

LECTURE (4)

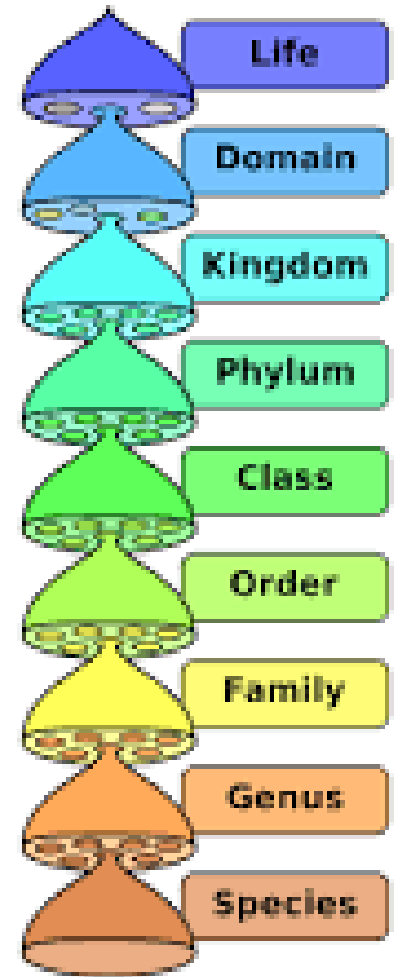
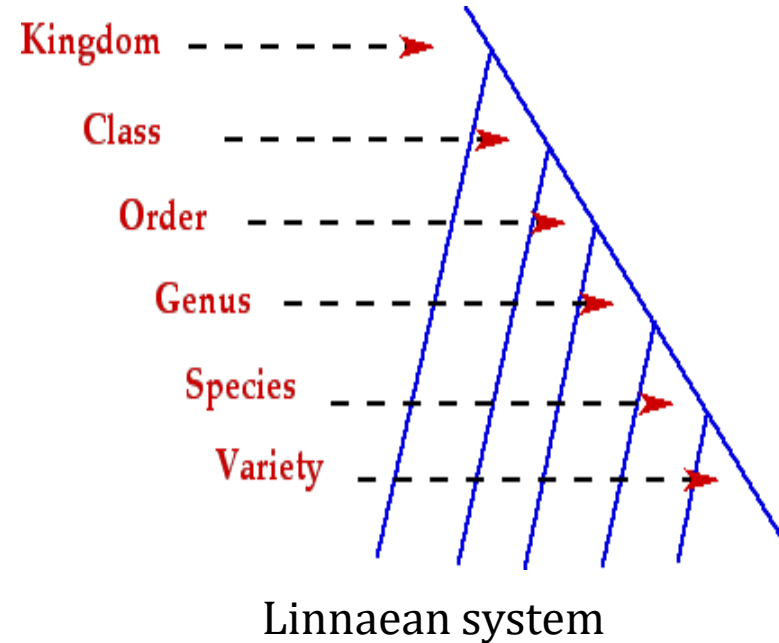
Theories of taxonomy



Taxa are grouped according to two main Theories of classification:

(1)- Traditional taxonomists

- use Linnaean system of binomial nomenclature and hierarchical ranks to reflect evolutionary history
- look at overall similarity or phonetics which may recognize groups



Hierarchical ranks

Class

Order

Family

Genus

Species 1
Species 2
Species 3
Species 4

Genus

Species 1
Species 2
Species 3

Family

Genus

Species 1
Species 2

Order

Family

Genus

Species 1
Species 2
Species 3
Species 4
Species 5
Species 6
Species 7
Species 8
Species 9

Genus

Species 1
Species 2

Genus

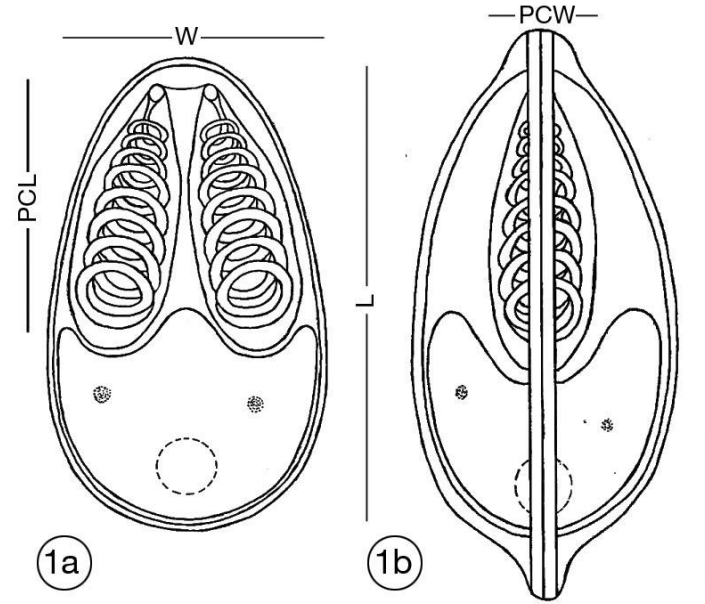
Species 1

Genus

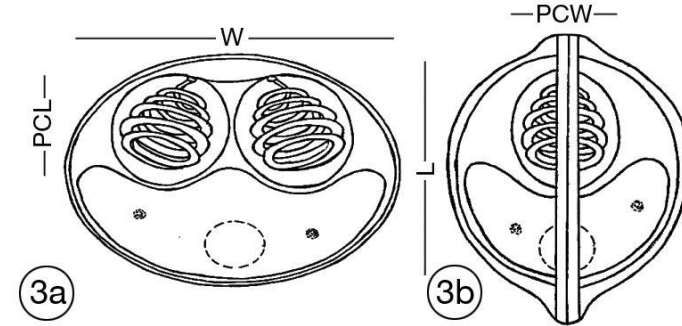
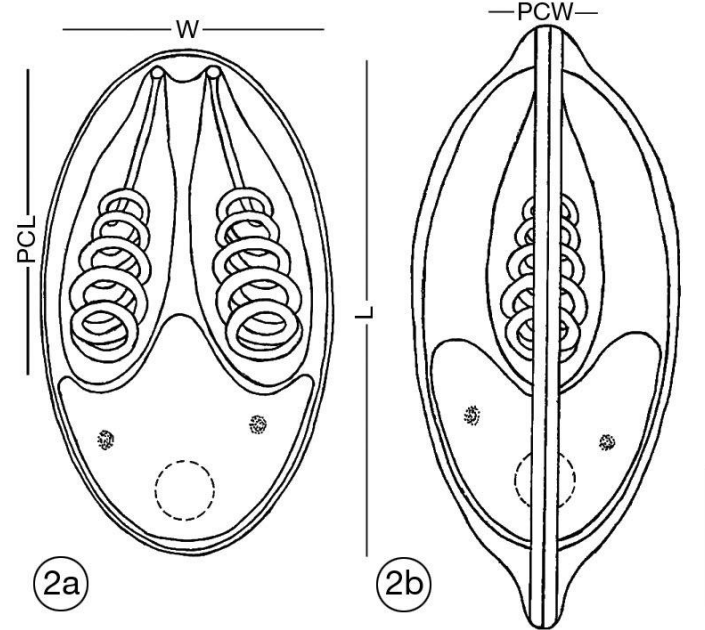
Species 1
Species 2
Species 3

Example

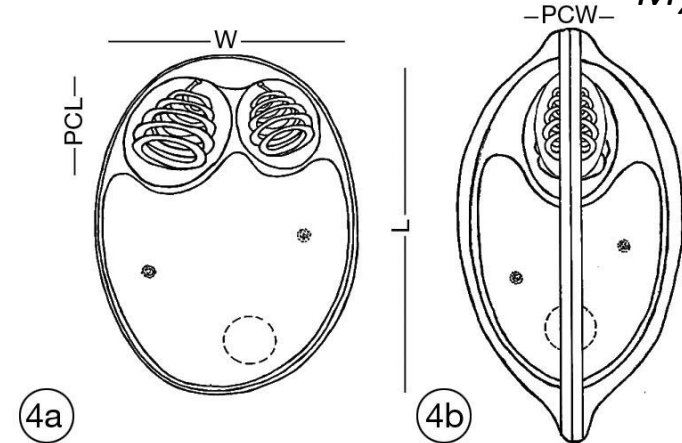
Myxobolus agolus



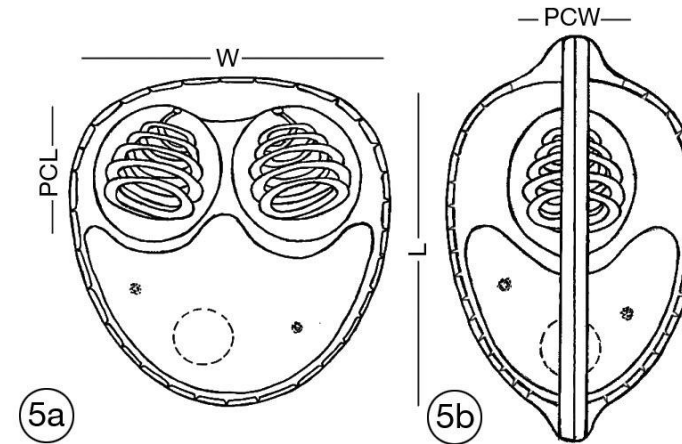
Myxobolus fomenai



Myxobolus brachysporus



Myxobolus tilapiae



Triangula egyptica

Which two species of reef sharks are most closely related?
How do you know?



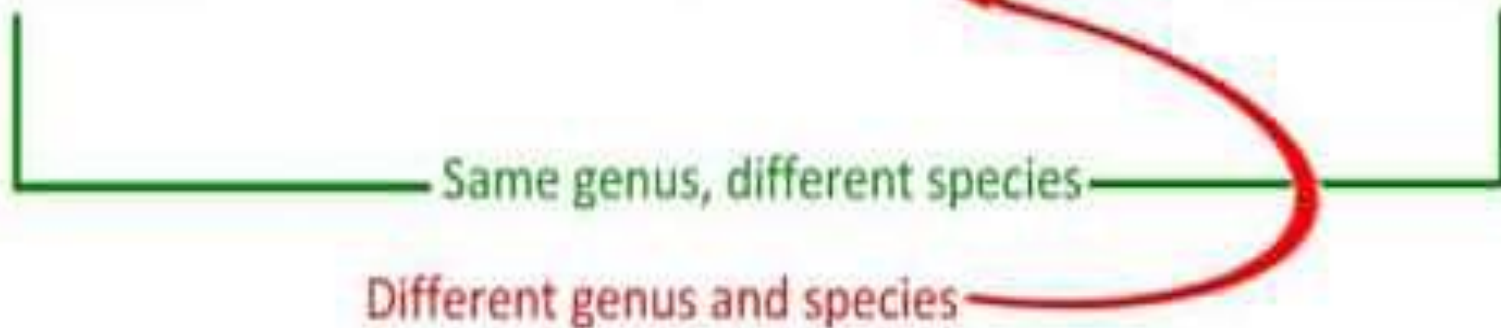
Carcharhinus melanopterus
Black-tip reef shark



Triaenodon obesus
White-tip reef shark



Carcharhinus perezii
Caribbean reef shark



Which two are most closely related?



Canis lupus familiaris
Domestic dog

Canis lupus laniger
Tibetan wolf

Canis rufus
Red Wolf

Same species, different subspecies

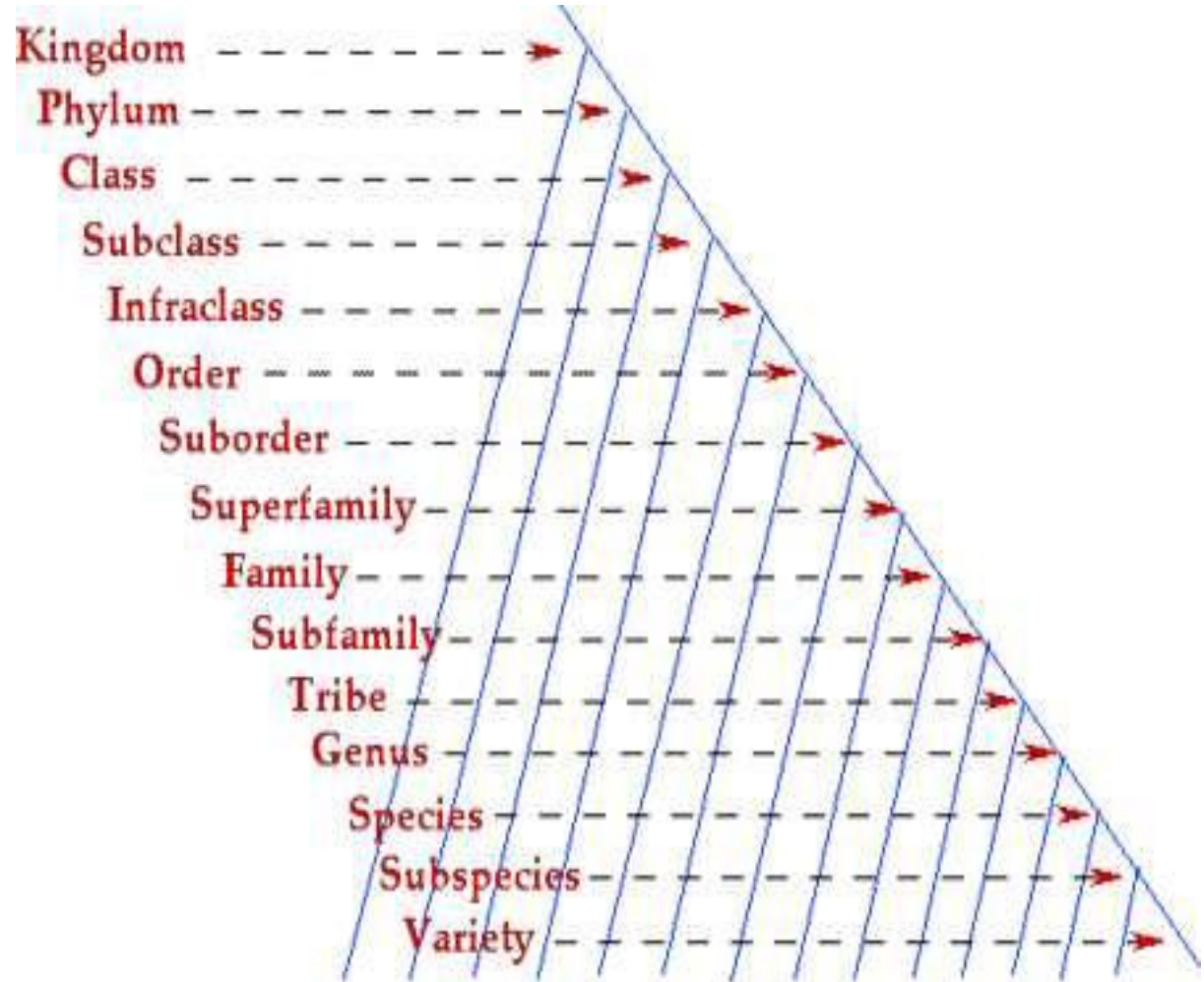
Same genus, different species

(*Homo sapiens*)

(2)- Cladistics or phylogenetic

- does not use binomial nomenclature or hierarchical ranks

- only examines the branching patterns of evolution using phylogenetic trees that reflect paraphyletic, monophyletic and paraphyletic groups using DNA sequence data

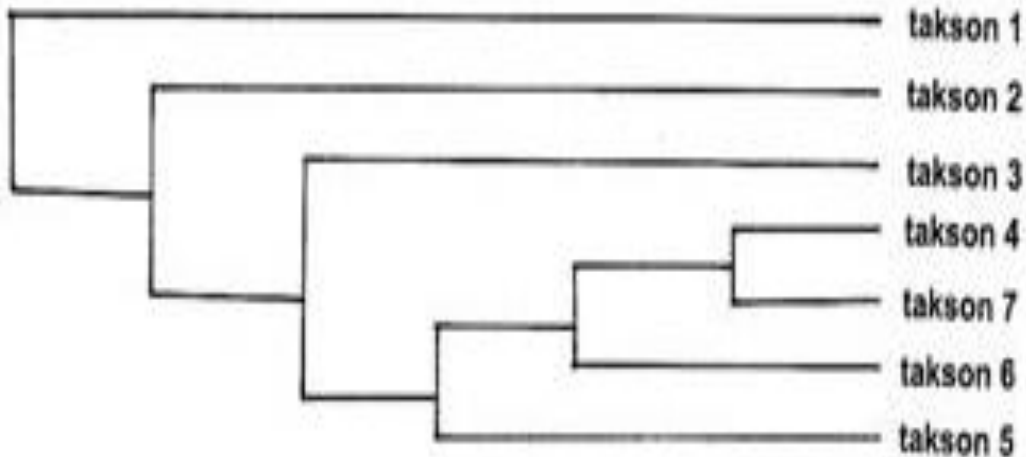


More Modern system

There are many types of Cladistics, from them are:

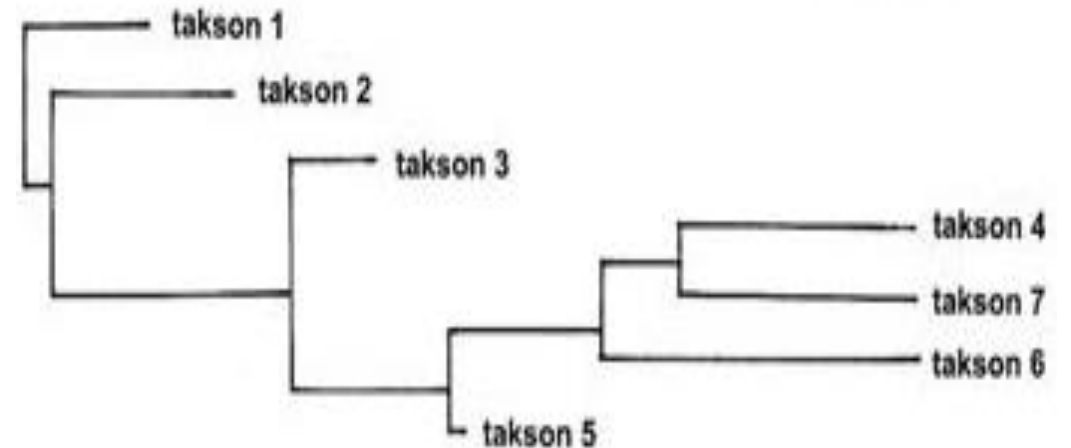
Cladogram

Illustrates evolutionary relationships of organisms via relative common ancestry and branch lengths are meaningless and arbitrary



Phylogram

Illustrates relationships of organisms with branch lengths proportional to time or similarity

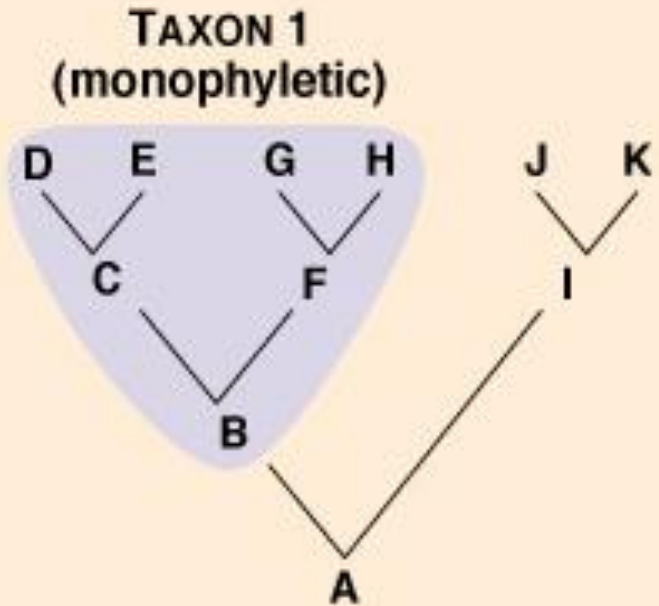
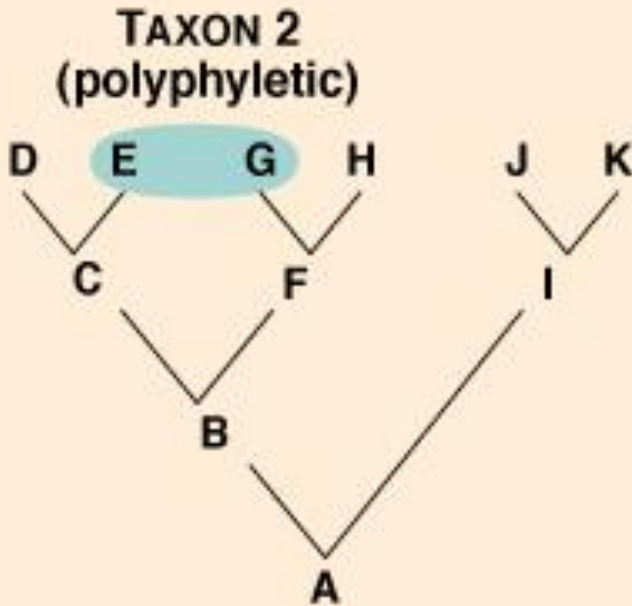
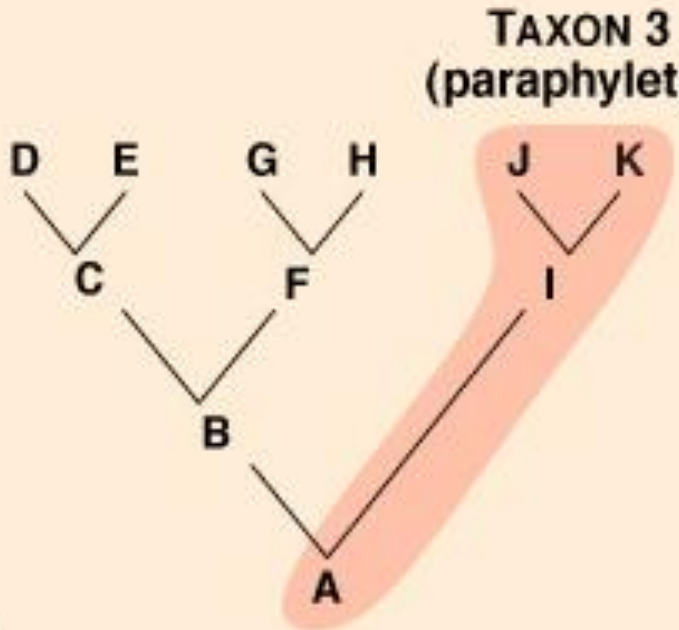


Basic steps in cladistics

- 1) select group of organisms
- 2) determine characters & states
- 3) determine the polarity of character states (primitive or derived)
- 4) for each character, classify ancestral & derived comparison to outgroup traits shared with outgroup = ancestral

Kinds of Characters

- **Synapomorphy** - a shared derived character state
- **Autapomorphy** - a derived character state unique to one study group member
- **Symplesiomorphy** – a shared primitive character state

Monophyletic group	Polyphyletic group	Paraphyletic group
<p>taxon that includes most recent common ancestor and all its descendents</p> <p>species are genetically closely related and identified by its morphology</p>	<p>taxon having species derived from more than one common ancestor</p> <p>species are not genetically closely related but have similar environments</p>	<p>taxon that includes common ancestor but not all its descendents</p> <p>species different and can be identified by its morphology</p>
<p>TAXON 1 (monophyletic)</p>  <p>(a)</p>	<p>TAXON 2 (polyphyletic)</p>  <p>(b)</p>	<p>TAXON 3 (paraphyletic)</p>  <p>(c)</p>

Monophyletic groups

Monophyly

Each of the colored lineages in this echinoderm phylogeny is a good monophyletic group

Asterozoa

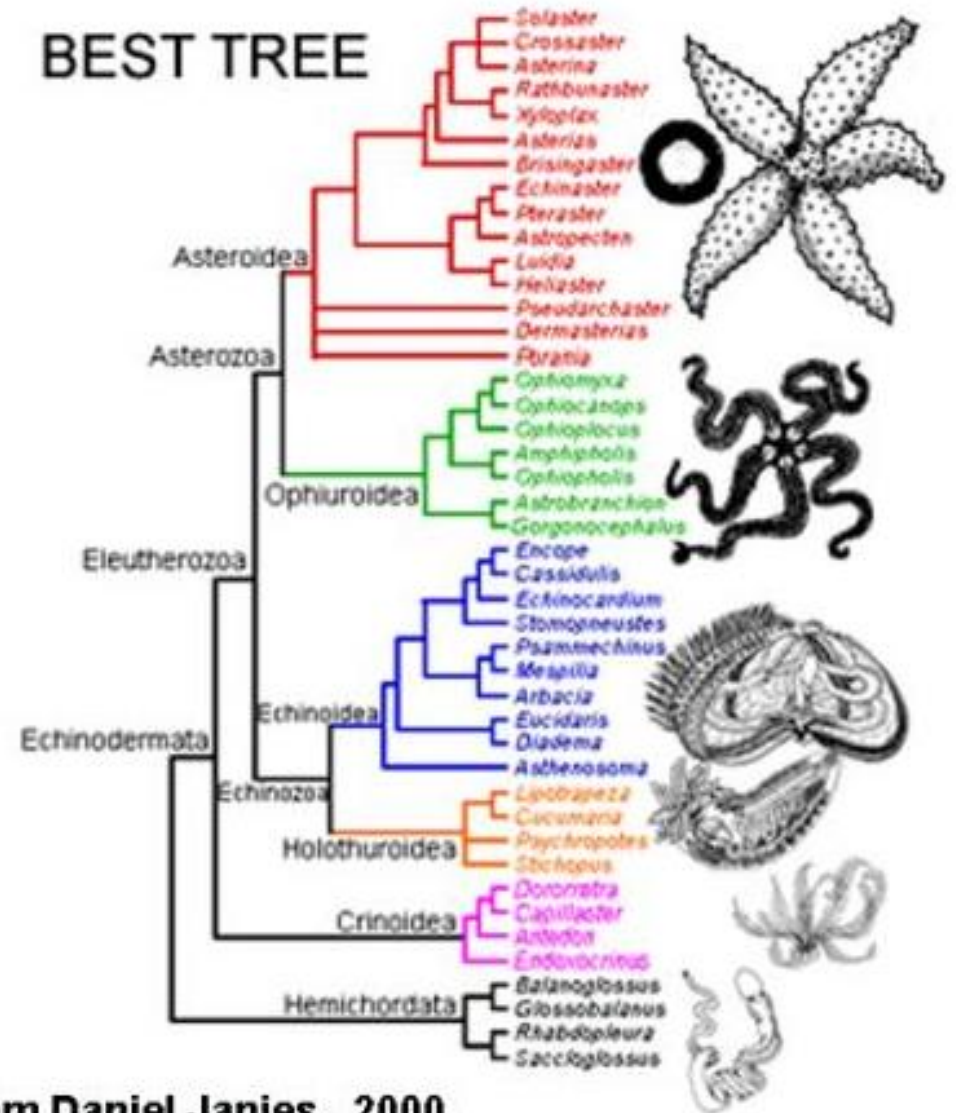
Ophiurozoa

Echinozoa

Holothurozoa

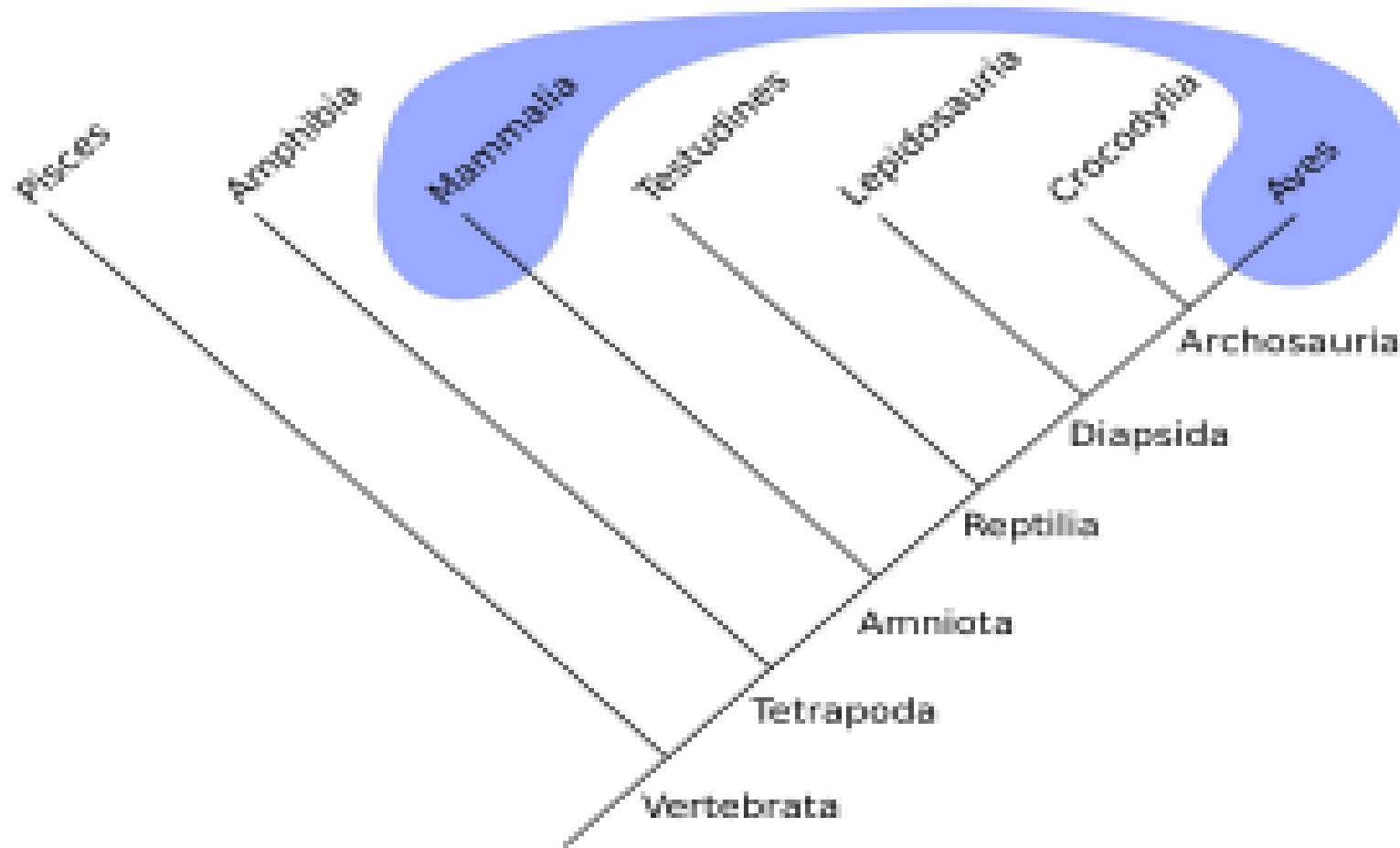
Crinozoa

Each group shares a common ancestor that is not shared by any members of another group



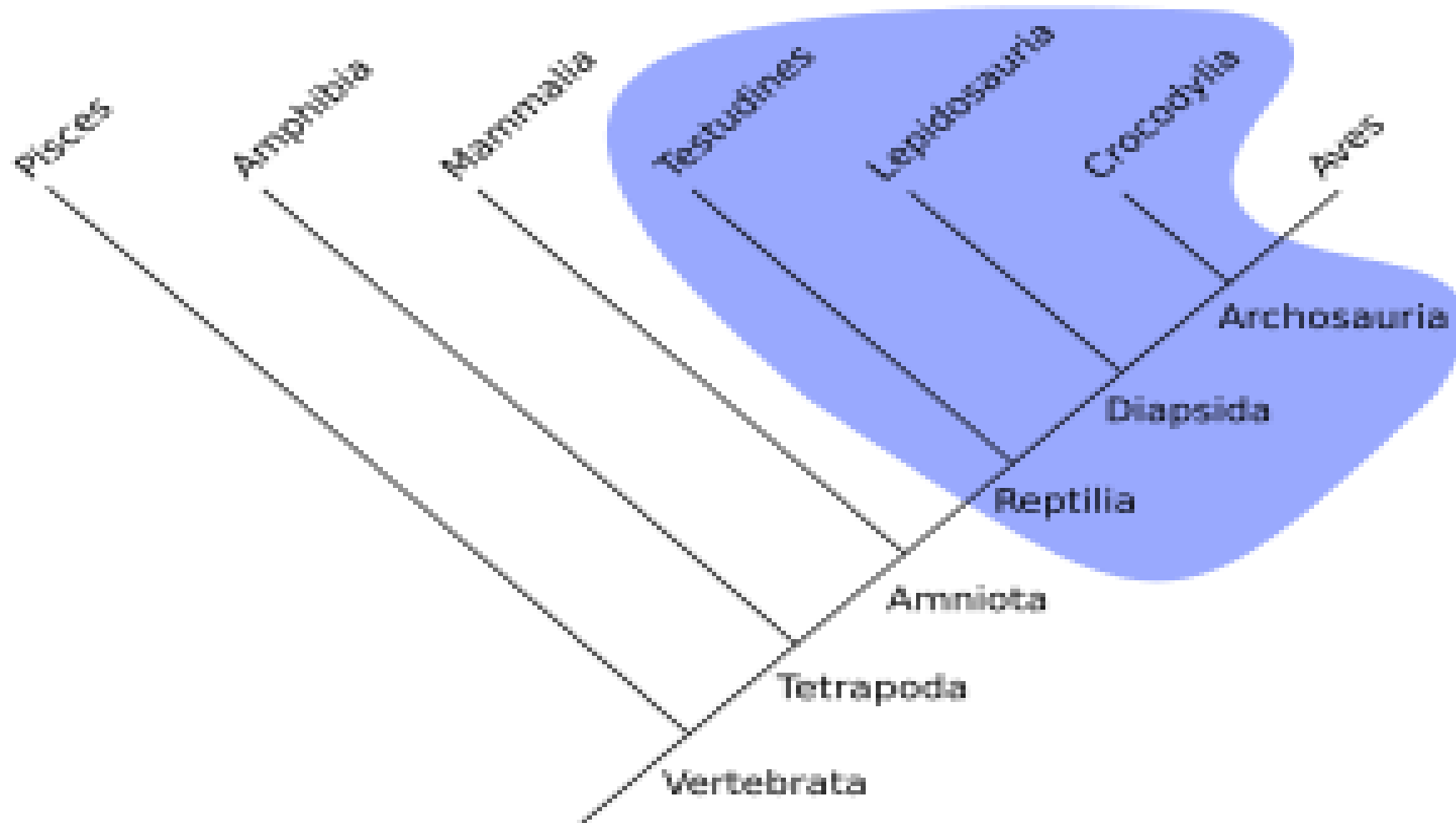
From Daniel Janies. 2000.

A polyphyletic group is a group whose members do not share a recent common ancestor



Example: Homeotherms (warm-blooded animals)

A paraphyletic group includes a common ancestor and some but not all of its descendents

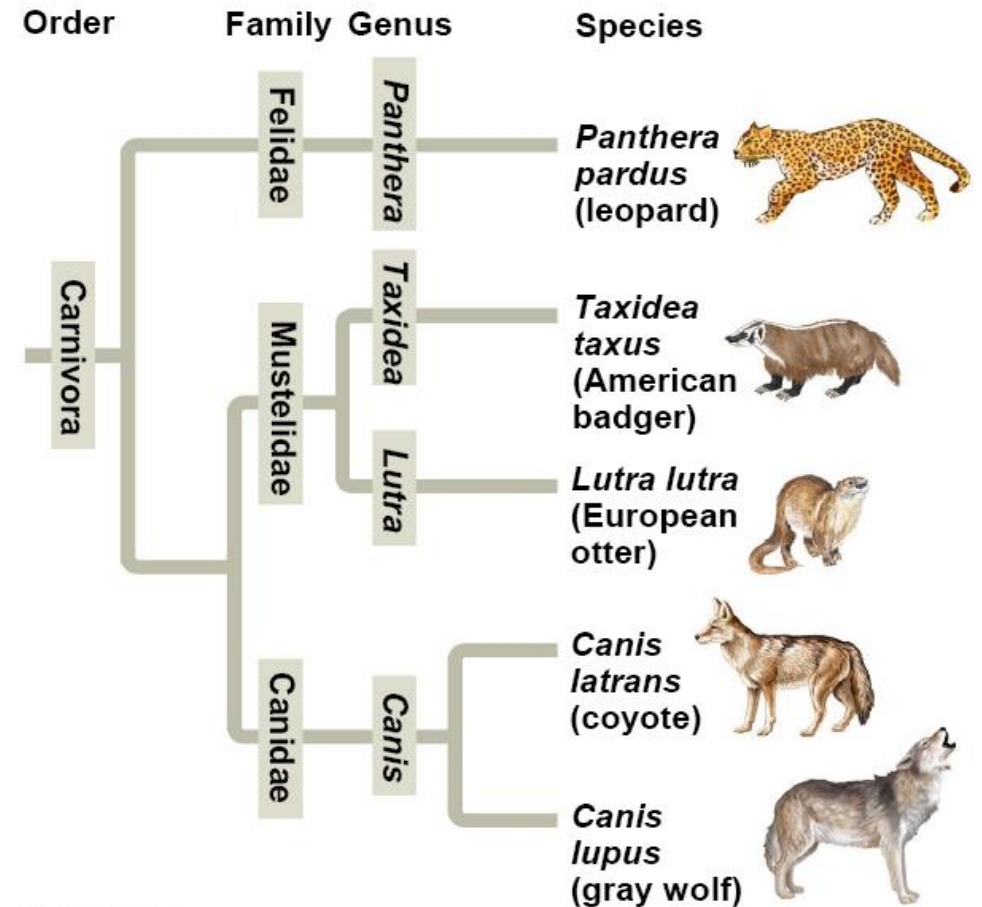
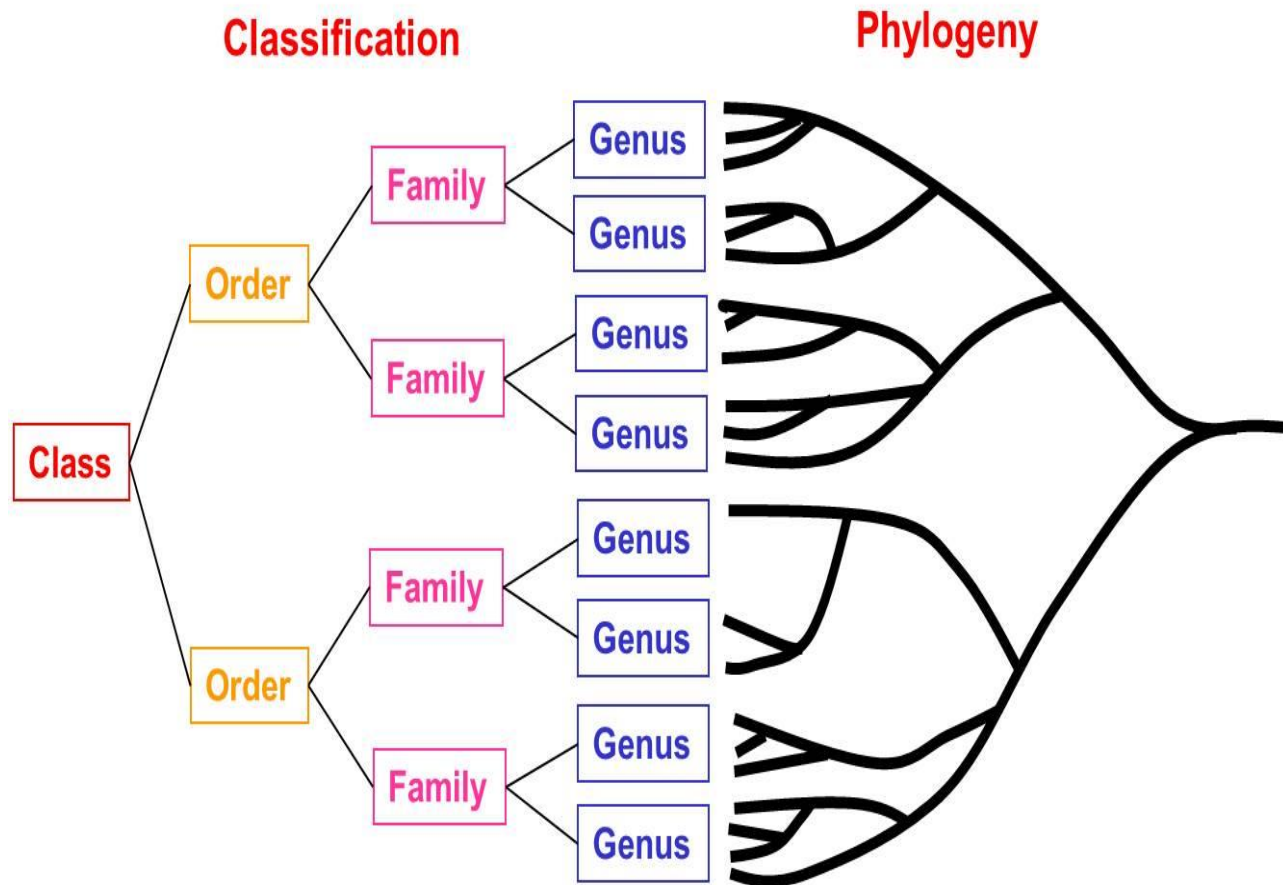


Example: Reptilia (defined to exclude birds)

Linking Classification and Phylogeny

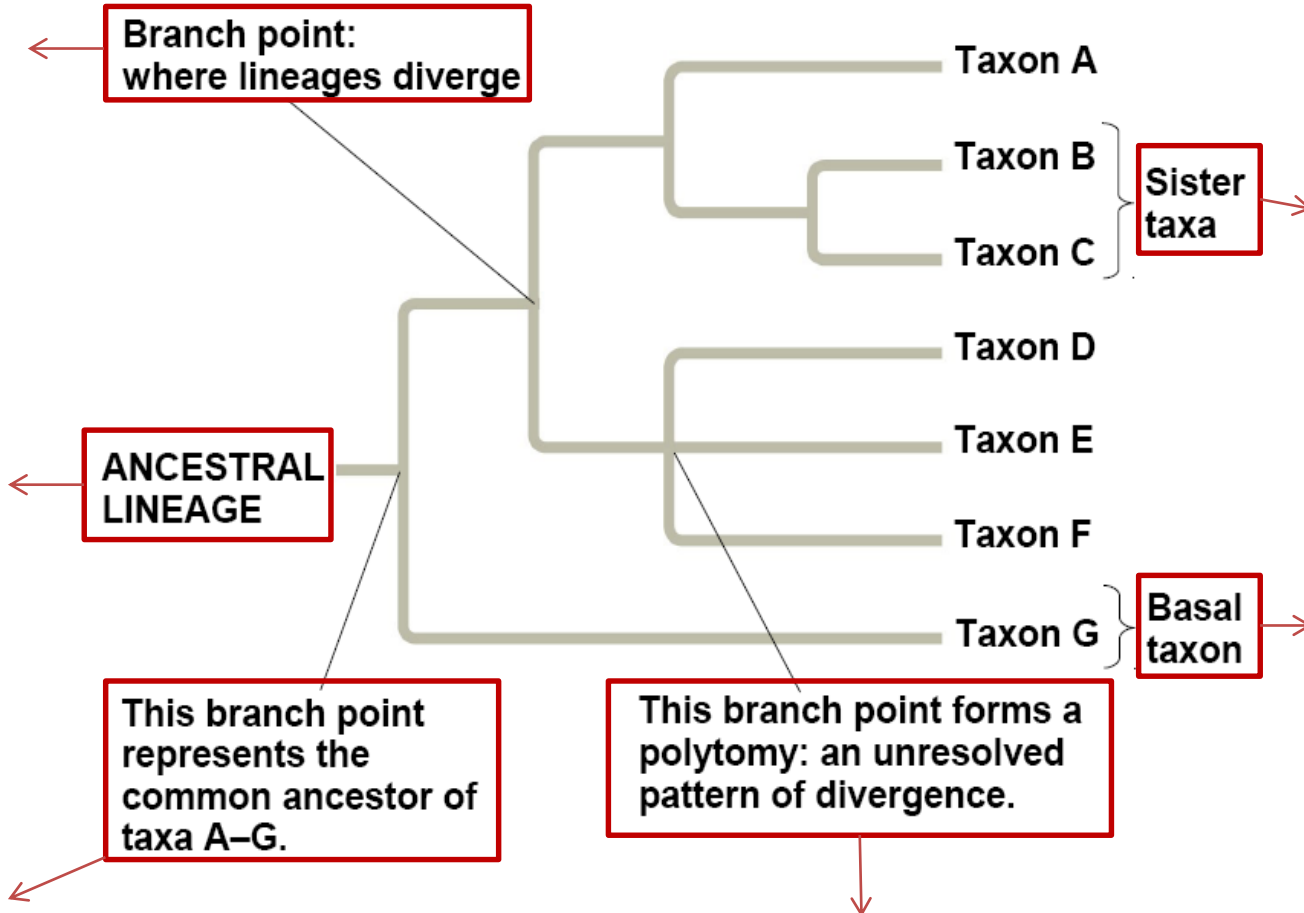
Phylogenetic (cladistic) classification reflects evolutionary history

The only objective form of classification – organisms share a true evolutionary history regardless of our arbitrary decisions of how to classify them



A **phylogenetic tree** represents a hypothesis about evolutionary relationships

Each **branch point** represents the divergence of two species



Sister taxa are groups that share an immediate common ancestor

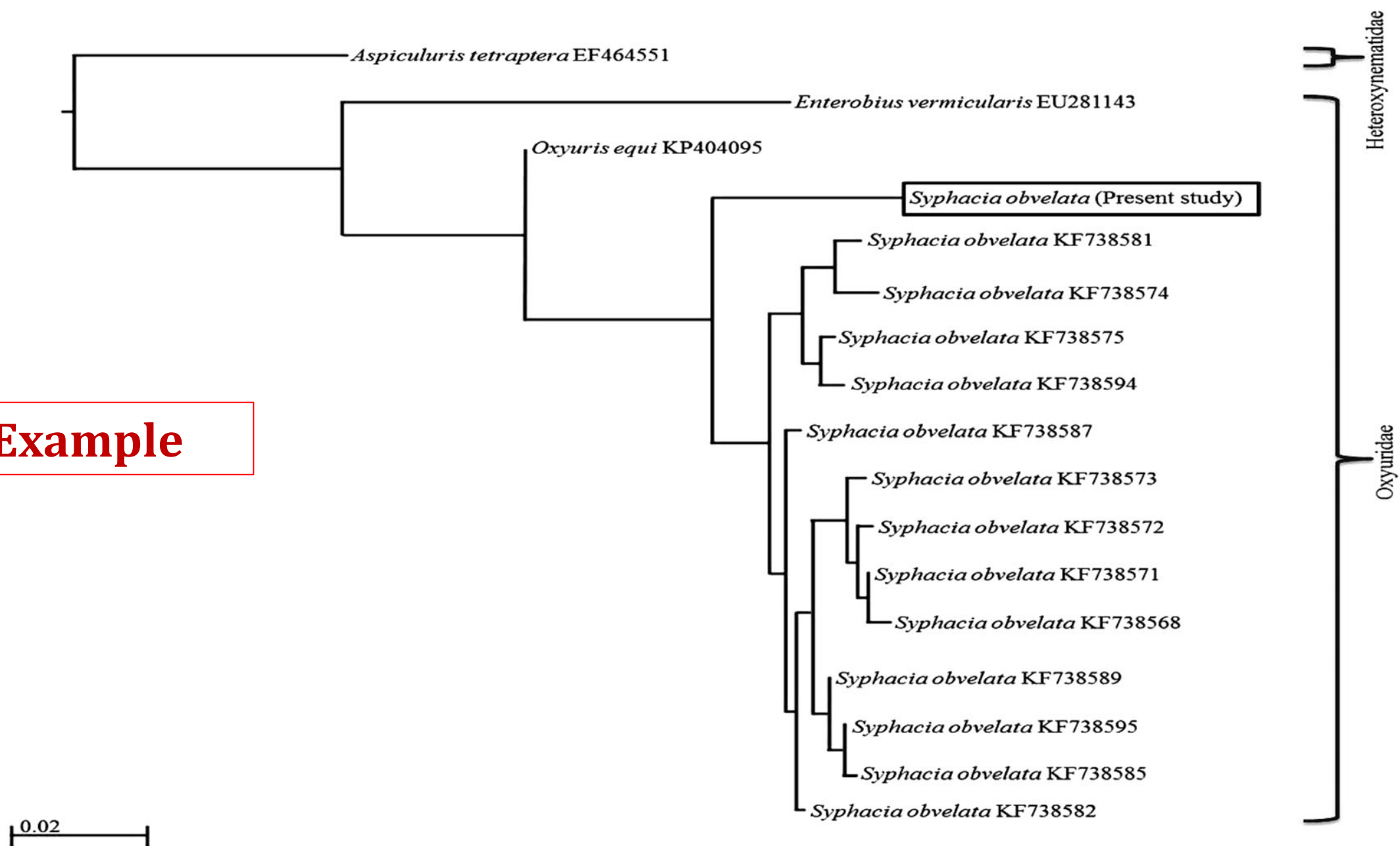
A **basal taxon** diverges early in the history of a group and originates near the common ancestor of the group

A **polytomy** is a branch from which more than two groups emerge

Each **branch point** represents the divergence of two species

A **rooted** tree includes a branch to represent the last common ancestor of all taxa in the tree

Example



Thank you