Cladistics

- **Clade** ("branch") — replace traditional taxon
  - Groups of organisms presumed to be derived from a common ancestor are organized by **bifurcating** (two-way splitting) of a branch
  - Each bifurcation is based upon the acquisition of a new, unique character (**apomorphy**).
- **Maximum parsimony**: the branch pattern that can be created with the fewest required steps is most likely the most correct.

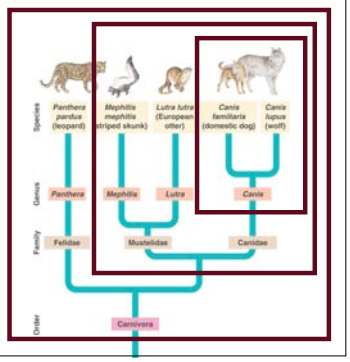
Cladistics

More vocabulary:

- A true **clade** must be **monophyletic**
  - must include an ancestor and all of the known descendants of that ancestor.
  - A grouping that only includes an ancestor and some of its descendants is **paraphyletic**.
  - A grouping that includes organisms from different ancestries is **polyphyletic**.
- Derived **apomorphic** characters shared by members of a clade are **synapomorphic**.
- Ancestral characteristics inherited prior to the branching of a clade are **plesiomorphic**.

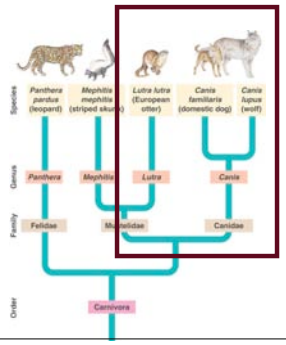
Cladograms

Monophyletic clades



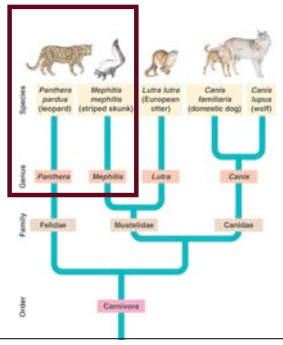
Cladograms

Paraphyletic grouping



Cladograms

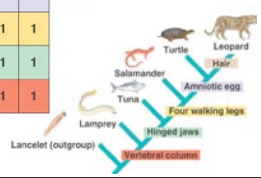
Polyphyletic grouping



Building Cladograms

Assemble a **table of character states**

	Lancelet (outgroup)	Lamprey	Tuna	Salamander	Turtle	Leopard
Hair	0	0	0	0	0	1
Amniotic (shelled) egg	0	0	0	0	1	1
Four walking legs	0	0	0	1	1	1
Hinged jaws	0	0	1	1	1	1
Vertebral column (backbone)	0	1	1	1	1	1



Building Cladograms

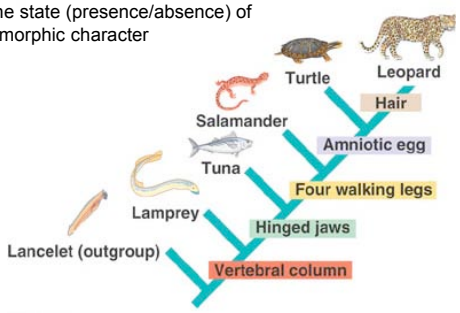
Major assumptions:

1. The group of organisms is monophyletic
2. The **outgroup** (used for comparison) is closely related to, but separate from your group
3. You can tell which character states are homologous or analogous.

	Lancelet (outgroup)	Lamprey	Tuna	Salamander	Turtle	Leopard
Hair	0	0	0	0	0	1
Amniotic (shelled) egg	0	0	0	0	1	1
Four walking legs	0	0	0	1	1	1
Hinged jaws	0	0	1	1	1	1
Vertebral column (backbone)	0	1	1	1	1	1

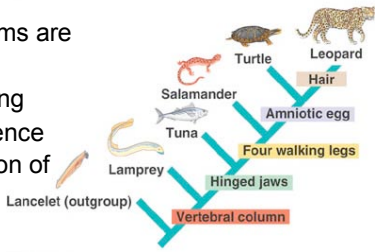
Building Cladograms

Each bifurcation of the branch is based upon the state (presence/absence) of an apomorphic character



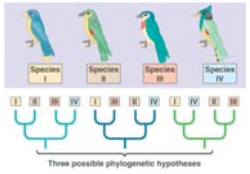
Cladograms

Cladograms are made by determining the sequence of evolution of shared derived characters



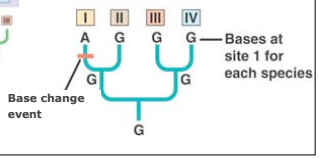
Cladograms

Rule of Parsimony:
The simplest explanation is the most likely explanation.



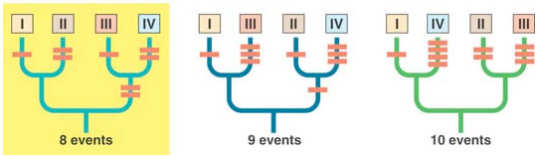
Sites in DNA sequence

Species	1	2	3	4	5	6	7
I	A	G	G	G	G	G	T
II	G	G	G	A	G	G	G
III	G	A	G	G	A	A	T
IV	G	G	A	G	A	A	G



Cladograms

Rule of Parsimony:
The simplest explanation is the most likely explanation.



Cladograms

Rule of Parsimony:
The simplest explanation is the most likely explanation.

But not always!