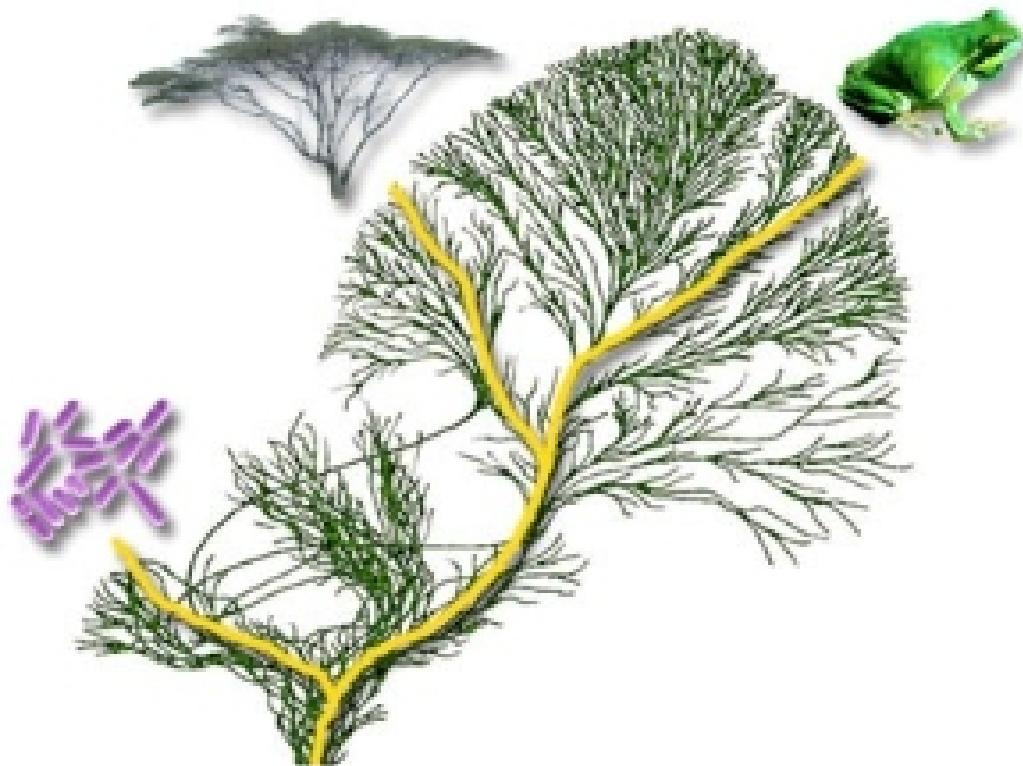


Systematics: The Science of Biological Diversity (Topic 1)

Learning Objectives
Plant Diversity (BOT 3015)
Dr. Mast

1. What is the broad goal of systematics? Explain the significance of this.
 - a. **Systematics:** the scientific study of biodiversity and its evolutionary history.
 - i. The broad goal of systematics is to *discover all of the branches of the phylogenetic tree of life*.
 - b. **Tree of Life:** Evidence from morphological, biochemical, and gene sequence data suggests that all organisms on Earth are genetically related, and the genealogical relationships of living things can be represented by a vast evolutionary tree, the Tree of Life. **The Tree of Life then represents the phylogeny of organisms**, i. e., the history of organismal lineages as they change through time. It implies that **different species arise from previous forms via descent**, and that all organisms, from the smallest microbe to the largest plants and vertebrates, are **connected by the passage of genes along the branches of the phylogenetic tree** that links all of Life.
 - c. **Phylogeny:** the evolutionary relationships among organisms; Phylogeny, the genealogical map for all lineages of life on earth, provides an overall framework to **facilitate biological information retrieval, prediction, and analysis**. Assembly of a framework phylogeny, or Tree of Life, for all major lineages of life requires a greatly magnified effort, often involving large teams working across institutions and disciplines.



2. What are the activities of taxonomy? What role does a type specimen play in taxonomy? Where can one find type specimens?
 - a. **Taxonomy:** the identifying, naming, and classifying of species.
 - i. 80 % completion for plant naming
 - ii. 1.5 million species of fungi, only 99,000 named
 - iii. 17 % completion for naming and describing all species.
 - b. **International Code of Botanical Nomenclature:** governs naming of plants, photosynthetic protists, and fungi.
 - i. Latin description can now be in English.
 - ii. Updated every 6 years, Melbourne in 2011.
 - c. **Type Specimen:** identified when published; *type anchors name*.
 - i. Often held in herbarium for basis of comparisons with other specimens in determining whether they are members of the same species
 - ii. Each name has a type specimen, which anchors the name.

3. What is biodiversity informatics?

- a. **Biodiversity informatics:** the application of informatics techniques to biodiversity information. The herbarium database and website is an example.
- b. **iDigBio:** a joint project between FSU and UF. iDigBio is the National Resource for Advancing Digitization of Biological Collections.
- c. **Bio-Blitz:** a census of species in a given area in 24 hours, which gives historic baseline for comparison; a baseline for environmental change.

4. What percentage of the world's plant and fungal species have been named? How many extant species of each are estimated to exist?

- a. **80 %** completion for plant naming
- b. **17 %** completion for naming and describing all species.
- c. **7 %** complete for fungi
- d. **1.5 million** species of fungi, only **99,000** named

5. Explain the historical context in which the binomial system of nomenclature emerged. Identify the parts of a binomial. Which part is meaningful by itself? Compare the utility of common vs. scientific names.

- a. **Carl Linnaeus** published "species plantarum" described each species in Latin in a sentence limited to 12 words i.e. **polynomials**.
 - i. Created the two term naming system- **binomial**.
 - 1. The first part of the name identifies the **genus** to which the species belongs; the second part identifies the species within the genus. For example, humans belong to the genus *Homo* and within this genus to the species *Homo sapiens*.
- b. Composed of **Genus, Specific Epithet and Author**
 - i. *Solidago sempervirens* L. – (genus, specific epithetic (not useful by itself/ can be reused), author).

6. What categories are used in biological classification? How are these hierarchically related?

- a. **Taxon:** a taxonomic group of any rank.
- b. **Classification:** The arrangement of entities in a hierarchical series of nested classes, in which similar or related classes at one hierarchical level are combined comprehensively into more inclusive classes at the next higher level. A **class** is defined as "a collection of similar entities.
- c. The level of which it is ranked is called a **category**
 - i. Ex: genus and species are categories and *Prunus* and *Prunus Persica* are taxa in those categories.

- Kingdom, phylum, division, class, order, family, genus, species.

7. What distinguishes an artificial classification from a natural one?

- a. **Artificial system of classification:** classify organisms primarily as an aid to identification and generally by a few characters.
 - i. Linnaeus' sexual system is an artificial system of classification by which plants were classified into 24 classes based on the number and arrangements of the stamens in each flower.
 - ii. Everyone with X amount of stamens and Y pistils grouped together.
- b. **Natural system of classification:** accurate reflection of the evolutionary relationships among organisms.
 - i. The Angiosperm's Phylogeny Group's classification is a natural system of classification.
- c. **Phylogeny:** The evolutionary relationships among organisms

8. Identify monophyletic, paraphyletic, and polyphyletic groups on a phylogeny. Be able to distinguish between diagrams of phylogenies that differ in a significant way (as opposed to a superficial rotation of a clade, etc.).

- a. **Monophyletic group [clade]:** composed of an ancestor and all its descendants; none of descendants are excluded. Genus should consist of all species descended from the most recent common ancestor and only of species from that ancestor.
 - i. Can be removed from the tree by simply "one" cut
- b. **Paraphyletic group:** a group composed of a common ancestor but not all decedents of that ancestor.
 - i. Some may not be included because of divergent evolution.
- c. **Polyphyletic group:** a group that excludes the most recent common ancestor of all members. In other words a group with two or more ancestors but not including the true common ancestor of all its members.
- d. **Clade:** a group consisting of an ancestor and all its descendants, a single "branch" on the "[tree of life](#)".
 - i. The ancestor can be indicated by its relation to two or more specifiers that are mentioned explicitly. This can be done in three ways: **Node-based**, **Stem-based**, and **Apomorphy-based**.

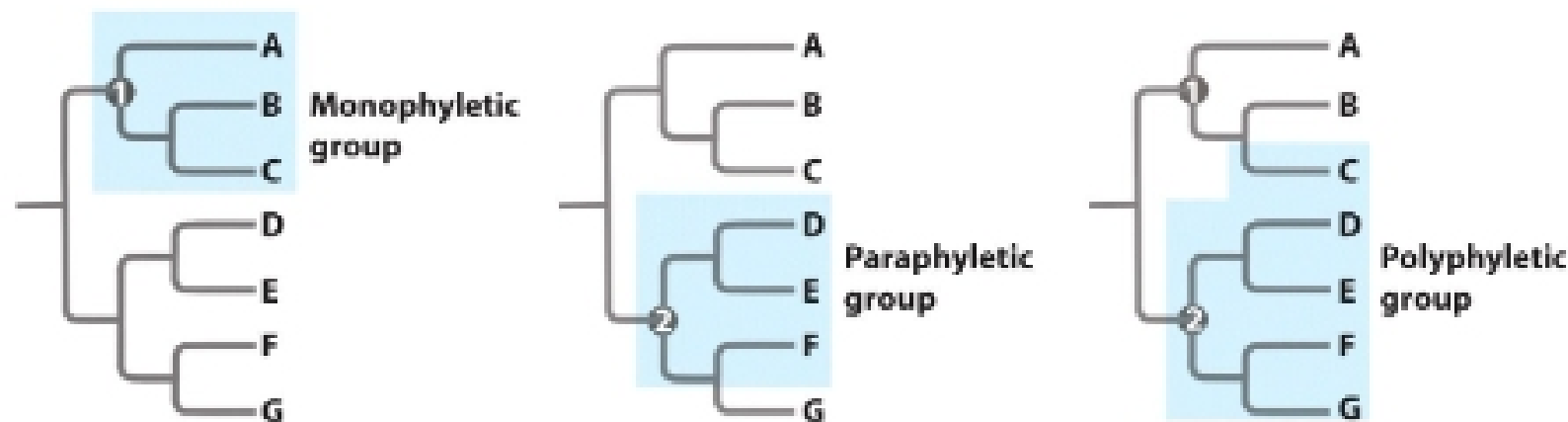
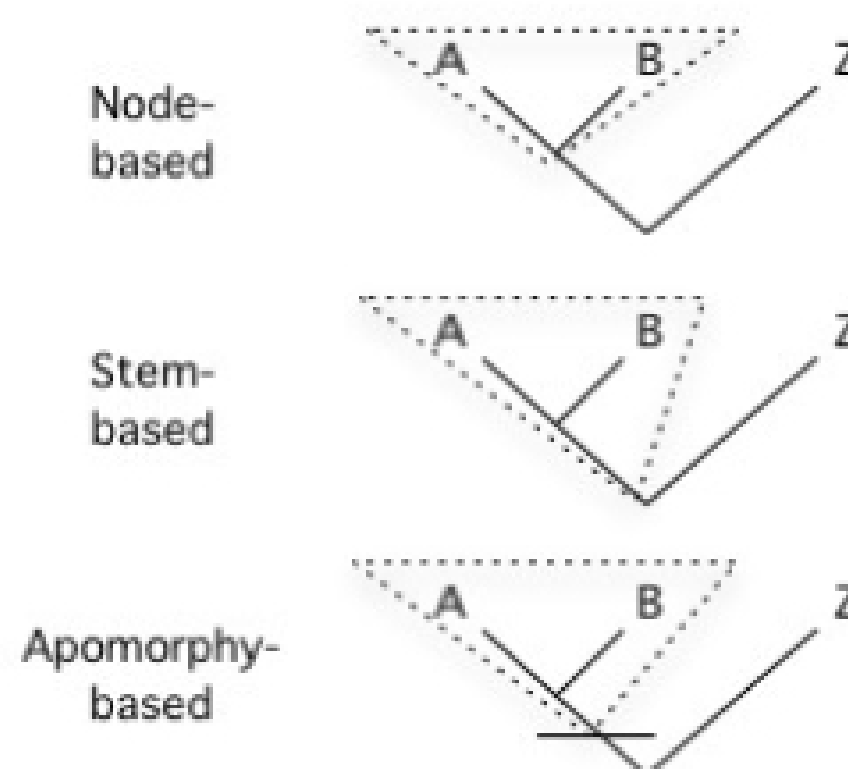


Figure 12-4
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9. In what way have the kinds of characters used to reconstruct phylogenies changed? How are phylogenies reconstructed?