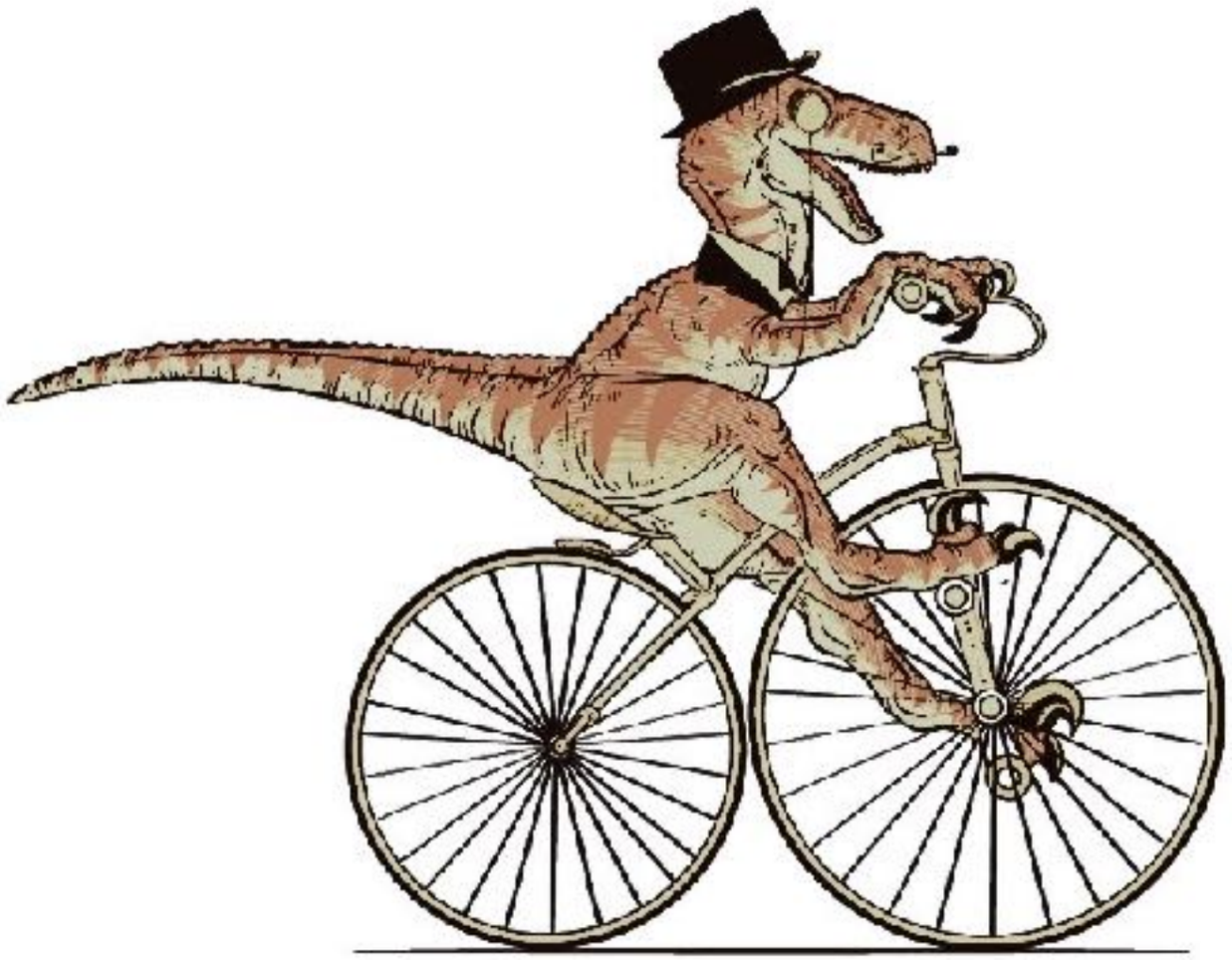
http://jdyeakel.github.io/teaching/dinos/



Depositional Environments

& Taphonomy

Taphonomy: study of the transition from the biosphere to the lithosphere

Quick burial

(a)

Replacement and/or permineralization

Nearly complete specimen exposed

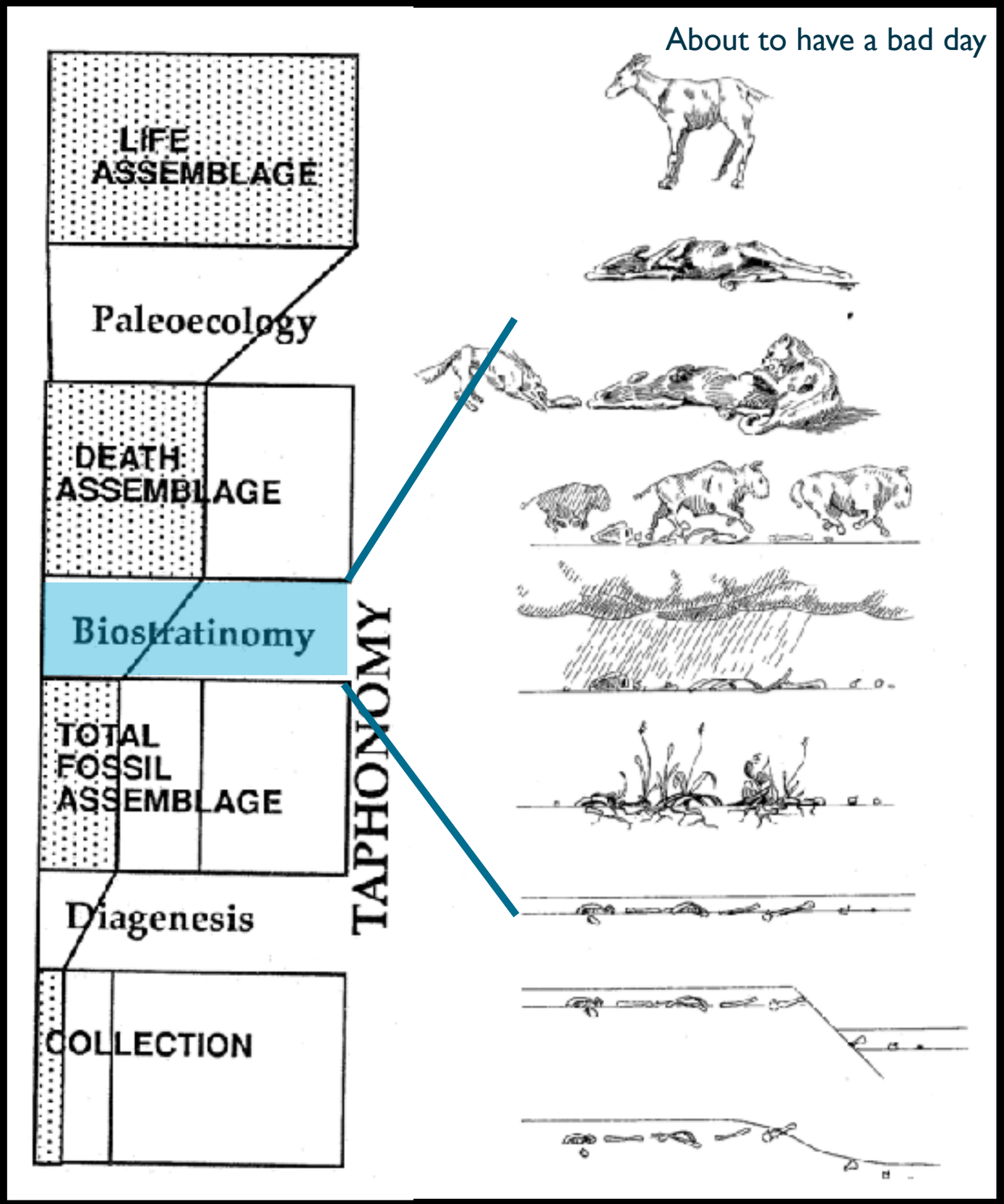
Dinosaur dies

(b)

Dismemberment before burial – scavenging and other natural processes

Isolated bones buried and mineralized

Isolated bones exposed



Key: Rapid Burial!

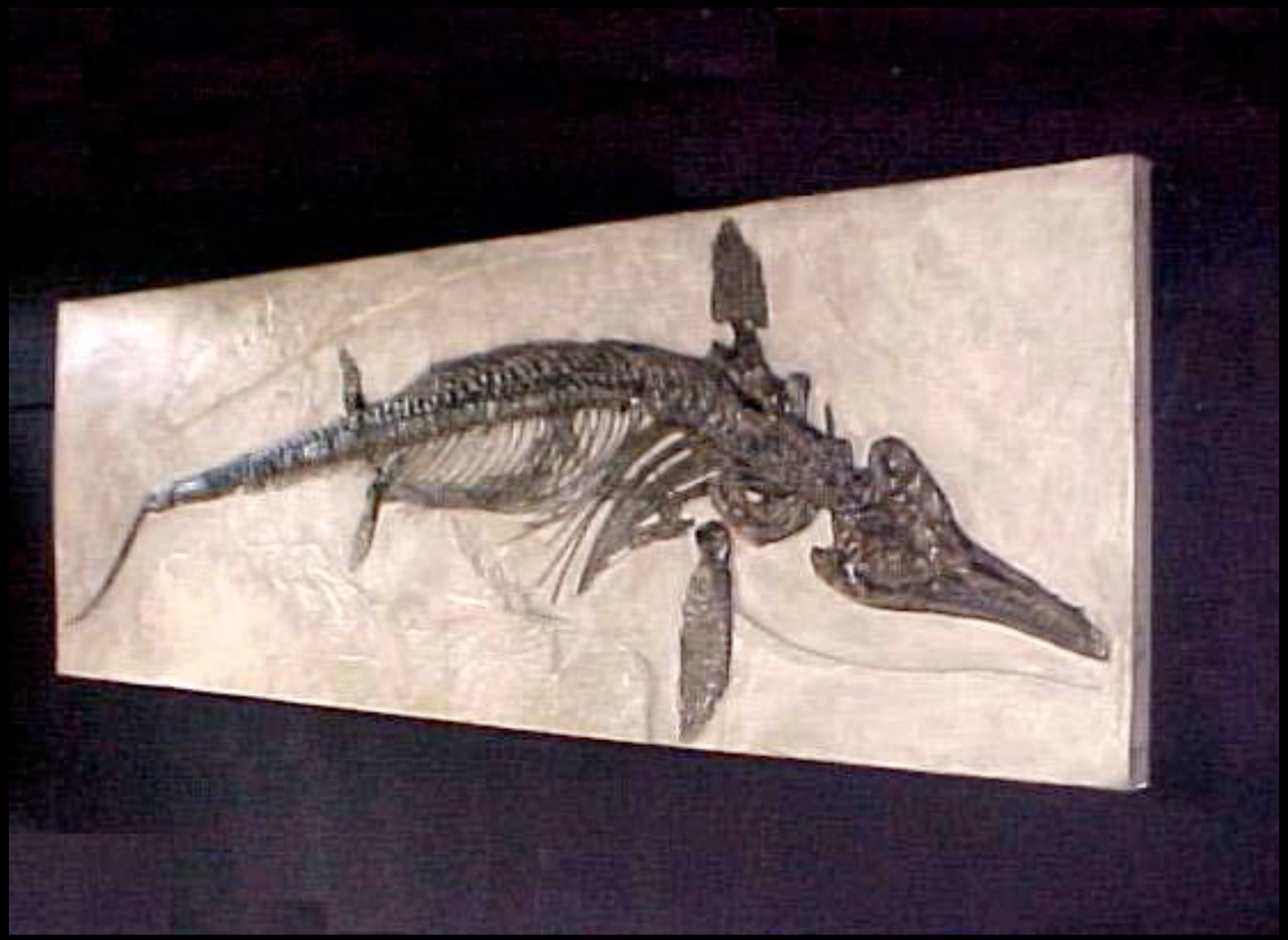
Remains preserved at the death site (autochthonous)

Remains transported (allochthonous)

Fluvial (Rivers)

Deserts
(rare)

Shallow Marine
(rare)

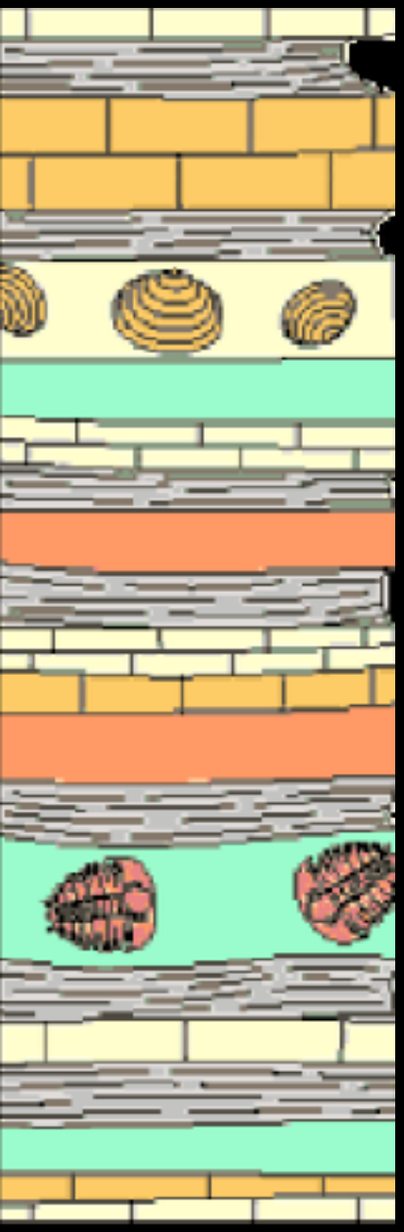


All dinosaurs lived on land. Why do we care about coastal fossil sites, etc.?

Placing fossils in TIME

Relative vs. Absolute Dating

YOUNGER



495 Ma

510 Ma

520 Ma

545 Ma

Absolute dates
Volcanic Ash

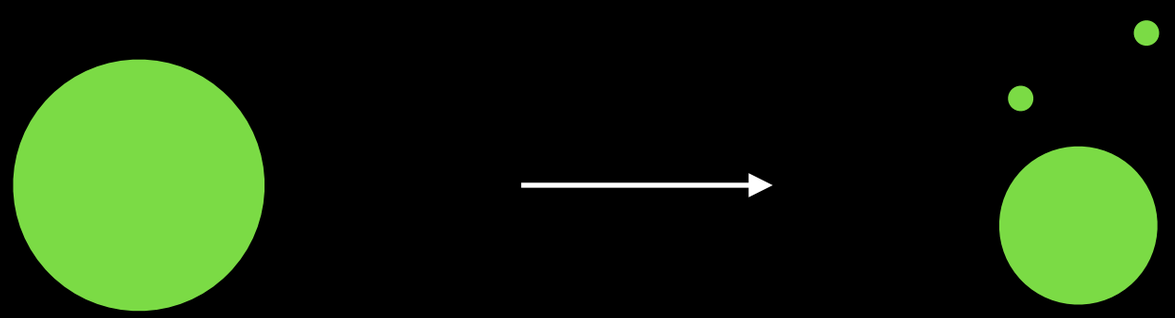
Relative ages

Issues:

- Last appearance
- Lazarus Taxa

OLDER

Radiometric Dating
via radioactive (UNSTABLE) isotopes



If we know:
-Original amt of parent isotope
-How much of the parent isotope is left
-Rate of decay of that isotope

Then we can estimate:
Amount of elapsed time

Absolute dating!

Biostratigraphy

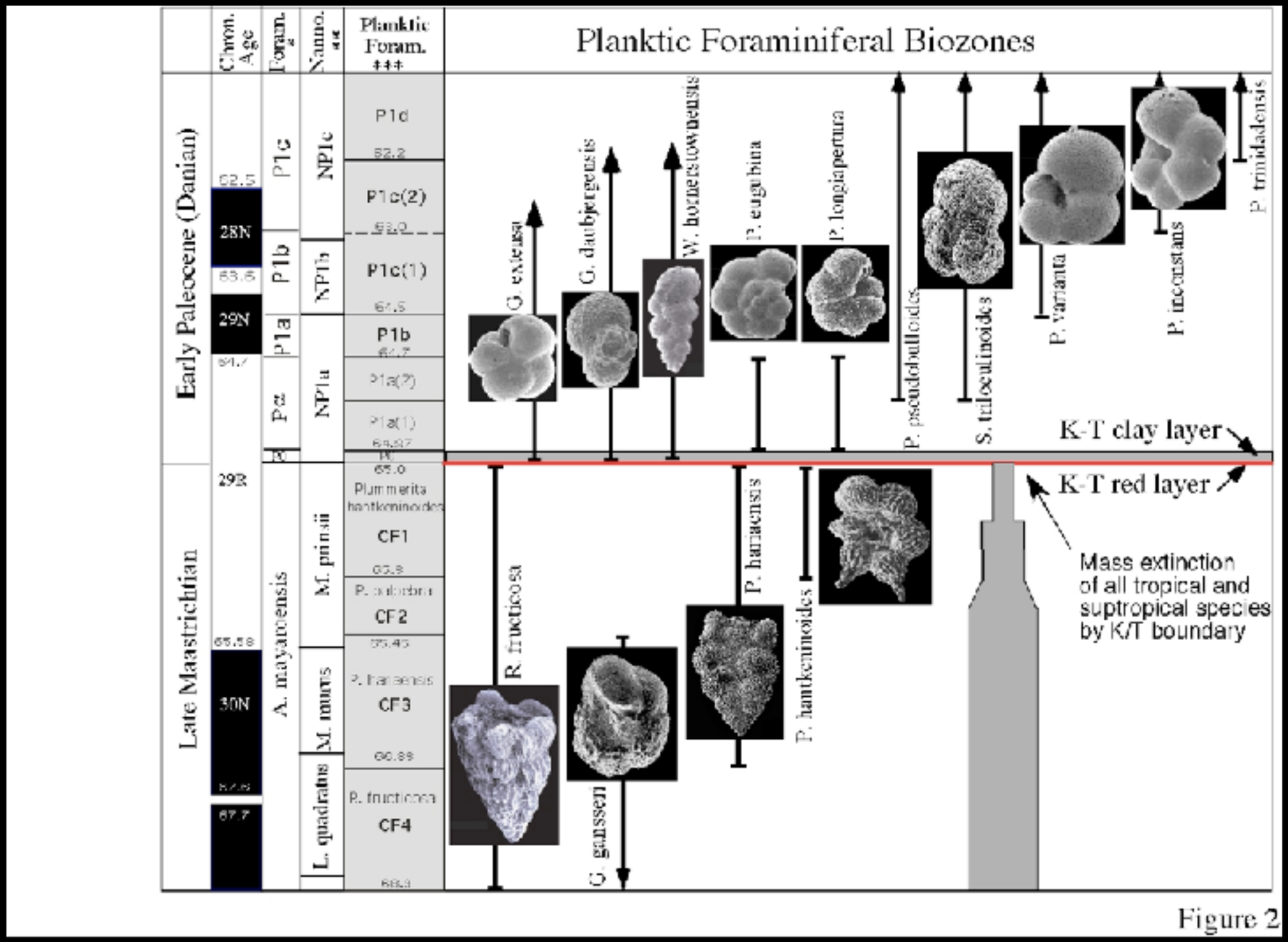
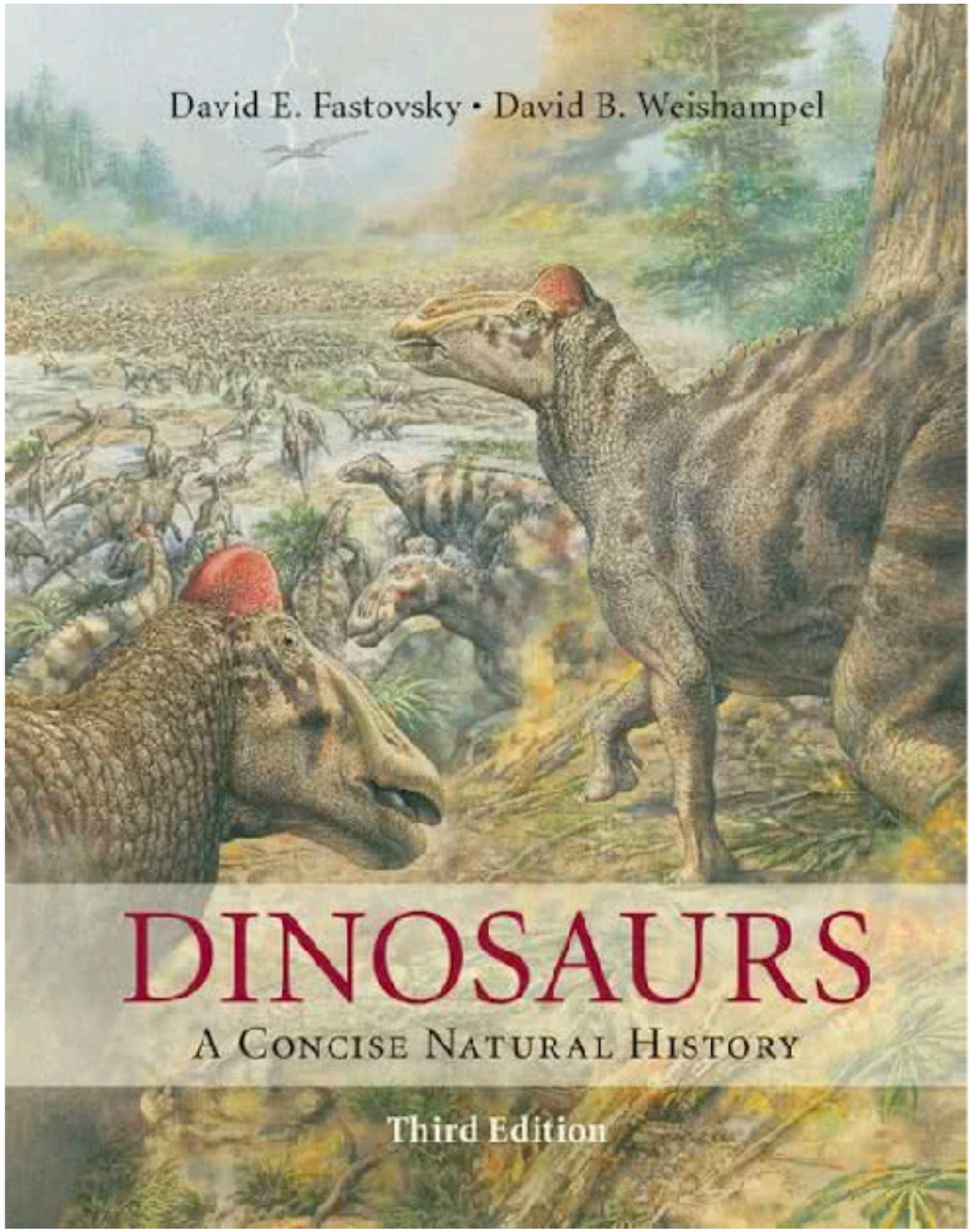


Figure 2

Relative Dating



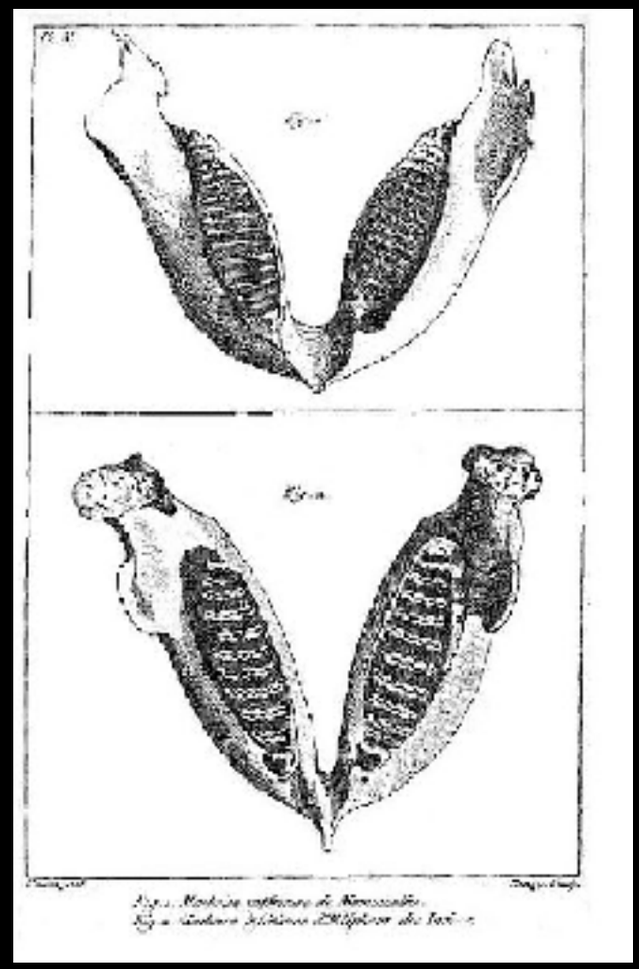
Reading for this week:
Fastovsky & Weishampel

Chapter 3: the key to the rest of the class

George Cuvier (1769-1832)

Indian elephant

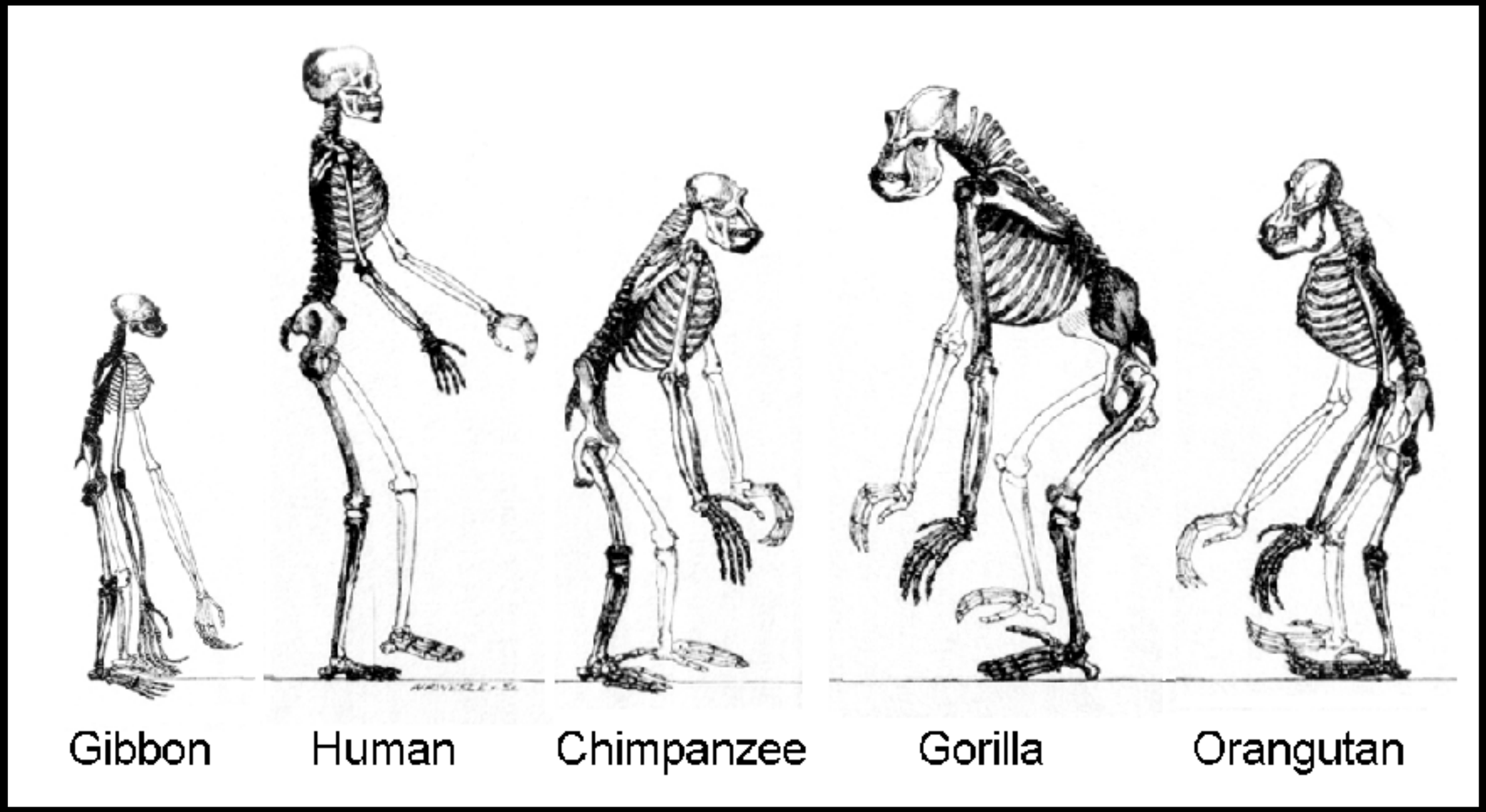
Mammoth



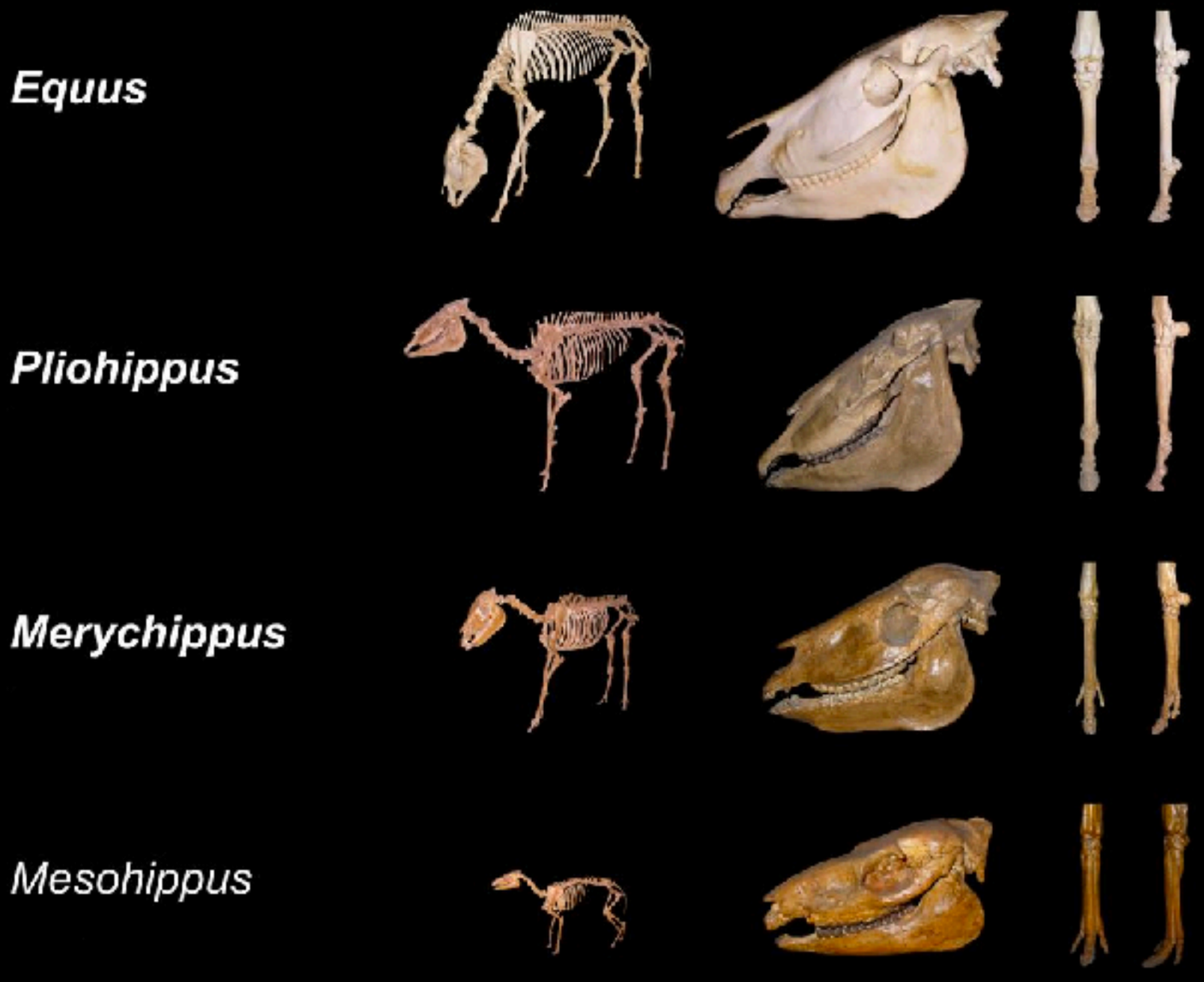
Catastrophism

(vs. Uniformitarianism)

Similarity in form (comparative morphology)

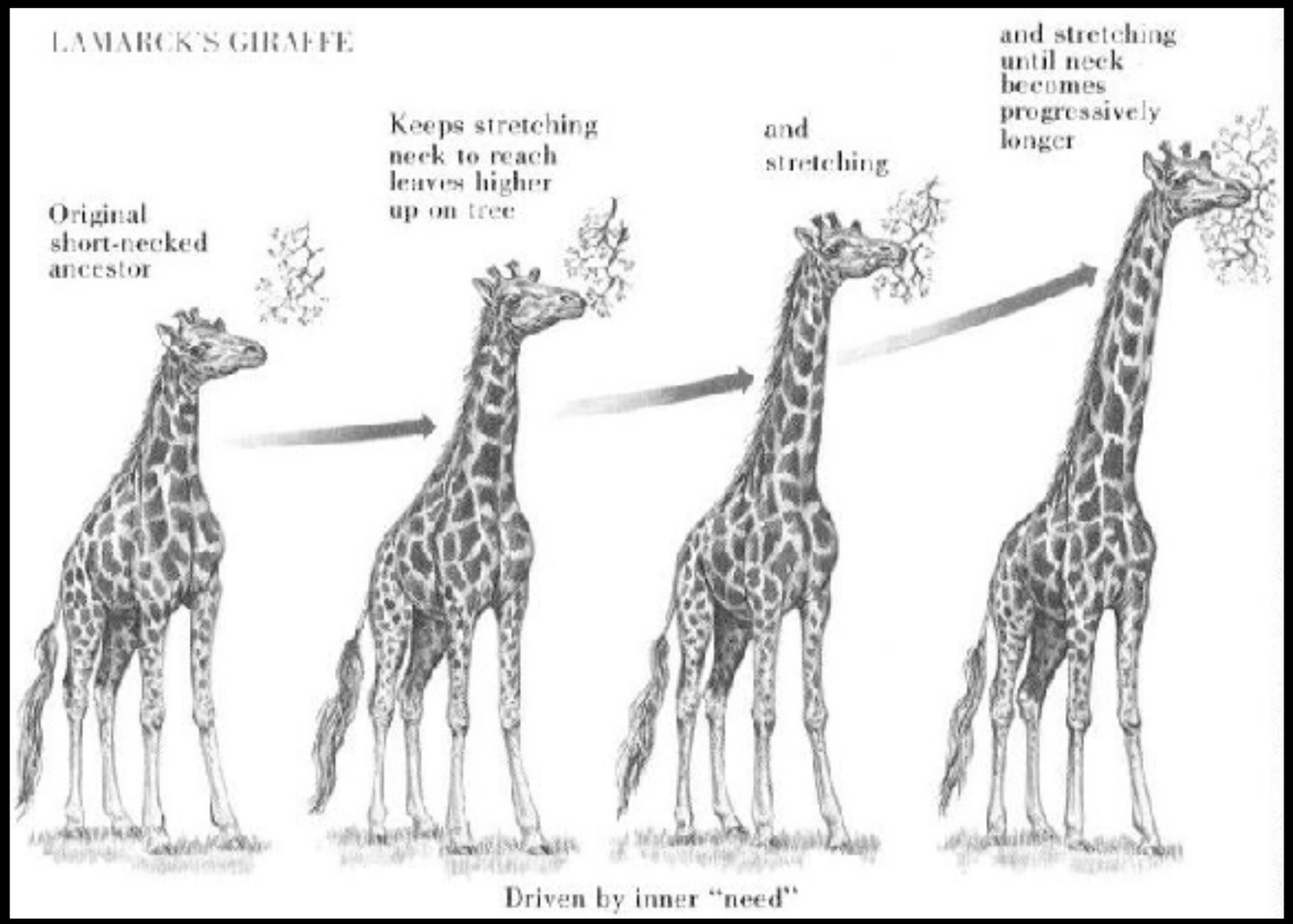


Evolution
‘Change over time’



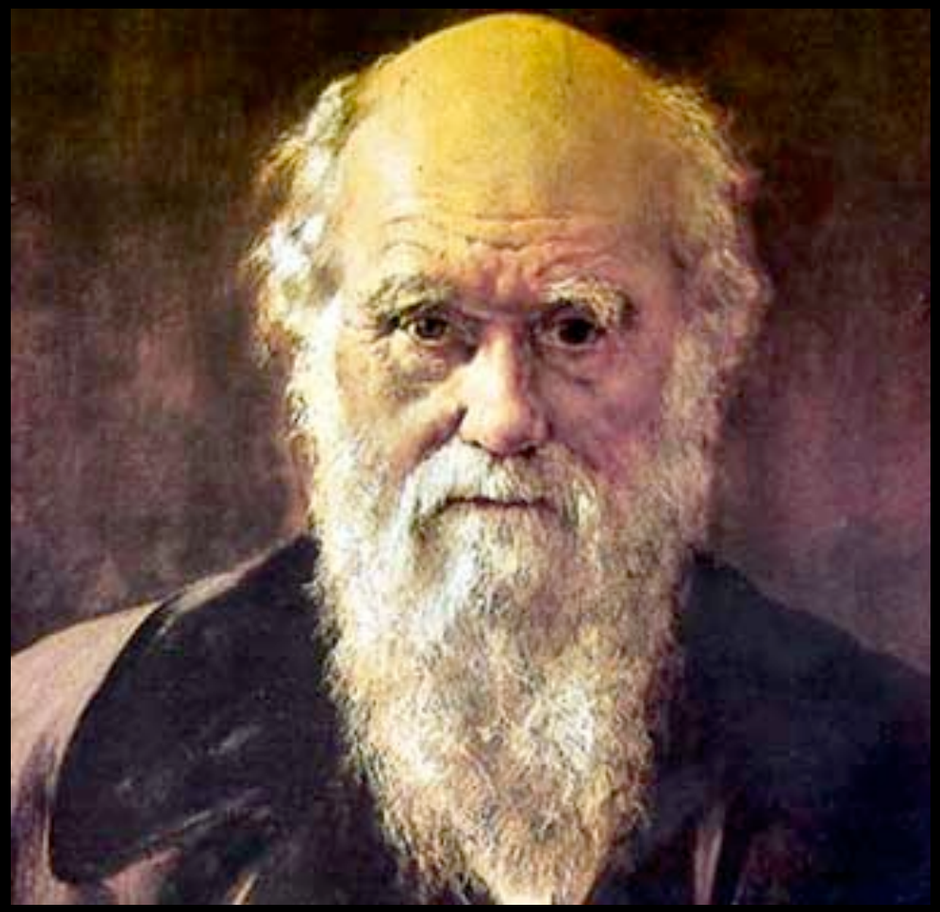
…but what is the process?

- Lamarckian evolution



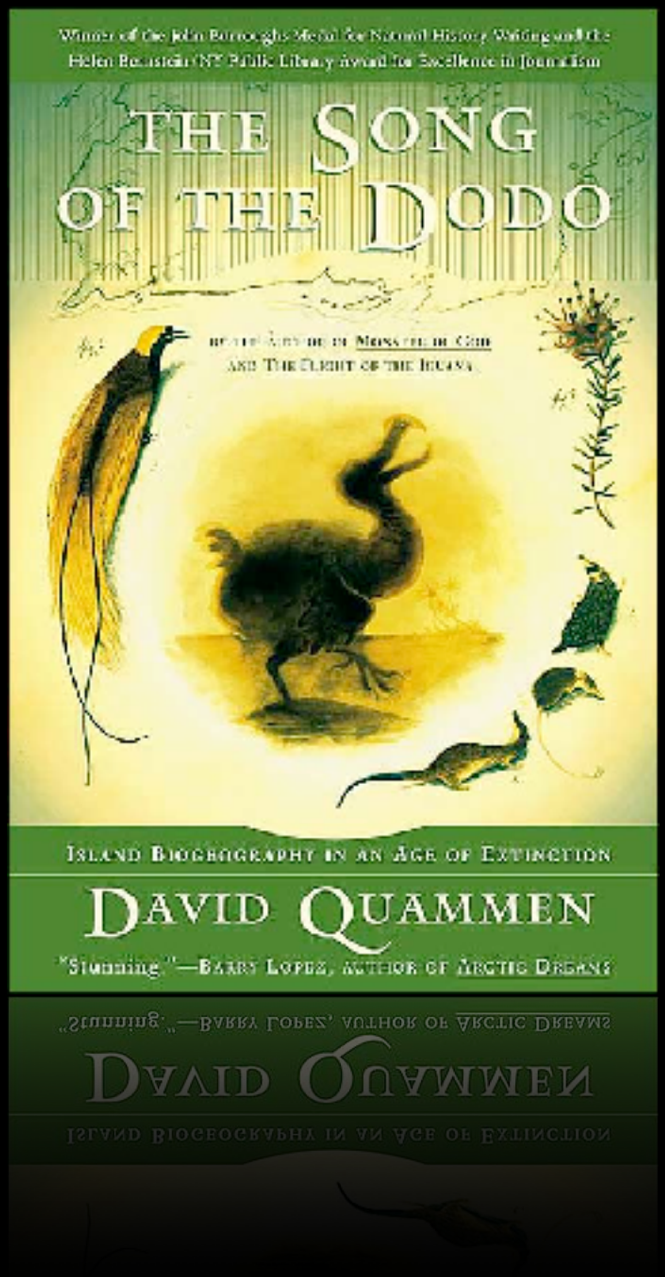

Jean-Baptiste Pierre Antoine de Monet Chevalier de la Marck

Evolution by Natural Selection



Charles Darwin

Alfred Russel Wallace



Evolution by Natural Selection!

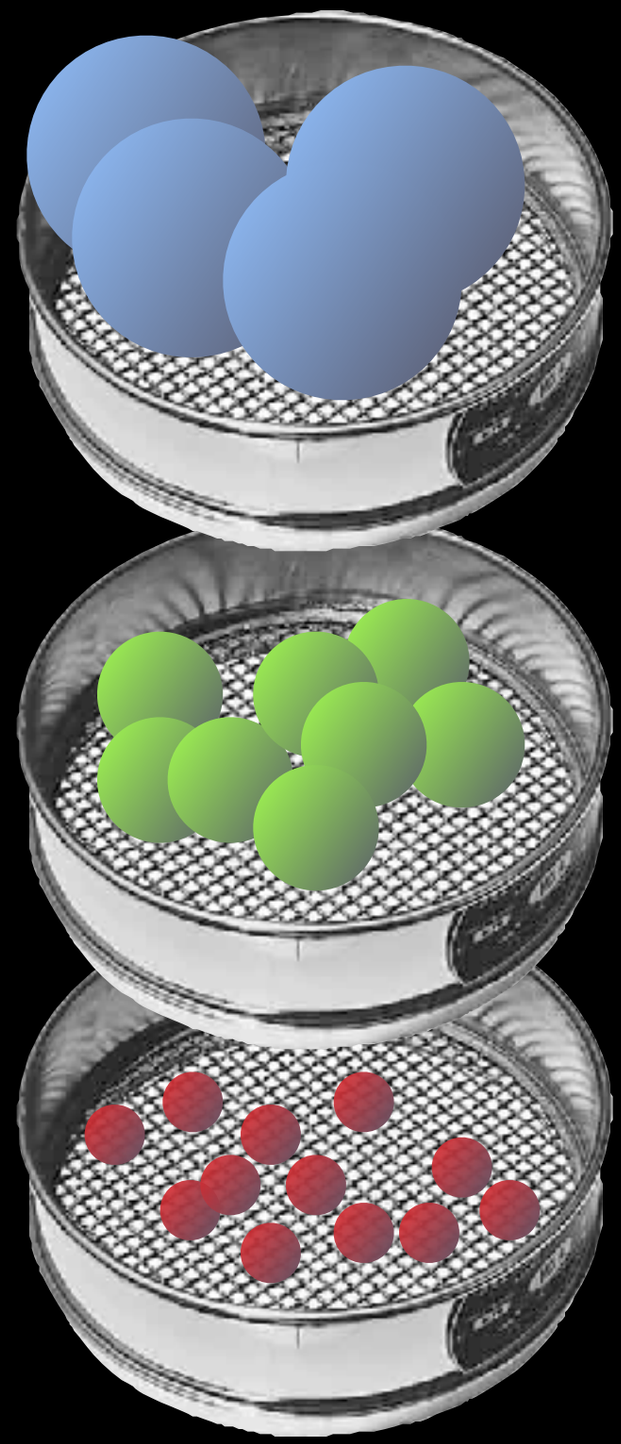
1. Inheritance
2. Variation
3. Selective ‘force’

   Variants don’t have equal reproductive success

   \+ Fecundity
   \+ Survivorship

Fitness

time



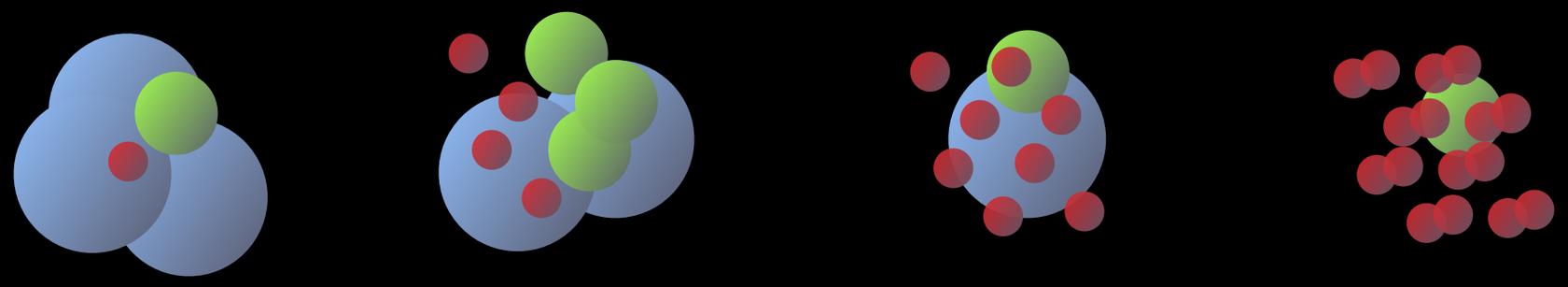
Individuals vs. Populations

Individuals

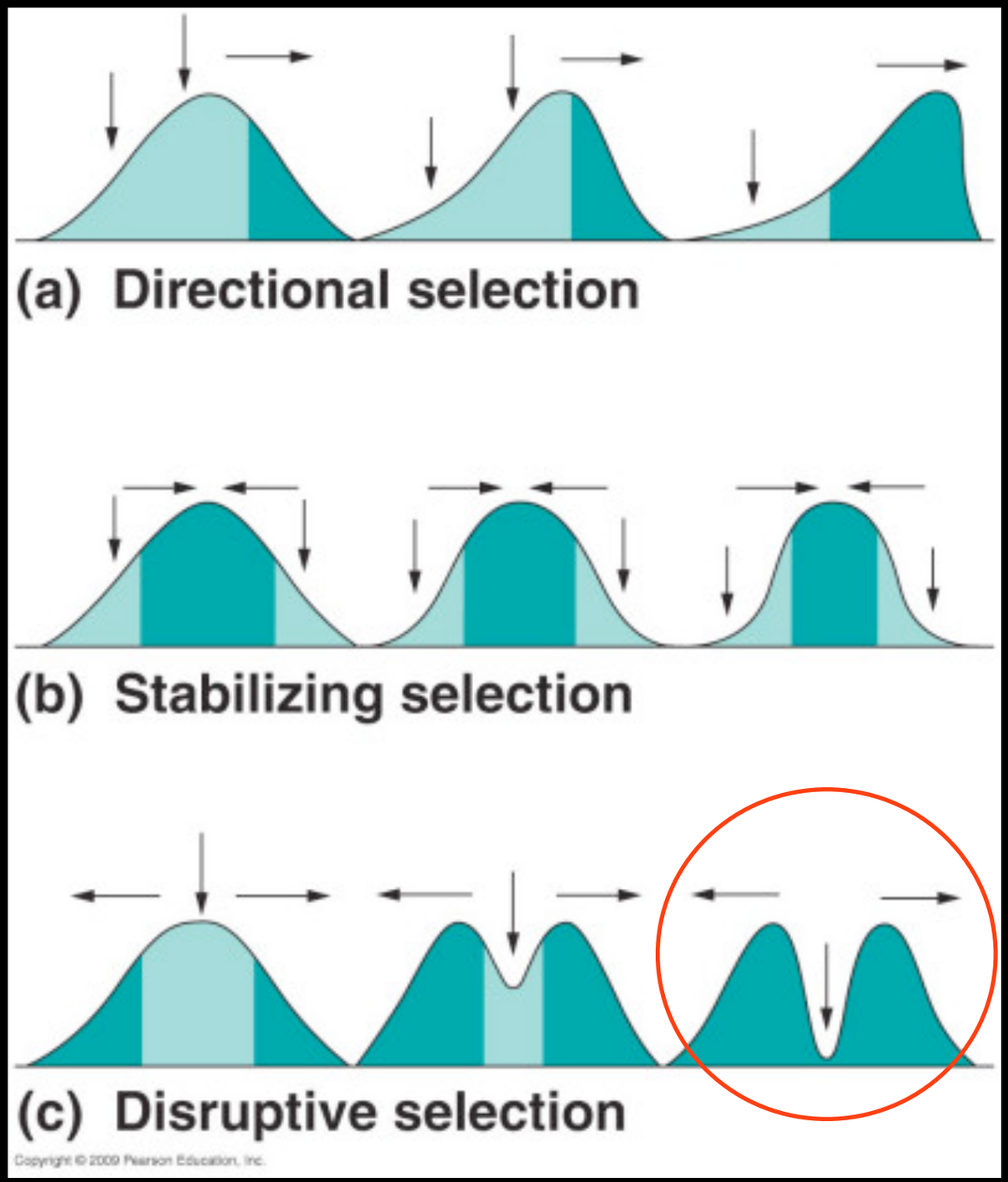
NATURAL SELECTION

Populations

EVOLUTION



Modes of Selection



For Section:
Think of examples
(not the ones I use) for each

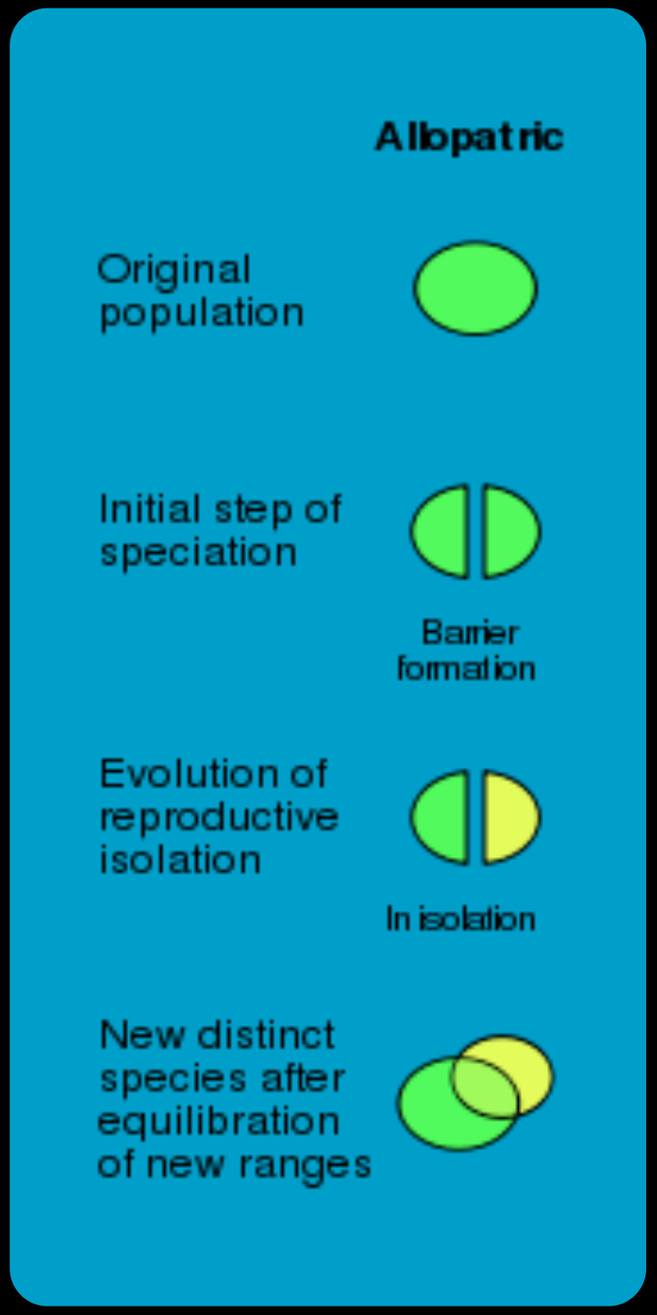
e.g. human height

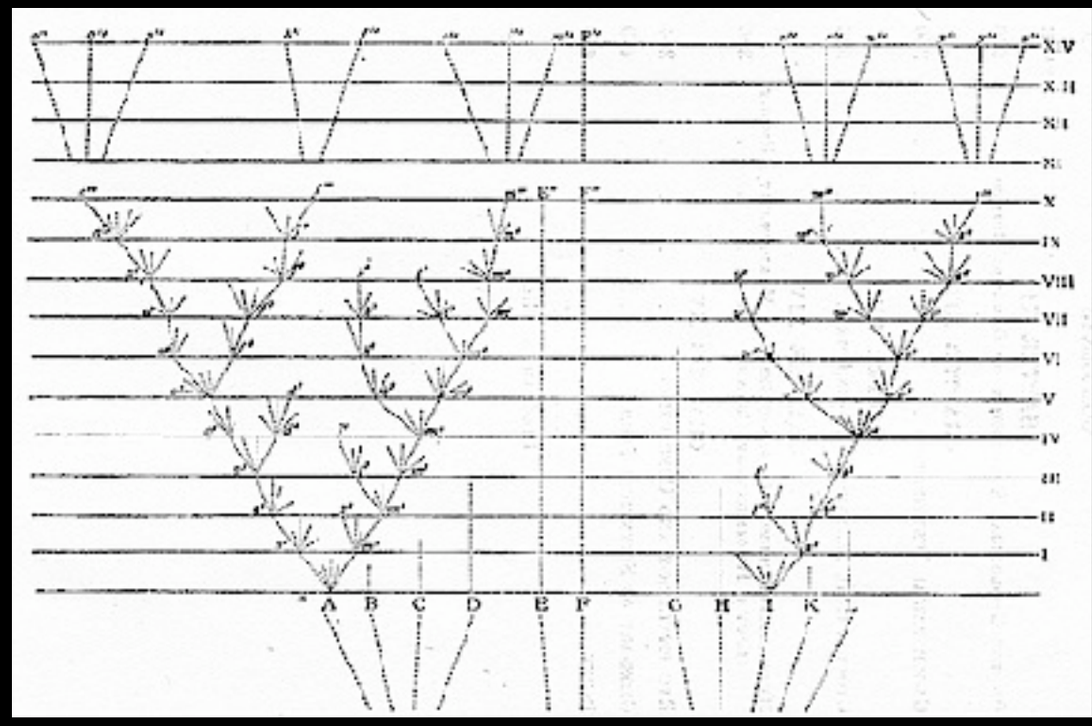
e.g. birth weight in humans

~speciation
(this is what we will be focusing on)

t_1 t_2 t_3

Speciation: Evolution by Natural Selection

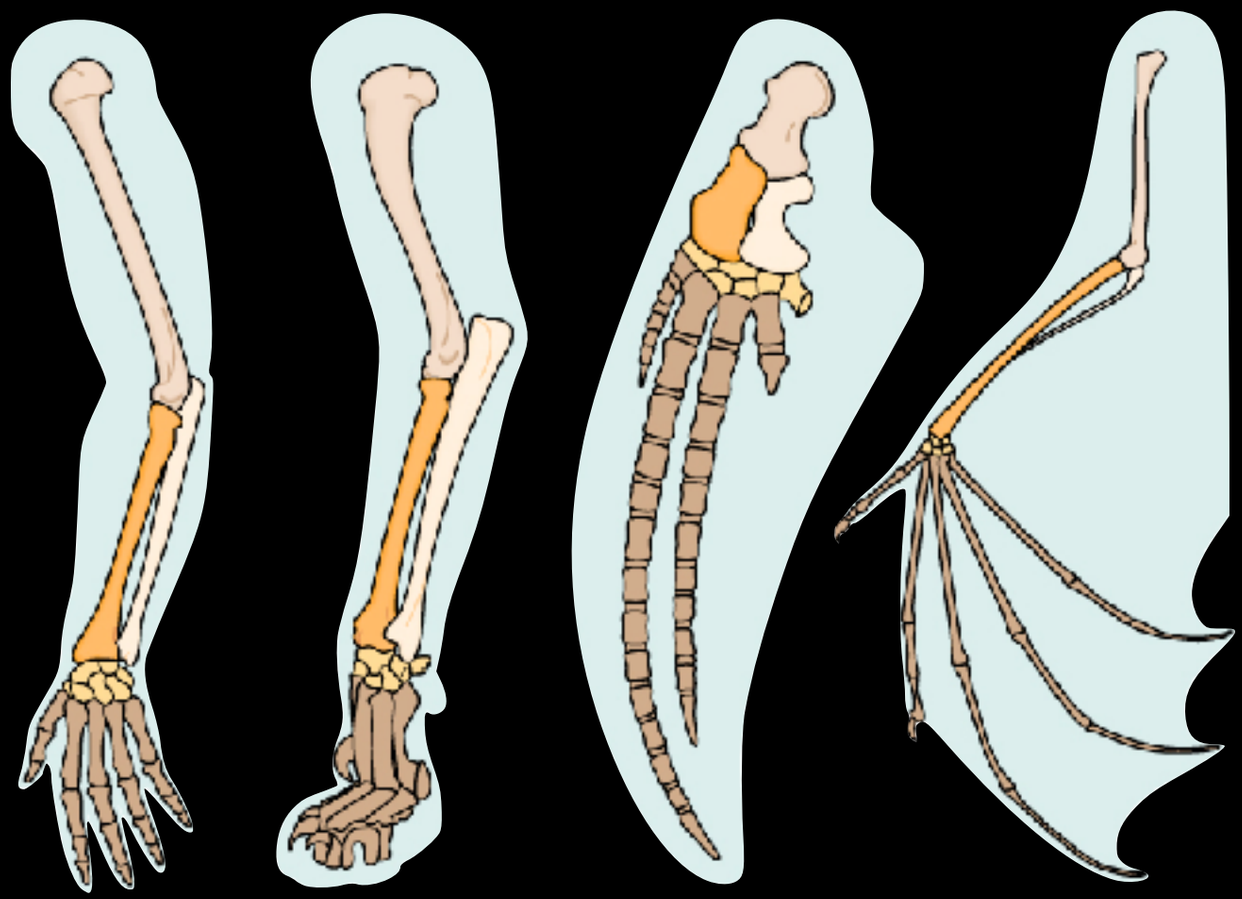




That is the theory... so what is the evidence?

Evidence for Evolution

1.Homologous characteristics

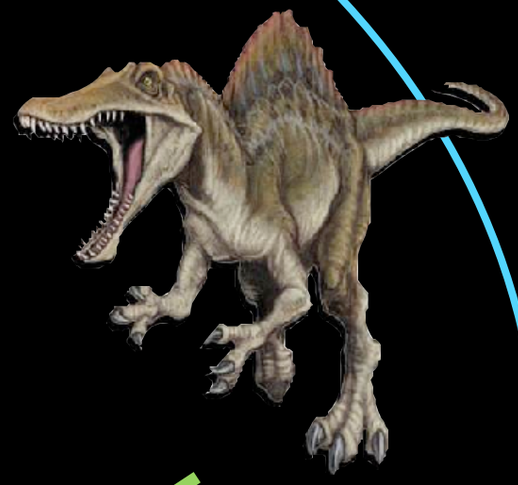


Human Cat Whale Bat

Evidence for Evolution

Evidence for Evolution

Homologous

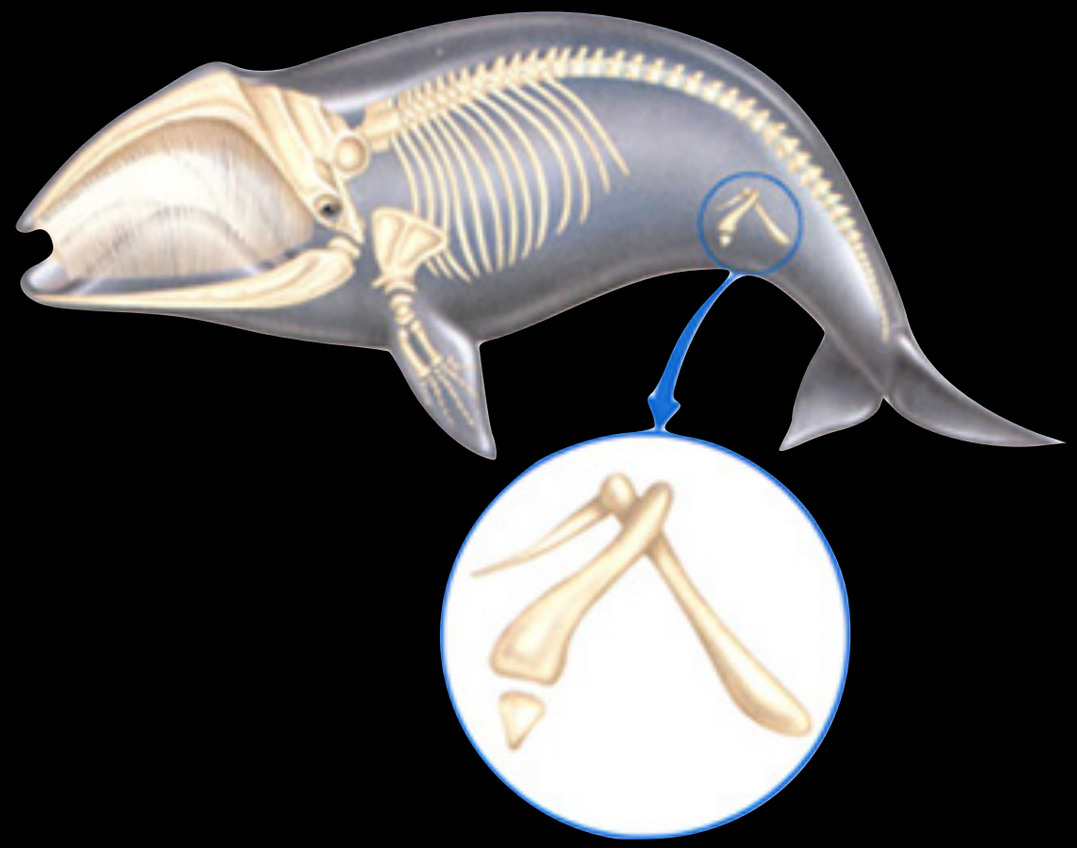


human limbs ~ dino limbs
{The Tetrapod body plan}

Analogous

fly wings ≠ pterosaur wings

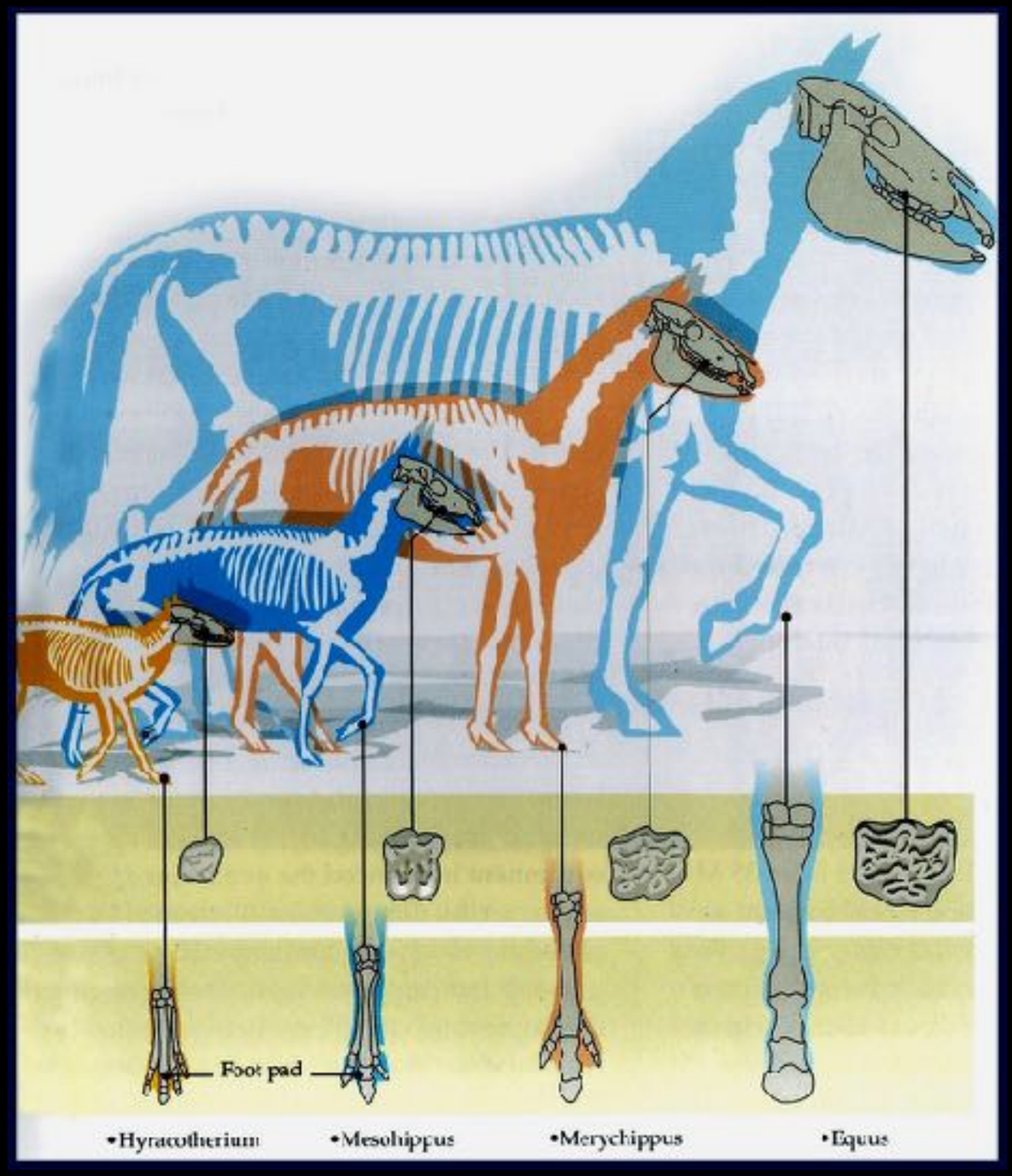
2. Vestigial Traits



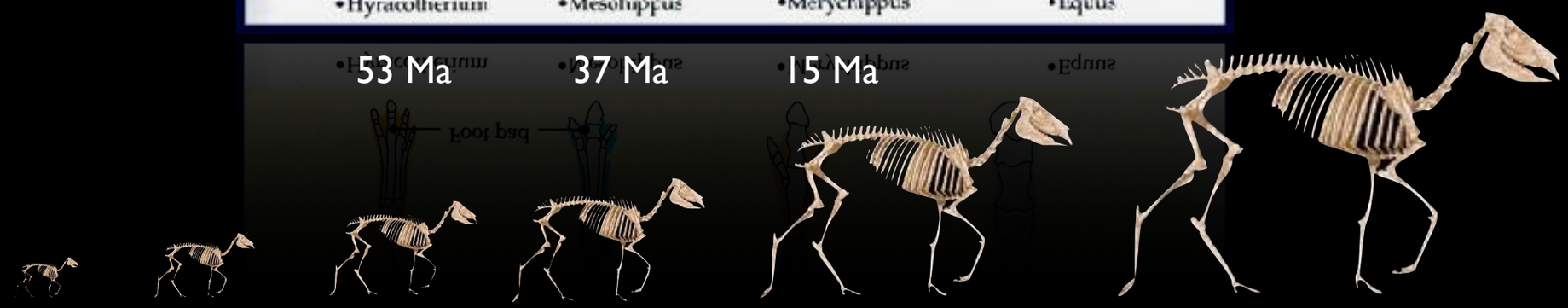
Vestigial Traits

Evidence for Evolution

3. The Fossil Record



53 Ma 37 Ma 15 Ma

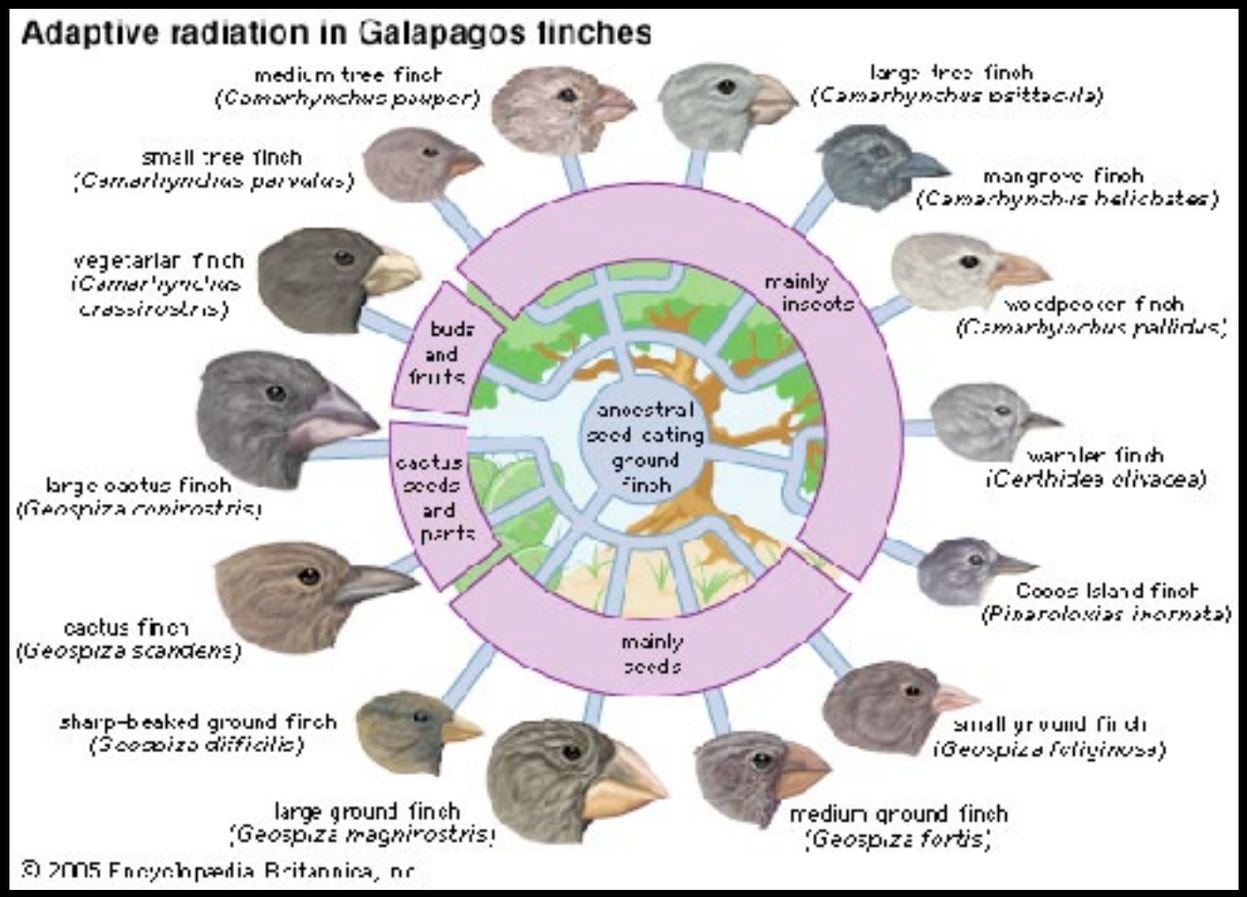


Evidence for Evolution
by Natural Selection

3. Modern Evolutionary Events

Evolution can occur on much smaller timescales than once thought

Finch Radiation

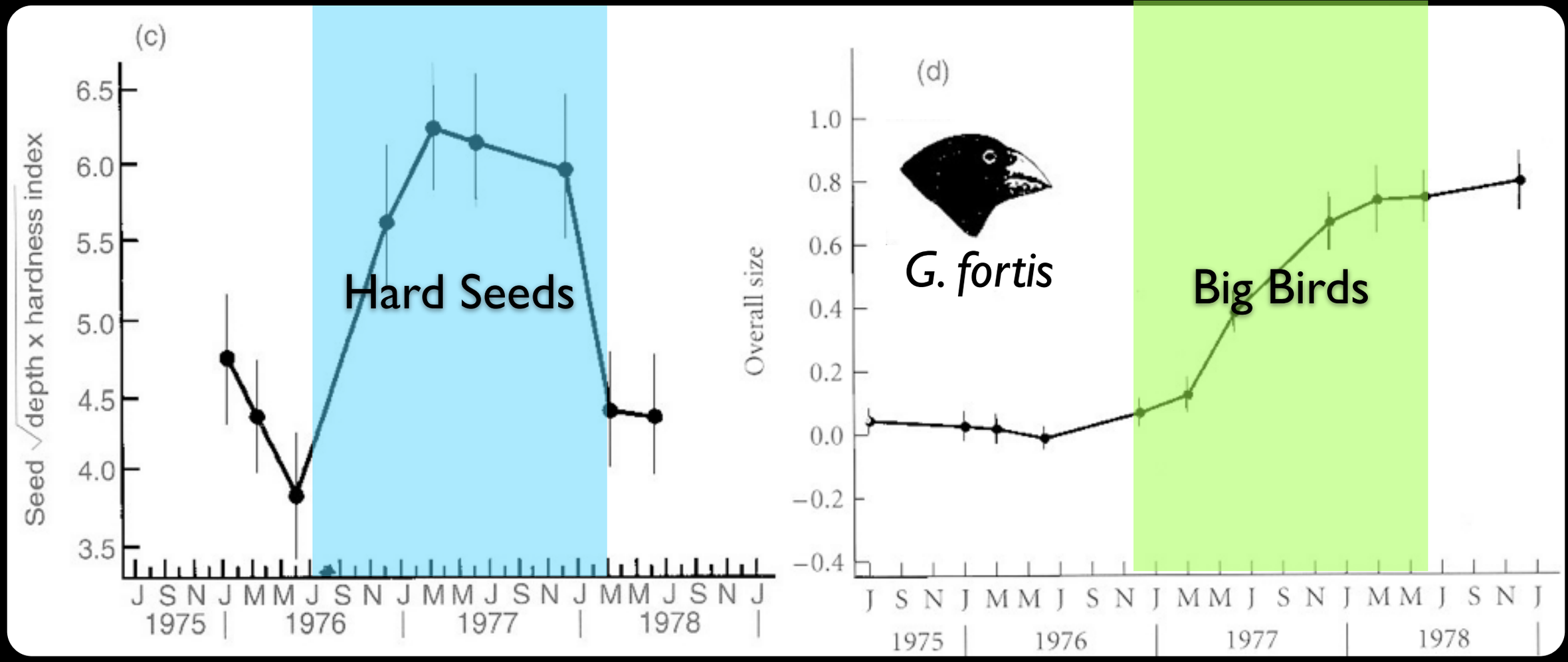


Islands: Natural Laboratories

1. Inherited traits (beak size)
2. Variation in trait

Evidence for Evolution
by Natural Selection

Selection on Galapagos finches

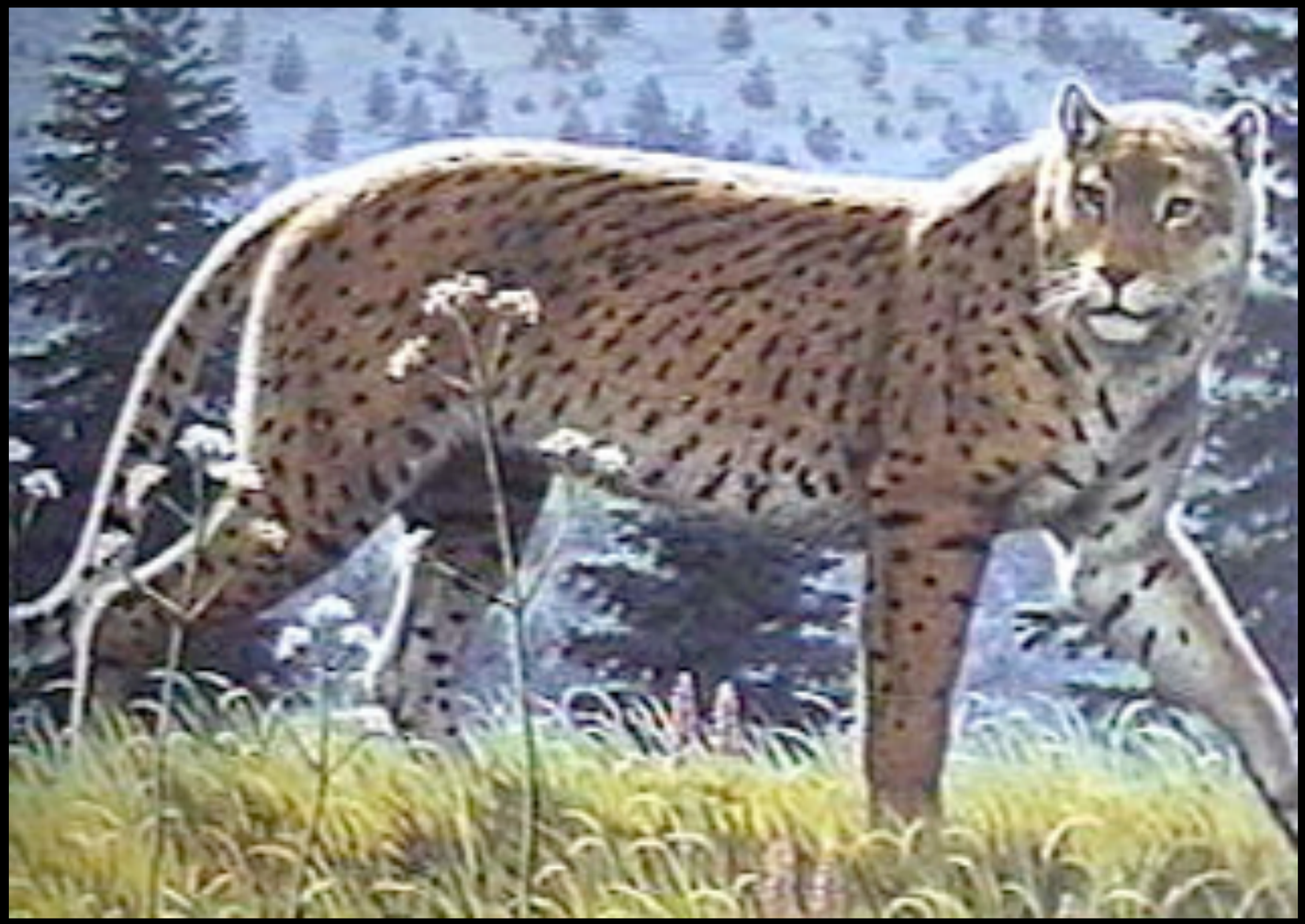


Major Drought

Selection

1. Inherited traits (beak size)
2. Variation in trait
3. Selection based on fitness (survival)

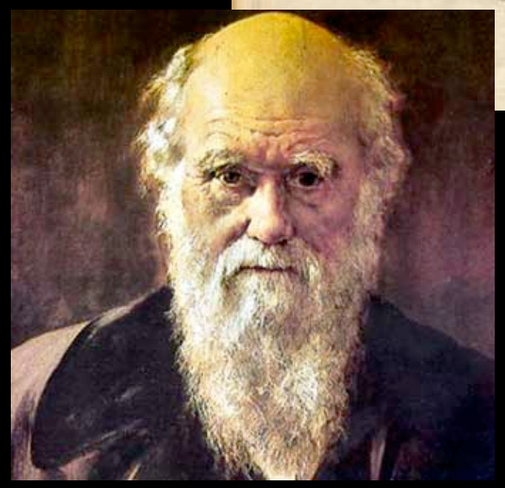
Coevolution



Coevolution

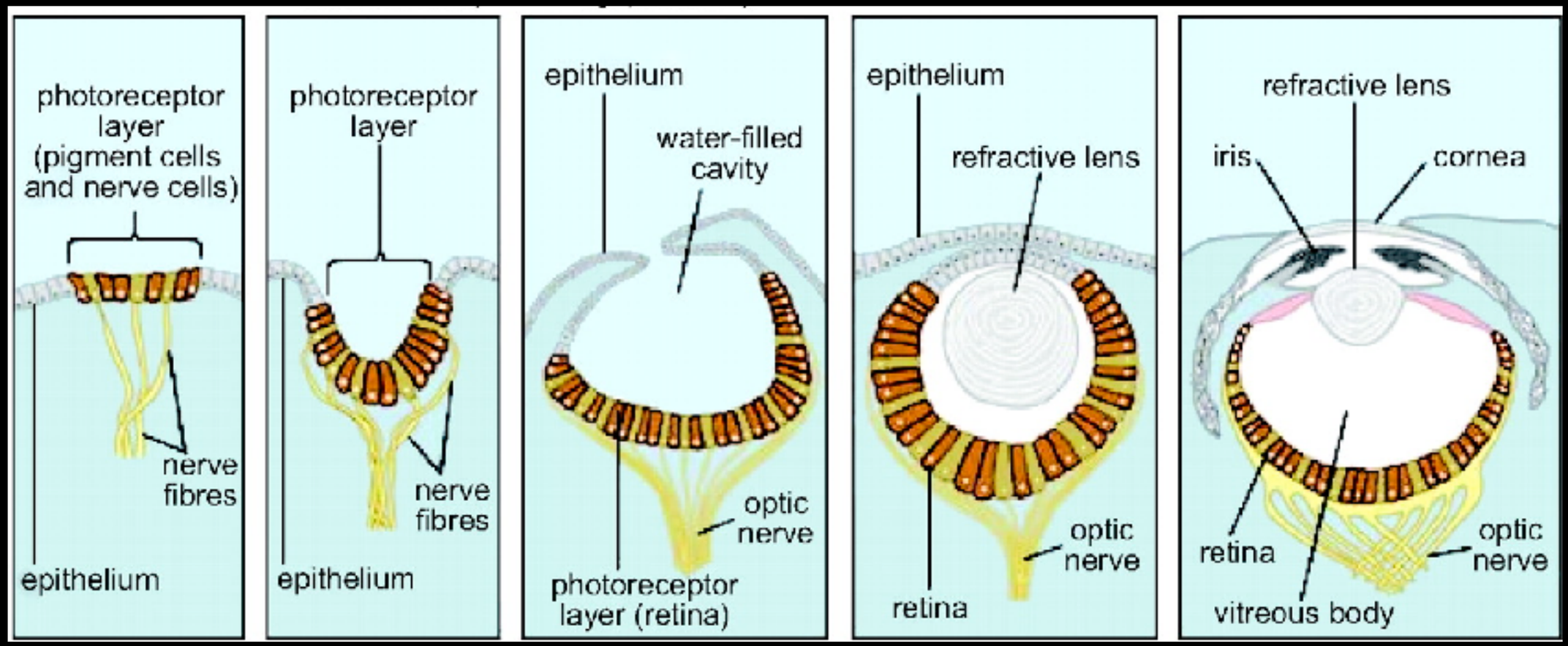
"I have just received such a Box full from Mr Bateman with the astounding *Angræcum sesquipedalia* with a nectary a foot long - Good Heavens what insect can suck it?"

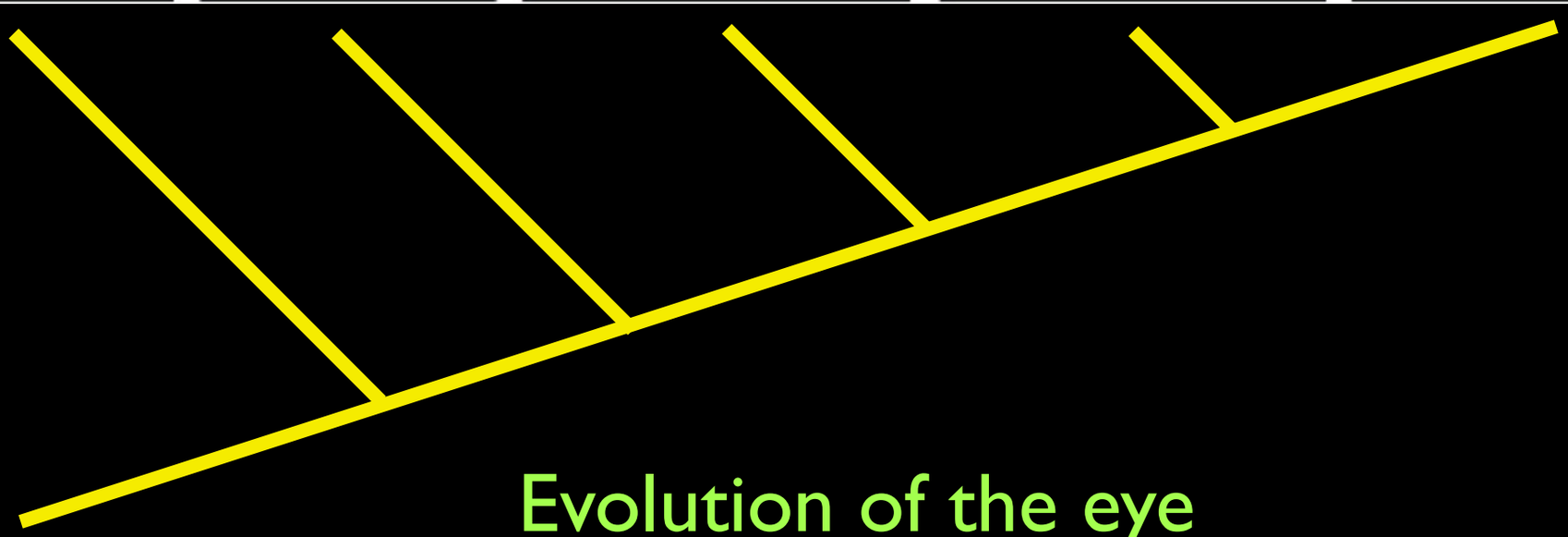
A. sequipedale



Evidence for Evolution
by Natural Selection

Evolution occurs in many small steps
Over a very long time...





Evolution of the eye

Cladograms

This is possibly the most important concept for the rest of the course...

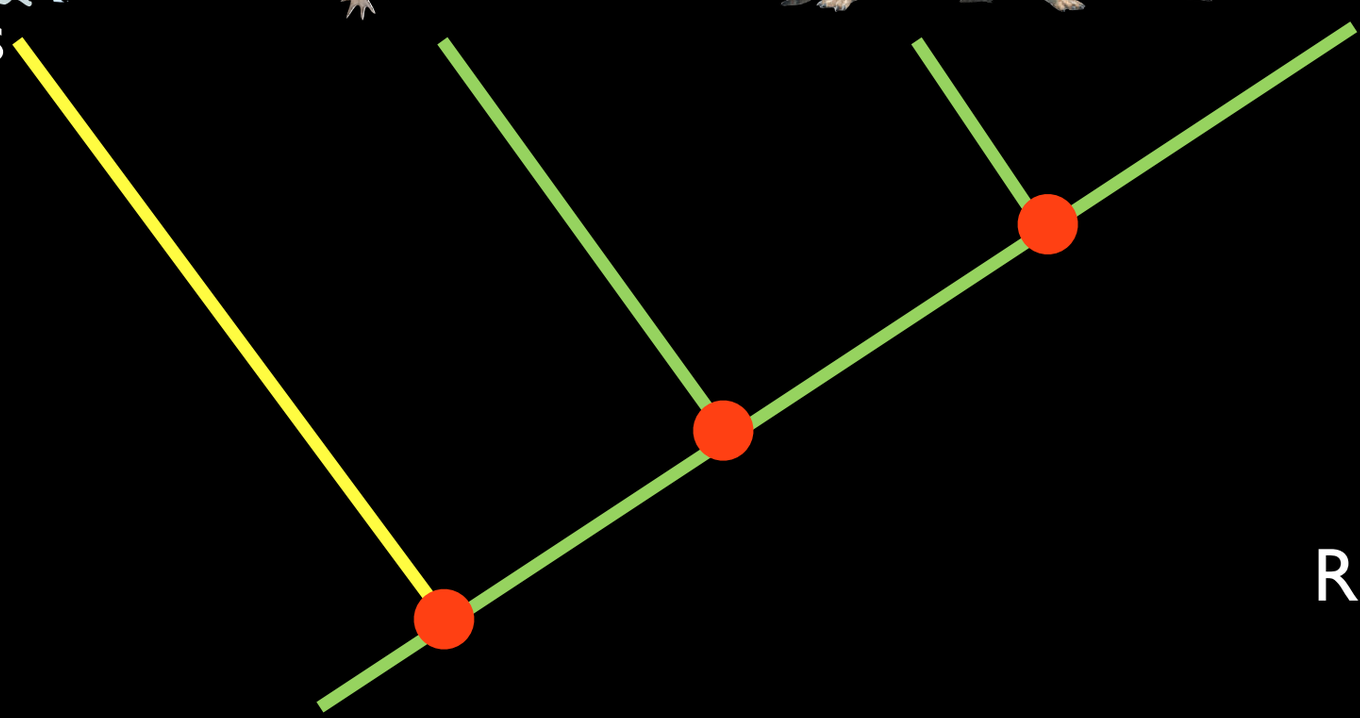
- A cladogram is a hypothesis of evolutionary relationships
- No absolute time... just sequences of events
- Parsimony

Cephalopods

Amphibians

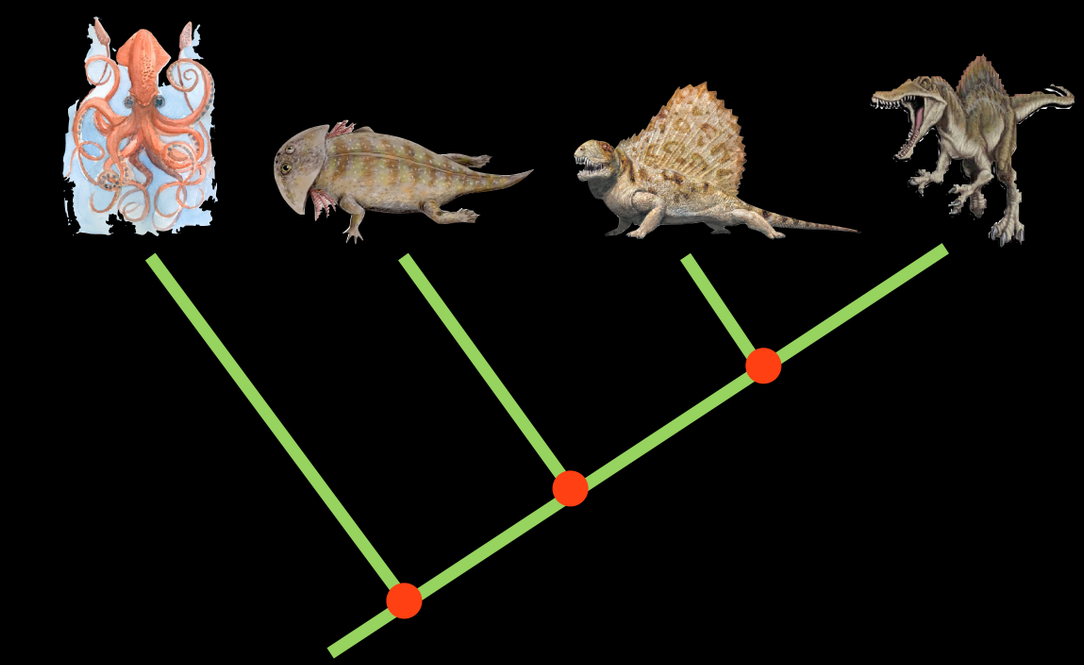
Synapsids

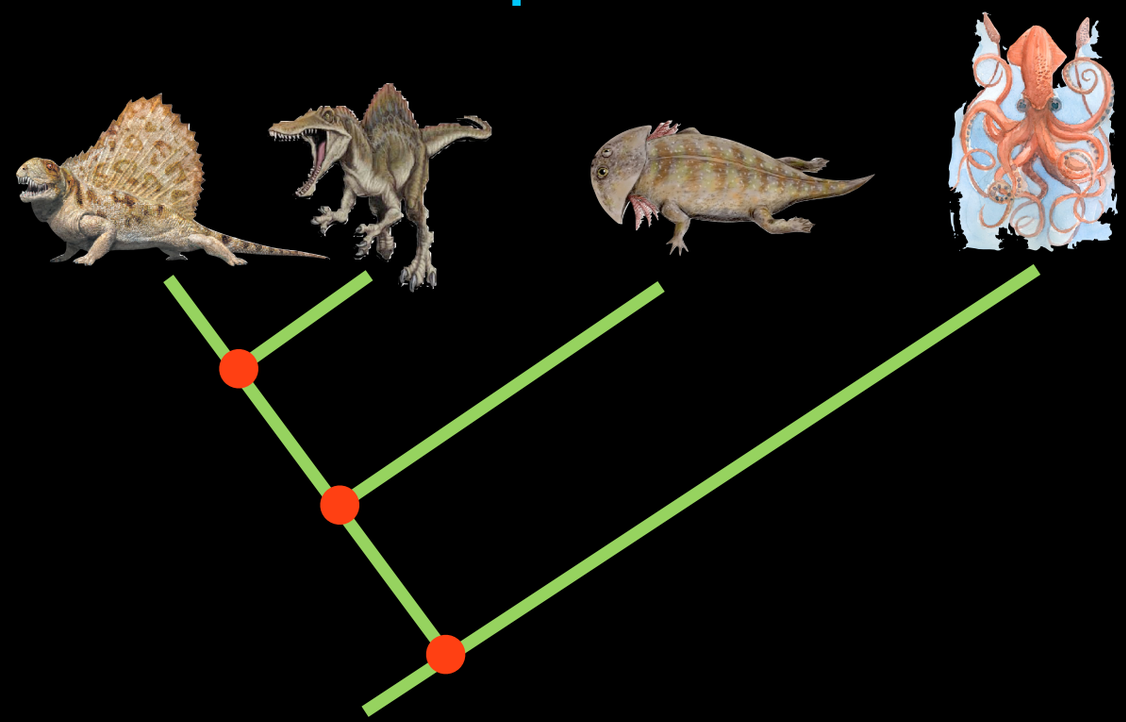
Therapsids



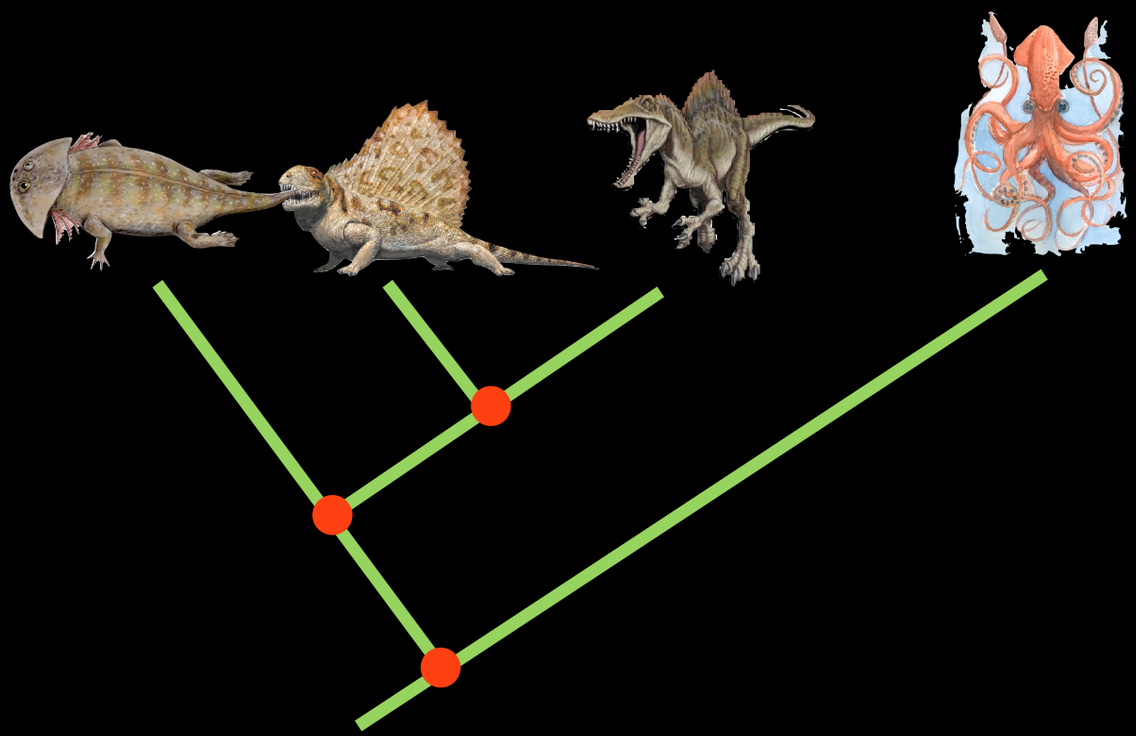
RELATIVE time

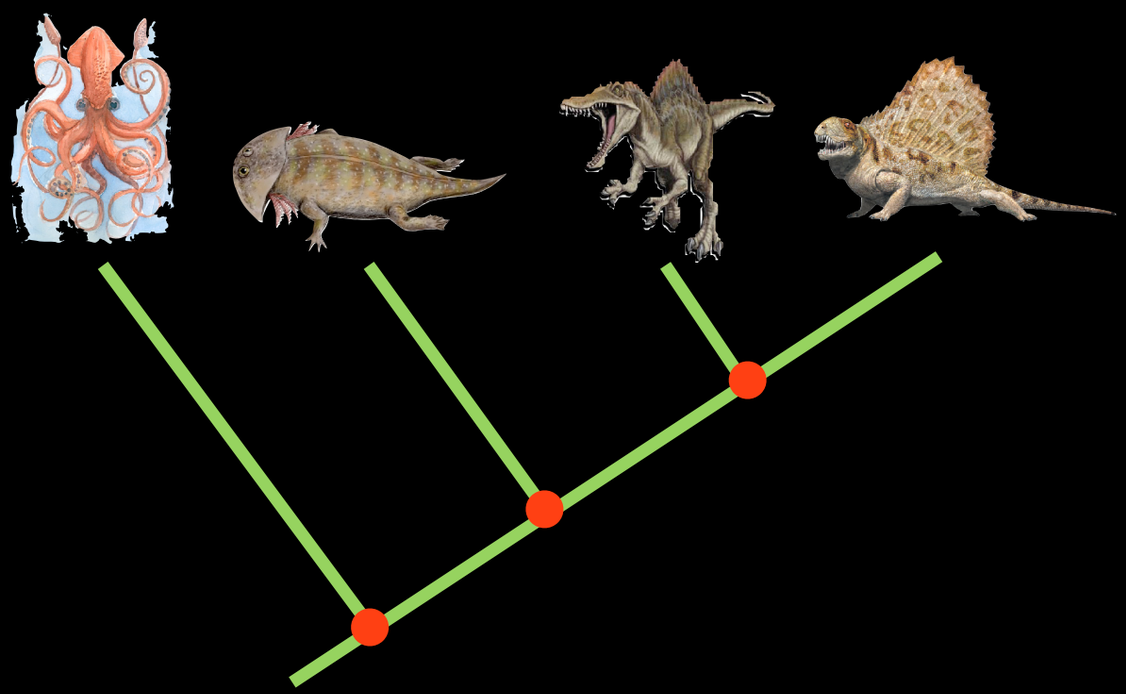
Different Hypotheses of Relationships?

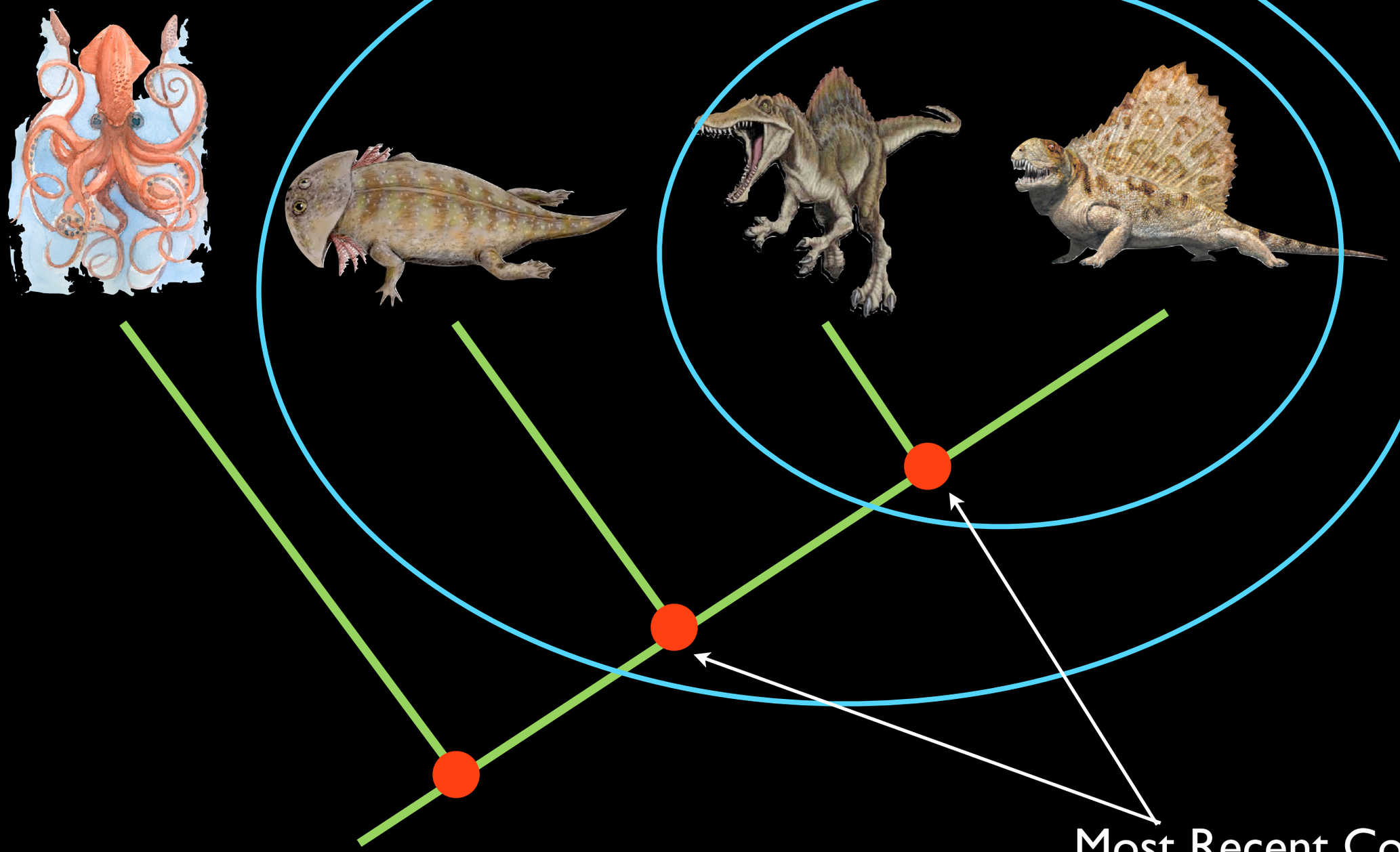




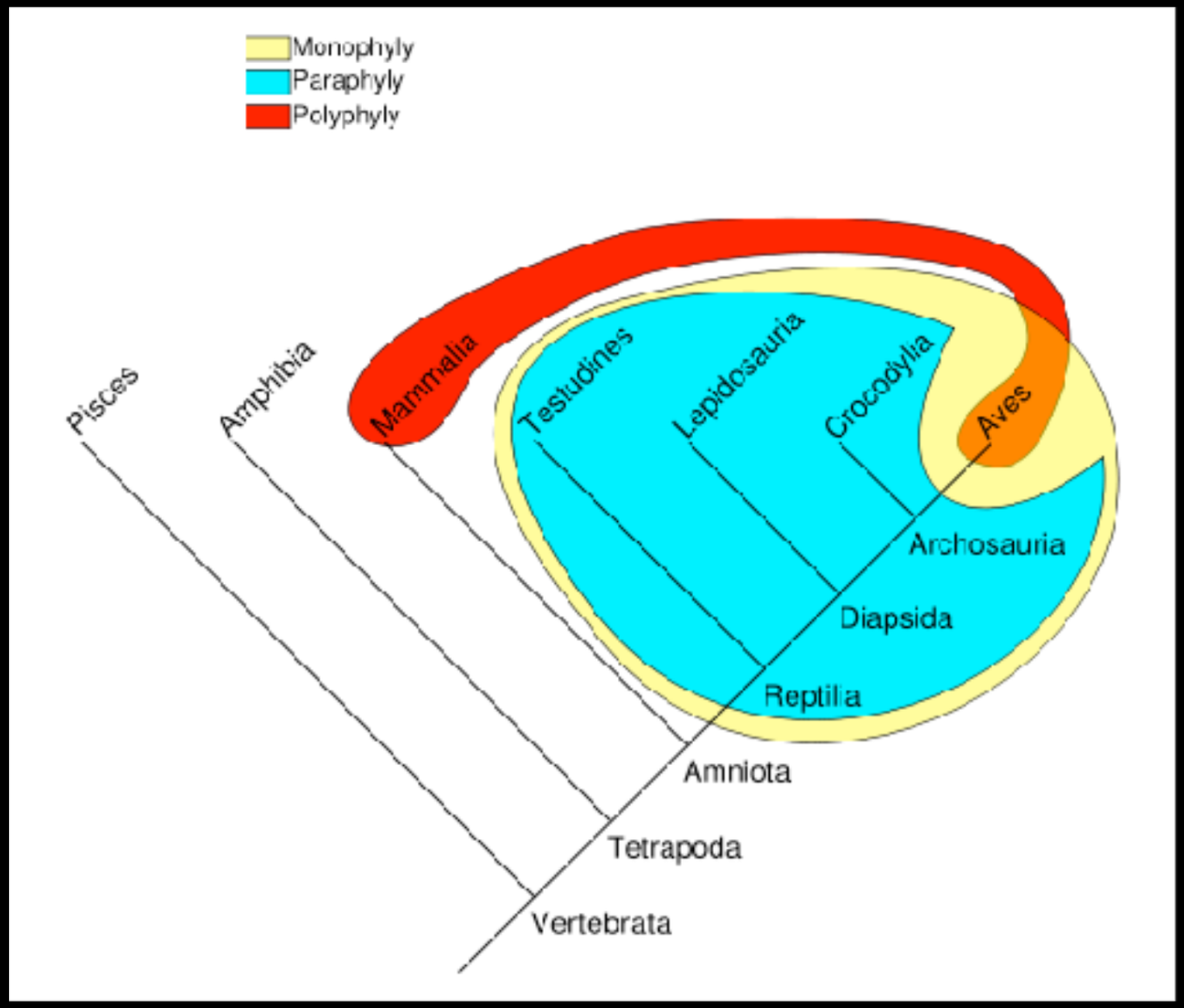
No! These are all the SAME!





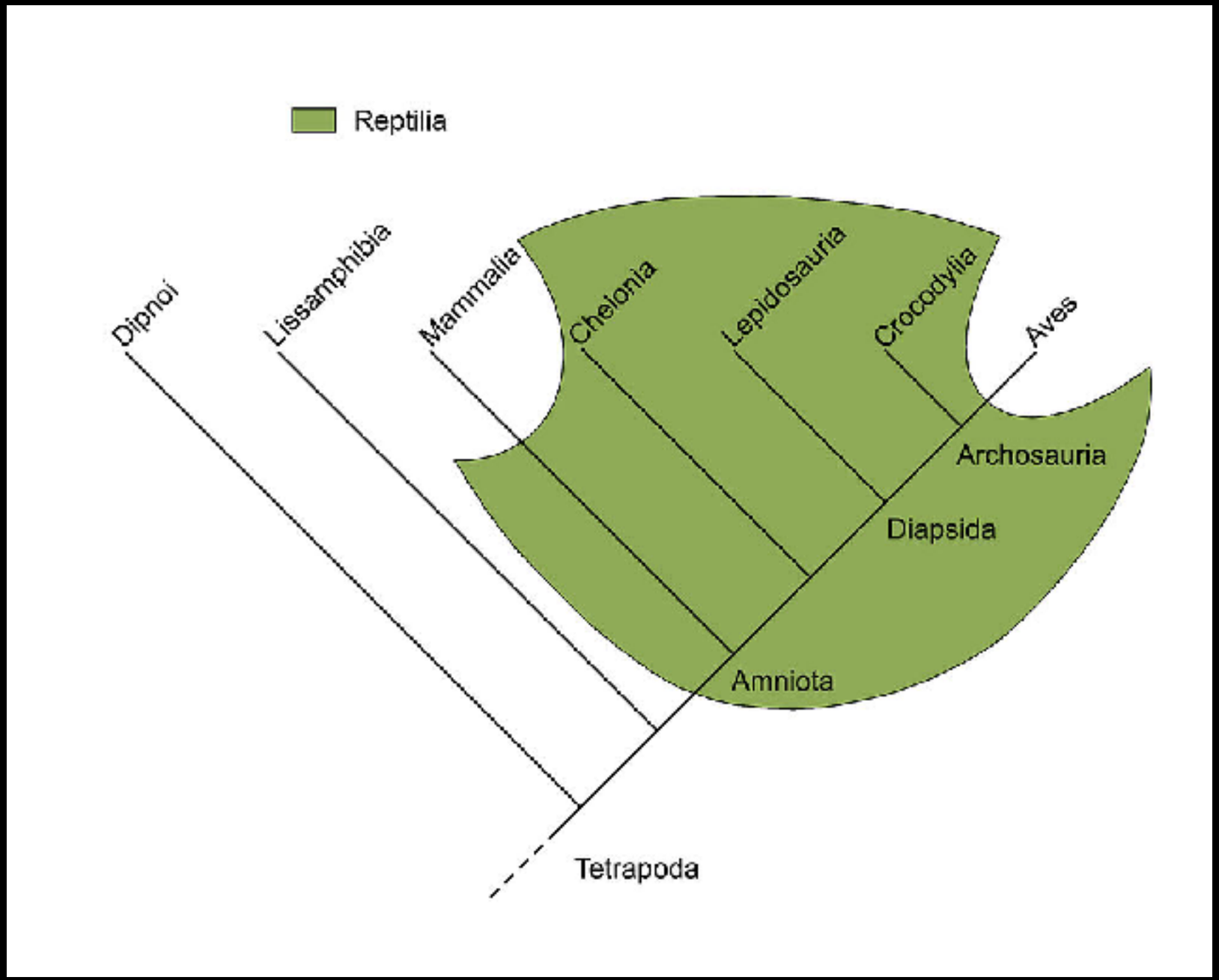


Monophyletic Groups

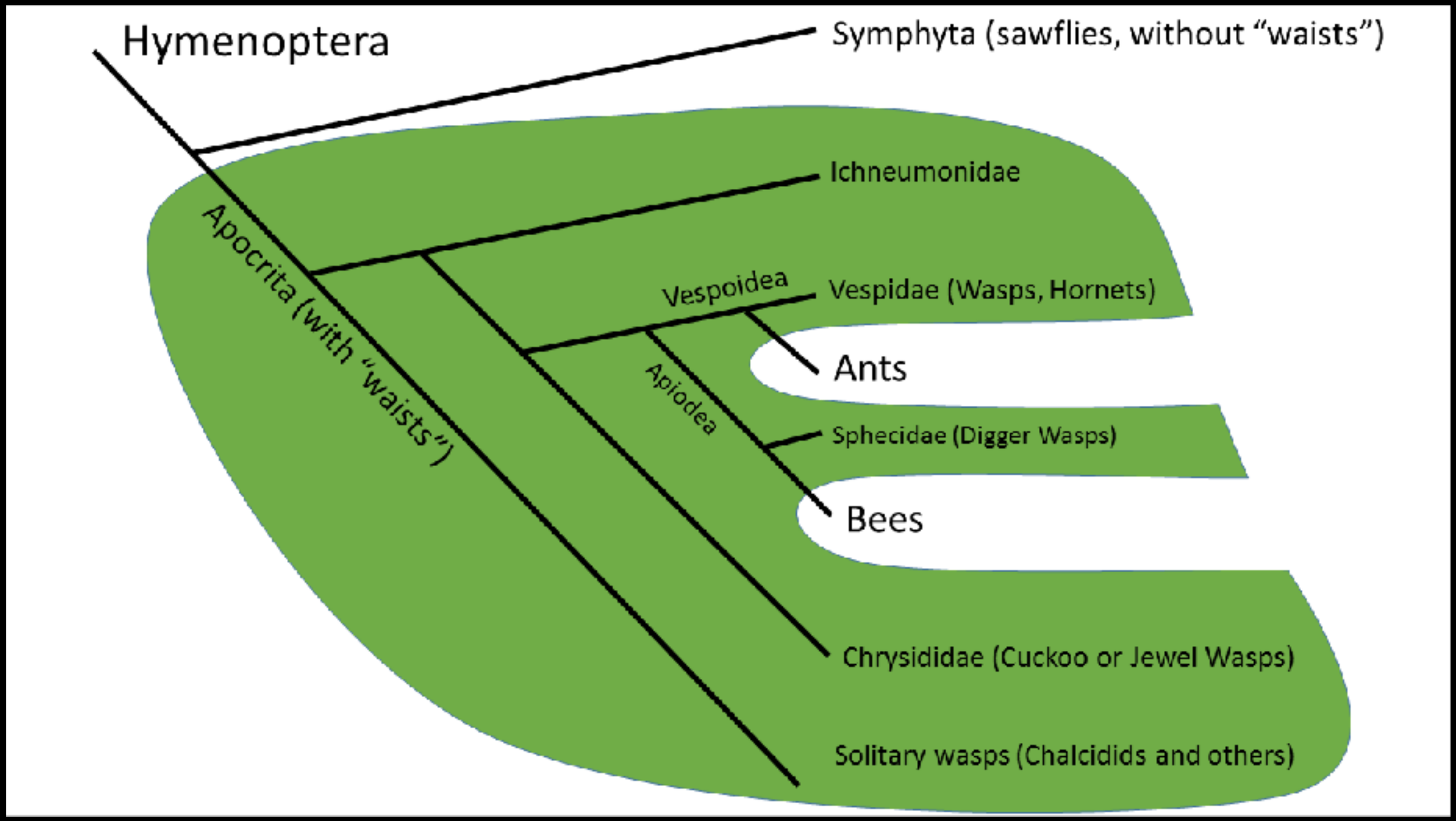


- Paraphyletic: A group that contains the most recent common ancestor of it's members, but not all of it's descendants
- Polyphyletic: A group that does NOT contain the common ancestor of it's members

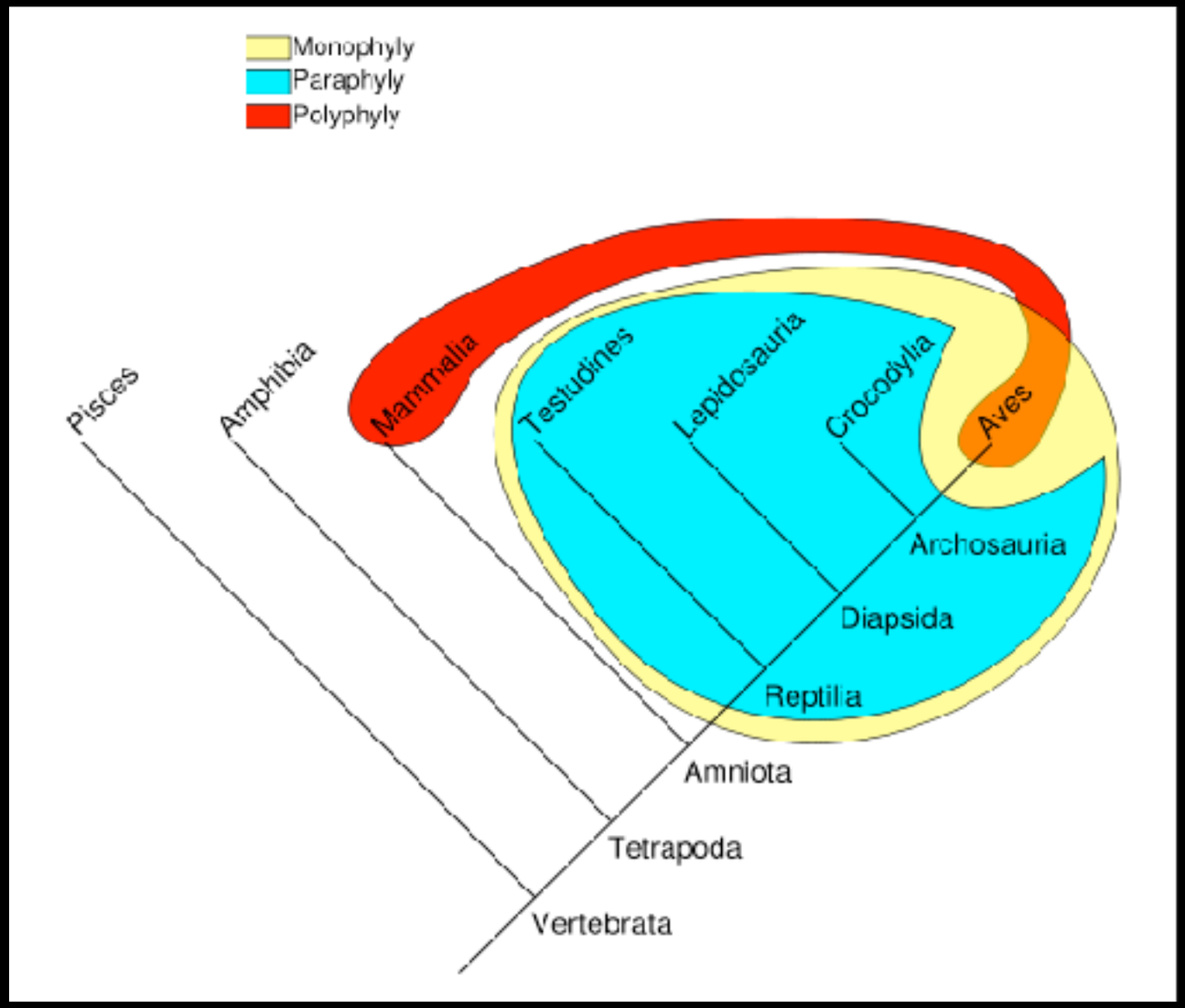
- Paraphyletic



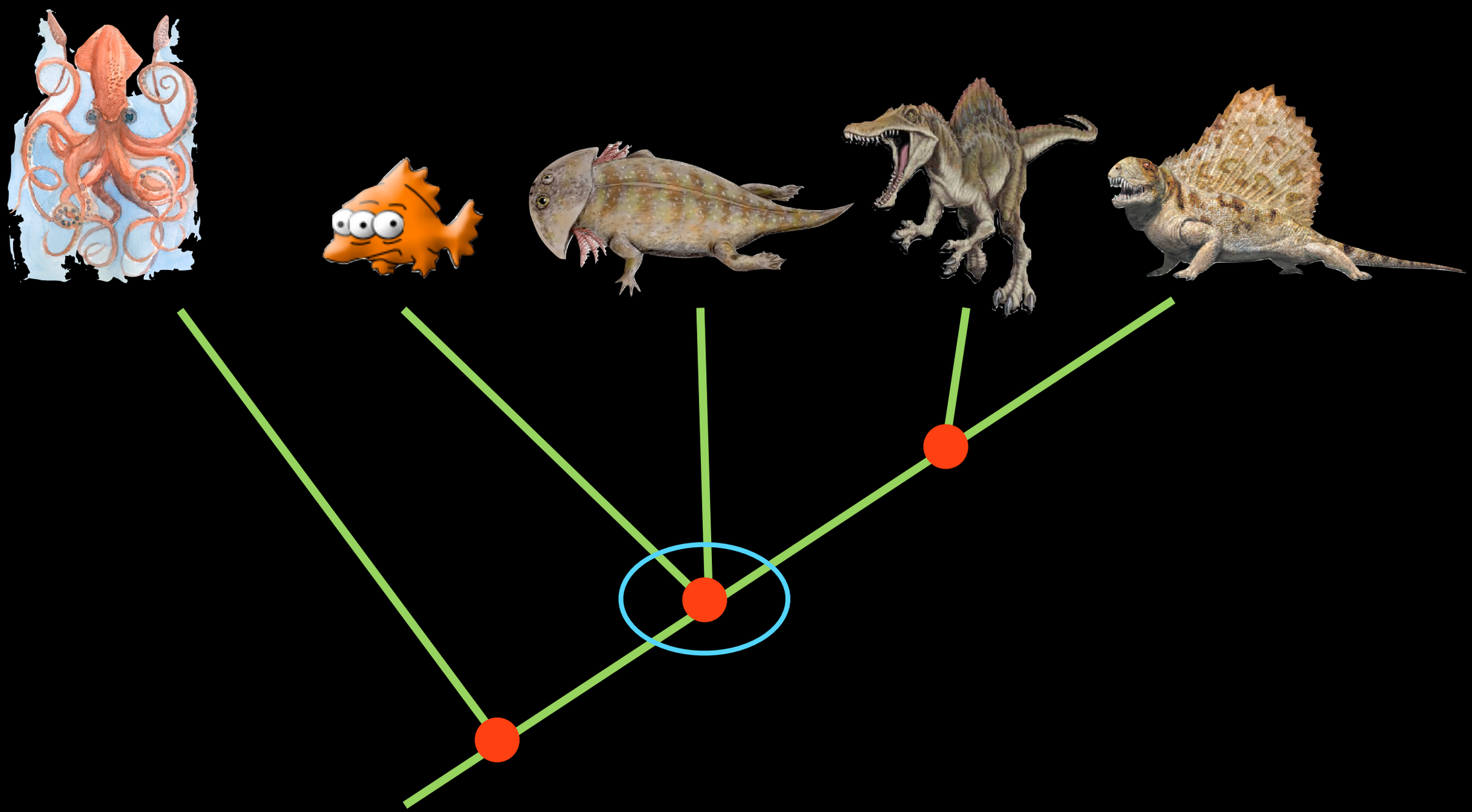
- Paraphyletic



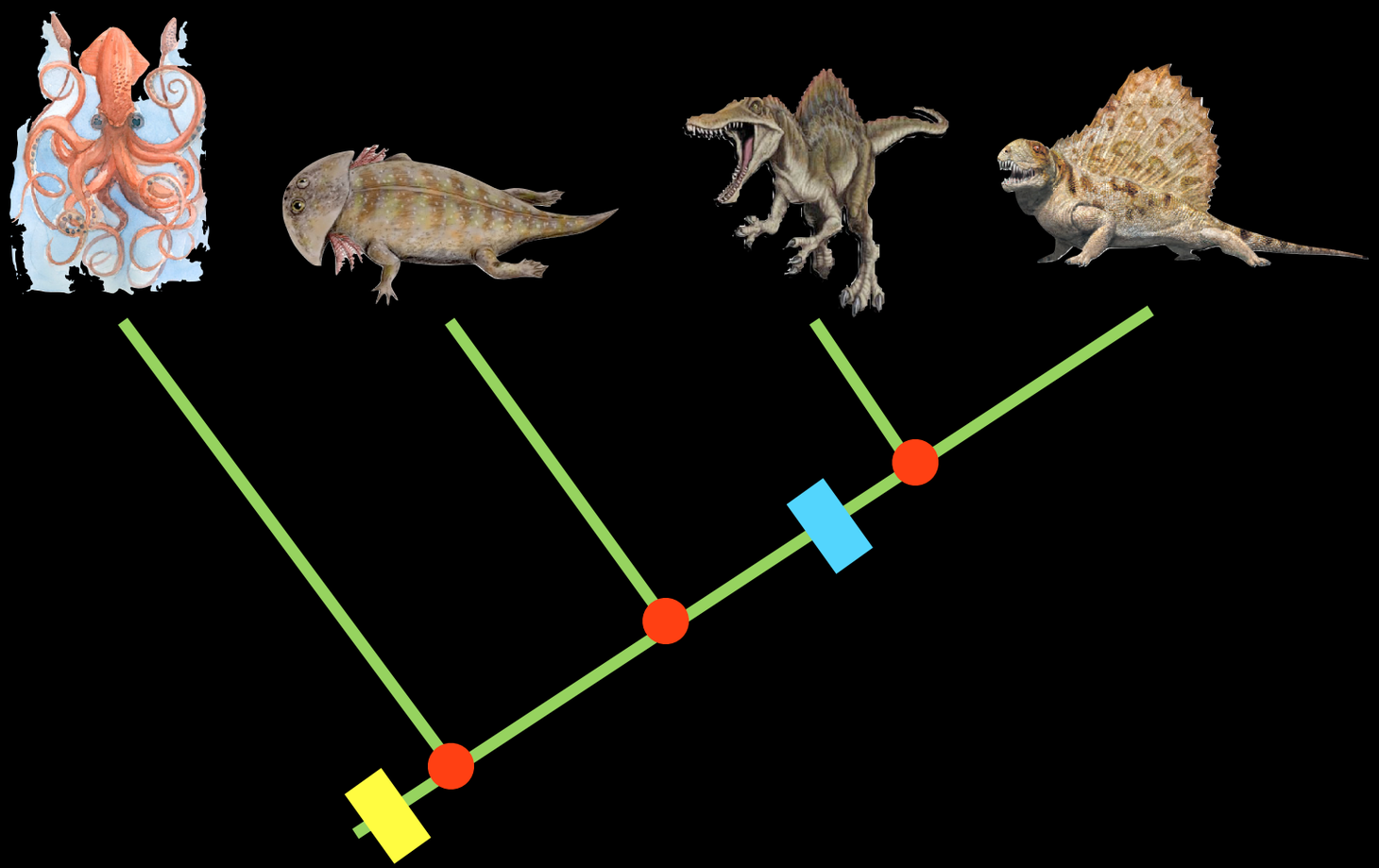
- Polyphyletic



Warm-blooded amniotes



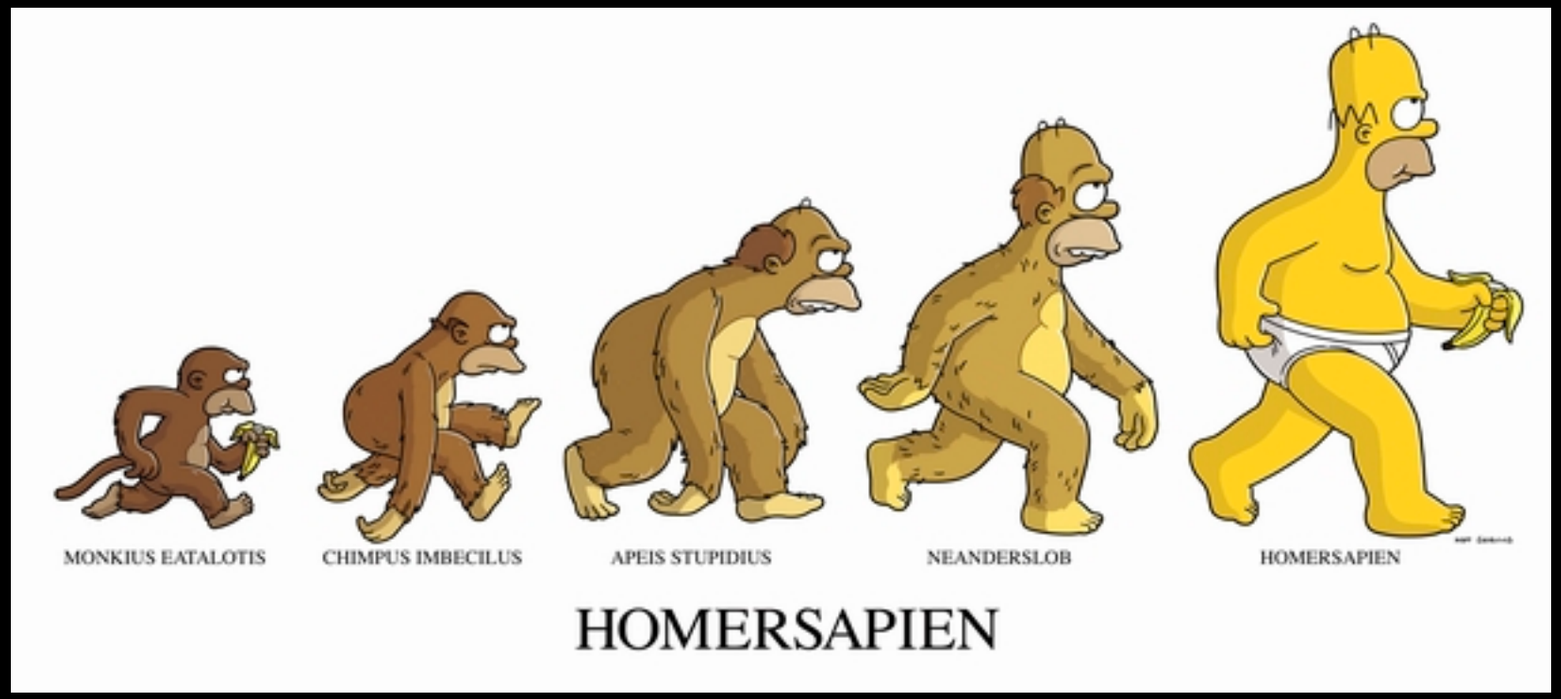
Polytomy ~ unresolved relationship

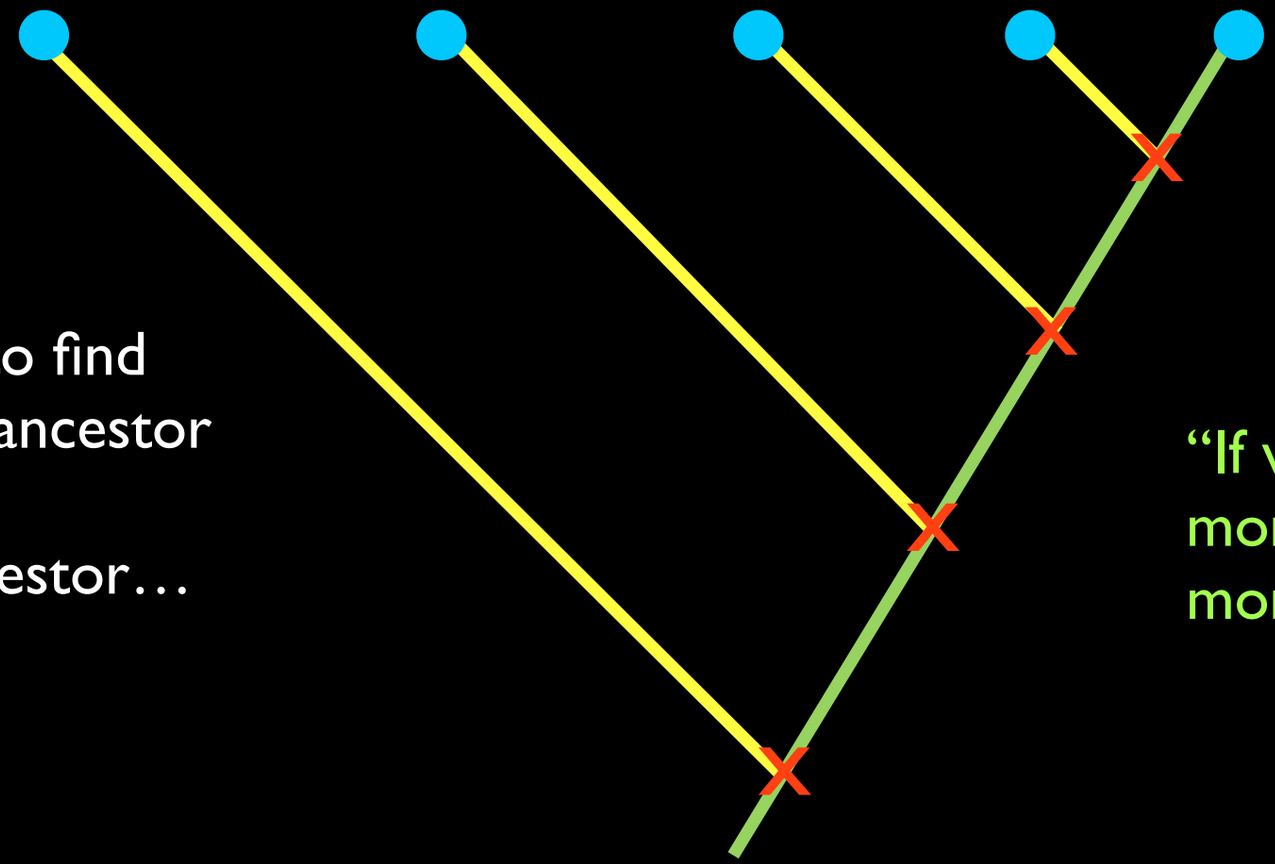


Some Terms

- Shared, derived characteristics = Synapomorphy
  - **Do** have splitting, or bifurcation, information
  - Derived, newly evolved

- Non-diagnostic ANCESTRAL traits of a CLADE = Plesiomorphy
  - Have no ‘splitting’, or bifurcation, information
  - Ancestral, ‘primitive’





- We never expect to find the true common ancestor
- No such thing as a primitive living ancestor…

"If we evolved from monkeys, why are there still monkeys?"

Not a progression... a 'tree'

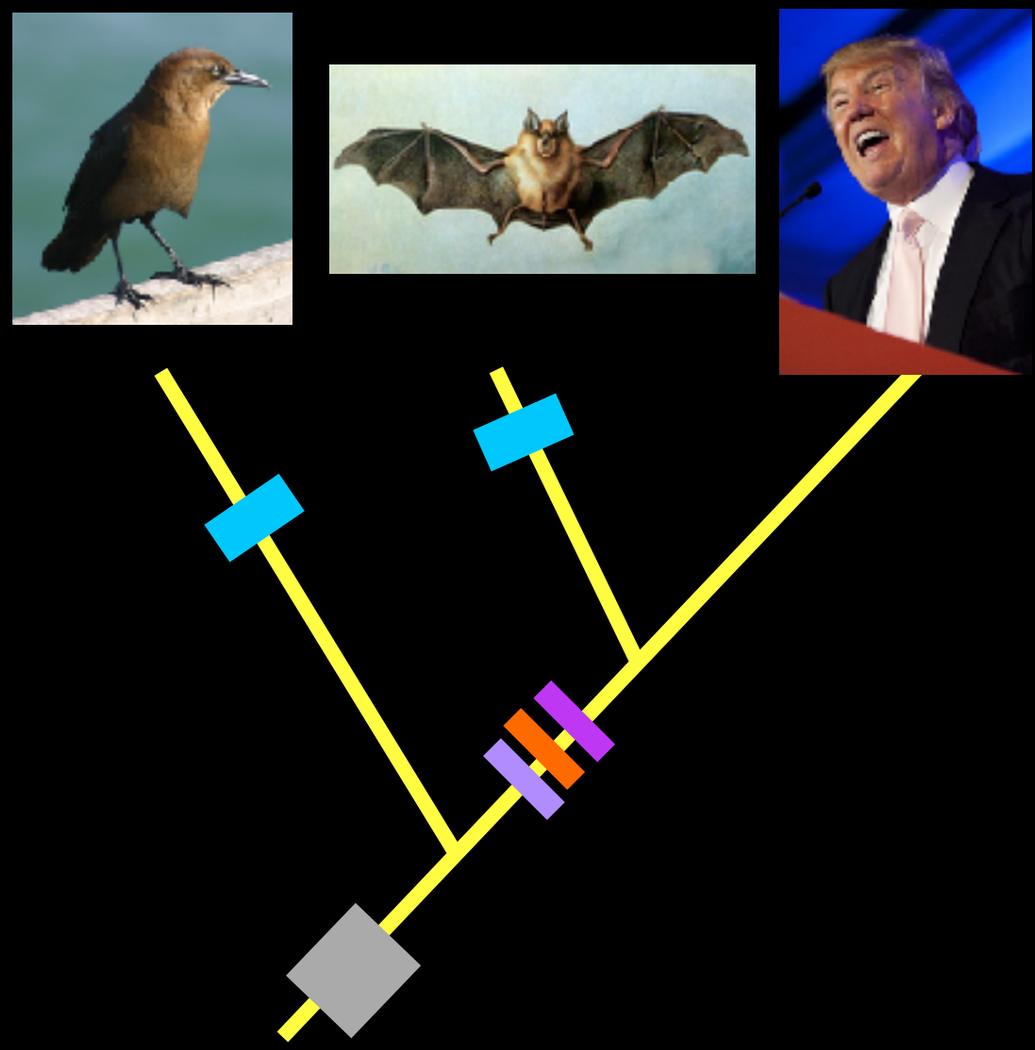
Parsimony

Parsimony

Most parsimonious

7 evolutionary events

VS.

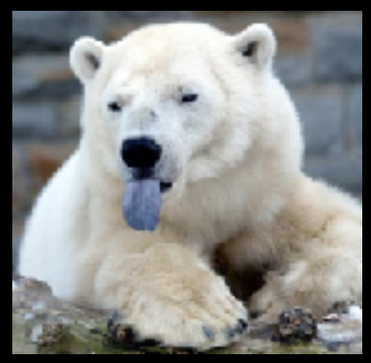


5 evolutionary events

Okay, now put these animals and characters on a PARSIMONIOUS cladogram

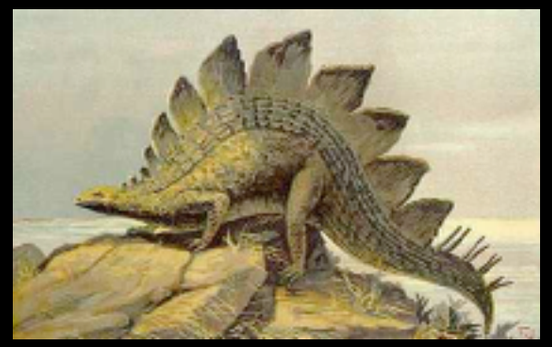
Species

Bird



Bear

Shark



Stegosaurus

Deinonychus

Characters

‘Bird-Hip’/
Ornithischian condition

Loss of Teeth

Vertebral Column

Tetrapod body plan

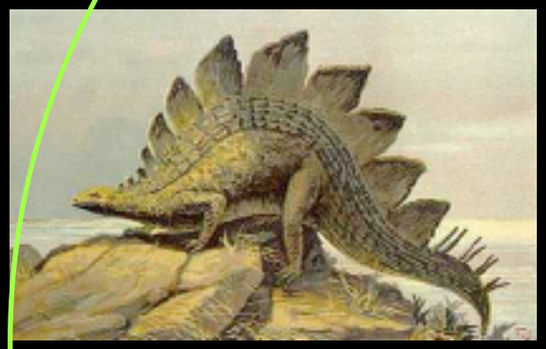
The Answer

‘Bird-Hip’/
Ornithischian condition

Tetrapod body plan

Loss of Teeth

Vertebral Column



Stegosaurus

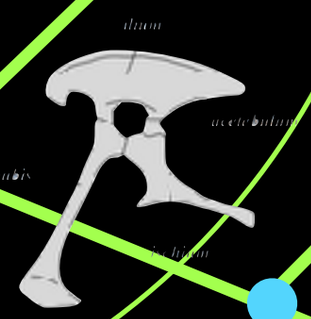
Bird

Deinonychus

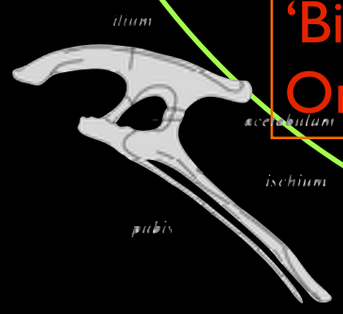
Bear

Shark

Loss of Teeth



‘Bird-Hip’/
Ornithischian condition



Tetrapod body plan

Amniota

Vertebrata

Vertebral Column

DINOSAURIA