Taxonomy

The traditional "Linnean" taxonomic naming system for life uses seven levels of organization called taxa.

Kingdom

Phylum

Class

Order

Family

Genus

Species

This system uses the **binomial nomenclature** format to name individual species. In other words, the scientific name of a species includes two words; a capitalized genus followed by a species name in lower case.

Example 1

Common name: **Beaver**

Scientific name: ***Castor canadensis***

Genus Species

Example 2

Kingdom	Animalia	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Mammalia	Mammalia
Order	Artiodactyla	Artiodactyla	Artiodactyla	Artiodactyla
Family	Cervidae	Cervidae	Cervidae	Cervidae
Genus	Odocoileus	Odocoileus	Cervus	Alces
Species	*Odocoileus virginianus*	*Odocoileus hemionus*	*Cervus elaphus*	*Alces alces*
abbreviated species name	*O. virginianus*	*O. hemionus*	*C. elaphus*	*A. alces*
Image				
Common name	White tailed deer	Mule deer	Elk	Moose

Carl Linnaeus grouped species by distinctive physical characteristics. The physical characteristics of an organism are collectively known as its morphology. The morphological concept of species (that is dividing up species based on features of their morphologies) is very useful, but imperfect. There remain challenging questions such as how morphologically different must individuals be to be considered a different species? Where do we draw the line between species especially when they are morphologically very similar? What criteria can be used to decide at what point we call similar organisms separate species? In other words, how can we define the term *species*?

What is a Species?

The Biological Species Concept:

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What are the main problems / limitations of the morphological and biological definitions of species?

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How has genetics impacted taxonomy?

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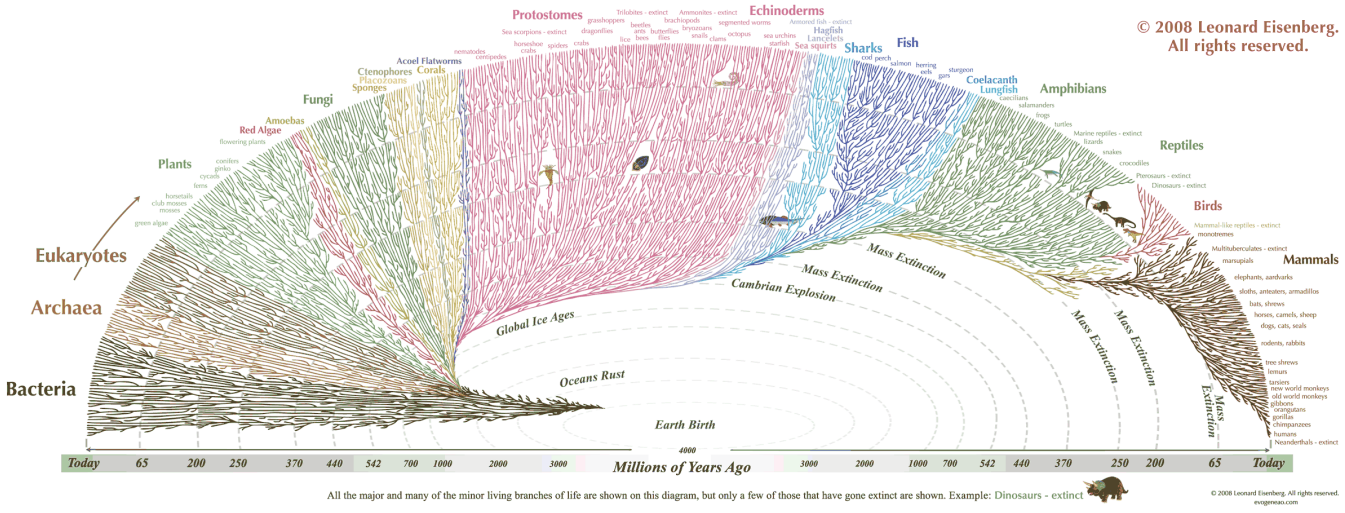
When organisms are grouped by morphology it becomes clear that there is a full spectrum of complexity of organisms. Life exists as simple one celled (unicellular) organisms and as increasingly complex multicellular forms. Linnaeus and others attempted to rank organisms from the "lowest" to "highest" forms. Over time, scientists began to notice that older fossils contained increasingly more simple organisms. Darwin's theory of evolution which was later confirmed by modern genetics has led us today to interpret the diversity of life on earth as a result of shared common ancestors changing over time from the simplest to the most complex forms. Organisms are no longer viewed as higher or lower on the tree of life, but rather as a combination of preserved successful forms of life living parallel to and interdependent with their continually diversifying family of living close and distant relatives.



What is Phylogenetics?

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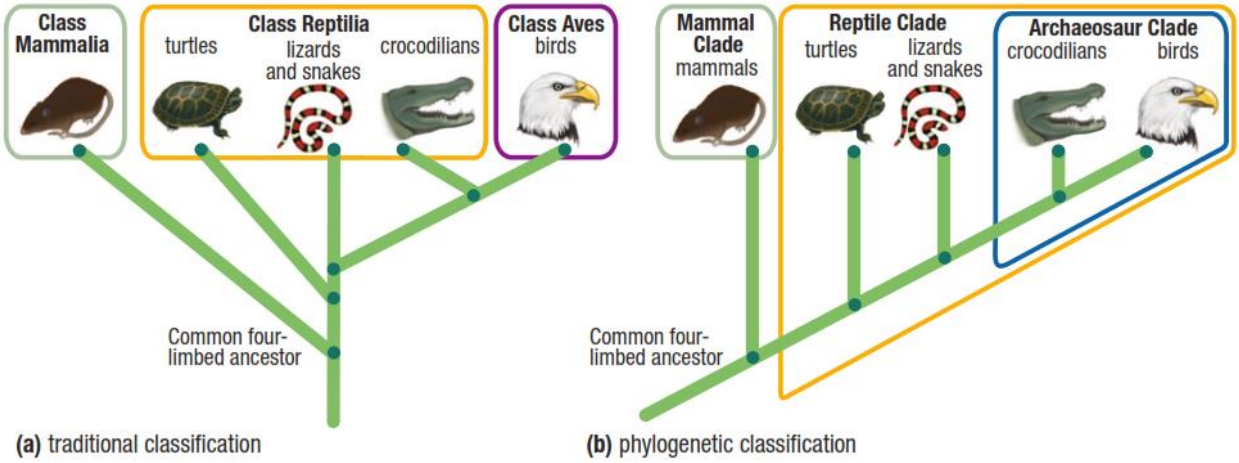
A phylogenetic tree is a diagram combining taxonomic information with genetic information to show the evolutionary relatedness of species as we best understand it today. The image on the previous page is one example of a phylogenetic tree. One key advantage of producing a diagram like this is that more meaningful groups of organisms can be made based on shared ancestry. Compare the images below see how the classification of the crocodilians has changed today.



Phylogenetics has led to new taxonomic groupings called ***clades***. This refers to a group of organisms that includes a common ancestor and all of its known decedents. Clades can be very broad or very narrow depending on how long ago they shared a common ancestor and how much diversification has occurred since. The clade system is not limited to only seven levels of taxonomic rankings like the traditional classification system. On the other hand, it can be very challenging to accurately determine evolutionary relatedness using both fossil and genetic information as compared to grouping organisms by morphology.

The traditional taxonomic classification system and modern phylogenetics both have pros and cons and are the two primary ways in which we study taxonomy in biology. A solid foundation in both is essential to understanding biology.

Identify whether each of the following boxes represents a clade or not: