

WHAT IS SYSTEMATICS?

Systematics is defined as a science that includes and encompasses traditional **taxonomy**, the description, identification, nomenclature, and classification of organisms and that has as its primary goal the reconstruction of **phylogeny**, or evolutionary history of life. This definition of *systematics* is not novel, but neither is it universal. Others treat taxonomy and systematics as separate but overlapping areas. Plant systematics is studied by acquiring, analyzing, and synthesizing information about plants and plant parts.

Systematics is founded in the principles of **evolution**, its major premise being that there is one phylogeny of life. The goal of systematists is, to discover that phylogeny.

TAXONOMY

Taxonomy is a major part of systematics that includes four components: **Description, Identification, Nomenclature, and Classification. (DINC.)** The general subjects of study are **taxa** (singular, **taxon**), which are defined as groups of organisms. Ideally, taxa should have a property known as **monophyly** and are traditionally treated at a particular rank. It should be pointed out that the four components of taxonomy are not limited to formal systematic studies but are the foundation of all intellectual endeavors of all fields, in which conceptual entities are described, identified, named, and classified. In fact, the ability to describe, identify, name, and classify things undoubtedly has evolved by natural selection in humans and in other animals as well.

Description is the assignment of features or attributes to a taxon. The features are called **characters**. Two or more forms of a character are **character states**. One example of a character is petal color, for which two character states are yellow and blue. Another character is leaf shape, for which possible character states are elliptic, lanceolate, and ovate. Numerous character and character state

terms are used in plant systematics, both for general plant morphology. The purpose of these descriptive character and character state terms is to use them as tools of communication, for concisely categorizing and delimiting the attributes of a taxon, an organism, or some part of the organism. An accurate and complete listing of these features is one of the major objectives and contributions of taxonomy.

Identification is the process of associating an unknown taxon with a known one, or recognizing that the unknown is new to science and warrants formal description and naming. One generally identifies an unknown by first noting its characteristics, that is, by describing it. Then, these features are compared with those of other taxa to see if they conform. Plant taxa can be identified in many ways. A taxonomic key is perhaps the most utilized of identification devices. Of the different types of taxonomic keys, the most common, used in all Floras, is a dichotomous key. A **dichotomous key** consists of a series of two contrasting statements. Each statement is a **lead**; the pair of leads constitutes a **couplet**.

Nomenclature is the formal naming of taxa according to some standardized system. For plants, algae, and fungi, the rules and regulations for the naming of taxa are provided by the International Code of Botanical Nomenclature. These formal names are known as **scientific names**, which by convention are translated into the Latin language. The fundamental principle of nomenclature is that all taxa may bear *only one scientific name*. Although they may seem difficult to learn at first, scientific names are much preferable to common (vernacular) names. The scientific name of a species traditionally consists of two parts (which are underlined or italicized): the genus name, which is always capitalized, e.g., *Quercus*, plus the specific epithet, which by recent consensus is not capitalized, e.g., *agrifolia*. Thus, the species name for what is commonly

called California live oak is *Quercus agrifolia*. Species names are known as **binomials** (literally meaning two names) and this type of nomenclature is called binomial nomenclature, first formalized in the mid-18th century by Carolus Linnaeus.

Classification is the arrangement of entities (in this case, taxa) into some type of order. The purpose of classification is to provide a system for cataloguing and expressing relationships between these entities. Taxonomists have traditionally agreed upon a method for classifying organisms that utilizes categories called **ranks**. These taxonomic ranks are hierarchical, meaning that each rank is inclusive of all other ranks beneath it. As defined earlier, a **taxon** is a group of organisms typically treated at a given rank. Thus, in the example of Figure 1, Magnoliophyta is a taxon placed at the rank of phylum; Liliopsida is a taxon placed at the rank of class; Areaceae is a taxon placed at the rank of family; etc. Note that taxa of a particular rank generally end in a particular suffix.

There are two major means of arriving at a classification of life: phenetic and phylogenetic. **Phenetic** classification is that based on overall similarities. Most of our everyday classifications are phenetic. For efficiency of organization (e.g., storing and retrieving objects, like nuts and bolts in a hardware store) we group similar objects together and dissimilar objects apart. Many traditional classifications in plant systematics are phenetic, based on noted similarities between and among taxa. **Phylogenetic** classification is that which is based on evolutionary history, or pattern of descent, which may or may not correspond to overall similarity.

Major Taxonomic Ranks Taxa

Kingdom: Plantae

Phylum: (**Division** also acceptable) Magnoliophyta

Class: Liliopsida (Monocots)

Order: Arecales

Family: Arecaceae

Genus: (plural: genera) *Cocos*

Species: (plural: species) *Cocos nucifera*

Figure 1: The primary taxonomic ranks accepted by the International Code of Botanical Nomenclature.