Terminology Used in Plant Descriptions

This is a review of terms used in these keys for identifying plants. Terms are also defined in the Glossary; some specialized terms are defined within the family descriptions at the beginning of each family.

Flowers

The foundation of plant taxonomy is the classification of plants according to their floral structure. Plants are most easily identified in this or any other key if they are in flower or fruit. A description of the typical floral structure is included in each family description.

Flowers may include the following parts, from the inside out: *pistil* (or pistils), *stamens*, *petals*, and *sepals* (Fig. *2*). These are attached to the *receptacle*. The stalk which supports the flower is the *pedicel*. When both stamens (containing male gametes) and pistil (containing female gametes) are in the same flower, the flower is *perfect*; when only one of these organs is present, the flower is *imperfect*. If flowers are imperfect but flowers of both sexes (both *staminate* and *pistillate* flowers) are present on one plant, the plant is *monoecious*. When a single sex is present on one plant (*i.e.*, two plants of different sexes are necessary for pollination), the plant is *dioecious*.

A *pistil* consists of an *ovary* containing one or more *ovules* (which develop into seeds), the (often) slender *style*, and the *stigma* or receptive surface at the tip of the style. The pistil is formed from one or more ovule-bearing units known as *carpels*. The number of carpels included in a pistil often can be determined by counting the number of styles and/or stigmas arising from the ovary. The interior of the ovary is often divided into chambers or "cells" known as *locules*. These are noted in family descriptions as, for example, "2-celled". The number of locules is related to the number of carpels, although the loss of internal partitions between adjacent carpels may reduce the number of locules. A flower may have more than one pistil; in such flowers, each pistil consists of a single carpel and each style can be traced to a different ovary.

The position of the ovary with respect to the receptacle is also an important character. The ovary may be above the receptacle, so that the petals and sepals are attached beneath the ovary (Fig. 12); this is a *superior ovary*. When the ovary is enclosed by the floral tissue, so

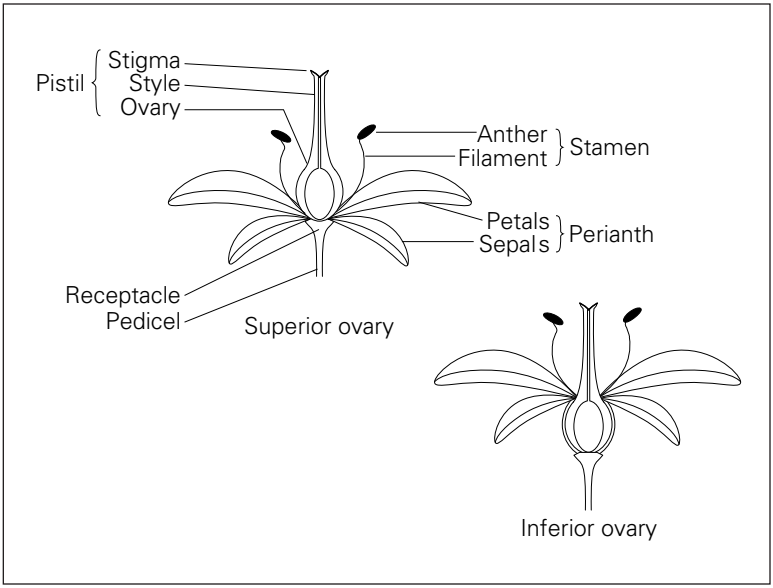

Figure 2: Floral structure

that the petals and sepals are attached at the top of the ovary, it is an *inferior ovary* (Fig. 39).

> These keys have been designed to require a minimum of dissection. However, to determine whether the ovary of a flower is superior or inferior, it may be helpful to use a knife to make a longitudinal cut through the center of the flower. Use a hand lens if necessary.

A *fertile stamen* consists of a slender *filament* and the *anther*, which contains pollen. Some stamens may be *sterile*, meaning that a stamen-like structure exists without a pollen-producing anther. This sterile stamen (or *staminode*) may also be petal-like (*petaloid*) in appearance, *i.e.*, expanded and colored. The fusion of stamen filaments with each other (so that they are *connate*) or the other floral parts can be significant in identification.

The *sepals* and *petals* together are the *perianth* of the flower. The number of sepals (together called the *calyx*) and petals (the *corolla*) is often an important character; a plant description might indicate

"parts in 4s" or that the "calyx and corolla are 4-merous". While the sepals of most plants are green, they may sometimes be petaloid. In some flowers, it is difficult to distinguish sepals from petals, thus the plant description may simply refer to *tepals*. The sepals and petal may be separate (*free*) or more or less fused to one another (*united*). Fusion of parts is noted in family descriptions; if no mention is made, it should be assumed that the individual sepals and petals are separate.

The flower may be subtended by specialized leaves known as *bracts*. In some families, such as the Euphorbiaceae, the bracts may be colored or otherwise prominent and resemble petals (Fig. 26). A tightly organized arrangement of bracts called the *involucre* forms the base of the head of the Compositae and is also present in flowers of some other families. Flowers may be *regular* with all parts of a whorl being the same size and shape. Regular flowers (Figs. 13, 19, 34) are usually radially symmetrical; a cut through more than one direction will produce two similar halves. *Irregular* flowers are most often bilaterally symmetrical, where floral parts are grouped or fused so that a cut through only one plane will produce two equal halves (Figs. 23, 36, 39), or they may be entirely asymmetrical.

Inflorescences

Flowers occur in arrangements which are often characteristic of the plant species. The entire flowering portion of the plant, including flowers, "stems" (pedicels), and bracts, is referred to as the *inflorescence* (Fig. 3). When the flower or inflorescence is at the top or end of the stem, it is *terminal*. When the inflorescence or flower is located in an *axil* (usually subtended by leaves), it is *axillary* (or *lateral*). *Solitary* flowers are often terminal, sometimes on a *scape* arising from a rosette of leaves. Flowers on pedicels along a single unbranched axis, erect or drooping, form a *raceme* (Fig. 23). When pedicels are not present, the flowers are *sessile* and the inflorescence is a *spike*. The basic branched inflorescence is the *panicle*, in which pedicels are located along several branches arising from a central axis. In an *umbel*, all pedicels arise from a central point, with the flowers arranged in a flat plane or a convex rounded cluster (Fig. 14). A *corymb* has a similar appearance, but the pedicels arise at different points along the stem. Both the umbel and corymb may be compound, with different tiers of pedicels within the inflorescence

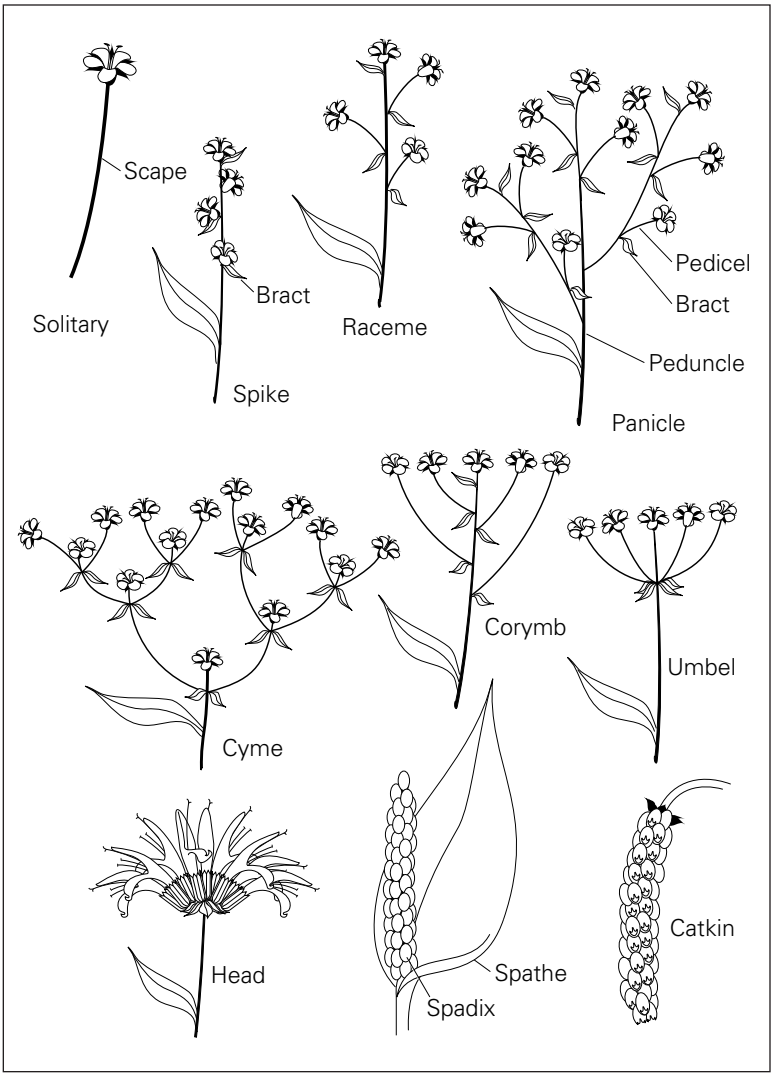

Figure 3: Inflorescence types

(Fig. 28, compound umbel). Combinations of two inflorescence types may occur, such as a panicle of racemes (Fig. 15). The *cyme* may take many forms, but is always characterized by a single central flower which matures before the rest of the inflorescence (Figs. 22,

34). The *head* is composed of flowers tightly arranged on a flat or discoid axis (Fig. 41). The typical inflorescence of the Araceae is the *spadix*, a fleshy spike, subtended by a large bract, the *spathe*. *Catkins* are typical of many woody species; they are spikes or racemes of unisexual flowers.

Fruits

The type of fruit produced is often a key character in plant identification; an ideal specimen includes both flowers and fruits. Fruits are the ripened ovaries of flowers, contain the seeds, and may include accessory structures. Some types of fruit are *dry* at maturity, while others have a *fleshy* fruit wall.

Indehiscent dry fruits do not open to release seeds at maturity. The fruit wall and the seed coat are fused together in the *grain*, the characteristic fruit of the Gramineae. The *achene* is also a small single-seeded fruit, with a dry thin fruit wall closely appressed to the seed coat. Wings or other appendages may be attached to the achene (Fig. 15); a *samara* is a winged achene typical of some woody plants. A *utricle* is a small single-seeded fruit resembling an achene, but with the fruit wall loose from the seed coat. *Nuts* and *nutlets* are dry indehiscent fruits with hard fruit walls. Sometimes there is an involucre attached to the nut, as in the *acorn* (the characteristic fruit of *Quercus* spp., Oaks).

Dehiscent dry fruits open to release seeds. The *capsule* develops from an ovary with more than one carpel, so that internal partitions between locules (“cells”) are often visible. Seeds are released when the capsule opens at the top or sides. A *follicle* forms from one carpel and splits along one seam (Fig. 32). A *legume* is also formed from one carpel but splits along two seams; it is the typical fruit of the Leguminosae. The *silicle* and *silique* each split along both sides, leaving a membranous partition in the middle; they are typical of the Cruciferae (Figs.19, 20). Pieces of the dry fruit wall which separate from one another during dehiscence are called *valves*. A *schizocarp* arises from an ovary where the mature carpels split away from one another, so that each unit (a *mericarp*) resembles an entire indehiscent fruit.

Fleshy fruits are all indehiscent. The *berry* is several-celled (though partitions may not be visible at maturity) and many-seeded. A *drupe*

has a single, usually large seed. A *pome* is typical of some Rosaceae (such as *Malus*, apple), in which the swollen, fleshy receptacle encloses the papery fruit wall. Some plants have multiple fruits which develop from the entire inflorescence.

Leaves

The leaf consists of a *petiole* (usually stalk-like) and an expanded *blade* (Fig. 4). The leaf is attached to the stem at the *node*, while the length of the stem between leaf attachments is the *internode*. Either the petiole or the blade may be modified or missing; the leaves of some plants lack blades and consist only of petioles, flattened or not. *Sessile* leaves only have a blade. In other leaves, the petiole may be flattened to form a

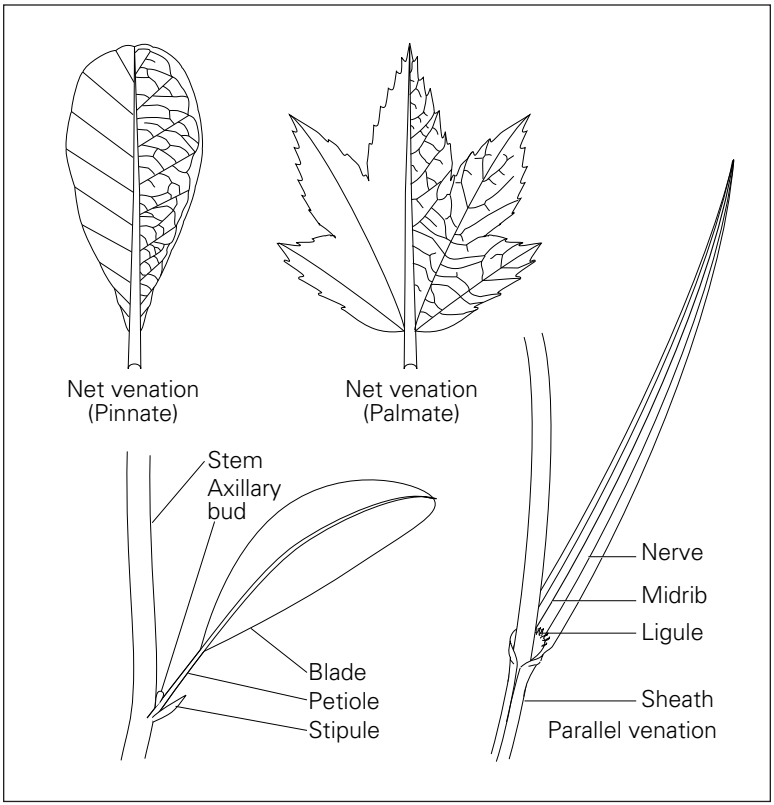

Figure 4: Leaf structure

sheath, which encircles the stem; a *ligule*, a ridge of tissue at the top of the sheath, may be present. Small (usually) leaflike structures, the *stipules*, are often present at each side of the point of leaf attachment. The space described by the angle between the upper side of the leaf attachment and the stem is referred to as the *axil*. The *axillary bud* may eventually expand to produce a branch or a flower.

Venation is an important character for identification (Fig. 4). The central vein (the *midrib*) is usually the most prominent. When other especially prominent veins are visible, they are called *nerves*. In leaves with *net venation*, two patterns of venation are possible. Secondary veins arise in two rows along the midrib in a leaf with *pinnate* venation, while secondary veins arise from a central point near the petiole in *palmate* venation. In leaves with *parallel venation*, all major veins are parallel to the midrib.

Leaf arrangement (Fig. 5) may be *alternate*, in which one leaf is attached at a node, o*pposite*, with a pair of leaves at a node, or *whorled*, with three or more leaves at a node.

Leaves may have an undivided blade (a *simple* leaf), or may be divided into *leaflets* (a *compound* leaf). *Pinnately compound* leaves are based on pinnate venation, with parts of the midrib exposed between individual leaflets (Fig. 5). *Palmately compound* leaves are based on palmate venation, with leaflets meeting at a central point. A *ternately compound* leaf has three leaflets, based on palmate venation. A *trifoliolate* leaf has three leaflets, based on pinnate venation. Leaves may also show two or even three levels of compoundness; a twice-pinnately-compound leaf is referred to as *bipinnate*. A simple rule to distinguish leaflets from leaves is to look for an axillary bud; leaves have them, leaflets do not.

Leaf shapes are shown in Fig. 6. Terms for the shape of the leaf apex and leaf base are illustrated in Fig. 7. *Peltate* leaves are often round, with a centrally attached petiole. *Perfoliate* leaves are sessile, with the leaf base entirely surrounding the stem. *Decurrent* leaf bases continue down the stem as ridges of tissue. Leaf margins (Fig. 8) may be *entire* (lacking teeth or indentations), *toothed*, or *lobed*. Leaves may be *pinnately lobed* (based on pinnate venation) or *palmately lobed*. Deeply lobed leaves, with sinuses extending three-quarters of the distance from the margin to the midrib or more, are

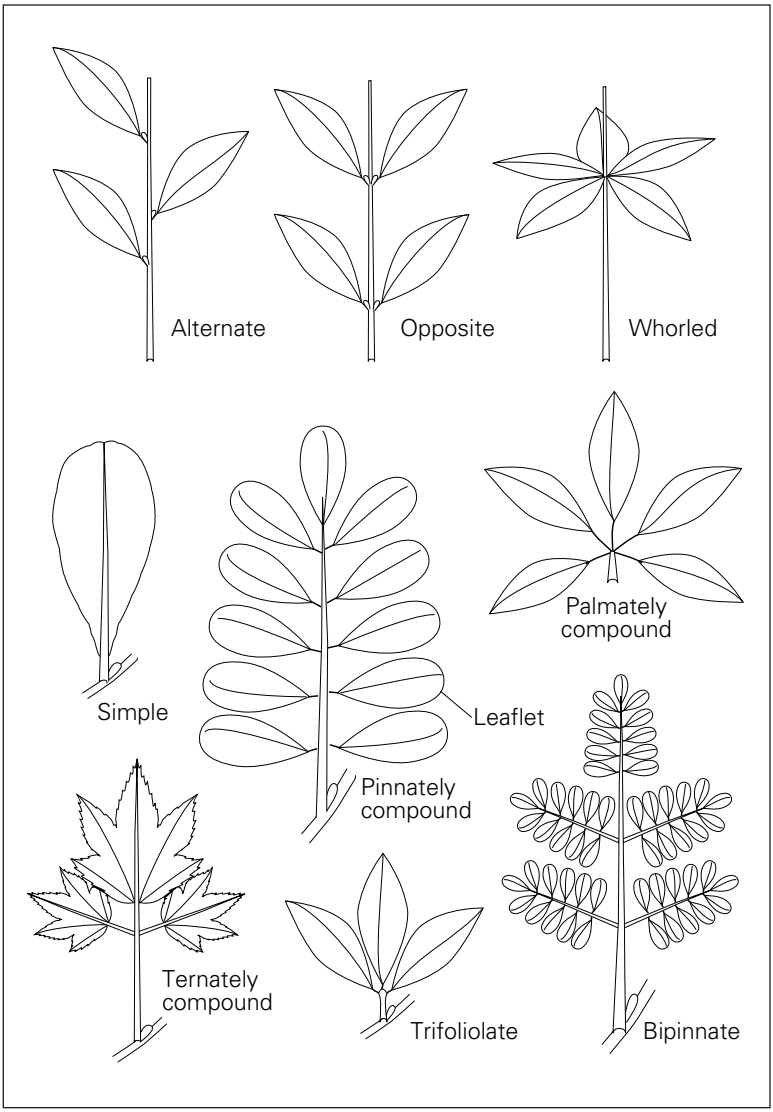

Figure 5: Leaf arrangement; compound leaves

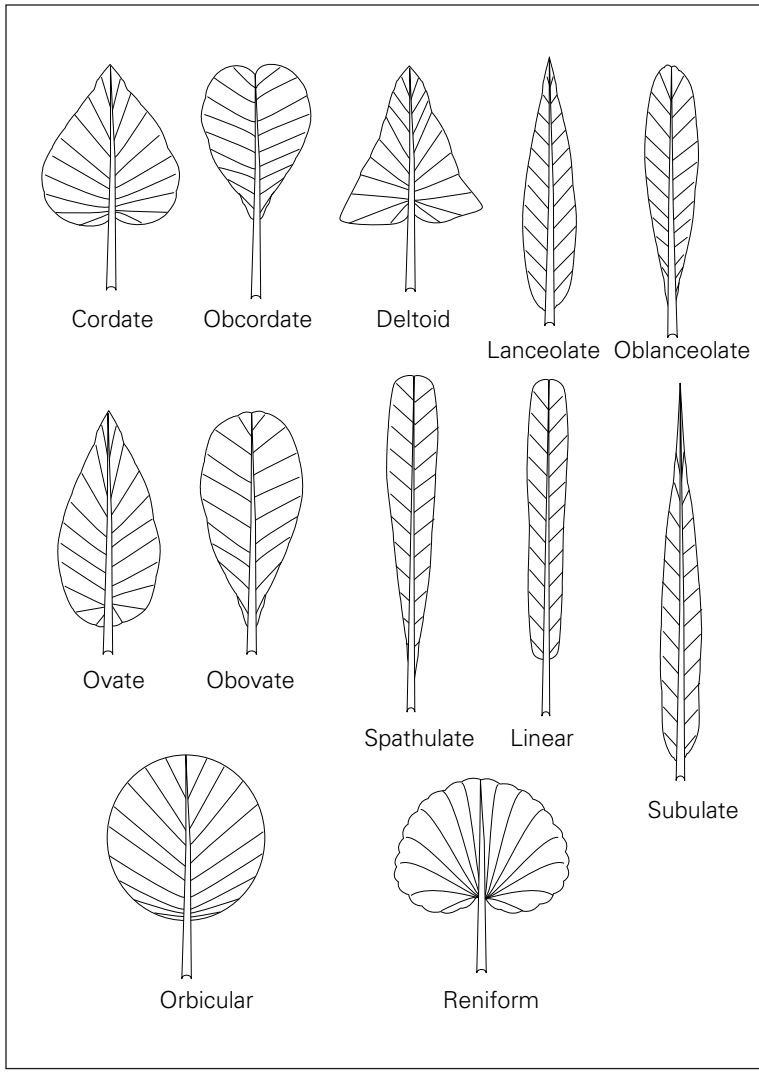

Figure 6: Leaf shapes

divided. Leaves divided into many narrow segments, producing a feathery appearance, are *dissected* (Fig. 8). Note that lobed, divided, and dissected leaves still retain some blade tissue along the midrib, in contrast to compound leaves.Terms for different types of toothed margins are illustrated in Fig. 8.

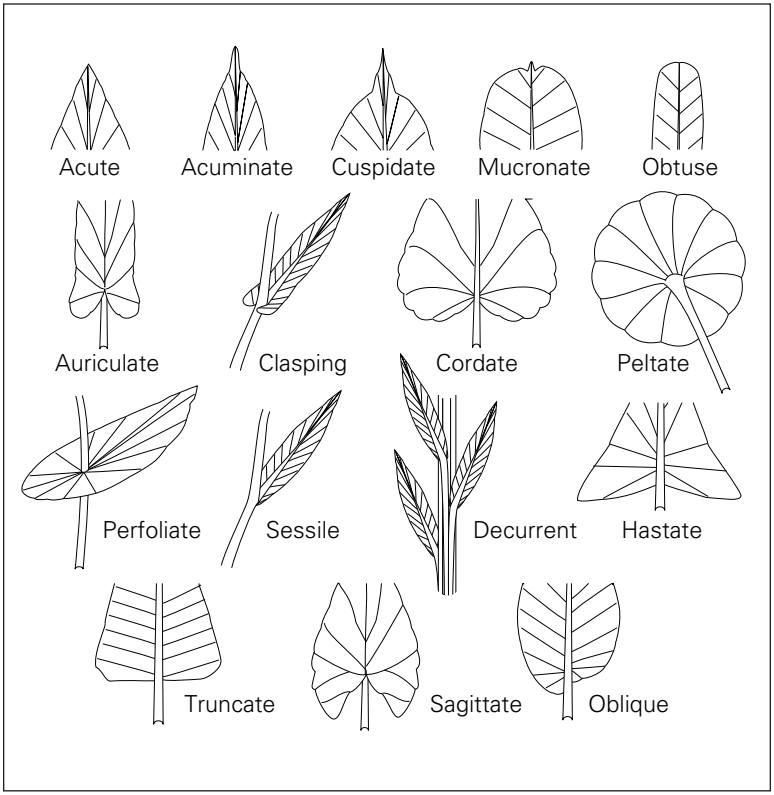

Figure 7: Leaf apices; leaf bases

Surfaces

Stems, leaves, and floral parts may have distinctive surface structures or appearance which are useful in identification. A magnifying glass or hand lens is sometimes useful to distinguish them. A surface without hairs is *glabrous*. A hairy surface is *pubescent* and is covered by *pubescence*, which can be quite variable in length, shape, and texture. For example, a *pilose* surface is covered with fine, thin hairs, while a *tomentose* surface is densely hairy. Hairs may have special shapes, such as hooked or *stellate* (star-shaped). Hairs which point down towards the base of the plant are *retrorse*. A *glaucous* surface is noticeably waxy, with a bluish or whitish bloom; a *glan-*

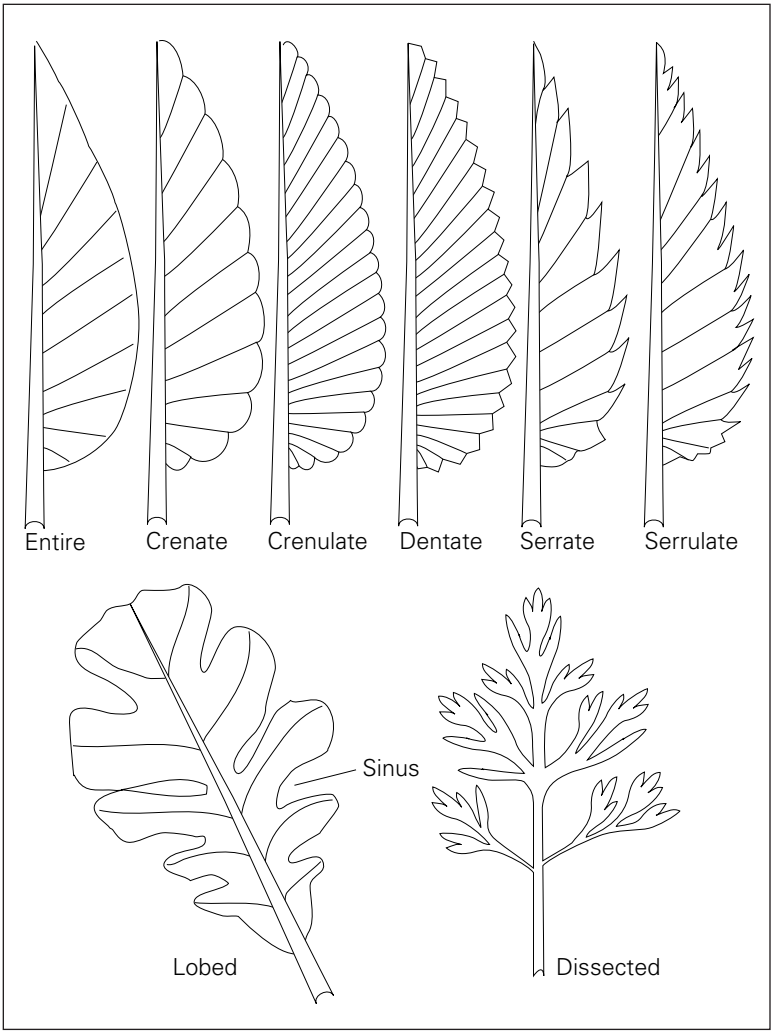

Figure 8: Leaf margins

dular surface has visible, often darker, gland cells. Surfaces may be *punctate*, with tiny depressions, or *tuberculate*, with small protrusions. *Prickles* are sharp pointed extrusions and may be found on any surface, while *thorns* are hard, sharp modified branches found at axils and stem tips.

Plant form

Terrestrial plants fall into two obvious categories. Woody plants include trees, shrubs, and woody vines. They typically persist over many growing seasons as above-ground woody structures. Herbaceous plants (sometimes called *herbs*) consist of succulent green tissue which does not persist through an entire year (typically dying back in winter) in Michigan. Plants which form rosettes of leaves close to the ground are an exception. *Subshrubs* are mostly herbaceous plants with a small amount of persistent woody tissue; the upper parts die back as with herbs.

Aquatic plants may be submerged entirely, floating, emergent (lifted somewhat above the water), or merely growing in very wet soil at water's edge.

The stem growth habit of a species may be distinctive. Plants are upright (*erect*) or *prostrate*, growing completely flat on or along the ground. They may also be *decumbent* (stems trail along the ground, but tips are erect), *spreading* (stems are held more or less horizontal), or *ascending* (stems angle upward). Plants dependent on other plants or objects for support are usually considered to be *vines*. These may *climb* (lean on trees or shrubs, anchored with thorns, tendrils, or branches) or *twine* (wrap around stems of the other plant).

The pattern of maturation and flowering is a useful character in identification.Woody species and many herbs are *perennial*, in that the plant lives for more than two growing seasons and (usually) flowers each season. Herbaceous perennials in Michigan die back to a root system, *crown* (a thickened stem with buds), or a flat *rosette* of leaves. Plants which are not perennial exhibit several possible flowering patterns. *Annuals* germinate from seed, mature, flower, fruit, and die in one growing season; most often this is during spring, summer, and fall. However, *winter annuals* germinate in the fall, form a rosette, and bolt (send up a flower stalk) with the onset of warm weather and the correct daylength, often completing their entire life cycle by late spring. *Biennials* germinate in the spring or summer of one growing season, overwinter (usually as a rosette) and then flower and fruit in the second growing season.

Reading a family description

The description of each plant family contains information in a compact format. This representative, though fictional, family description has been annotated to assist in interpretation of the format. Note that the numbers of floral parts are sometimes shown in ranges; in these cases, the number of that part varies, with numbers in parentheses representing unusual conditions. The flowering season is indicated at the end of the description when all Michigan representatives of the family flower in the same season.

Small, monoecious **(look for two sexes of flowers on one plant)**, aquatic herbs with opposite, entire leaves. Flowers regular, unisexual **(staminate or pistillate),** small, 1 or 2 per leaf axil (**either condition is likely**); sepals 0; petals 0 **(sepals and petals are absent)**; stamens 1–3(5) **(usually 1 to 3 stamens, but can have up to 5)**; pistil 1, styles 2 **(a single ovary with two styles)**; ovary superior **(a longisection will show that the ovary sits on top of the receptacle)**, 4-celled **(a cross-section of the ovary will show 4 compartments)**. Fruit splitting into 4 nutlets. Summer.