Taxonomy II

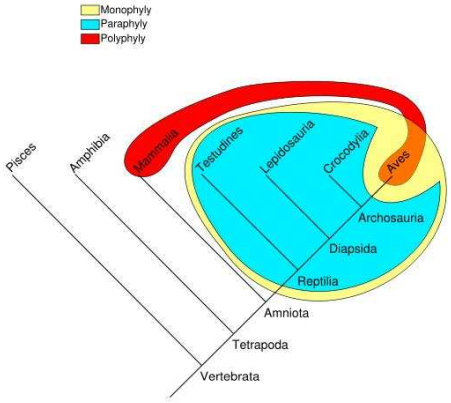
Classification & Identification

March 5, 2008

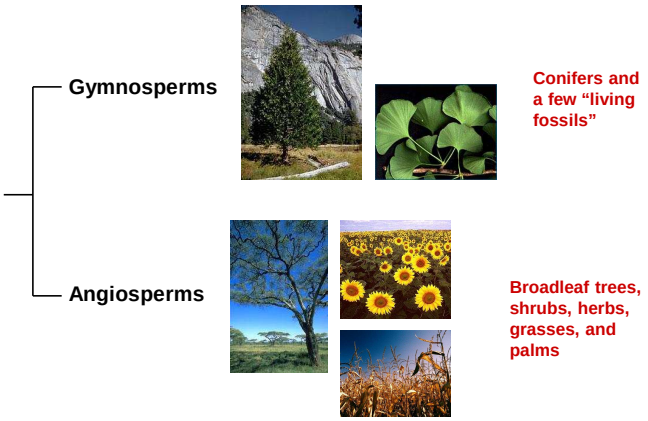
Recap: What you should know

- **Definitions:** *Taxonomy, Cladistics, Clades, Species*
- **Vocabulary**: Plant taxa (*Species … Phylum*), *binomial naming system, dichotomous* key or tree, *parsimonious*.
- **History:** Contributions of Aristotle, Theophrastus, Linnaeus, Darwin, Engler, & modern genetics.
- **Concepts:** Parsimonious "tree of life" construction, "molecular clock" of mutation as the basis for cladistics.

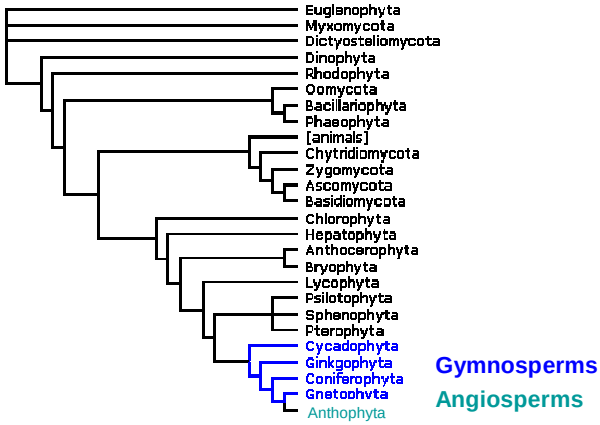
Clades & Classifications



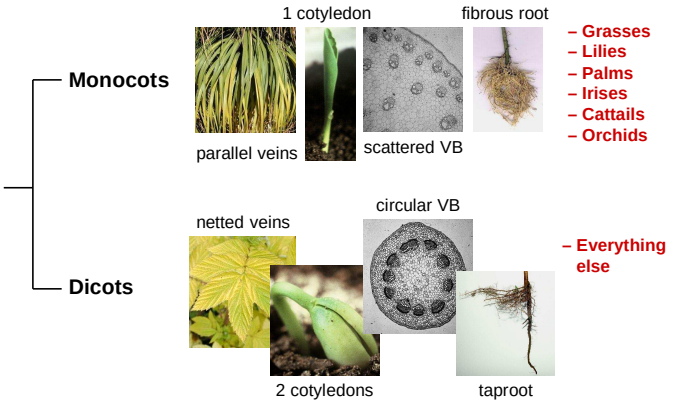
Two major taxonomic groups of seedplants



Mono-, para-, or poly-phylletic?

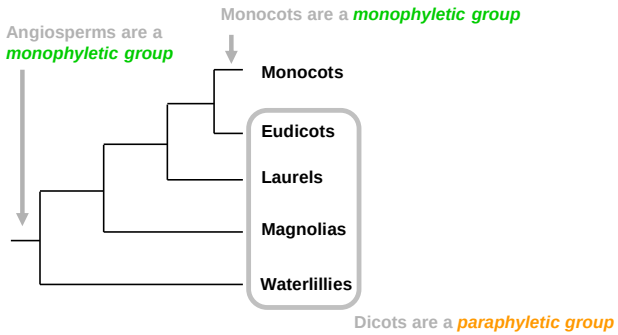


Two major taxonomic groups of Angiosperms



(Theophrastus already recognized these two groups)

Mono-, para-, or poly-phylletic?

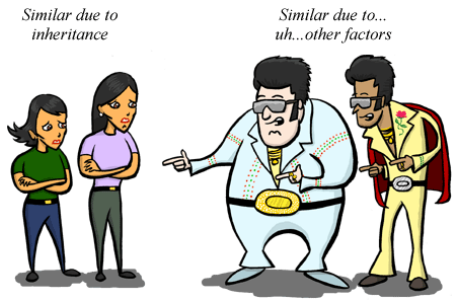


Taxonomy vs. Cladistics

Taxonomy	Cladistics
• Limited number of subjective classifications that make sense	• Each node is a hypothetical taxonomic unit (HTU)
• Arbitrary fixed hierarchical levels that are "permanent"	• Taxa flexible and quickly changeable if required
• Many paraphyletic groups are in use	• Only monophyletic groups are acceptable
• Naming species and classes is an essential objective	• Only gives temporary names to groups, no names for species
• Making identification easy is a key objective of classification	• Identification requires quantitative/genetic analysis

… more about classification systems and identification keys: grouping methods

Homologous **Analogous**



Examples for homologies

obvious

Pitcher Plant leaves modified into pitchers to catch insects

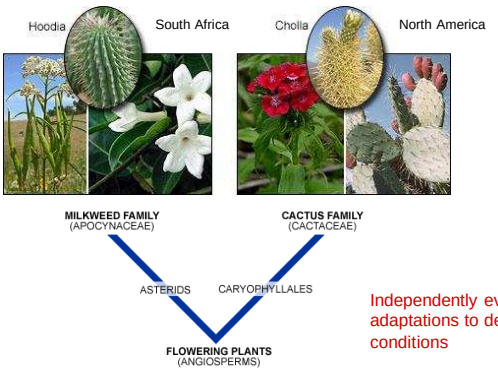
Venus' Flytrap leaves modified into jaws to catch insects

Poinsettia bright red leaves resemble flower petals

Cactus leaves have become spines

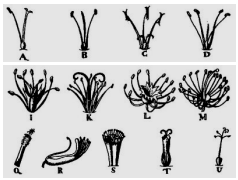
not obvious

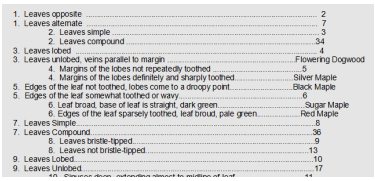
Examples for analogies



Independently evolved adaptations to desert conditions

… more about classification systems and identification keys: grouping methods



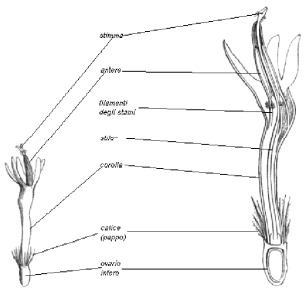


1. Leaves opposite 2
1. Leaves alternate 7
2. Leaves simple 3
2. Leaves compound 34
3. Leaves lobed 4
3. Leaves unlobed, veins parallel to margin ..... Flowering Dogwood
4. Margins of the lobes not repeatedly toothed 5
4. Margins of the lobes definitely and sharply toothed ..... Silver Maple
5. Edges of the leaf not toothed, lobes come to a droopy point ..... Black Maple
5. Edges of the leaf somewhat toothed or wavy 6
6. Leaf broad, base of leaf is straight, dark green ..... Sugar Maple
6. Edges of the leaf sparsely toothed, leaf broad, pale green ..... Red Maple
7. Leaves Simple 8
7. Leaves Compound 36
8. Leaves bristle-tipped 9
8. Leaves not bristle-tipped 13
9. Leaves Lobed 10
9. Leaves Unlobed 17

Slowly evolving **homologous** traits are excellent for "tree of life" classification and for big, comprehensive identification keys.

Fast evolving traits are often **analogous** and do not reflect evolutionary relationships. They are often good for limited, regional identification keys, because the traits are easily observable

Flowers are excellent for classification because they evolve slowly – why?



Centaurea cyanus L. (floridoso)

fiore tubuloso del disco (ermafrodita)

sezione di fiore tubuloso del disco

Why flowers work well for classification and comprehensive identification trees:

- Major changes to reproductive system detrimental – very conservative trait
- Flowers usually not subject to strong selection pressures – slowly evolving

Recap: What you should know

- **Definitions:** n/a
- **Vocabulary:** *monophyletic, paraphyletic, polyphyletic, homologous analogous*
- **Concepts:** Taxonomy vs cladistics (objectives, methods, advantages), *use of homologies vs analogies* traits in classification and identification keys

Study Questions

- Explain what *monophyletic, paraphyletic,* and *polyphyletic* groups are, and give two examples each for *monophyletic* and *paraphyletic* plant groups.
- What is the difference in objectives and methods in taxonomy versus cladistics, and what are the advantages/disadvantages of the two systems?
- Why do taxonomists group species differently for and identification keys versus classification systems?
- Why is an evolutionary correct dichotomous identification key not useful?
- Explain what *homologies* and *analogies*, and give two examples for each in plants.
- Which plant traits evolve fast/slow and why?
- Which plant traits should be used for (1) classification, (2) comprehensive identification keys and (3) limited keys.