolutionary advantage over the more vulnerable spores found in ferns and mosses. Seeds are variable in size, shape, color, and pattern and may be important in some plant classifications. Some small seeds have little endosperm and therefore are short-lived. A seed with a good protective seed coat and lots of endosperm, stored under low temperature and humidity, can last for decades! 

Literature cited
For more information


