Laboratory 1: Vegetative Morphology

Purpose: The purpose of this lab is to familiarize you with general plant morphology and anatomy and to introduce, or perhaps refresh, some basic terms that are used to describe the vegetative (non-reproductive) features of vascular plants. (Next session we will have a similar lab covering reproductive morphology.) It is not necessary at this point to consider the taxonomy of the specimens you will be examining. Rather, the lab is designed to show you some of the diversity in vascular plant structure and to discuss some of the terminology that plant systematists use to describe that diversity. Despite all of the variation in form, it is important to remember that plants are composed of only three organs: leaves, stems and roots. All of the structural diversity that exists among vascular plants is based on modifications of each of these three organs.

Procedure: As you examine the material on display be sure to note the differences in the vegetative portions of the shoot of different specimens. Additionally, you should be able to identify and briefly characterize those structures/features in BOLD print. This lab focuses on leaves, but you should also pay attention to the overall stem morphology as well.

Examine each of the specimens on display for the features discussed below. Be sure to note whether the leaves are simple or compound, and if compound if they are pinnately or palmately compound. Also note their shape and how they are inserted along the stem.

Tips: At this point you do not need to memorize the plant names, as we are only concerned with the general morphology of plants as a whole. Take the time to draw examples of the features in bold below – even if you do not consider yourself a good artist, drawing is probably the best way to learn the material in this class. Not all of the terms are defined for you below, so be sure to be clear on their definitions before you leave lab. See Chapter 9 (p.347-407) in Simpson for additional assistance.

LEAVES AND NODES

Basic Structure - The leaves are typically the major photosynthetic organ in the majority of vascular plants and, in most cases, can be divided into two distinct regions: the blade or lamina (the expanded portion of the leaf), and the petiole (the stalk which attaches the leaf to the stem). The blade can also be divided into the leaf base (towards the petiole) and the apex (away from the petiole). If a petiole is absent (i.e. the blade is attached directly to the stem) the leaf is said to be sessile on the stem. If a petiole is present, the leaf is said to be petiolate.

Division - Simple leaves are those in which there is only a single blade. When more than one blade is present the leaf is compound and each blade is called a leaflet or pinna (pl. pinnae). These leaflets can arise from a common point at the tip of the petiole (i.e. a palmately compound leaf) or they can be arranged along an extension of the petiole, called the rachis, in a pinnate fashion (i.e. pinnately compound leaf). Additionally, pinnately compound leaves can be once, twice or even three times pinnately-compound (see fern specimen on display). Leaflets can be differentiated from leaves by the presence of an axillary bud in the axil formed where a true leaf meets the stem. Axillary buds are absent from the axils where leaflets are joined to a rachis.
Vasculature - Leaves, or leaflets as the case may be, also have characteristic arrangements of vascular tissue, the so-called "veins" of the leaf. Most dicotyledonous plants (dicots) have either a pinnate venation in which secondary or lateral veins arise from a primary vein or midvein running the length of the leaf or a palmate venation in which several (or more) major veins originate from a common point. A third type of venation pattern, parallel venation, is typical of many monocotyledonous plants (monocots) such as grasses.

Morphology - Leaves also exhibit differences in the overall shape of the blade ranging from scale or needle-like (as in many conifers) to linear to lanceolate to elliptic and orbicular. The leaf blade base can be acute, obtuse, rounded, cordate or peltate. Yet another important feature of leaf blades is the type of margin (leaf edge) they possess. If there are no indentations of any kind along the margin the blade is said to be entire. Alternatively, the margin may be variously toothed (i.e. serrate, dentate or crenate). Leaf blades may be pinnately-lobed, such as in many oaks (Quercus), or palmately-lobed as in maples (Acer) or sweetgum (Liquidambar).

Arrangement - Leaves can be inserted along the stem in either an alternate, opposite or whorled fashion. The point at which a leaf (or leaves) attaches to the stem is called a node and the region of the stem between two adjacent nodes is an internode. In many, but not all flowering plants there is oftentimes an additional structure, called a stipule, at each node along the stem. Depending on the particular plant, the stipule may be attached either to the leaf base or directly to the stem. Stipules vary greatly in shape and size and can be minute and deciduous (i.e. falling away) or persistent and enlarged, sometimes to such an extent that they become the major photosynthetic organ. Also associated with each leaf/node is an axillary or lateral bud. These buds may be either exposed (i.e. "naked") or surrounded by two or more bud scales. In addition to lateral buds, there are also terminal buds at the tip of the shoot. Both types of buds are meristematic, that is they contain a region of actively dividing, undifferentiated cells that produce new (primary) growth. In the case of lateral buds, their growth results in new branches (and possibly flowers) being formed.

ROOTS AND UNDERGROUND STEMS

Roots – If the primary root of a plant is dominant, it is called a taproot. A plant with mainly adventitious roots (roots that arise from the stem) that lacks a taproot is said to have a fibrous root system.

Stems – Stems can be modified in many ways, and often serve as underground storage organs. A horizontal underground stem with short internodes and scalelike leaves is called a rhizome (e.g. Zingiber, ginger). A tuber is an underground storage stem with outer buds that usually lacks leaves or scales (e.g. Solanum tuberosum, potato). A stolon (also called a runner) is a stem with long internodes that grows on or just below the ground (e.g. Fragaria, strawberry). A corm is an underground storage stem with scalelike leaves. A bulb is a small underground stem surrounded by thick storage leaves (e.g. Allium, onion).
Leaves

Roots and Underground Stems

A. Tap root
B. Fibrous roots
C. Rhizome
   Adventitious roots
D. Tuber
E. Stolon

from Walters and Keil 1996
Vascular Plant Taxonomy, 4th ed.