

Topic: Systematics

Reading: Chapter 18

Main concepts:

- Taxonomy is the science of naming and classifying living organisms. Systematics builds on the older science of taxonomy and works to classify things according to their phylogeny: their evolutionary relationships. Relationships are inferred from morphology (what the organisms looks like) and molecular similarities (such as genetics).
- Taxa (singular: taxon) are hierarchical categories into which living things are sorted by their degree of relatedness. The current taxonomic levels are: domain, kingdom, phylum, class, order, family, genus, species. "Domain" is a new taxon. A species name consists of two parts: the genus and the specific epithet.
- Cladistics is a method of reconstructing phylogenetic trees using degrees of relatedness. A cladogram is a forked diagram showing hypothesized splits in groups of organisms over time.
- Domains Archaea and Bacteria are prokaryotic (single-celled organisms that lack membrane-bound organelles). Domain Eukarya contains kingdoms Protista, Fungi, Plantae, and Animalia.
- Kingdoms Plantae, Fungi, and Animalia appear to be monophyletic — that is, each group appears to have had a single ancestral type. Kingdom Protista is multiphyletic, which makes it a poor taxon in modern schemes. Originally, Protista contained all single-celled eukaryotes, but even then it was monophyletic. It has become a catch-all kingdom for things that are hard to classify. In the future it will probably be split into more naturalistic groups, but many of the organisms are poorly understood, and there is controversy over where to make the splits.
- Classifications frequently change. The concept of "species" is difficult to define, and tension exists between the "lumpers" and "splitters" among systematic biologists. One definition that systematists have proposed for "species" is the phylogenetic species concept: "The smallest diagnosable group that contains all the descendants of a single common ancestor."
- The vast majority of species currently living on Earth have not been named or described. We know that biodiversity is vast, but we understand only a small fraction of it. Naming and describing organisms is an important first step to understanding how different ecosystems work, especially endangered ecosystems.

Common misconceptions:

- Most people believe that species are easy to define, often because the organisms they are most familiar with are well-defined domestic animals: dogs, cats, horses, etc. In the natural world, scientists may observe, for example, two populations of birds that look very much alike, but perhaps rarely meet and interbreed. Deciding whether to call them separate species or two populations of the same species can be difficult.
- Because we are more aware of vertebrate animals, students often believe that vertebrate animals are "dominant" or "most abundant." However, around 90% of animals species that have been named are invertebrates. And animals are vastly outnumbered by protists and prokaryotes.

Reading notes:

- What major contribution to systematics did Linnaeus make? How did Darwin's work change the way that scientists viewed classification?
- What features of an organisms are used to describe it and determine its relationships to other organisms?
- How does the proposed phylogenetic concept of "species" differ from the ecological definition given on page 3 (section 1.1) of your textbook?
- List the major defining features of the three domains and the four kingdoms within Domain Eukarya.
- What is a cladogram, and how is one constructed?
- What is biodiversity, and why is it important?

Useful websites:

- "Encyclopedia of Life" <http://www.eol.org> is a worldwide project, spearheaded by E.O. Wilson, to catalog the living species and describe the biodiversity on Earth.
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