

Chapter 26

Overview

- Taxonomy and Systematics
- Phylogenetic Trees
- Horizontal Gene Transfer

Taxonomy

The Science of describing, naming, and classifying living and extinct organisms and viruses.

Systematics

Study of biological diversity and the evolutionary relationships among organisms, both extinct and modern.

- Taxonomic groups are based on hypothesis regarding evolutionary relationships from systematics
- Hierarchical system involving successive levels
- Each group at any level is called a **taxon**
- Highest level is **Domain**
 - All life belongs to 3 domains
 - Bacteria, Archaea, and Eukarya
 - The Eukarya Domain is often divided into Kingdoms in the next level
This is typically called the 4 Kingdom concept

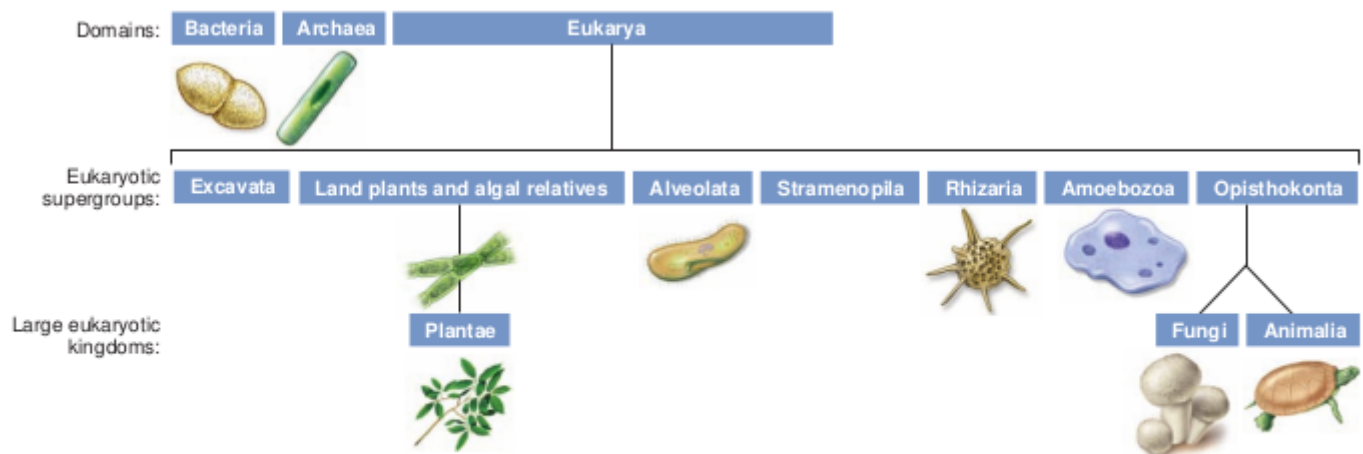


Figure 26.1 A classification system for living and extinct organisms. All organisms can be grouped into three large domains: Bacteria, Archaea, or Eukarya. Eukaryotes are divided into seven supergroups. As discussed in Chapter 28, the division of eukaryotes into supergroups is under current investigation and should be viewed as work in progress.

Four Kingdoms

- Domains Bacteria and Archaea
 - Prokaryotic cells
 - Lack nucleus
- Kingdom Protista, Fungi, Plantae, Animalia
 - Eukaryotic cells
 - True nucleus

Types of cells

Prokaryotic

- Lack Nucleus
- Lacks membrane-bound organelles
- Typically singled celled

Eukaryotic

- Well defined nucleus
- Membrane-bound organelles
- internal membrane system (compartments)

Binomial Nomenclature

- Genus name + Specific epithet
 - ex. *Homo sapiens* ('wise humans')

- Genus name is always capitalized
- Specific epithet is never capitalized
- Both names are either *italicized* or underlined

Phylogenetic Trees

- Phylogeny
 - Evolutionary history of a species or group of species
- To propose a phylogeny, biologist must use the tools of **systematics**
- Trees are usually based in morphological and genetic data
 - Subjective vs. Objective data
- Diagram that describes the phylogeny
- A hypothesis of evolutionary relationships among various species
- Based on available information

Monophyletic Group or Clade

- Group of species (taxon) consisting of the most recent ancestor and all of its descendants
- Smaller and more recent clades are nested within larger clades that have a common ancestor

Paraphyletic group

- Contains a common ancestor and some, but not all of its descendants

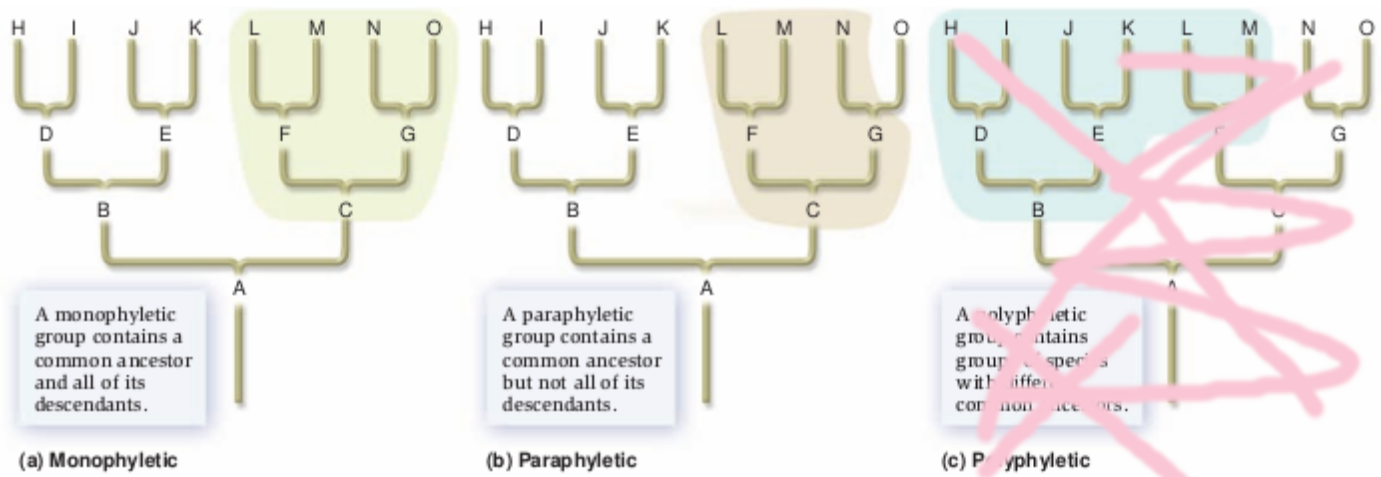


Figure 26.5 A comparison of monophyletic, paraphyletic, and polyphyletic taxonomic groups.

- Over time, taxonomic groups will be reorganized so that only monophyletic are recognized
- Reptiles were a paraphyletic group because birds were excluded
- **In the class and lab, we are going to separate birds and reptiles**

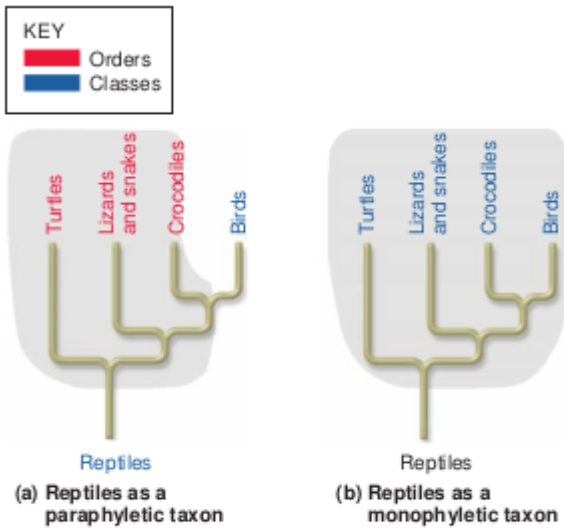


Figure 26.6 An example of a taxon that is not monophyletic. (a) The class of reptiles as a paraphyletic taxon. (b) The group can be made monophyletic if birds and the other orders were classified as classes within the reptile clade.

Systematics

Morphological Analysis

- First systematic studies focused on morphological features of extinct and modern species
- Most of early classifications were based upon morphological features

Molecular Analysis

- Analysis of genetic data (DNA, Amino Acids, rRNA) to identify and study genetic similarities and propose phylogenetic trees
- DNA and Amino Acid sequences from closely related species are more similar to each other than sequences from more distantly related species

Horizontal Gene Transfer

- any process in which an organism incorporates genetic material from another organism without being the offspring of that organism (by means of asexual reproduction)

Vertical Evolution

- Changes in groups due to descent from a common ancestor (sexual reproduction)

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