

## **Lab 01 - Introduction & The Basal Angiosperm Grade**

Lab Readings: Plate 1. Reproductive Terminology (pp 978-979) in Rhoads & Block (2007).  
Plate 2. Leaf Terminology (pp 980-981) in Rhoads & Block (2007).

### **I. Introduction**

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Your goal in lab is to recognize common plants in Pennsylvania by name, and to acquire skills for learning the names of plants anywhere in the world. Lab quizzes and the final lab practical will ask you to determine plants to 1) **family** from memory, 2) **genus** using your own key to genera that you will be allowed to construct, or 3) **species (and subspecific taxon** when applicable) using the keys in Rhoads & Block (2007). Keys are useful devices in biology – they allow you to identify the taxonomic name of an organism by guiding you through a set of nested observations or questions about what the organism looks like. Keys are some of the most important products that systematists produce.

**A. Species are fundamental units of systematic study.** No matter where you are in the world, as a scientist working with plants, the primary information you will need is the name of the species you are working with. The name of a species is your ticket to 1) learning what's known about it, 2) directing further attention where needed for your work, and 3) communicating with others about your work. Learning the name of a species begins with someone either telling you or with you determining it yourself. Your instructor will not be able to accompany you all around the state of Pennsylvania in order to tell you the name of every plant you encounter. Rather, he will teach you how to use keys. We are lucky in Pennsylvania to have a powerful book, *Plants of Pennsylvania* (Rhoads & Block 2007), with which you can identify and learn about the more than 3,000 species of vascular plants that occur wild in the Commonwealth. You will be expected to use Rhoads & Block to ID species on lab quizzes and exams.

**B. Genera are important concepts to learn regionally.** Genera (singular = genus) are groups of closely related (similar-looking) species. Whereas species within a genus should be quite similar to one another, species in two different genera should be rather distinct from one another. For these reasons, genera are convenient constructs for communication and learning. For example, if I tell you that a particular plant is an oak (of the genus *Quercus*), then you might rightly assume that the plant is a tree, produces acorns and possess durable wood, even if you did not know the species. If instead I tell you that a particular plant is a pine (of the genus *Pinus*), then you could assume that the plant was a tree (or shrub), produces cones (not acorns), and possesses wood that is less durable than oak for flooring and is too pitchy for using in an indoor fireplace. Additionally, knowing that something is an oak or pine gives you a great start towards determining the species. For example, recognizing that a tree in PA is a pine automatically limits your species search from over 3000 to just 9 species.

**C. Families make your knowledge transferrable to anywhere in the world.** Families are groups of related genera. Although it is important to learn species and genera locally, this knowledge has limitations. First, when you travel far from home, you are likely to find unfamiliar genera and species. If you can spot family characters, however, you will be well on your way to identifying the unfamiliar species. Second, knowing that an unfamiliar species is in the same family with a familiar species can be a clue to how to use or to avoid the unfamiliar species.

**D. Vascular plant phylogeny.** Your survey of genera and families this semester will be organized phylogenetically from week to week (Fig 1). You will not have to learn the phylogeny depicted in Figure 1 for lab, but it is presented here to provide you with an overview of how the groups we study are related to one another.

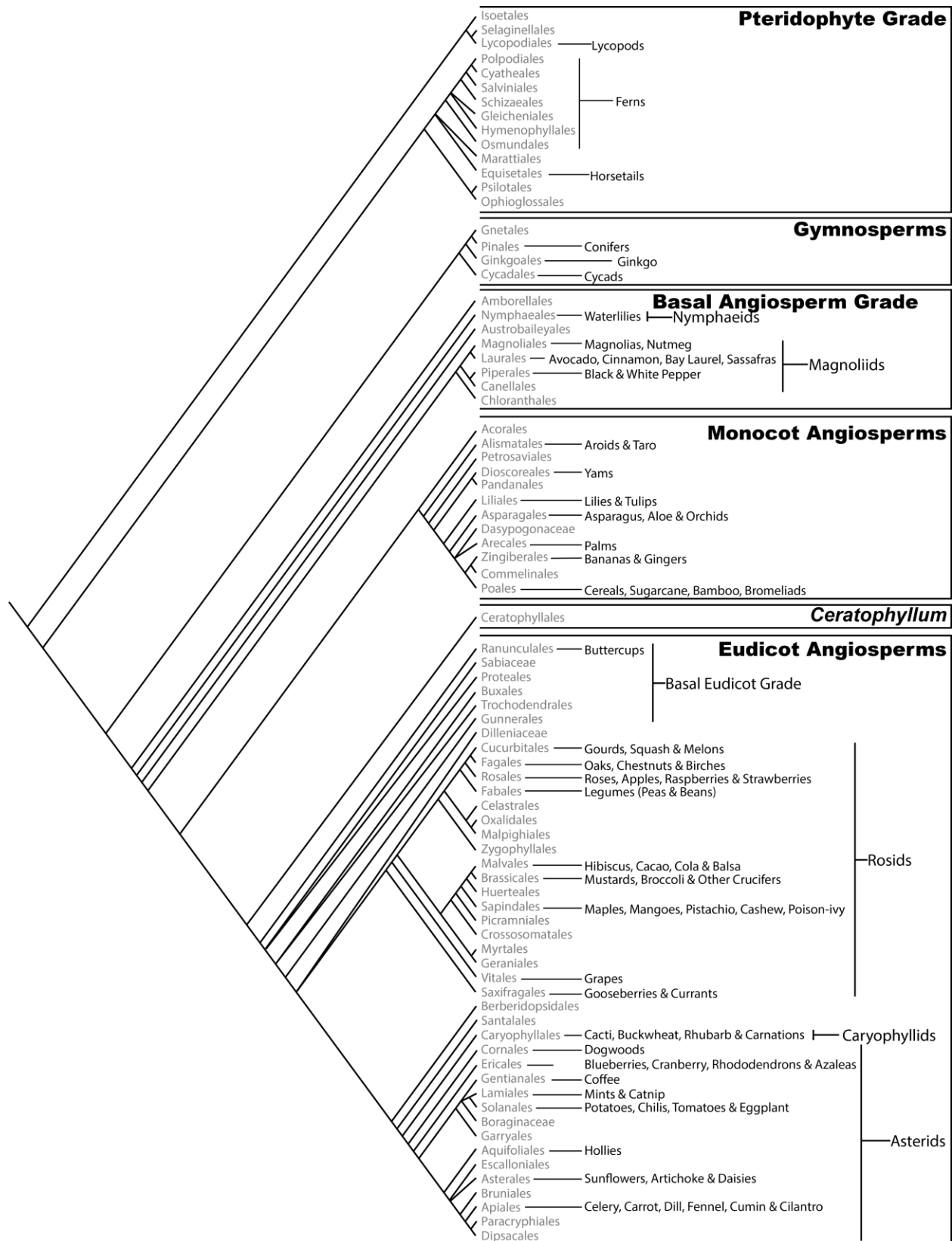


Fig 1. Ordinal phylogeny for vascular plants with names of major groups we'll study marked at right. Orders (or families) in black are those represented in the native Pennsylvania flora (Rhoads & Block 2007), whereas those in grey are not. Based on studies by Smith et al. (2006) and Qiu et al. (2007) for pteridophytes, APG III (2009) for dicots and monocots, and Chaw et al. (2000) for gymnosperms and the spine of the cladogram. The informal names to the right of the phylogeny delimit names for major clades or grades that commonly used by the systematic botany community.

**1. Clade vs. Grade.** A clade is a section of a cladogram (e.g., Fig 1) that includes a common ancestor and all of its descendants. “Clade” is synonymous with “monophyletic group” and all members of a clade share a more recent common ancestor with each other than they do with members of other clades. A grade is an artificial construct sometimes named (informally) and used by biologists for convenient contrast to a clade that possesses some important characteristic that members of the grade lack. There are three grades named in Figure 1 (Pteridophytes, Basal Angiosperms, and Basal Eudicots): all other names refer to clades.

For example, **Pteridophytes** comprise a grade of lineages that are free-sporing and lack seeds, pollen, and a eustele. They stand in convenient contrast to the monophyletic seed plants (gymnosperms and angiosperms) which evolved seeds, pollen, and the eustele (thus, wood) which enabled seed plants to spread further into terrestrial environments and form today’s forest ecosystems. Indeed, the seed plants evolved from the pteridophytes. Even though ferns are more closely related to seed plants than to Lycopods from a phylogenetic perspective, they share primitive characteristics (lack of seeds, pollen and eusteles) with Lycopods and are therefore often lumped into the concept of *Pteridophytes* in introductory botany classes.

Within the angiosperms, the **Basal Angiosperm Grade** is a group of lineages that possess a suite of flower characteristics resembling the earliest Angiosperms. The ancestors of the Basal Angiosperm Grade gave rise to the important Monocots and Eudicots that today include our most species-rich and economically important plants.

**2. Phylogeny, Recency of Common Ancestry & Interpreting Cladograms.** Recency of common ancestry determines how closely related two or more groups are to one another. A cladogram describes this. For example, within the Basal Angiosperm Grade, the orders Magnoliales and Laurales are more closely related to one another than either is to Piperales (Fig 1). If you follow their lines on the cladogram back, they connect with one another sooner (more recently in an evolutionary sense) than they do with that of the Piperales. Piperales is equally related to both Magnoliales and Laurales, and all three are more closely related to one another than either is to Nymphaeales. In fact, the Magnoliales (or Laurales or Piperales for that matter) is more closely related to Eudicots than it is to Nymphaeales.

## **II. Basal Angiosperm Grade**

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The first genera and families you will study this semester will be from the Nymphaeids and Magnoliids of the Basal Angiosperm Grade. Basal Angiosperms are descendants of the earliest flowering plants and many have retained primitive floral features that fossils indicate were possessed by these earliest angiosperms (Table 1).

Table 1. Primitive floral traits present in some or all members of the Basal Angiosperm Grade.

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- 1) Flowers showy
  - 2) Parts numerous or in 3’s
  - 3) Receptacle more or less elongate
  - 4) Where numerous, parts spirally arranged
  - 5) Poor differentiation between organ classes
  - 6) Laminar stamens
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In addition to their evolutionary significance, many Basal Angiosperms are economically or ethnobotanically important (Table 2). You may therefore find it fun to finally learn about the systematics of these important species you may already be somewhat familiar with.

Table 2. Economically important Basal Angiosperms.

- 1) Nymphaeids are all aquatic and many, such as water-lilies, are of great horticultural import.
- 2) Magnoliids are characterized by special ethereal oil cells in most parts, and these oils are responsible for many of our spices.
- 3) From Magnoliaceae, we have *Magnolia* with many species of horticultural notoriety.
- 4) From Lauraceae, commercially important spices or fruit from *Cinnamomum* (cinnamon), *Laurus* (bay laurel), & *Persea* (avocado). *Sassafras* still important today, but nowhere near its import during the colonial period when it was the first large export from colonial America.
- 5) From Piperaceae, important spice black and white pepper (*Piper nigrum*).

## A. Families to Know on Sight (no keying allowed for lab quizzes or final)

### 1. Nymphaeids

#### a. Nymphaeaceae

Diagnostic Summary: Aquatic, rhizomatous herbs with floating to emergent, cordate, hastate or peltate blades; Flowers large, showy, solitary & scapose, with variably numbered to many spirally arranged parts and poor differentiation between organ classes; Fruit a spongy berry or spongy, irregularly dehiscent capsule.

Generalized Floral Formula:  $\text{Ca}^{4-6(-14)}$ , poorly differentiated from corolla  $\text{Co}^{8\text{-many}}$   $\text{A}^{\text{many}}$ , laminar, some petaloid  $\text{G}^{[3\text{-many}]}$

#### Interpreting this Floral Formula:

**Calyx** of 4-6 (rarely up to 14) sepals, which are poorly differentiated from petals. **Corolla** of 8 to many petals. **Androecium** of many stamens. Laminar refers to the fact that stamens are flattened (some resembling petals) and not well differentiated into the filament and anther of the textbook stamen. **Gynoecium** of 3 to many, superior carpels that are fused ([ ]) into a single pistil.

### 2. Magnoliids

#### b. Magnoliaceae

Diagnostic Summary: Trees/Shrubs with circular stipular scars at nodes; Flowers large, showy, solitary, with many spirally arranged parts on elongate receptacle; Parts more or less aromatic; Fruit an aggregate of follicles or samaras.

Generalized Floral Formula:  $\text{P}^{\text{many}}$  or  $\text{Ca}^3 \text{Co}^{6\text{-many}}$   $\text{A}^{\text{many}}$ , laminar  $\text{G}^{\text{many}}$

#### Interpreting this Floral Formula:

**Perianth** of many tepals, not differentiated into a calyx and corolla, or with **Calyx** of 3 sepals. **Corolla** of 6 to many petals. **Androecium** of many stamens. Laminar refers to the fact that

stamens are more or less flattened and not well differentiated into the filament and anther of the textbook stamen. **Gynoecium** of many free, superior carpels.

c. Lauraceae

**Diagnostic Summary:** Trees/shrubs with strongly aromatic bark and leaves; Flowers small, whorled, 3-merous, with yellow-green or white tepals and valvate anthers; Fruit a single seeded berry or drupe.

**Generalized Floral Formula:**  $P^{3+3(+3)} A^{3-12(-many), valvate} G^1$

Interpreting this Floral Formula:

Perianth of 6 (rarely up to 9) tepals in two (or three) whorls, not differentiated into a calyx and corolla. **Androecium** of 3-12 (rarely up to many) stamens. Valvate refers to the anthers dehiscing by flap-like valves that flip open with pollen stuck to them. **Gynoecium** of one superior carpel.

**B. Genera to Know (you can write your own key to genera and use on lab quizzes & final)**

While I will give you the characters for families this semester, which you will have to commit to memory, learning the diagnostic characters for genera will be completely up to you. On top of this, there will be many more genera for you to know than families. In order to help you, I have provided you data sheets for you that will help guide your observations of genera on a weekly basis. I will also allow you to construct your own key to the genera we study. The data sheets will help you work on these keys between classes.

For each of the genera listed below, I have given you their general habit in parentheses. Each week you should spend lab as follows:

- 1) Completing a data sheet for each genus based on the herbarium and living specimens available. Complete what you can in lab based on what you have to study. Use descriptions of these genera in Rhoads & Block (2007) or elsewhere to help complete a data sheet.
- 2) Constructing a key to the week's genera.
- 3) As the genera accumulate over the weeks, you should try to integrate all genera into a master key. Some quizzes in future weeks will be on multiple weeks' worth of genera. The lab practical on the last day of lab will cover all genera.

**1. Nymphaeids**

a. Nymphaeaceae

1. *Nymphaea* (aquatic herbs)
2. *Nuphar* (aquatic herbs)

b. Cabombaceae

3. *Brasenia* (aquatic herbs)

**2. Magnoliids**

c. Magnoliaceae

4. *Magnolia* (trees & shrubs)
5. *Liriodendron* (trees)

d. Annonaceae

6. *Asimina* (trees)

e. Aristolochiaceae

7. *Asarum* (herbs)

f. Lauraceae

8. *Lindera* (shrubs)
9. *Sassafras* (trees)

g. Piperaceae

10. *Peperomia* ( $\pm$  succulent herbs)

### III. Keying Exercise

A **key** is a tool for taxonomic identification. A key to species, for example, is a tool that will enable one to **determine** (identify) an unknown plant to the proper species. A key to genera will enable one to determine an unknown plant to the proper genus. Periodically throughout the semester, you will be asked on a quiz to use your book to determine a plant to species. Alternatively, you may be asked to determine a plant to genus, not using your book but instead your own key that you constructed. The type of keys that we will use and construct in this class will be **dichotomous, indented** keys. A dichotomous key forces the user to determine the correct path through a nested sequence of **couplets**. A couplet is ideally a pair of mutually exclusive statements (**leads**) about the form a plant or plant part can take. A dichotomous, indented key is one in which each of the two couplet leads will either lead to a taxon or to another couplet and leads that possess the characteristics of the earlier lead are indented beneath that higher-level lead. Eventually, one should get to the correct taxon.

The process of constructing a key to genera, for example, begins with making systematic observations, notes and drawings of the focal set of genera. Today I will give you the complete set of couplets to a key (below) that will work for the 10 genera of nymphaeids and magnoliids. However, you must place the genera onto the key as endpoints at the appropriate place.

I suggest you base your key primarily on vegetative characters. For woody plants, this is all you will need you should be able to ID a genus without any reproductive characters. For herbaceous plants, vegetative characters should be used wherever possible, but it may be necessary to use reproductive characters to separate some genera easily.

#### 1. Aquatic herbs

- 2. Lvs peltate.....
- 2. Lvs not peltate
  - 3. Lf blade basal lobes angular; Petals or petaloid organs many.....
  - 3. Lf blade basal lobes rounded; Petals or petaloid organs 5-9.....

#### 1. Terrestrial herbs, shrubs or trees

- 4. Herbs
  - 5. Lvs opp; Aerial stm typically with a single pair of lvs; Fl of 3 petal-like organs, solitary, situated btw the pair of lvs.....
  - 5. Lvs alt; Aerial stm with > 2 lvs; Fl minute, lacking perianth, in erect spikes.....
- 4. Shrubs or trees
  - 6. Stm with stipular scars encircling twig at or near nodes
    - 7. Lvs broadly 4 to 6 lobed.....
    - 7. Lvs entire.....
  - 6. Stm without stipular scars encircling the twig
    - 8. Lvs varying from entire to 2-3-lobed on the same branch.....
    - 8. Lvs all entire
      - 9. Lvs > 15 cm long.....
      - 9. Lvs < 15 cm long.....

**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	a. Terrestrial vs. Emergent or Submergent Aquatic b. Caulescent vs. acaulescent c. Herb, Shrub, Tree, Vine/Liana d. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
<b>Infl</b>	<p><b>Position:</b> Terminal, Axillary</p> <p><b>Type:</b> Solitary, Racemose, Spicate, Umbel-like, Panicle-like, Catkin, Head, Other:</p> <p><b>Distinctive Subtending Bracts?:</b></p> <p><b>Stalking:</b> Pedunculate, Sessile</p> <p><b>General Shape:</b></p>
<b>Fl</b>	<p><b>Size or Showiness:</b></p> <p><b>Stalking:</b> Pedicellate, Sessile</p> <p><b>Floral Formula:</b>      Ca                      Co                      A                      G</p>
<b>Fr</b>	<p><b>Complexity:</b> Simple, Aggregate, Multiple, Accessory</p> <p><b>Fruit Type:</b> Berry-like, Capsule-like, Samaroid, Nut, Achene, Schizocarp, Other:</p>

**Other Distinctive Features**





**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	e. Terrestrial vs. Emergent or Submergent Aquatic f. Caulescent vs. acaulescent g. Herb, Shrub, Tree, Vine/Liana h. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
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<b>Fl</b>	<p><b>Size or Showiness:</b></p> <p><b>Stalking:</b> Pedicellate, Sessile</p> <p><b>Floral Formula:</b>      Ca                      Co                      A                      G</p>
<b>Fr</b>	<p><b>Complexity:</b> Simple, Aggregate, Multiple, Accessory</p> <p><b>Fruit Type:</b> Berry-like, Capsule-like, Samaroid, Nut, Achene, Schizocarp, Other:</p>

**Other Distinctive Features**



**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	i. Terrestrial vs. Emergent or Submergent Aquatic j. Caulescent vs. acaulescent k. Herb, Shrub, Tree, Vine/Liana l. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
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**Other Distinctive Features**



**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	m. Terrestrial vs. Emergent or Submergent Aquatic n. Caulescent vs. acaulescent o. Herb, Shrub, Tree, Vine/Liana p. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
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**Other Distinctive Features**



**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	q. Terrestrial vs. Emergent or Submergent Aquatic r. Caulescent vs. acaulescent s. Herb, Shrub, Tree, Vine/Liana t. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
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**Other Distinctive Features**





**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	u. Terrestrial vs. Emergent or Submergent Aquatic v. Caulescent vs. acaulescent w. Herb, Shrub, Tree, Vine/Liana x. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
<b>Infl</b>	<p><b>Position:</b> Terminal, Axillary</p> <p><b>Type:</b> Solitary, Racemose, Spicate, Umbel-like, Panicle-like, Catkin, Head, Other:</p> <p><b>Distinctive Subtending Bracts?:</b></p> <p><b>Stalking:</b> Pedunculate, Sessile</p> <p><b>General Shape:</b></p>
<b>Fl</b>	<p><b>Size or Showiness:</b></p> <p><b>Stalking:</b> Pedicellate, Sessile</p> <p><b>Floral Formula:</b>      Ca                      Co                      A                      G</p>
<b>Fr</b>	<p><b>Complexity:</b> Simple, Aggregate, Multiple, Accessory</p> <p><b>Fruit Type:</b> Berry-like, Capsule-like, Samaroid, Nut, Achene, Schizocarp, Other:</p>

**Other Distinctive Features**



**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	y. Terrestrial vs. Emergent or Submergent Aquatic z. Caulescent vs. acaulescent aa. Herb, Shrub, Tree, Vine/Liana bb. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
<b>Infl</b>	<p><b>Position:</b> Terminal, Axillary</p> <p><b>Type:</b> Solitary, Racemose, Spicate, Umbel-like, Panicle-like, Catkin, Head, Other:</p> <p><b>Distinctive Subtending Bracts?:</b></p> <p><b>Stalking:</b> Pedunculate, Sessile</p> <p><b>General Shape:</b></p>
<b>Fl</b>	<p><b>Size or Showiness:</b></p> <p><b>Stalking:</b> Pedicellate, Sessile</p> <p><b>Floral Formula:</b>      Ca                      Co                      A                      G</p>
<b>Fr</b>	<p><b>Complexity:</b> Simple, Aggregate, Multiple, Accessory</p> <p><b>Fruit Type:</b> Berry-like, Capsule-like, Samaroid, Nut, Achene, Schizocarp, Other:</p>

**Other Distinctive Features**



**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	cc. Terrestrial vs. Emergent or Submergent Aquatic dd. Caulescent vs. acaulescent ee. Herb, Shrub, Tree, Vine/Liana ff. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
<b>Infl</b>	<p><b>Position:</b> Terminal, Axillary</p> <p><b>Type:</b> Solitary, Racemose, Spicate, Umbel-like, Panicle-like, Catkin, Head, Other:</p> <p><b>Distinctive Subtending Bracts?:</b></p> <p><b>Stalking:</b> Pedunculate, Sessile</p> <p><b>General Shape:</b></p>
<b>Fl</b>	<p><b>Size or Showiness:</b></p> <p><b>Stalking:</b> Pedicellate, Sessile</p> <p><b>Floral Formula:</b>      Ca                      Co                      A                      G</p>
<b>Fr</b>	<p><b>Complexity:</b> Simple, Aggregate, Multiple, Accessory</p> <p><b>Fruit Type:</b> Berry-like, Capsule-like, Samaroid, Nut, Achene, Schizocarp, Other:</p>

**Other Distinctive Features**



**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	gg. Terrestrial vs. Emergent or Submergent Aquatic hh. Caulescent vs. acaulescent ii. Herb, Shrub, Tree, Vine/Liana jj. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
<b>Infl</b>	<p><b>Position:</b> Terminal, Axillary</p> <p><b>Type:</b> Solitary, Racemose, Spicate, Umbel-like, Panicle-like, Catkin, Head, Other:</p> <p><b>Distinctive Subtending Bracts?:</b></p> <p><b>Stalking:</b> Pedunculate, Sessile</p> <p><b>General Shape:</b></p>
<b>Fl</b>	<p><b>Size or Showiness:</b></p> <p><b>Stalking:</b> Pedicellate, Sessile</p> <p><b>Floral Formula:</b>      Ca                      Co                      A                      G</p>
<b>Fr</b>	<p><b>Complexity:</b> Simple, Aggregate, Multiple, Accessory</p> <p><b>Fruit Type:</b> Berry-like, Capsule-like, Samaroid, Nut, Achene, Schizocarp, Other:</p>

**Other Distinctive Features**





**Taxon Morphological Data Sheet**

<b>Genus</b>	<b>Family</b>
<b>Habit</b>	kk. Terrestrial vs. Emergent or Submergent Aquatic ll. Caulescent vs. acaulescent mm. Herb, Shrub, Tree, Vine/Liana nn. Succulent vs. Not succulent
<b>Armature</b>	Armed (Spines, Prickles, Thorns) vs. Unarmed. If armed, where:
<b>Lvs</b>	<p><b>Form:</b> Broad, Needle-like, Scale-like or Microphyllous</p> <p><b>Complexity:</b> Simple, Pinnate, Palmate, Dissected</p> <p><b>Phyllotaxy:</b> Alternate (spiral, distichous), Opposite, Whorled, Rosette.</p> <p><b>Attachment:</b> Petiolate, Pseudo-petiolate, Sessile, Sheathing.</p> <p><b>Margin:</b> Entire, Toothed (serrate/dentate/crenate), Lobed (pinnate/palmate/other), Undulate</p> <p><b>Venation:</b> Parallel, Pinnate, Palmate, Dichotomous</p> <p><b>Shape(blade):</b> Orbicular, Elliptic, (ob-)Ovate, (ob-)Lanceolate, (ob-)Cordate, Sagittate, Other:</p> <p><b>Apex (blade):</b> Acute, Acuminate, Obtuse, Round, Mucronate, Emarginate, Other:</p> <p><b>Stipules:</b> Stipulate, Exstipulate</p> <p><b>Upper Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p> <p><b>Lower Surface (blade, petiole):</b> Glabrous, Pubescent (color:                      texture:                      )</p>
<b>Infl</b>	<p><b>Position:</b> Terminal, Axillary</p> <p><b>Type:</b> Solitary, Racemose, Spicate, Umbel-like, Panicle-like, Catkin, Head, Other:</p> <p><b>Distinctive Subtending Bracts?:</b></p> <p><b>Stalking:</b> Pedunculate, Sessile</p> <p><b>General Shape:</b></p>
<b>Fl</b>	<p><b>Size or Showiness:</b></p> <p><b>Stalking:</b> Pedicellate, Sessile</p> <p><b>Floral Formula:</b>      Ca                      Co                      A                      G</p>
<b>Fr</b>	<p><b>Complexity:</b> Simple, Aggregate, Multiple, Accessory</p> <p><b>Fruit Type:</b> Berry-like, Capsule-like, Samaroid, Nut, Achene, Schizocarp, Other:</p>

**Other Distinctive Features**



Practice Quiz 1. Use your key to identify the unknown herbarium specimens to genus.

1.

2.

3.

4.

5.

6.

7.

8.