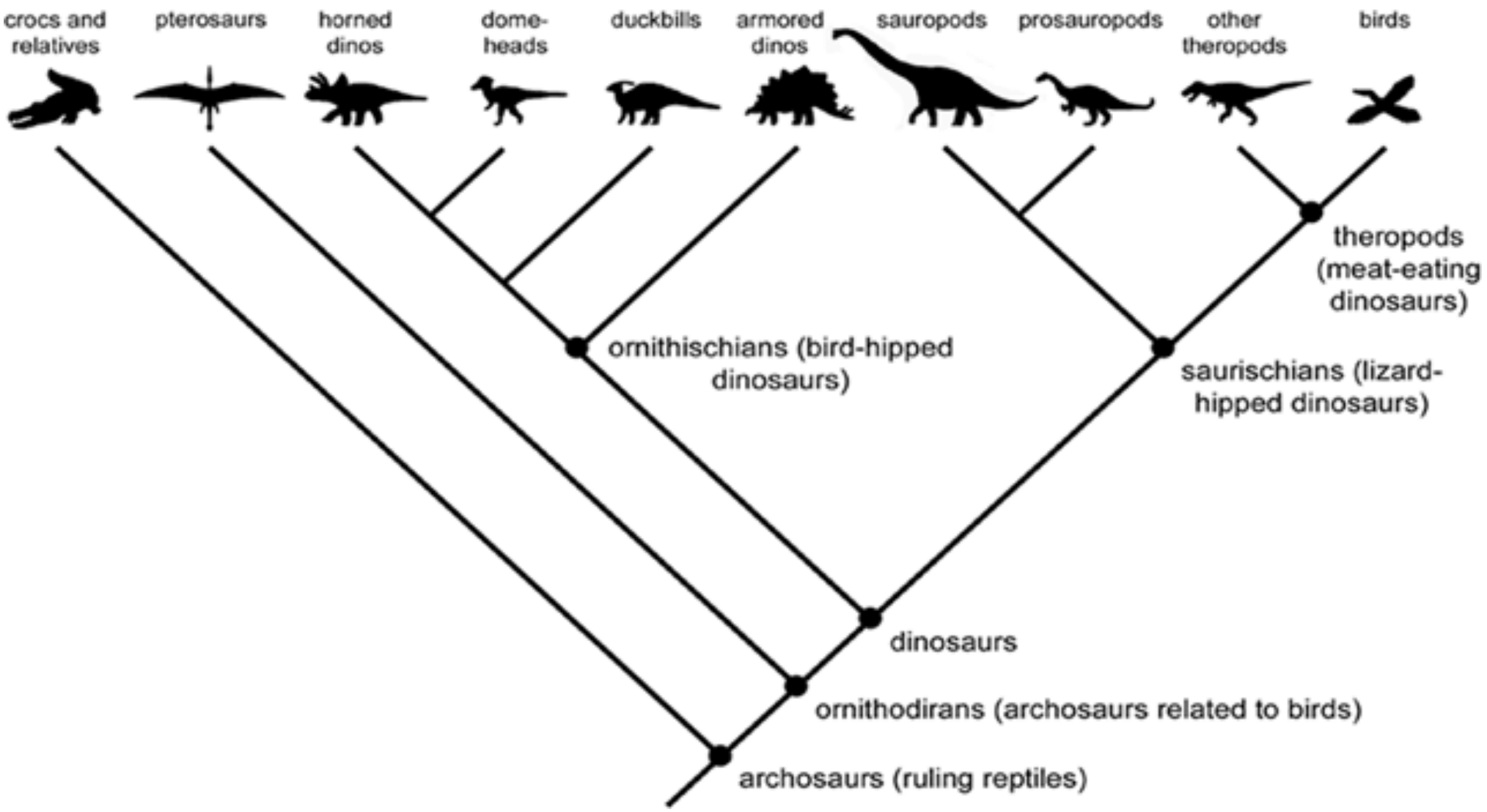
CLADISTICS


crocs and relatives
pterosaurs
horned dinos
dome-heads
duckbills
armored dinos
sauropods
prosauropods
other theropods
birds
theropods (meat-eating dinosaurs)
ornithischians (bird-hipped dinosaurs)
saurischians (lizard-hipped dinosaurs)
dinosaurs
ornithodirans (archosaurs related to birds)
archosaurs (ruling reptiles)

Carl Woese made an amazing discovery in biology…
Watch the short video clip as he relives his discovery.

As you watch:

1. *Make note of why his discovery was so important.*

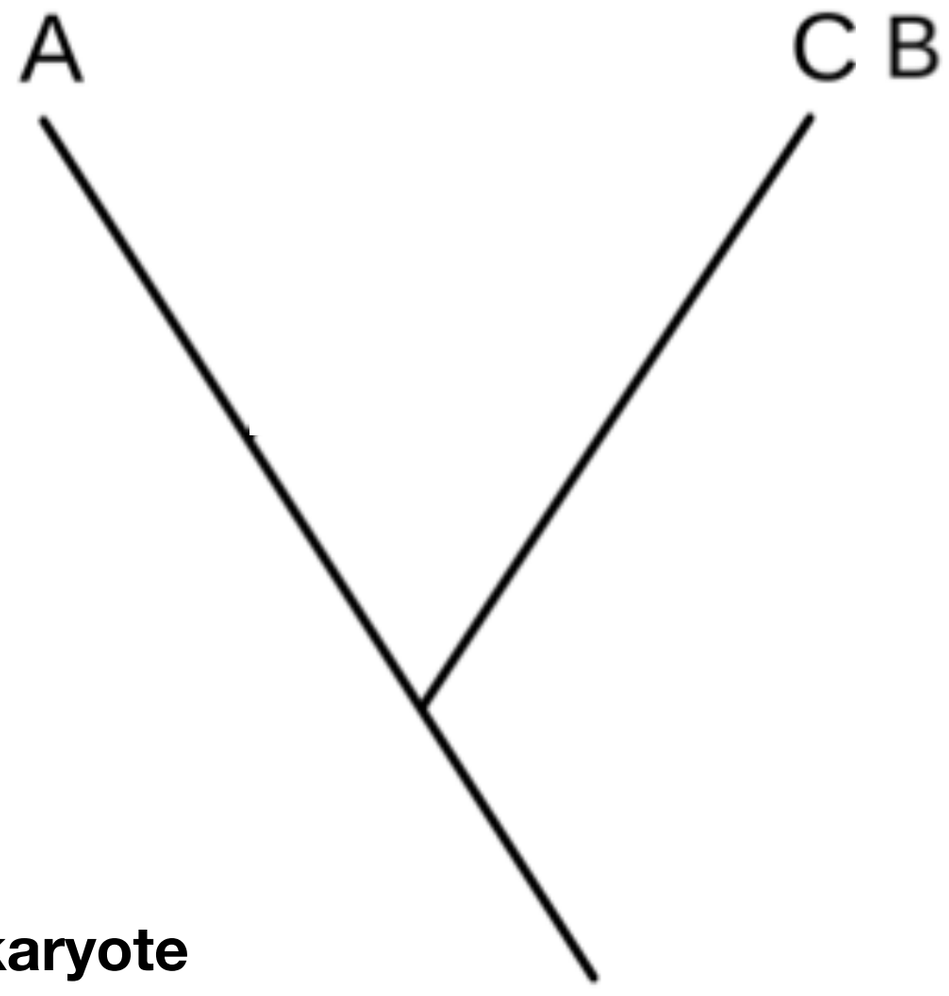
2. *How are archaea fundamentally different from other cells.*


Discovery
EDUCATION

1. Make note of why his discovery was so important.

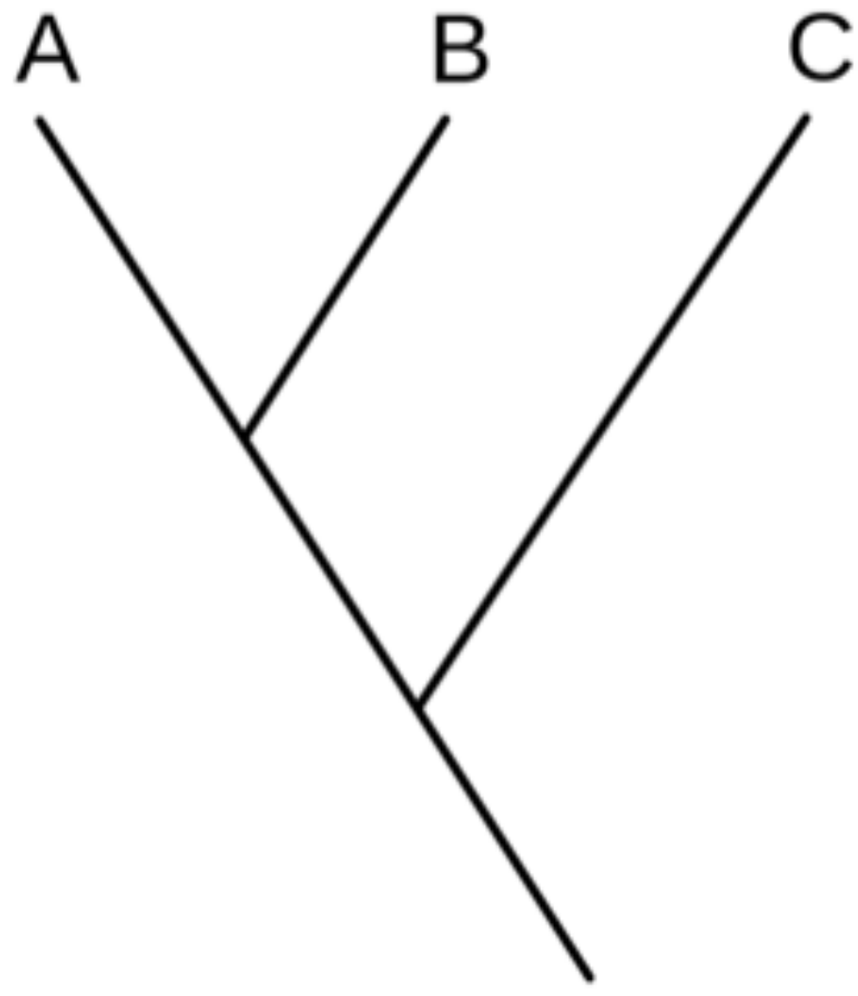
2. How are archaea fundamentally different from other cells.

1975



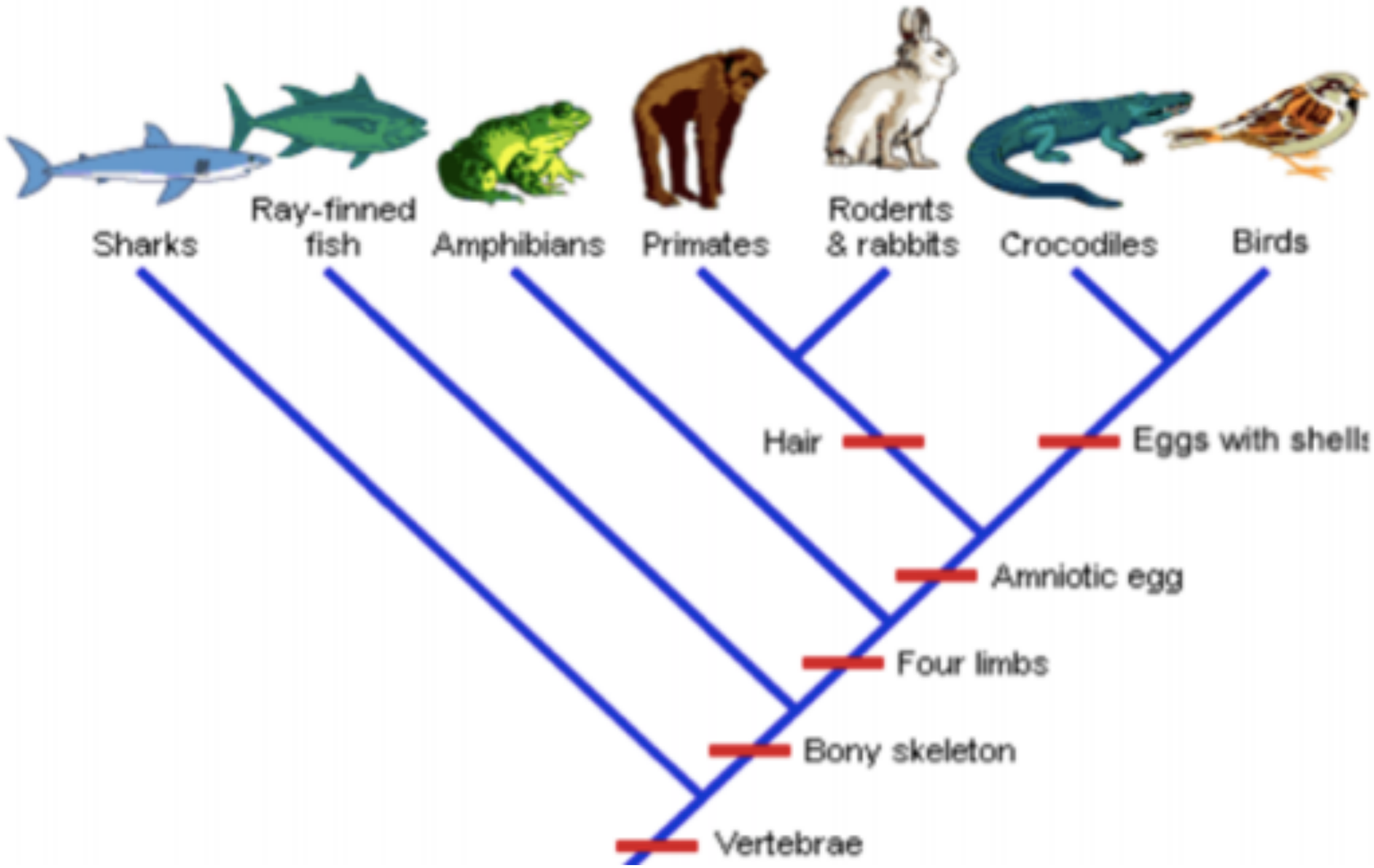
A- Eukaryote
B- Archaea
C- Prokaryotes

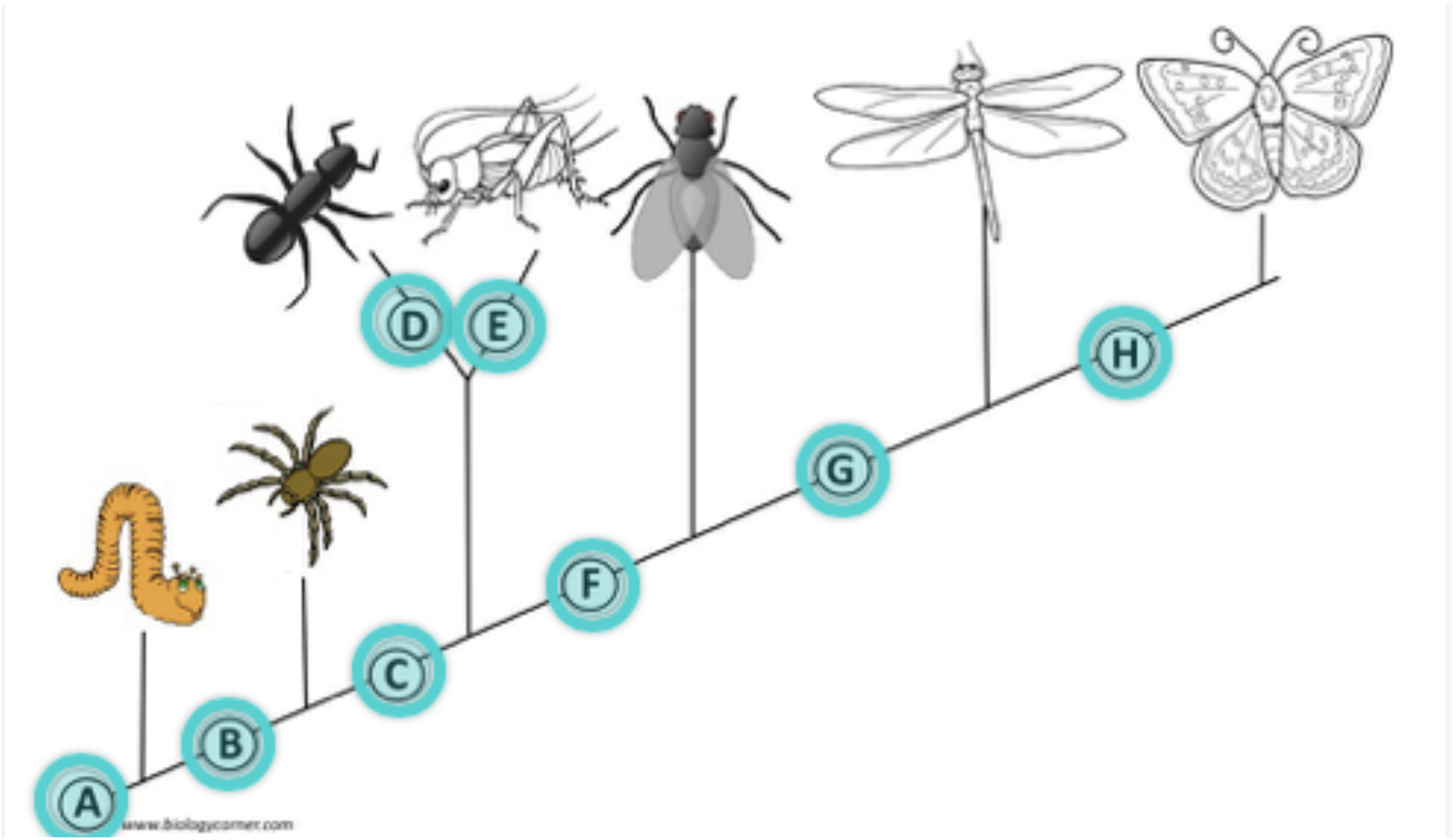
Carl Woese
1977



Let’s compare species

	Symmetry	Segmented	Legs	Antenna	Wings	Eyltron
Worm						
Spider						
Jelly fish						
Beetle						
Sponge						
Butterfly						
Ant						

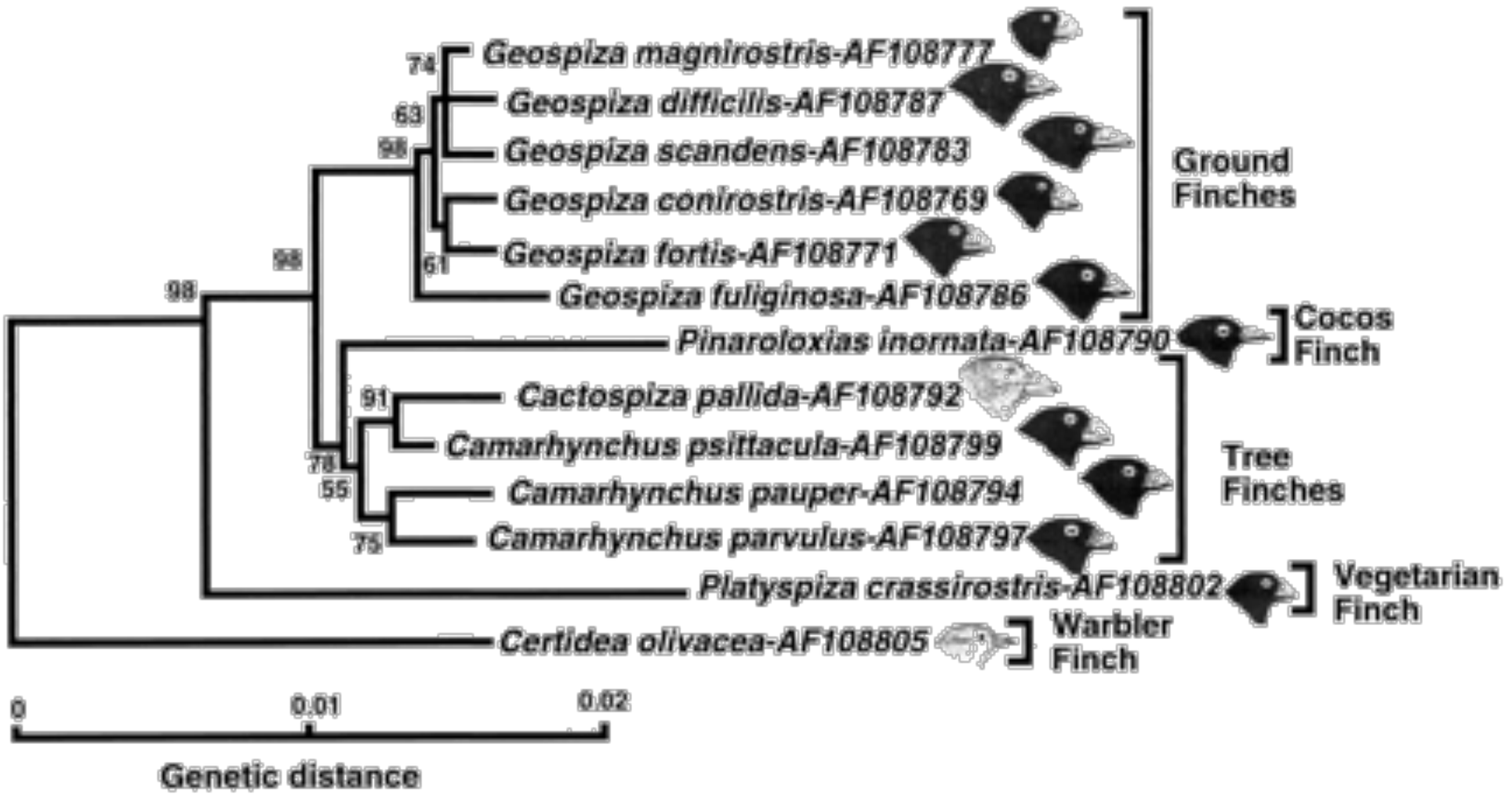

Sharks
Ray-finned fish
Amphibians
Primates
Rodents & rabbits
Crocodiles
Birds
Hair
Eggs with shells
Amniotic egg
Four limbs
Bony skeleton
Vertebrae

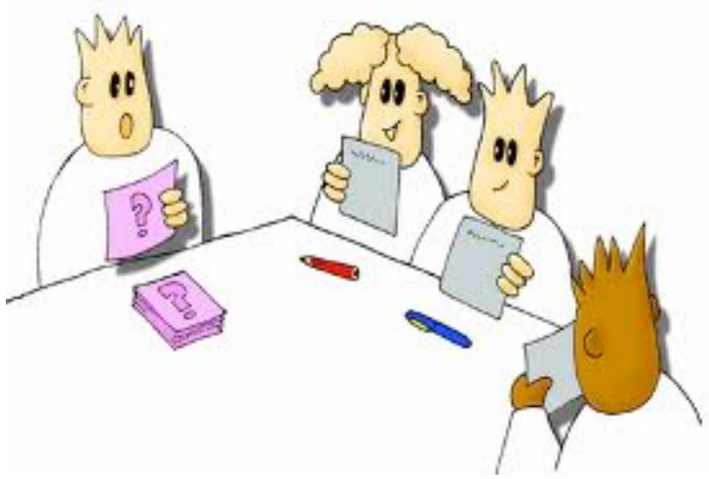

D
E
H
G
F
C
B
A
www.biologycorner.com

Clades

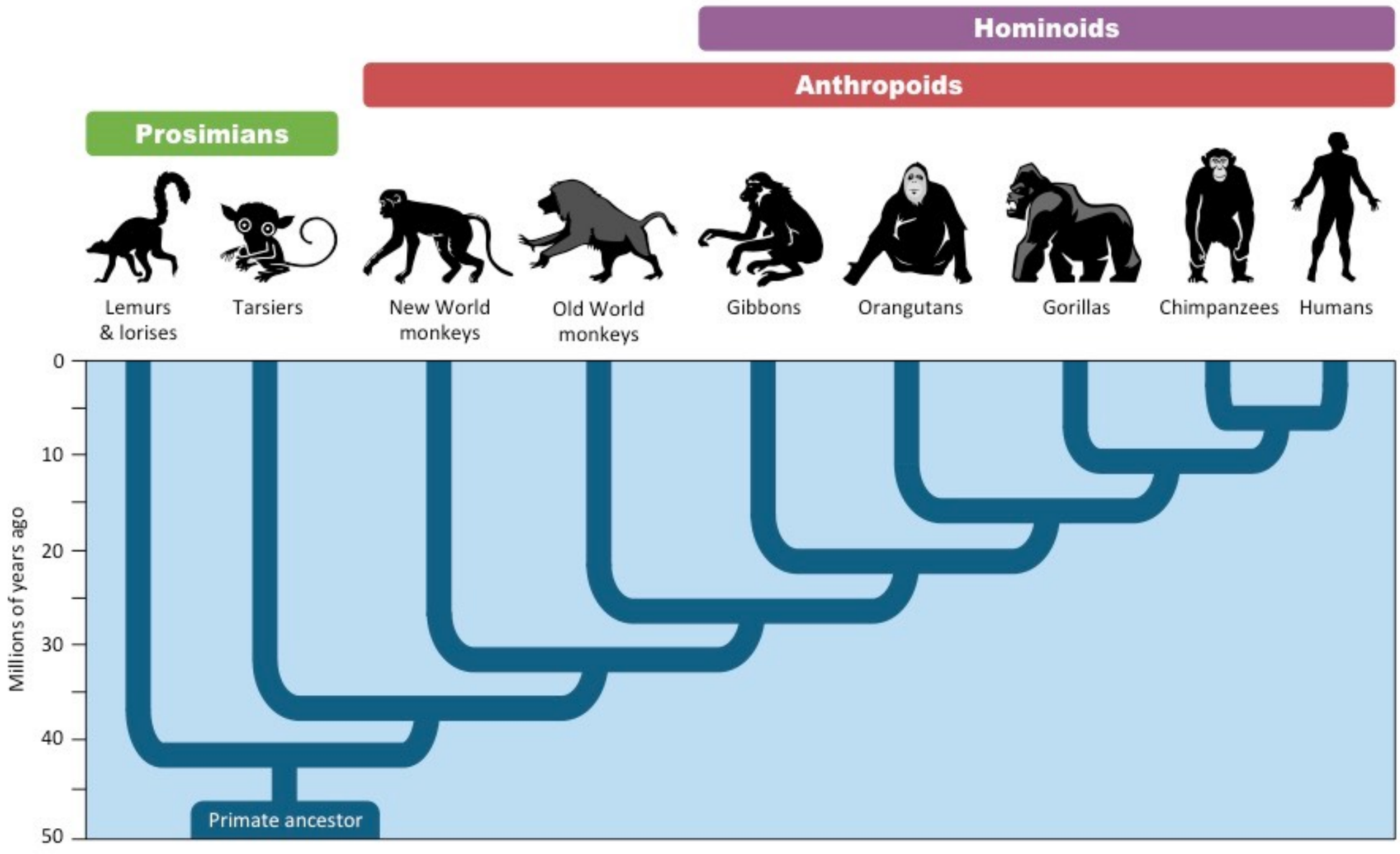
Clades are a group of organisms that have evolved from a common ancestor. This would include

- All living species
- Common ancestral species (extinct)



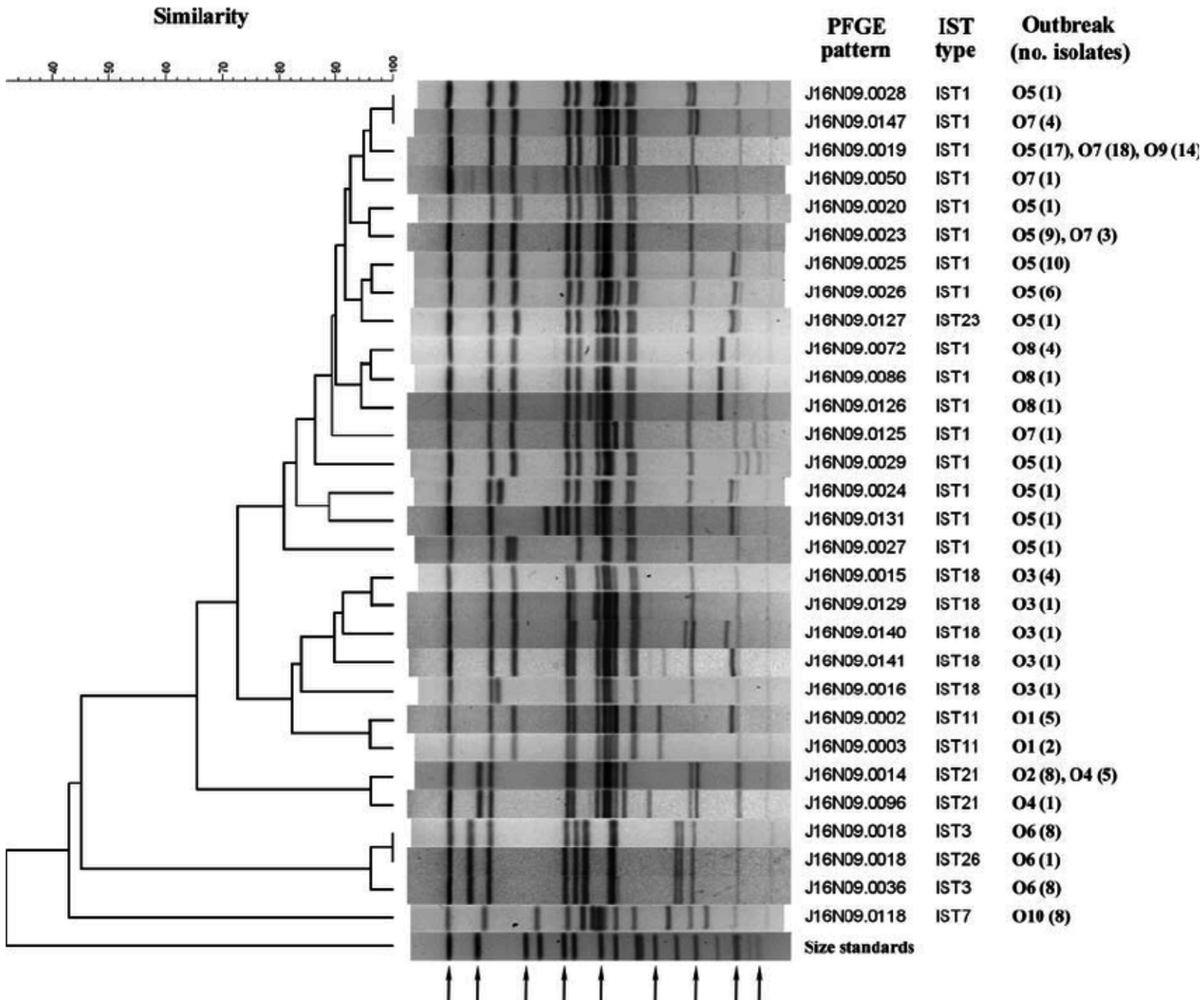


Which of these species would you not include in a unifying clade?



Clades

Clades generally would usually include species that show a strong gene DNA sequence or amino acid sequence of a protein relationship

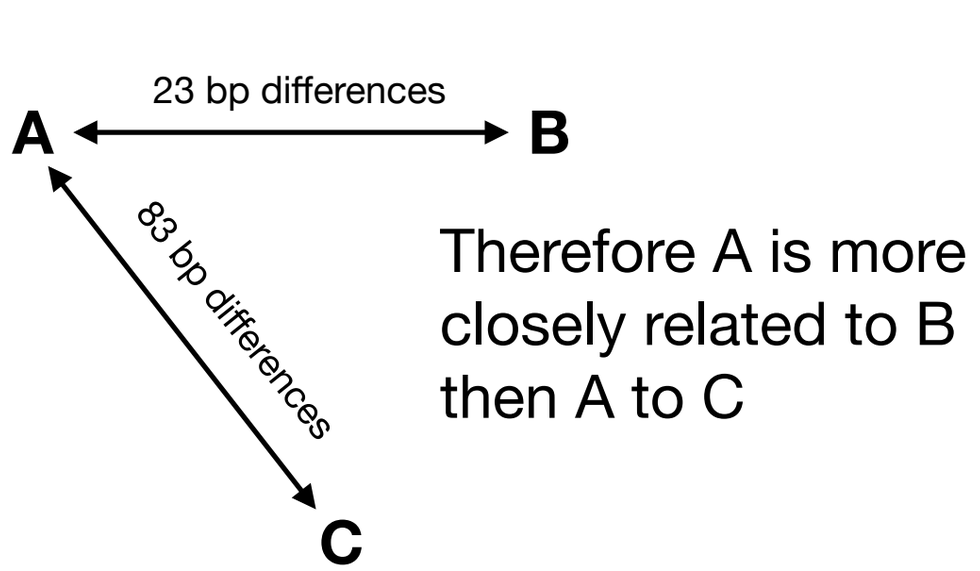


Cladograms include a molecular clock

• **Mutation** occur randomly and these changes in DNA and genes with be gradual over time.

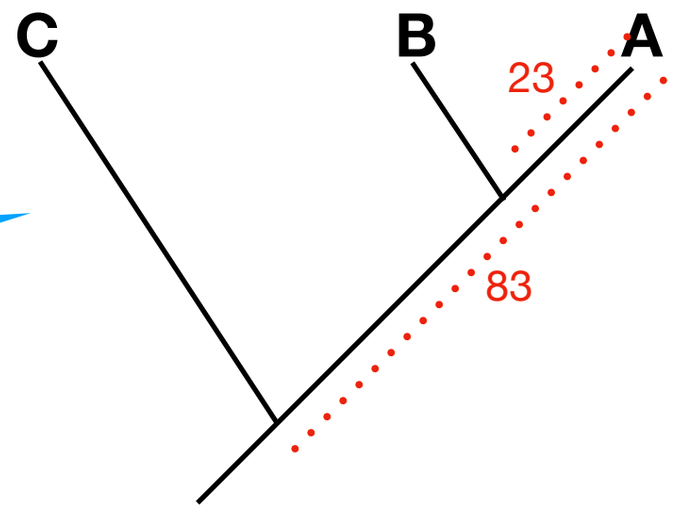
• Changes could allow estimates of how far back two species are related…

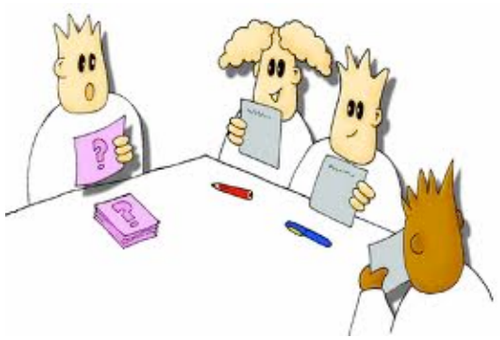
eg Species A,B,C



Therefore A is more closely related to B then A to C

Cladogram



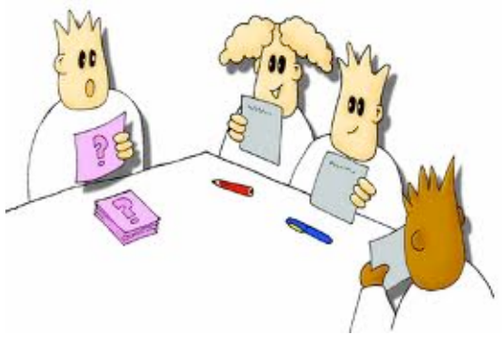


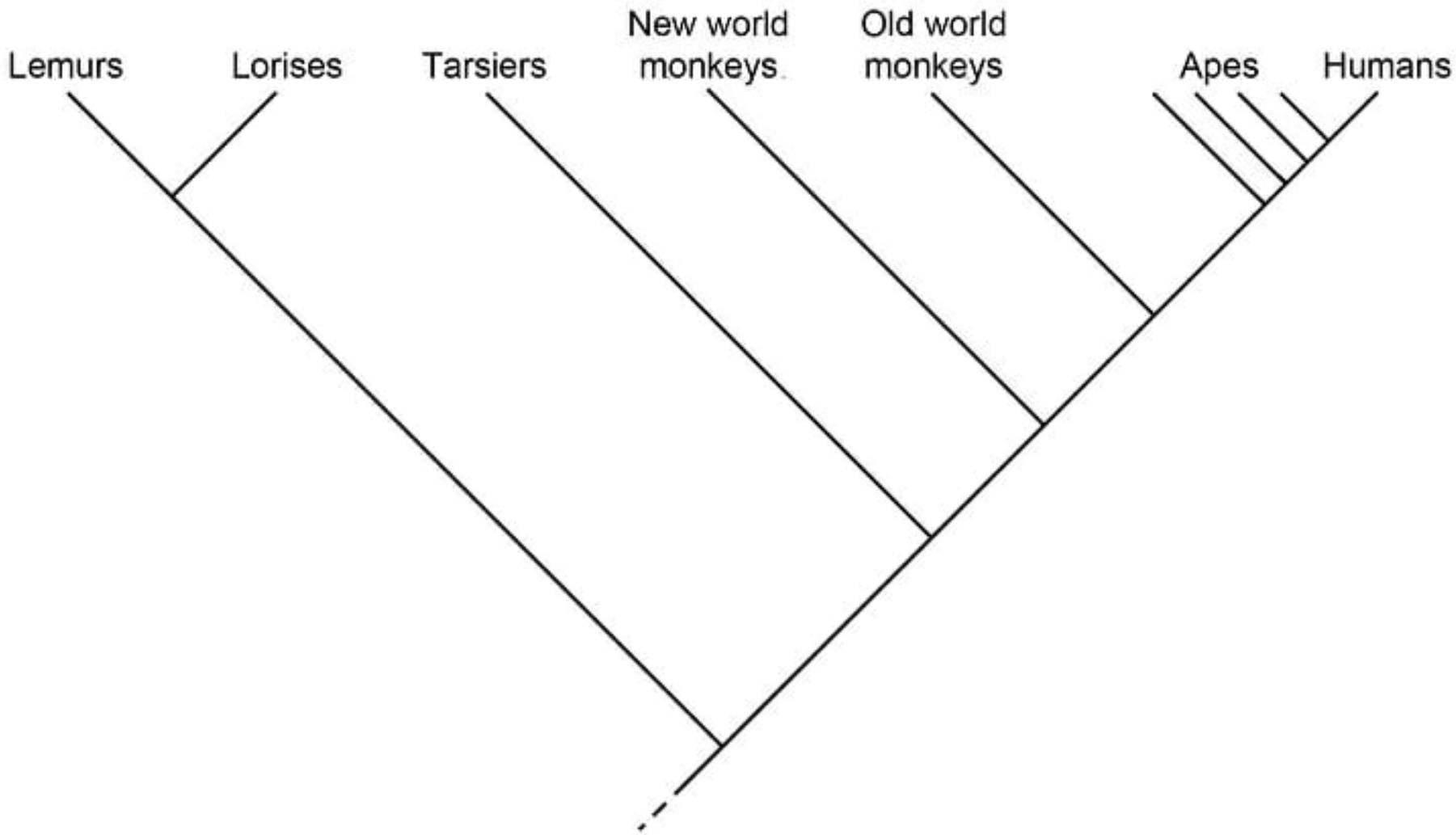
Which of these species the closest related?

Which species is the farthest related to the others?

Can you construct a cladogram of this?

Species A	Amino Acid Sequence: ISO-SER-ASP-GLN-PHE-ILE-LEU-GLN-SER-ARG-LEU-LEU-HIS DNA Sequence: ATTAGCGACCAGTTTATCCTACAATCCCGTCTACTTCAT
Species B	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-HIS-LEU-LEU-SER DNA Sequence: CTAATCCCCCCGTTTATCCTACTTTCCCATCTACTAAGT
Species C	Amino Acid Sequence: LEU-ISO-ASP-PRO-PHE-ILE-LEU-HIS-SER-ARG-LEU-LEU-ARG DNA Sequence: CTTATCGACCCGTTTATCCTACATTCCCGTCTACCTTCGT
Species D	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-HIS-LEU-LEU-SER DNA Sequence: TTAATCCCCCCGTTTATCCTACTTTCCCATCTACTAAGT
Species E	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-ARG-LEU-LEU-ARG DNA Sequence: CTTATCCCCCCGTTTATCCTACTTTCCCGTCTACTTCGT





Cladogram of Primates

Cladograms

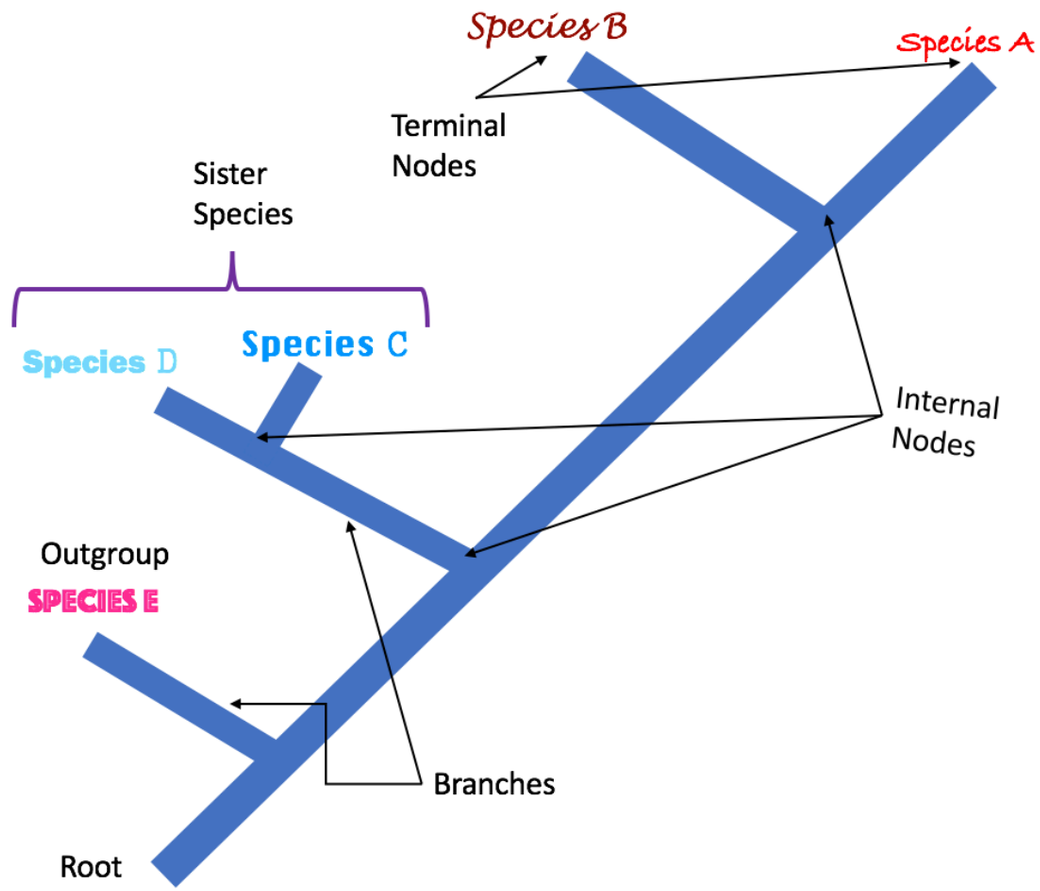
Cladograms show the most probable sequence of divergence in clades

- usually based on Amino acid sequence of proteins
- computer generated
- assumes that change is based on the simplest and most likely (principle of parsimony)

Branches are called **nodes**- hypothetical species split

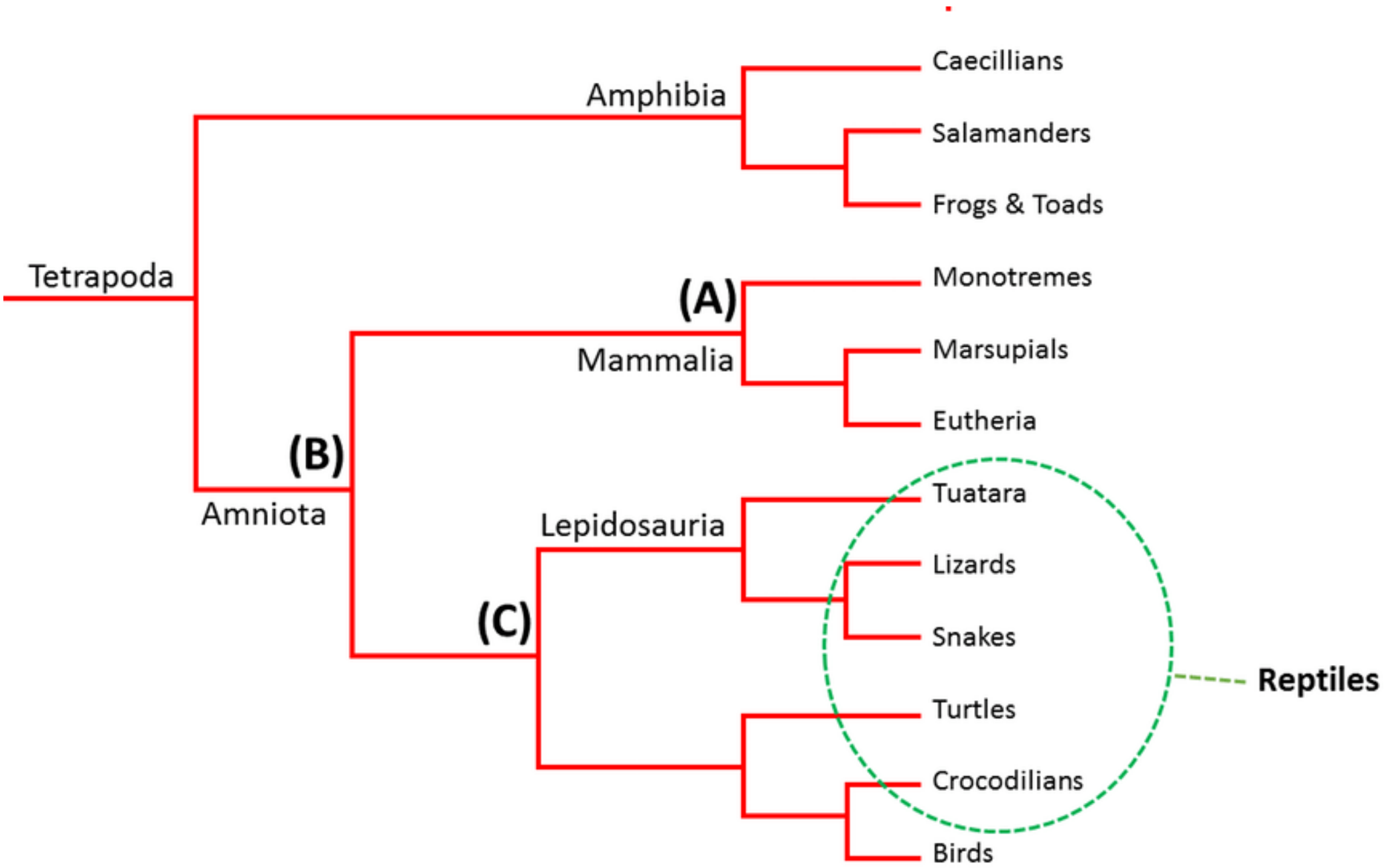
Sister species- are closest in a clade

Outgroup- a more distantly related group of organisms that serves as a reference group when determining the evolutionary relationships



Cladograms

This cladogram was constructed based on amino acid sequence



Cladograms

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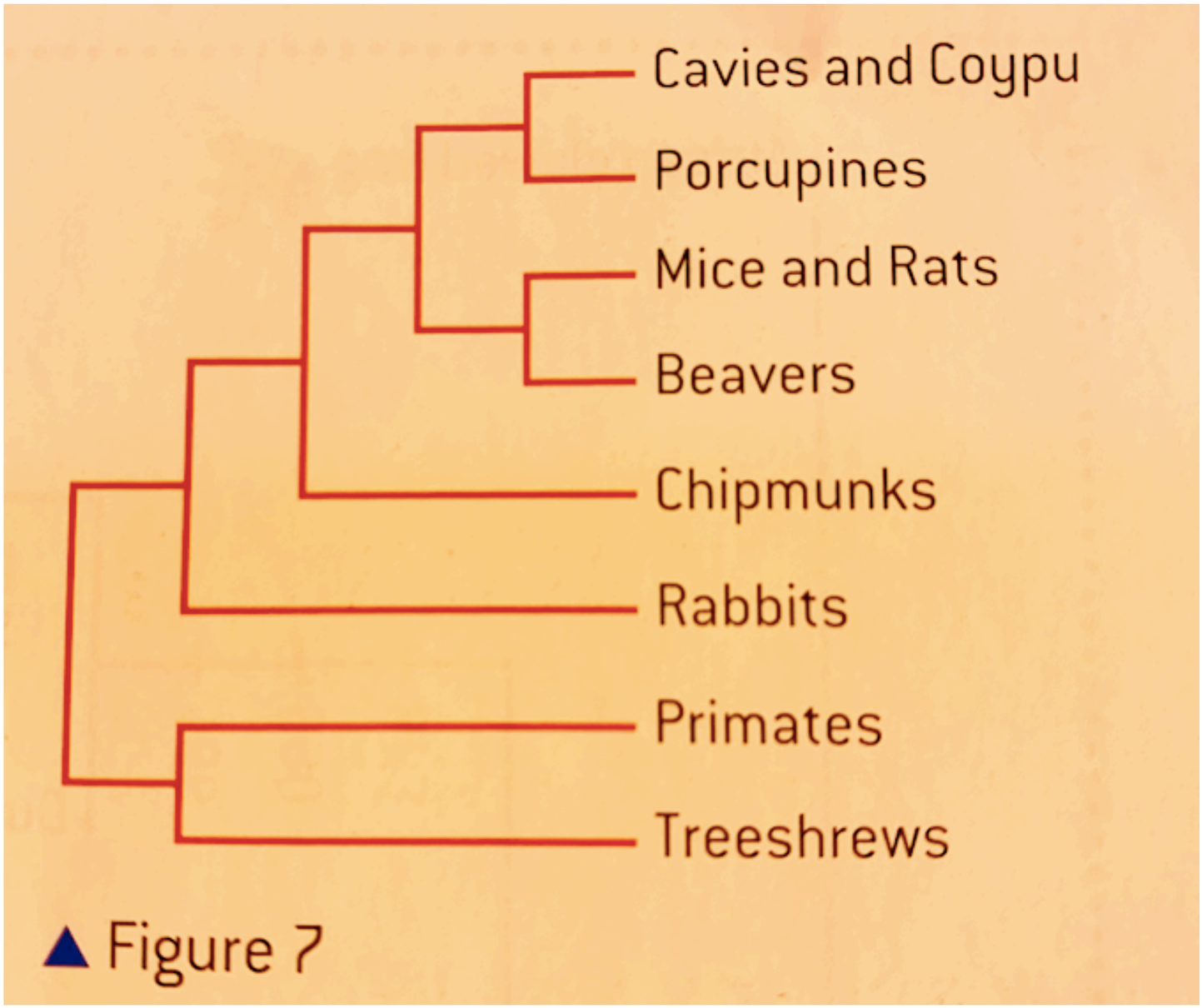
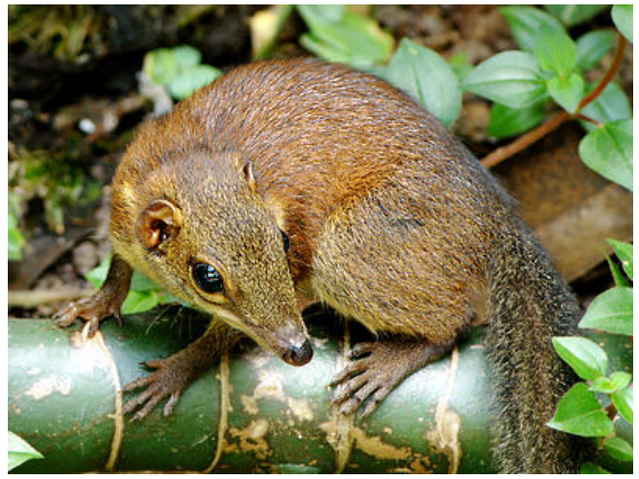
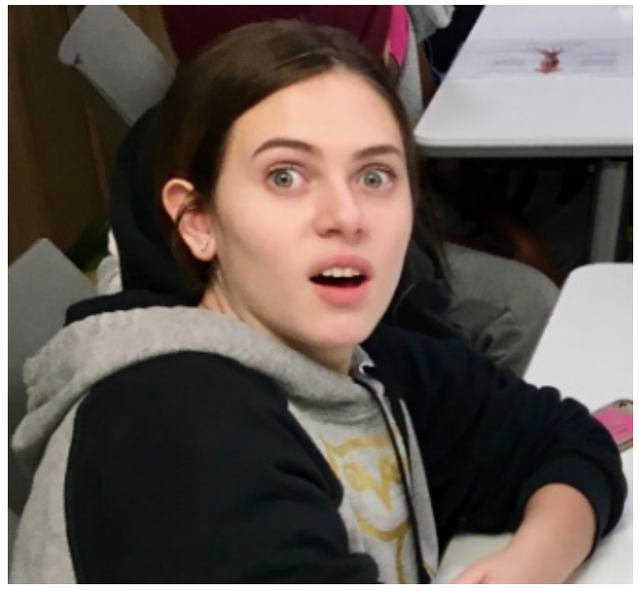


▲ Figure 7





Cladograms and Classification

• **evidence from cladograms** has shown that classifications of groups based on structure did not correspond with the evolutionary origins of a group of species

• Each cladogram is a working hypothesis, and may be incorrect

• Every new discovery of a characteristic can change clades

eg. birds were on their own clade, but now they are more like reptiles

eg. Scrophulariaceae, a one time plants family was created based on morphology (anatomy), clades based on DNA have reclassified into different and new families

eg. Carl Woese discovery archaea redistributed clades at the domaine level