

# Chapter 26

## Overview

- Taxonomy and Systematics
- Phylogenetic Trees
- Horizontal Gene Transfer

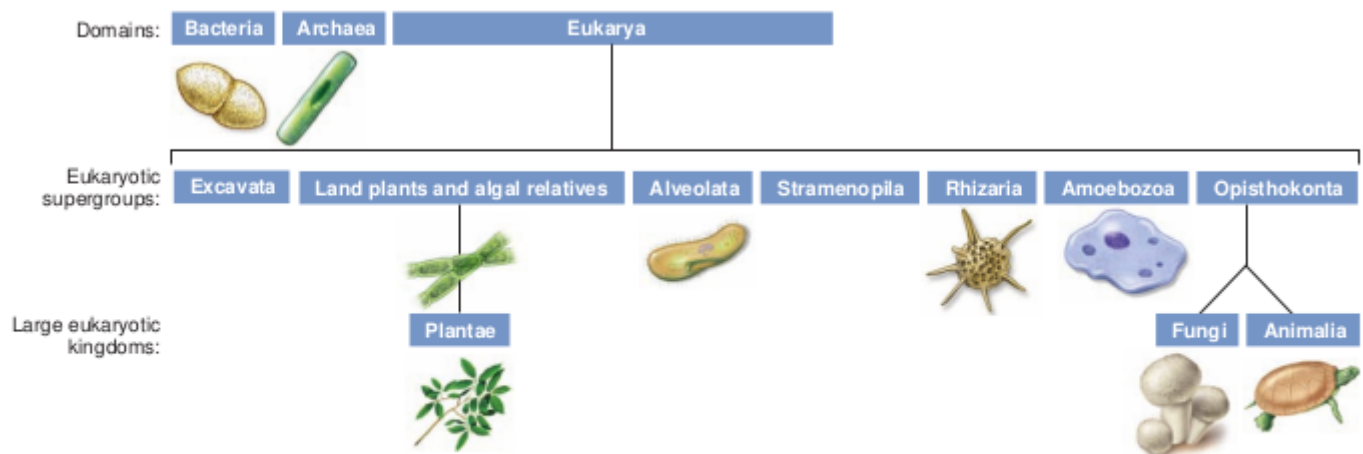
## Taxonomy

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

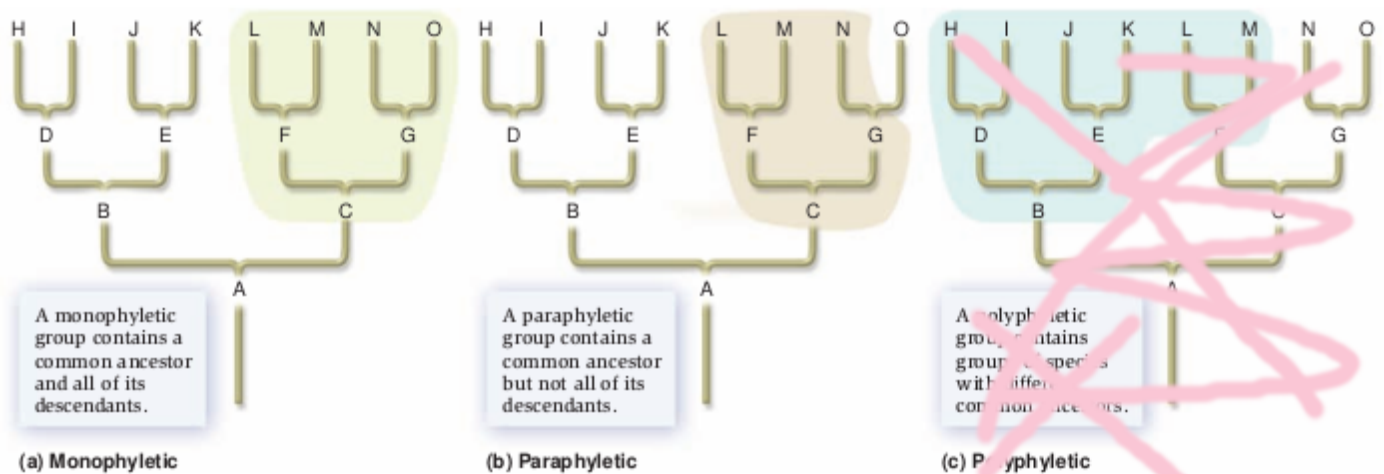
- Phylogeny
  - Evolutionary history of a species or group of species
- To propose a phylogeny, biologist must use the tools of **systematics**
- Trees are usually based in morphological and genetic data
  - Subjective vs. Objective data
- Diagram that describes the phylogeny
- A hypothesis of evolutionary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

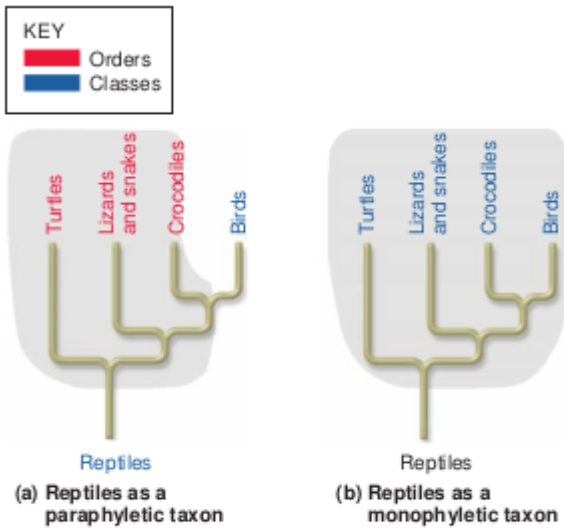
## Paraphyletic group

- 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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Created 2019-01-28 00:01:27 UTC by Aaron Kimbrell  
Updated 2019-04-01 05:09:41 UTC by Aaron Kimbrell