CLASSIFICATION

Why Classify?

Classification has been around ever since people paid attention to organisms.

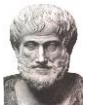
One primeval system was based on "harmful" and "non-harmful" organisms.

Life is easier when we organize things into groups.

History of Taxonomy

- **Biodiversity:** variety of organisms at all levels from populations to ecosystems.
- **Taxonomy**: the science of classifying living organisms according to their characteristics and evolutionary history
- **Taxa**: categories into which the organisms are classified.
- **Phylogeny**: evolutionary relationships between organisms

History



- Aristotle (Greek, ~300 BC)
  - divided animals into three groups based on where they lived- land, water, or air
  - divided plants into three groups based on differences in their stems

History

- Romans and Greeks: grouped plants and animals into basic categories
  - called "genus"
  - Latin work for group
- Middle ages: organisms classified in Latin
- 1700's: organisms named by adding descriptive phrases to genus
  - problem: sometimes consisted of 12 or more Latin words

LINNAEUN SYSTEM

Carolus von Linnaeus
(Swedish biologist, 1735)

- developed classification system based only on structural feature similarities
  - different features= different species
  - same features= same species
- Widely accepted by early 19th century
- Basic framework for all taxonomy today

Linnaean System

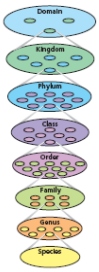
- **Binomial Nomenclature** (2 word naming system)

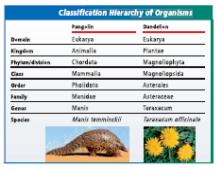
Genus: category containing similar species (noun, capitalized)

Species: single descriptive word (always lower case)

Ex: Red oak: Quercus rubra
Willow oak: Quercus phellos
(common name) (scientific name)

Linnaean System





Taxa:

Kingdom	King
Phylum	Phillip
Class	Came
Order	Over
Family	For
Genus	Great
Species	Spaghetti

most broad category → least inclusive

Linnaean System, cont.

Seven Taxa:	For Example:	For Example:
• Kingdom	Animalia	Animalia
• Phylum	Chordata	Chordata
• Class	Amphibia	Reptilia
• Order	Salientia	Testudines
• Family	Hylidae	Emydidae
• Genus	Hyla	Chrysemys
• Species	cinerea	scripta
	Green Tree Frog	Yellow-Bellied or Red-Eared Slider (Pond Turtle)

Modifications to Linnaean System

- The common system used today has five kingdoms, into which the organisms found on earth are classified:

1. Monera: (prokaryotes) bacteria.
2. Protista: (eukaryotes) microscopic, often unicellular.
3. Fungi: (eukaryotes) mushrooms, molds, lichens, etc....
4. Plants: (eukaryotes).
5. Animals: (eukaryotes).

Five Kingdom System (1969)

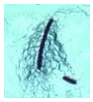
I. **KINGDOM MONERA** (monerans)

- 1 cell

- no true nucleus - prokaryote
(genetic material scattered and not enclosedby a membrane)

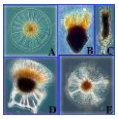
- some move (flagellum); others don't

- autotrophs and heterotrophs



ex: bacteria,
blue-green bacteria (cyanobacteria)

II. **KINGDOM PROTISTA** (protists)



- 1 cell

- have a true nucleus - eukaryote

- some move (cilia, flagella, pseudopodia); others don't

- some autotrophic; others heterotrophic

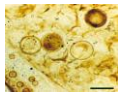
ex: amoeba, diatom, euglena, paramecium, some algae (unicellular), diatoms, etc.

III. KINGDOM FUNGI

- multicellular
- have nuclei
- mainly do not move from place to place
- heterotrophic (food is digested outside of fungus)

examples - mushroom, mold, puffball, shelf/bracket fungus, yeast, etc.





IV. KINGDOM PLANTAE

- multicellular
- have nuclei
- do not move
- autotrophic

examples - multicellular algae, mosses, ferns, flowering plants, trees, etc






V. KINGDOM ANIMALIA

- multicellular
- have nuclei
- do move
- heterotrophic

ex: sponges, jellyfish, insects, fish, frog, bird, man

SYSTEMATICS

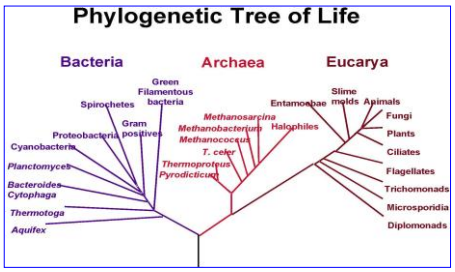
- Linnaeus classified organisms by outward structural similarities.
- Modern biologists also consider similarities in embryos, chromosomes, proteins, and DNA.

Systematics

Study of evolutionary relationships among organisms

Phylogenetics

- **Phylogenetics**: analysis of the evolutionary relationships among taxa (categories) based on:
  - visible similarities
  - embryological similarities
  - chromosome, DNA, RNA similarities
  - fossil record
  - homologous features

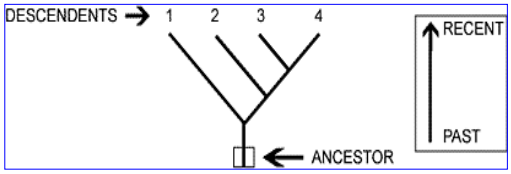


Phylogenetic Tree (Phylogeny)

Diagram that has branching pattern that shows relationship of organisms

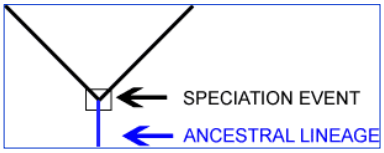
Reading Phylogenetic Trees

- like reading a family tree
- root of the tree represents the ancestral lineage
- tips of the branches represent the descendents of that ancestor
- as you move from the root to the tips, you are moving forward in time.



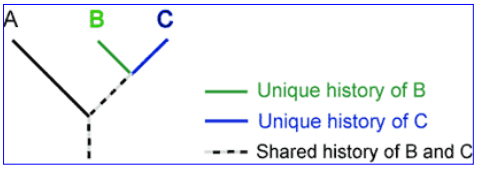
Reading Phylogenetic Trees

- When a lineage splits (speciation), it is represented as branching on a phylogeny
- When a speciation event occurs, a single ancestral lineage gives rise to two or more daughter lineages.



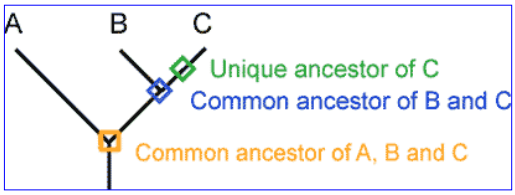
Reading Phylogenetic Trees

- Phylogenies trace patterns of shared ancestry between lineages.
- Each lineage has a part of its history that is unique to it alone and parts that are shared with other lineages.



Reading Phylogenetic Trees

- Similarly, each lineage has ancestors that are unique to that lineage and ancestors that are shared with other lineages — common ancestors



Cladistics

- Developed by Hennig (German) in 1966

Cladistics: system of taxonomy based on evolutionary relationships based on shared and derived characteristics

- determines sequence that different groups of organisms evolved
- focuses on nature of characters (traits) in different groups of organisms

- **ancestral (shared) characters/traits**:
  - evolved from common ancestor of both groups
  - feature that evolved only within the group

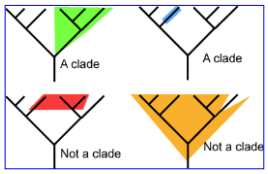
  ex: feathers in birds (evolved only in bird lineage, not inherited from ancestors that birds share with reptiles)

- **derived character/traits**:
  - set of unique characteristics found in specific group of organisms (common in all members of group)
  - evolved in an ancestor of one group but not the other

  ex: hair in mammals

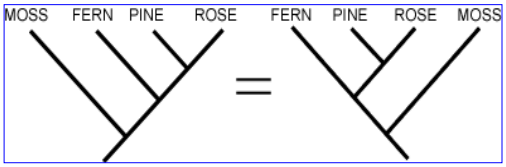
Cladograms

- **Cladogram**: phylogenetic diagram that is compares organisms
-
- **Clade**: evolutionary branch that includes common ancestor and all descendents (living and extinct) of that ancestor.
- **Outgroup**: organism that is only distantly related to other organisms, starting point for comparisons with other organisms being evaluated

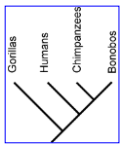


Reading Phylogenetic Trees

- For any speciation event on a phylogeny, the choice of which lineage goes to the right and which goes to the left is arbitrary.
- The following phylogenies are equivalent:



Reading Phylogenetic Trees

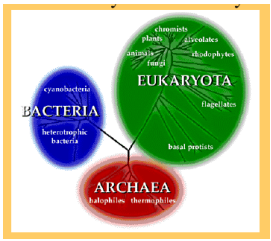


- **Misconceptions about humans**
- **It is important to remember that:**
  - **Humans did not evolve from chimpanzees.**
  - **Humans and chimpanzees are evolutionary cousins and share a recent common ancestor that was neither chimpanzee nor human.**
- **Humans are not "higher" or "more evolved" than other living lineages.**
- **Since our lineages split, humans and chimpanzees have each evolved traits unique to their own lineages.**

MODERN CLASSIFICATION

Three Domains/Superkingdoms (1990's)

- **Domain: taxonomic category above kingdom level**



Three Domains (Superkingdoms) Of Living Organisms

I. Bacteria: Most of the Known Prokaryotes

Kingdom (s): Not Available at This Time
Division (Phylum) Proteobacteria: N-Fixing Bacteria
Division (Phylum) Cyanobacteria: Blue-Green Bacteria
Division (Phylum) Eubacteria: True Gram Posive Bacteria
Division (Phylum) Spirochetes: Spiral Bacteria
Division (Phylum) Chlamydiae: Intracellular Parasites

II. Archaea: Prokaryotes of Extreme Environments

Kingdom Crenarchaeota: Thermophiles
Kingdom Euryarchaeota: Methanogens & Halophiles
Kingdom Korarchaeota: Some Hot Springs Microbes

III. Eukarya: Eukaryotic Cells

Kingdom Fungi
Kingdom Plantae
Kingdom Animalia

- Classification schemes will continue to be revised as new information is discovered about the relationships among organisms.