

Diversity Introduction - 1

A part of Biology 213 focuses on the diversity of organisms with whom we share our world. Diversity crosses all three terms of BCC's one-year biology course. Animal diversity is included in Biology 212 and bacterial genetics is briefly discussed in Biology 211. Biology 211 also includes an introduction to the broad classification systems used today, and many in Biology 212 learn much about current classification schemes through the study of evolutionary relationships of organisms. The diversity of Eubacteria, Archaea, Protists, Fungi and Plants traditionally are a part of Biology 213, with emphasis on plant diversity.

Throughout recorded history, humans have been trying to find natural explanations for our observations of events around us, including explanations for the wonderful diversity of organisms. Humans of all cultures have tried to group, or **classify** organisms, in attempts to clarify what has been observed.

Like everything else in biology, classification systems are a work in progress, and we are constantly reviewing and modifying our classification system. In particular, as we learn more, we refine and subdivide. From the two-kingdom system that "worked" from the mid-1700's to the mid-1900's, when Whittaker introduced the 5 kingdoms. We have now grown to a multiple kingdom system, particularly to address the "protists" of the Whittaker system of the 1960's and added a new, broader category above kingdom, the domain.

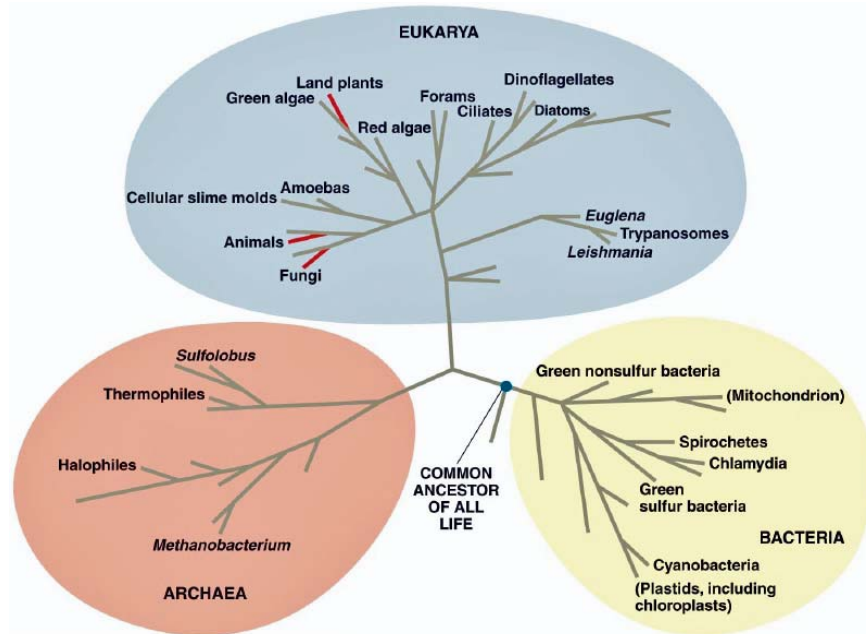


In Biology 211 we discussed ways in which DNA analysis is providing a means for classification based on common DNA (or RNA) sequences within genomes.

Data from molecular, morphology, and developmental traits, as well as other evolutionary data, are used to develop phylogenetic relationships among organisms, as is often studied in Biology 212. Such relationships are changing rapidly as systematic biologists learn more about organisms, particularly genomic relationships.

There is much information in your textbooks about how decisions are made in classification and how we organize groups of organisms.

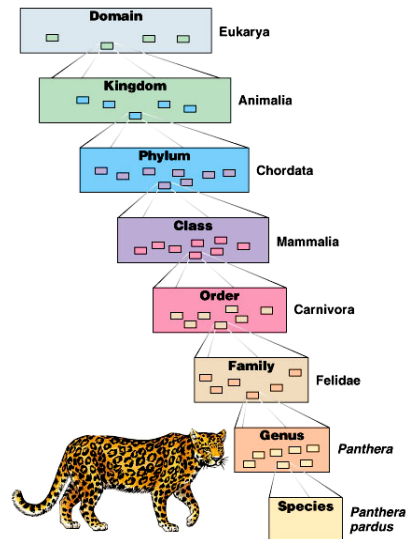
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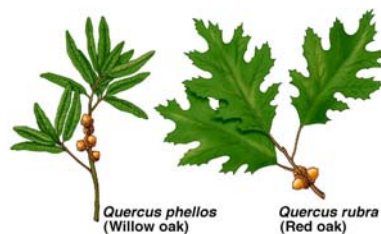
A "Tree of Life" developed from rRNA analyses

Nonetheless, classification categories we use today, first proposed by Carl von Linne (Linnaeus) in the 1700's are:

- Domain
- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species

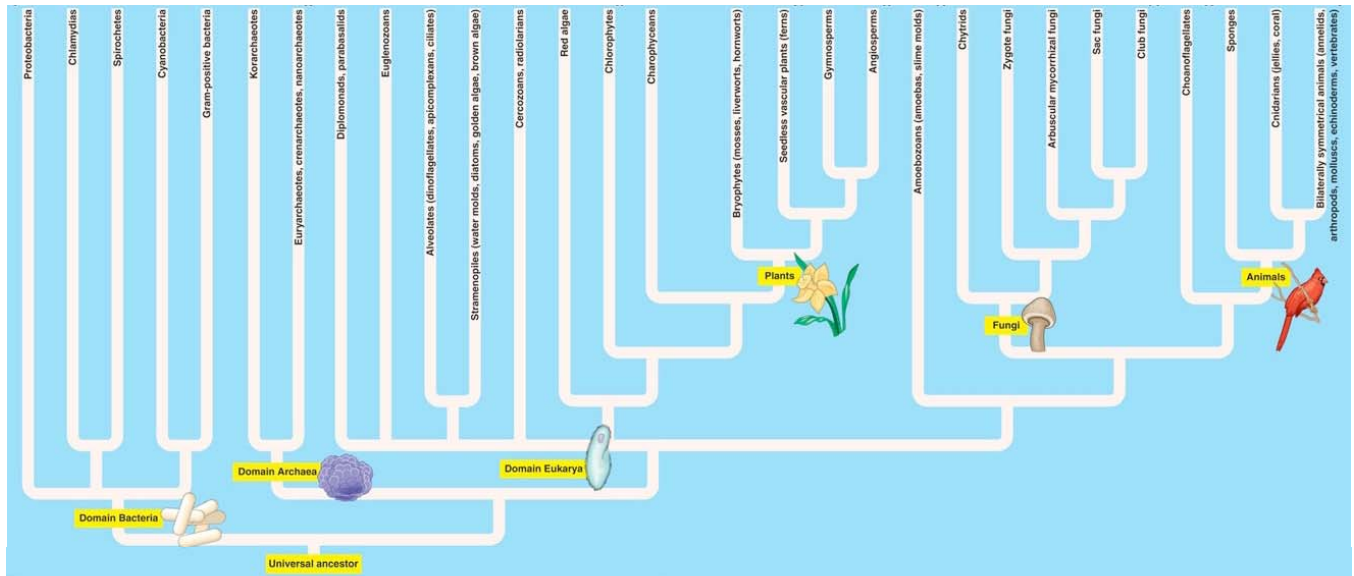


Each kind of organism is identified by species. The species name is a binomial, consisting of the genus plus a specific epithet. The genus name is capitalized and the specific epithet is not; when used in print, the species name should be italicized or underlined. The species name is also commonly called the "scientific name". Many common names can be (and are) given to any one species.



Brief Review of Domains and Kingdoms

As an introduction, it will be helpful to review the domains and kingdoms that have some level of agreement among biologists today.



Characteristics of the Three Domains

CHARACTERISTIC	BACTERIA	DOMAIN ARCHAEA	EUKARYA
Membrane-enclosed nucleus	Absent	Absent	<i>Present</i>
Membrane-enclosed organelles	Absent	Absent	<i>Present</i>
Peptidoglycan in cell wall	<i>Present</i>	Absent	Absent
Membrane lipids	Ester-linked	<i>Ester-linked</i>	Ester-linked
	Unbranched	<i>Branched</i>	Unbranched
Ribosomes ^a	70S	70S	80S
Initiator tRNA	<i>Formylmethionine</i>	Methionine	Methionine
Operons	Yes	Yes	<i>No</i>
Plasmids	Yes	Yes	<i>Rare</i>
RNA polymerases	One	One ^b	<i>Three</i>
Ribosomes sensitive to chloramphenicol and streptomycin	Yes	No	No
Ribosomes sensitive to diphtheria toxin	<i>No</i>	Yes	Yes

^a70S ribosomes are smaller than 80S ribosomes.

^bArchaeal RNA polymerase is similar to eukaryotic polymerases.

Prokaryotic Organisms

Domain and Kingdom Bacteria

- Prokaryotic cell structure
 - No internal membrane bounded structures (no organelles)
 - Genetic material not found within a nucleus
- Peptidoglycan in cell walls
- Includes
 - Cyanobacteria
 - Proteobacteria
 - Firmicutes
 - Spirochaetes
 - Chlamydia

Domain and Kingdom Archaea

- Prokaryotic cell structure
 - No internal membrane bounded structures (no organelles)
 - Genetic material not found within a nucleus
- Lack peptidoglycan in cell walls
- Biochemically unique in their methods of obtaining nutrients
- Often restricted to harsh environments (Halophiles, Thermophiles, and Methanogens)
- Includes
 - Euryarchaeota
 - Crenarchaeota
 - Korarchaeota
 - Nanoarchaeota

Eukaryotic Organisms (Domain Eukarya)

The Domain Eukarya includes three kingdoms of multicellular organisms that can readily be distinguished from each other, and the "everything else" (or the "dreaded" protists) being revisited by systematic biologists.

Kingdom Plantae

- Photosynthetic Autotrophs
Obtain inorganic materials from the external environment and process them into the organic compounds needed for life.
- Cells secrete a cell wall exterior to the plasma membrane
- Classified by life history variations, as well as presence or absence, and types of vascular tissue
- Some traditional "algae" groups, placed within the protists group in the mid-1900's are now being allied with plants. They include the red and green algae. Algae, which are aquatic organisms, have little or no tissue development, but share, in particular, similarities in chloroplast development with the land plants.

Kingdom Fungi

- Non-photosynthetic Heterotrophic
Obtain organic materials from the external environment and assimilate them for their needs
- Cells secrete a cell wall exterior to the plasma membrane
- Classified by cell structure, reproductive structures and life history

Kingdom Animalia

- Heterotrophic
- Cells lack a cell wall
- Classified by a combination of anatomical features and increasingly, developmental and molecular genetic similarities.

Kingdoms of the "Protists"

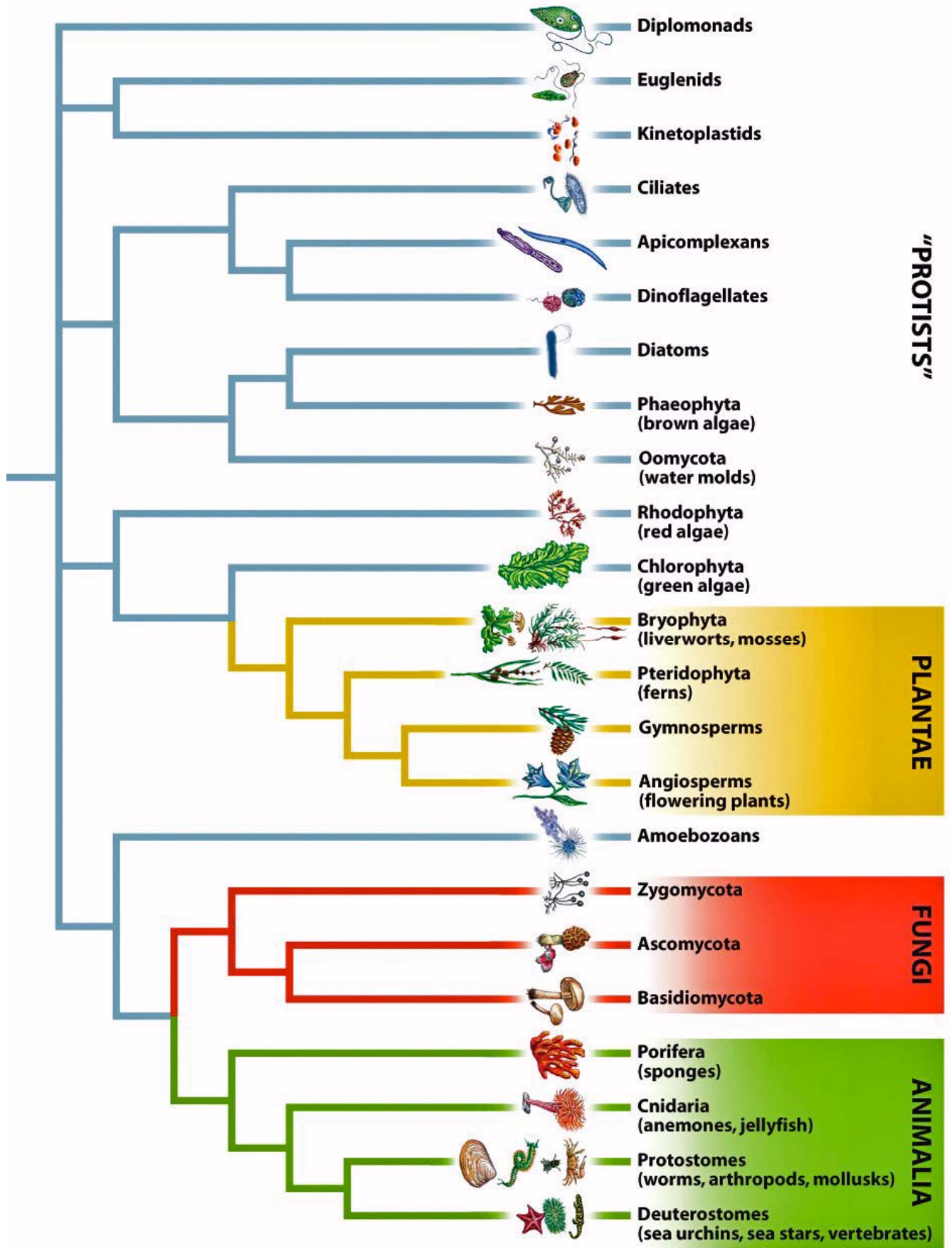
Includes organisms that don't fit into the other three eukaryotic kingdoms. The protists are divided into multiple kingdoms and alliances, depending on which "authorities" are used by text authors. In general:

- Protists lack "true" tissue development
- Have a variety of means of nutrition
- Have a variety of locomotory mechanisms

A more detailed list of classification features is on the "General Characteristics of the Domains and Kingdoms" Handout available on the class internet site compiled from assorted references, and in the *Life*, 9th edition textbook, Appendix A.

Note: The classification systems used in the textbooks for Biology 213 are not identical. This is common. No two authors are in agreement about classification. You can compare the classification appendices from different texts. The Raven et al, *Biology of Plants* text does not include the animal kingdom or those protists formerly included in the Protozoa (the non-photosynthetic protists).

Eukaryotes Classification



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