

## Chapter 26: Phylogeny and the Tree of Life

### 1. What is systematics? How is it used to develop phylogenetic trees?

To construct phylogenies, biologists utilize systematics, a discipline focused on classifying organisms and determining their evolutionary relationships. Systematists use data ranging from fossils to molecules and genes to infer evolutionary relationships.

### 2. What is taxonomy?

Taxonomy is the scientific discipline of naming and classifying organisms.

### 3. What is your binomial?

The two-part format of the scientific name, commonly called a binomial, was instituted in the 18<sup>th</sup> century by Carolus Linnaeus. Since I'm human, my binomial is *Homo sapiens*, meaning "wise man".

### 4. What are the two components of every binomial?

The first part of a binomial is the name of the genus to which the species belongs. The second part, called the specific epithet, is unique for each species within the genus.

### 6. Which are more closely related, organisms in the same phylum, or those in the same order?

Organisms in the same order are more closely related.

### 8. What is molecular systematics?

Molecular systematics, the discipline that uses data from DNA and other molecules to determine evolutionary relationships, is a valuable tool used today to sort homology from analogy.

### 9. What is a clade?

In the approach to systematics called cladistics, common ancestry is the primary criterion used to classify organisms. Using this methodology, biologists attempt to place species into groups called clades, each of which includes an ancestral species and all of its descendants. Clades, like taxonomic ranks, are nested within larger clades.

### 10. Why is Group I monophyletic?

Group I, consisting of three species (A, B, C) and their common ancestor (1) is a clade, also called a monophyletic group, which consists of an ancestral species and all of its descendants.

### 11. Why is Group II paraphyletic?

Group II is paraphyletic: it consists of an ancestral species (2) and some of its descendants (D, E, F) but not all of them (not G).

### 12. What is a polyphyletic group?

Group III is polyphyletic, meaning that some of its members have different ancestors. In this case, A, B, and C share a common ancestor (1), but species D has a different ancestor (2).

### 13. What are shared derived characters?

A shared derived character is an evolutionary novelty unique to a clade.

### 14. Why is hair, but not a backbone, a shared derived character for mammals?

For mammals, the backbone is a shared ancestral character, which originated in an ancestor of the taxon. In contrast, hair is a character shared by all mammals but not found in their ancestors.

20. *What two domains include all prokaryotes? Which two domains are most closely related?*

The domain Bacteria contains most of the currently known prokaryotes, including the bacteria closely related to chloroplasts and mitochondria. The second domain, Archaea, consists of a diverse group of prokaryotic organisms that inhabit a wide variety of environments. The third domain, Eukarya, consists of all the organisms that have cells containing true nuclei. Archaea and Eukarya are most closely related, having diverged most recently from Bacteria.

21. *Which kingdom is made obsolete by the three-domain system? Why?*

Of the five kingdoms previously recognized by taxonomists, most biologists continue to recognize Plantae, Fungi, and Animalia, but not Monera, which is obsolete because it would have members in two different domains.

22. *Which kingdom crumbled because it is polyphyletic?*

The kingdom of Protista has also crumbled because it includes members that are more closely related to plants, fungi, or animals than to other protists.