Phylogeny and the Tree of Life

Overview: Investigating the Tree of Life

- Classification is the grouping of organisms based on similar features. Systematics is the discipline of the classification of organisms and determines their evolutionary relationships. Systematists use fossil, molecular, and genetic data to infer evolutionary relationships.
- **Taxonomy** is the ordered division and naming of organisms. In other words, taxonomy is the science of studying classification. It looks at features and tries to arrange them in a logical order.

- **Species**
- «a group of living organisms which have been inhabiting a particular habitat for a certain period, consisting of similar individuals capable of exchanging genes or interbreeding. Their biochemical, behavioral and physiological responses are similar when exposed to similar environmental conditions»

Using *common names can be very confusing* because there are usually multiple *different names* given to the same organism using *different languages* that are not known to everyone.

Tench (English)
Suder (Flemish)
Schlei (German)
Kadife (Turkish)

- Scientific names are unique to only one type of organism and use Latin so that no matter what country a scientist is from or what language they speak, they will understand each other.

Canis lupus L., 1758

- The first letter of the genus is capitalized, and the entire species name is written in italics.
- Both parts together name the species. This is the species specific epithet.

Hierarchical Classification

- Linnaeus introduced a system for grouping species in increasingly broad categories.
- A ‘species’ is the fundamental taxon. Groups of similar species form the next largest taxon called a ‘genus’. Groups of similar genera form the next largest taxon called a ‘family’ …and so on, up to the largest taxon = **Domain**.
- The taxonomic groups from broad to narrow are, **domain**, **kingdom**, **phylum**, **class**, **order**, **family**, **genus**, and **species.**
- A taxonomic unit at any level of this hierarchy is called a **taxon.**

Classification and Phylogeny

- **Phylogeny** is the evolutionary history of a species or group of related species.
- Systematists investigate the evolutionary relationships using branched **phylogenetic trees.**
- A phylogenetic tree represents a hypothesis about evolutionary relationships, including a common ancestor and all its descendents.
- A phylogenetic tree is a family tree that shows a hypothesis about the evolutionary relationships thought to exist among groups of organisms. It does not show the actual evolutionary history of organisms.

Phylogenetic trees are usually based on a combination of these lines of evidence:

- **Fossil records**
- **Morphology**
- **Embryological patterns of development**
- **Chromosomes and DNA**

Fossil records

- The fossil records often provide clues to evolutionary relationships
- It cannot be read like a story book because some fossil records are incomplete
- Systematic taxonomists consider other evidences to confirm the information contained within the fossil record with other lines of evidence.

Morphology

Taxonomists study an organism's morphology and compare it to other living organisms.

Homologous features are important. But it is important to separate features that are **truly** homologous with those that seem homologous but are actually analogous.

The more homologous features two organisms share, the more closely related they are thought to be.

Embryological Patterns of Development

Early pattern in embryological development provide evidences for phylogenetic relationships.
They are also useful for testing hypotheses about relationships that have developed from other lines of evidence.

Chromosomes and Macromolecules

Organisms with similar morphologies or DNA sequences are likely to be more closely related than organisms with different structures or sequences.

Scientists compare amino acid sequences for homologous protein molecules of different species. The number of amino acid differences are clue to how long ago two species diverged from a shared evolutionary ancestor.