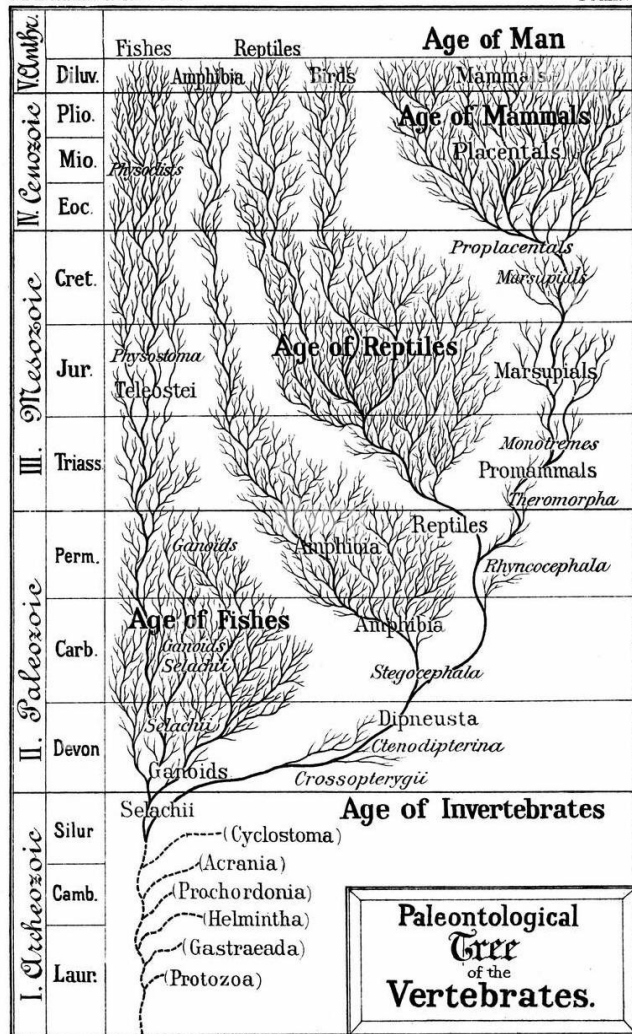




E. Haeckel del.

Age of the Reptiles

*Evolution of Scales & Feathers
During the Mesozoic Era*

Lecture 1

Reptile Origins



Handout: www.appreciatingearth.com/olli

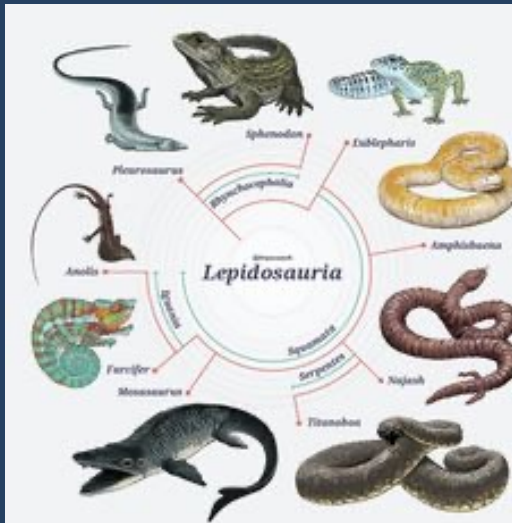
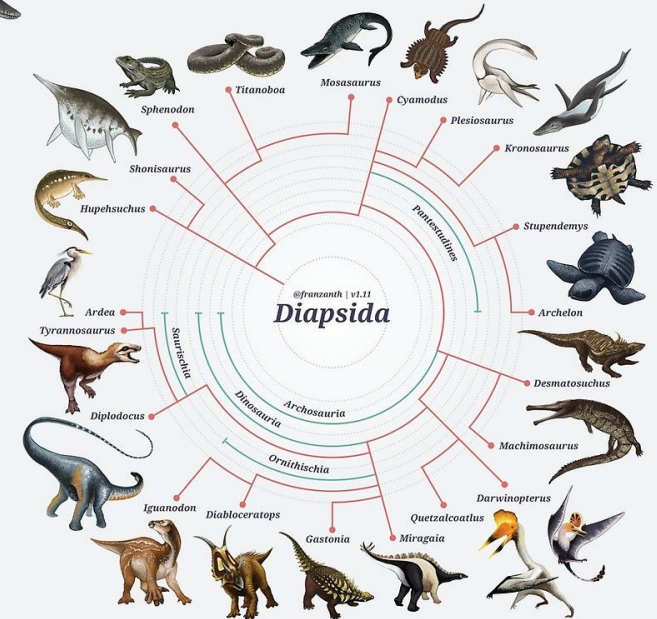
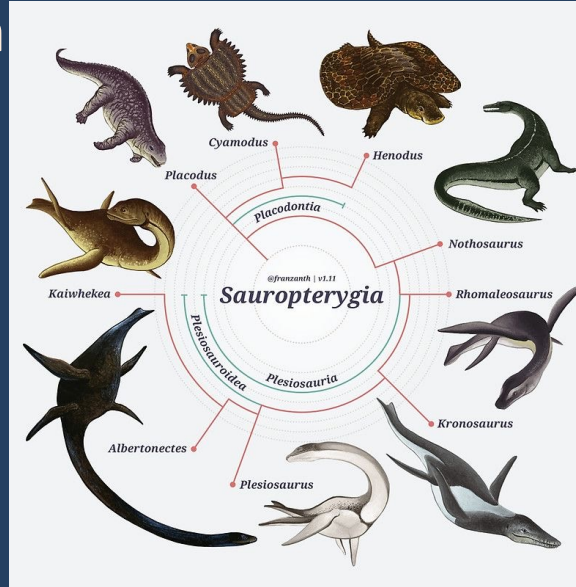


What is a Reptile?

- ~300 million years of evolution
- Ancestral amniotic eggs, dry skin, water conservation, thoracic breathing
- ~8000 living species of reptiles

Major reptilian groups:

- Chelonia-Testudines: **turtles & tortoises**
- Lepidosaur-Squamata: **lizards & snakes**
- Rhynchocephalia: **tuatara**
- Crurotarsi-Crocodylia: **crocodiles & alligators**
- Ornithodira-Pterosauria & Dinosauria (including **aves/birds**)
- Sauropterygia-Plesiosauria, Nothosauria, Ichthyosauria, Placodontia



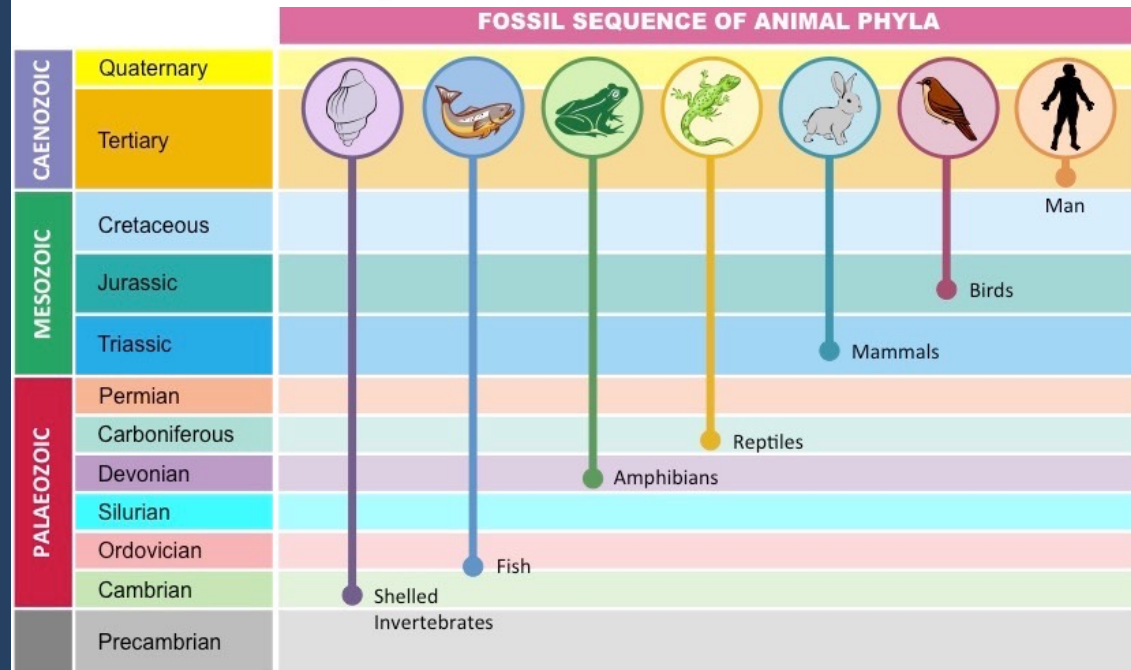
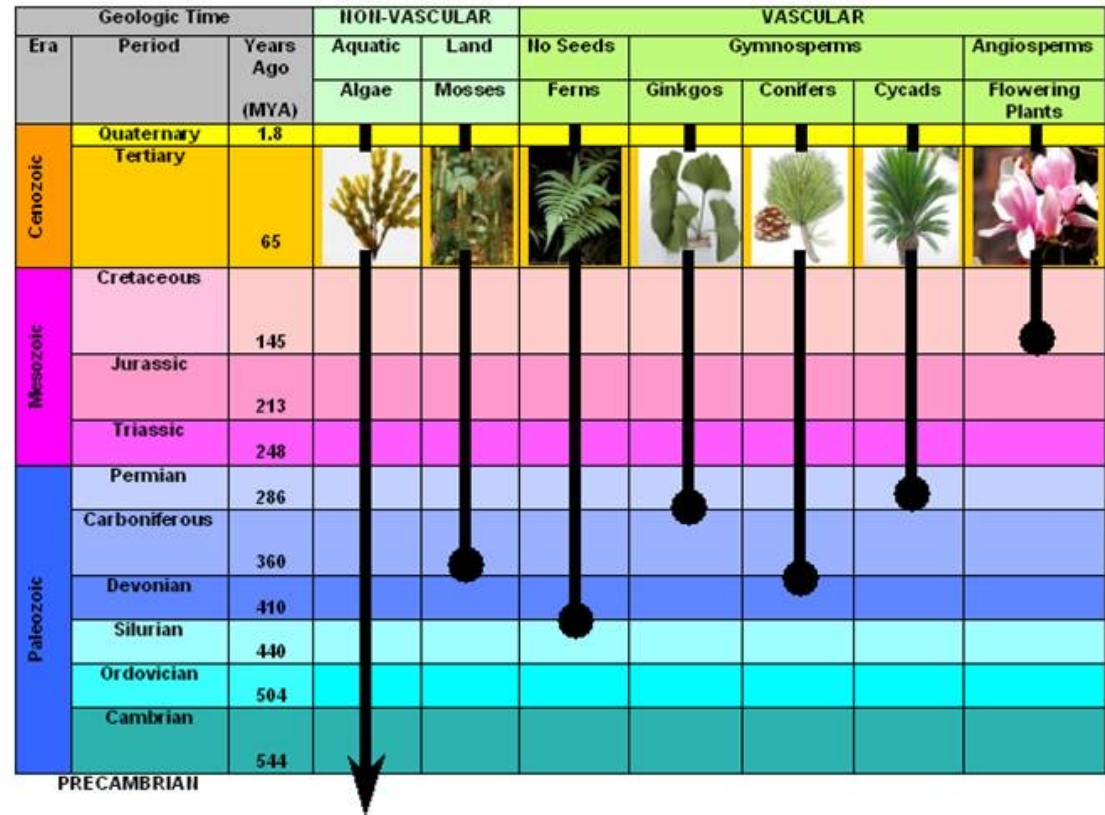
The Fossil Record

Fossilization is Rare

“The number of species known through the fossil record is <5% of the number of known living species, suggesting that the number of species known through fossils must be far <1% of all the species that have ever lived”.

(Prothero 2007)

PLANT EVOLUTION TIMELINE



Geologic Time & Evolution of Life

186 million years = 4.1% of Earth history

Geologic Timeline on handout

Geologic Timeline on handout

If 4.56 Billion Years = 1 Earth Year

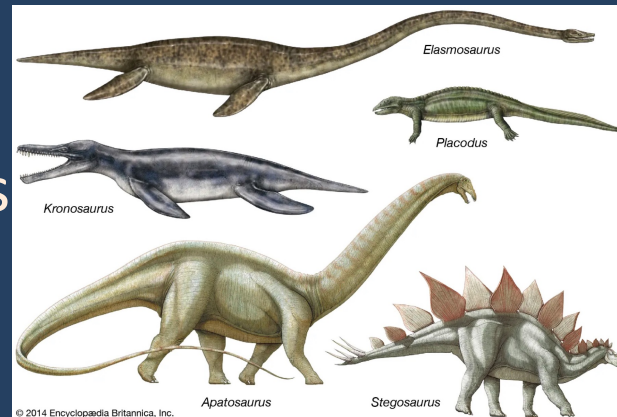
January 1	Earth forms
February 9	Life first evolves
October 25	Phanerozoic (Visible Life) Eon begins
December 5	Reptiles evolve
December 12	Pangaea Supercontinent forms
December 13	Dinosaurs evolve
December 16	Pangaea breaks-up
December 20	Birds evolve
December 26	Dinosaurs go extinct
December 31, 11 p.m.	Homo Sapiens appear
December 31, 11:58:45 p.m.	Most recent ice age ended
December 31, 11:59:30 p.m.	Written history begins
1/1000 th of a second before midnight	You were born



Tetrapod Evolution

4 Limbed Firsts:

- ~397Ma Tracks
- ~368Ma Amphibians
- ~340Ma Amniota
- ~320Ma Sauropsid
- ~315Ma Synapsid
- ~246Ma Marine reptile
- ~230 Dinosaurs
- ~215Ma Mammal
- ~210Ma Pterosaur

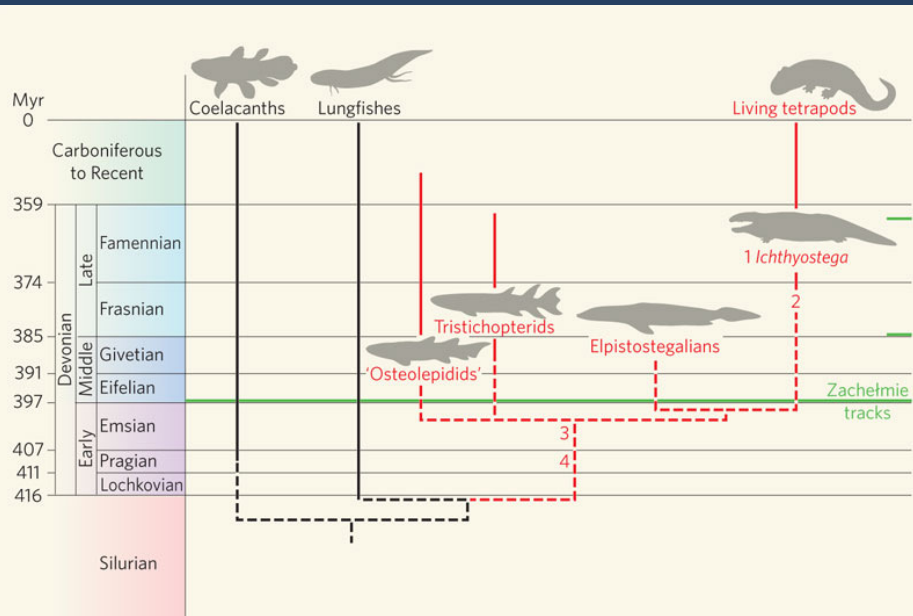
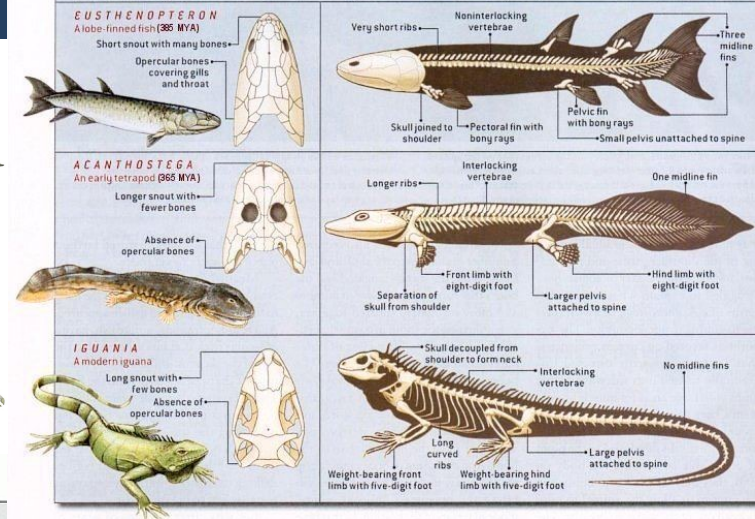


*Sea level
fluctuations
associated
with land-
sea
adaptations*

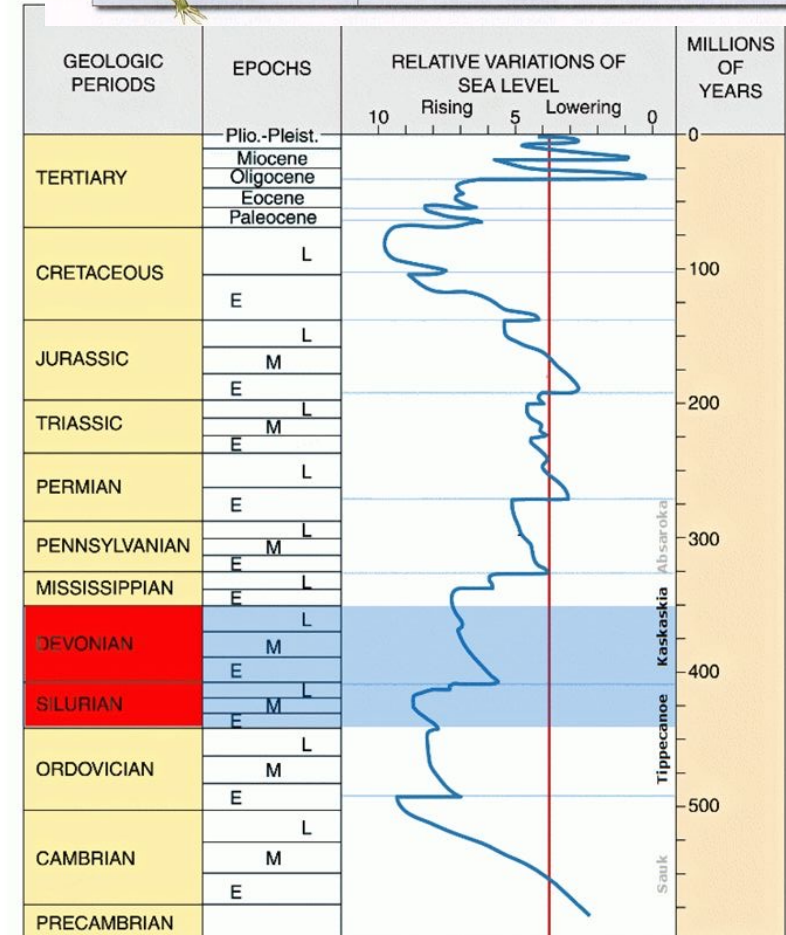
TURNING TETRAPOD

The evolution of terrestrial tetrapods from aquatic lobe-finned fish involved a radical transformation of the skeleton. Among other changes, the pectoral and pelvic fins became limbs with feet and toes, the vertebrae became interlocking, and

the tail fin disappeared, as did a series of bones that joined the head to the shoulder girdle [skull]. Meanwhile the snout elongated and the bones that covered the gills and throat were lost [skull].

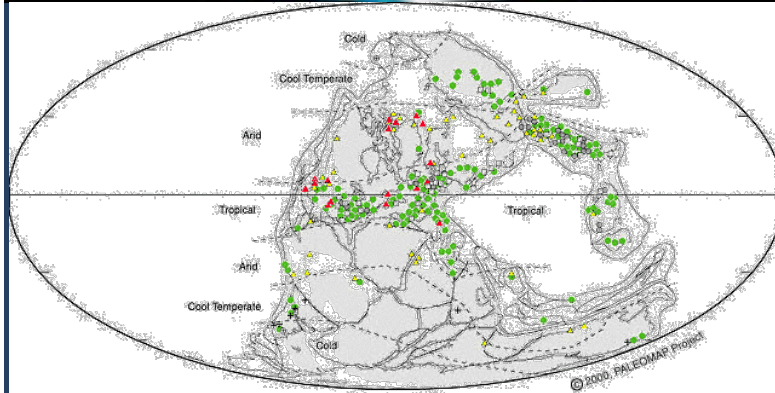
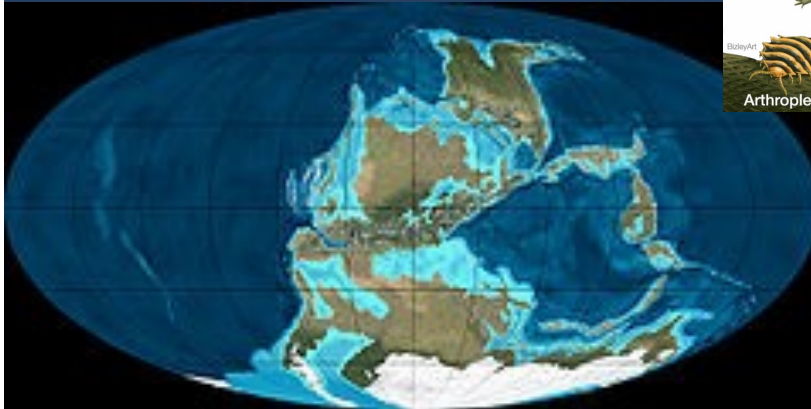


Historical Geology Middle Paleozoic Sea Level

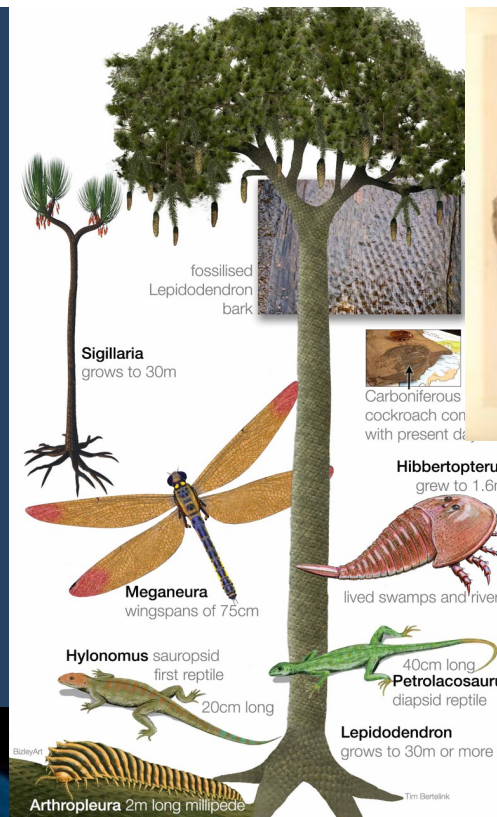


Earliest Reptiles /Sauropsids

- Evolved ~320Ma genetic evidence
- ~315Ma Hylonomus (scaled)
- ~302Ma Petrolacosaurus



Upper Carboniferous (Bashkirian - Moscovian)



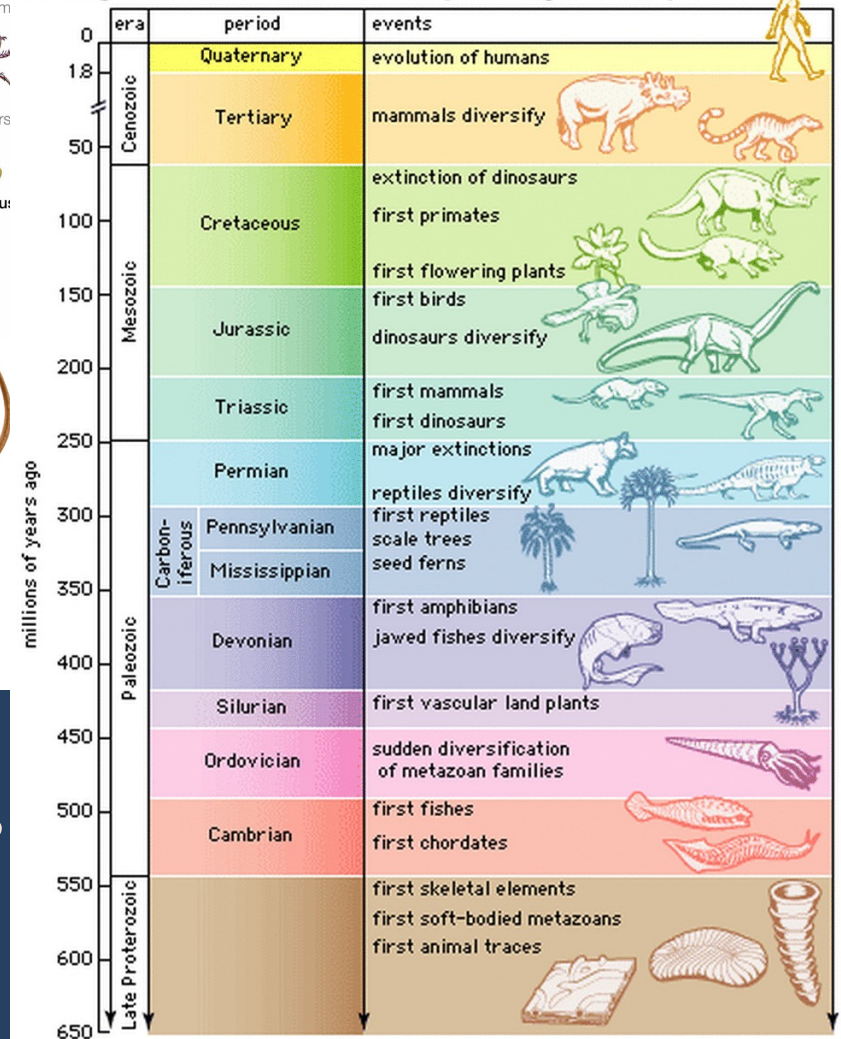
Paleozoic Era: Carboniferous Period



Petrolacosaurus kansensis

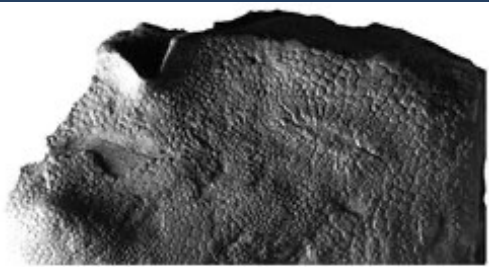
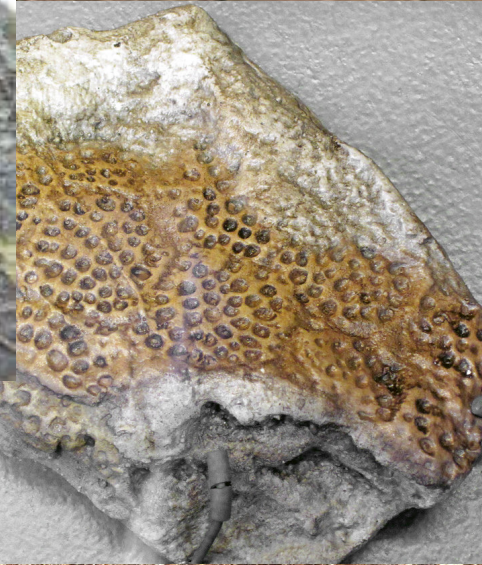


Geologic time scale, 650 million years ago to the present



Scales

- What is a scale? Small rigid plate growing out of skin to provide protection
- What is a scute? Bony external plate overlaid with horn
- Made of keratin
- Water conservation



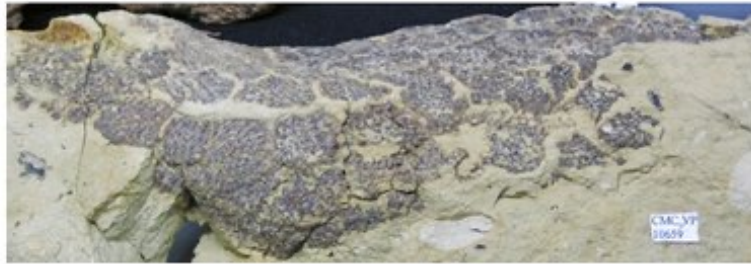
Hadrosaur (Edmontosaurus)
showing healed flesh wound



Triceratops



Sauropod



Diplodocus



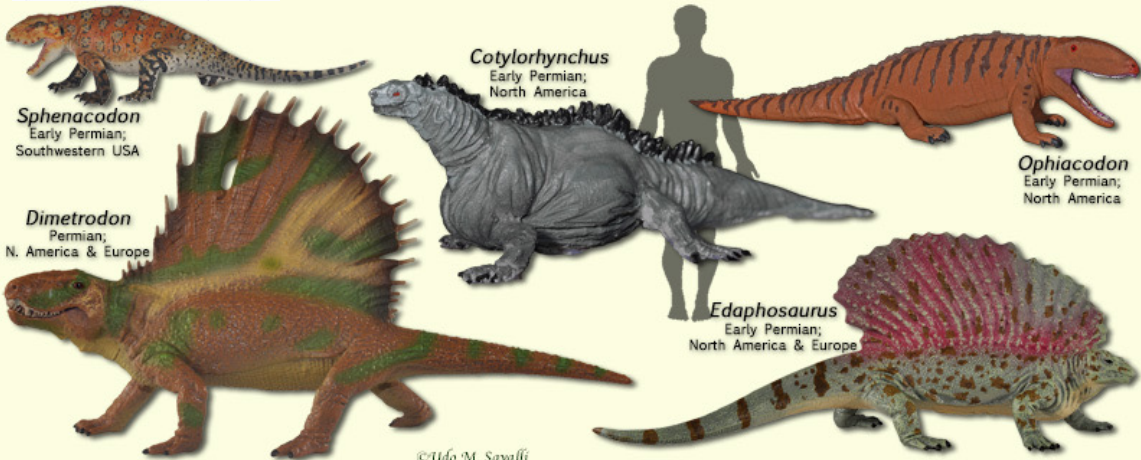
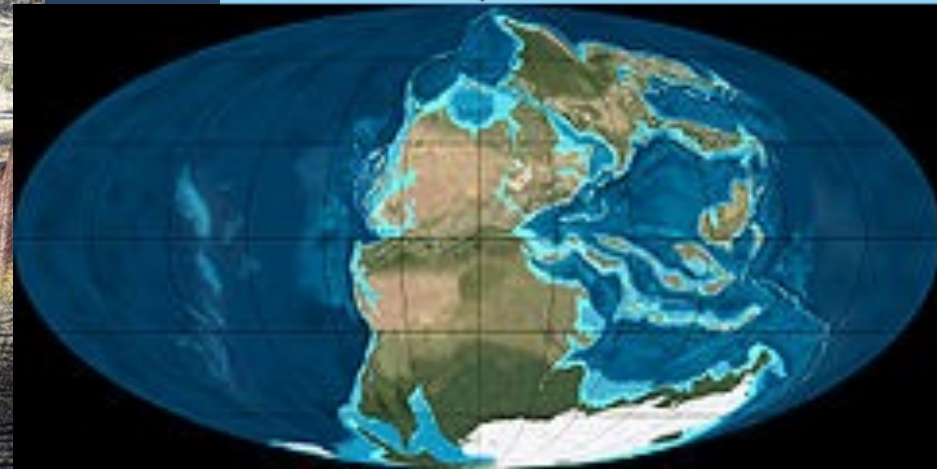
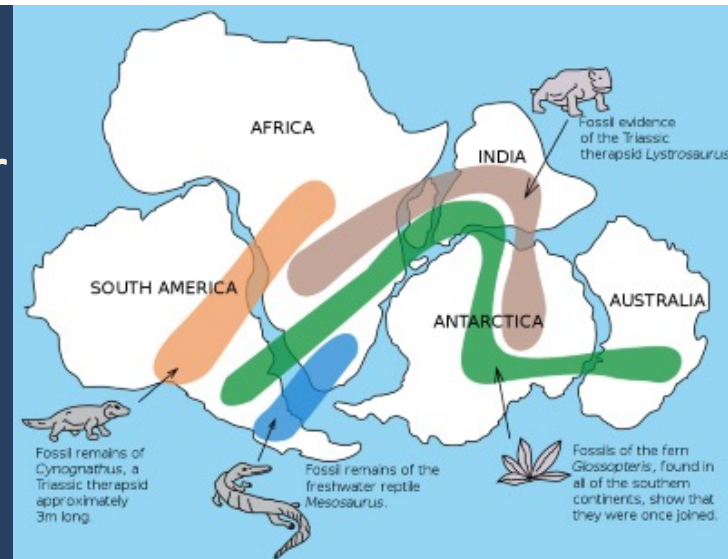
10 Minute Break!

Video Link:

<https://www.youtube.com/watch?v=TaMTLJUa-b4>

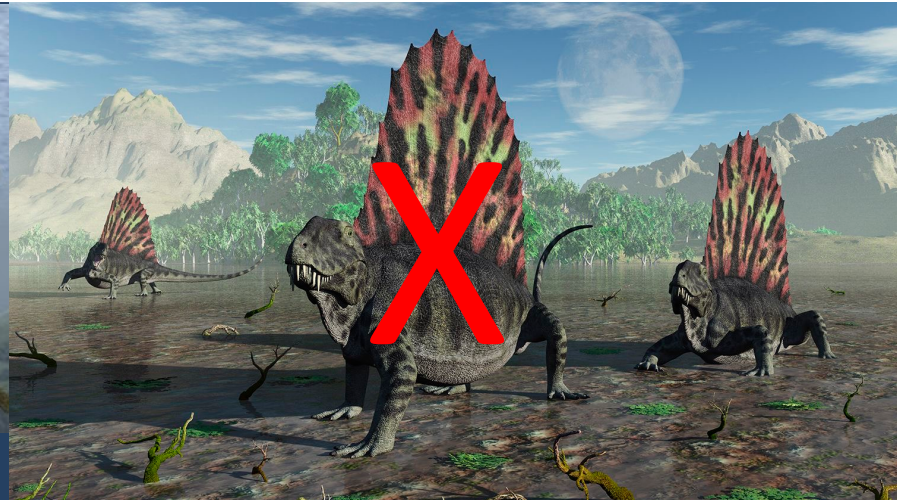
Pangaea: Permian Period

- Pangaea formation= climate warming & drier
- Plants: ferns + seed ferns + conifer + ginko
- Insects: diversified
- Amphibians: gigantism
- **Reptiles: gigantism & diversification**

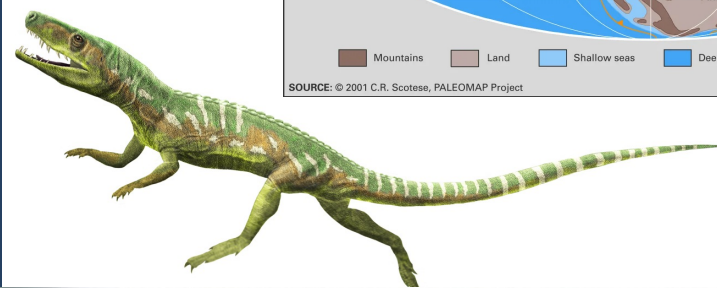
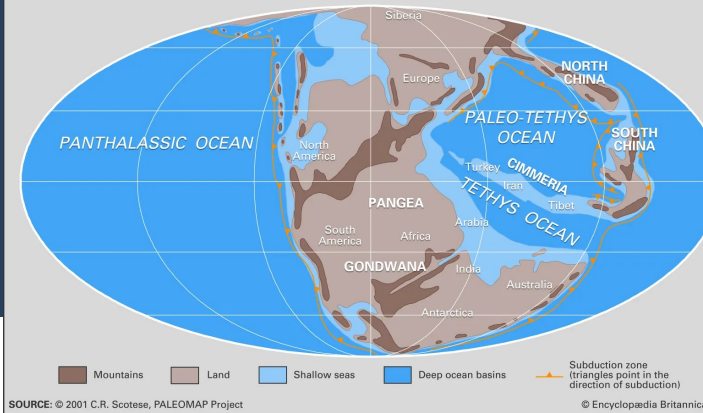


Video Link:
<https://www.youtube.com/watch?v=Cm5giPd5Uro&t=6s>

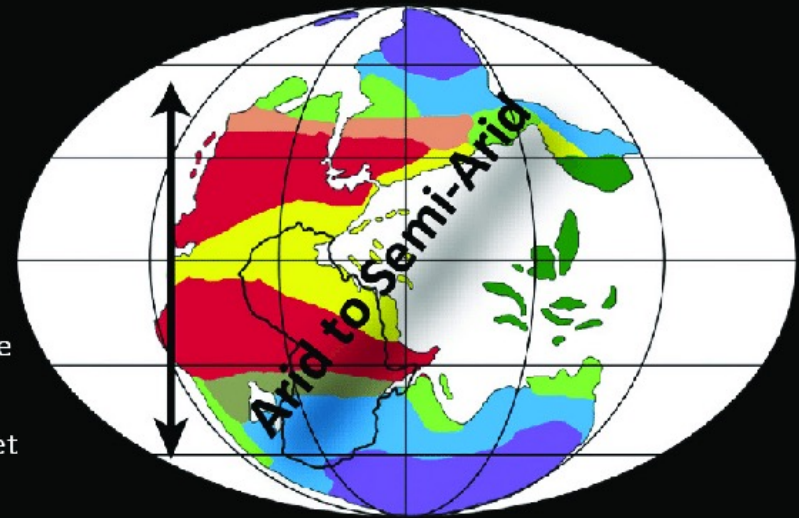
Pangaea Reptiles



Early Triassic 237 million years ago



- Tropical ever-wet
- Desert
- Cool temperate
- Cold temperate
- Mid-latitude desert
- Tropical summer-wet



30 cm
12 inches

Cynognathus



Strongly built and chunky, *Cynognathus* was a fierce hunter that lived in Africa. It had a large head with very sharp teeth and strong jaws, giving it tremendous biting ability.



SIZE:
1 m long

GROUP:
Cynodont (mammal-like reptile)



Permian (250Ma)

Surface Temperature

C

2

Sur

Vict

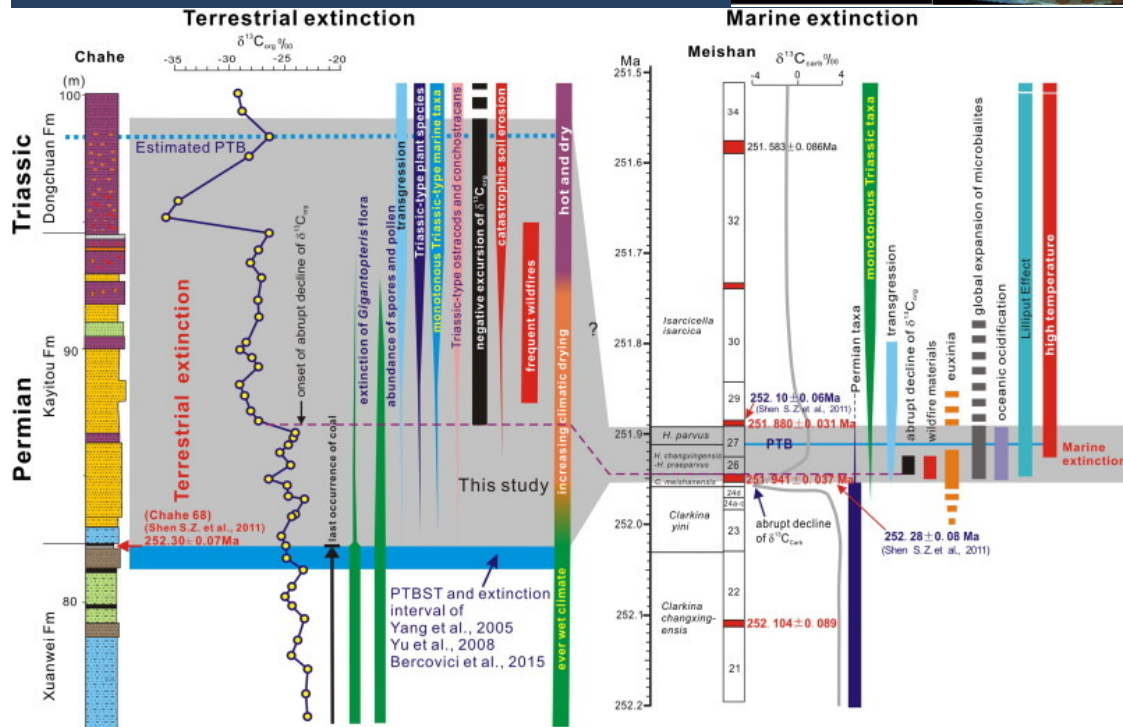
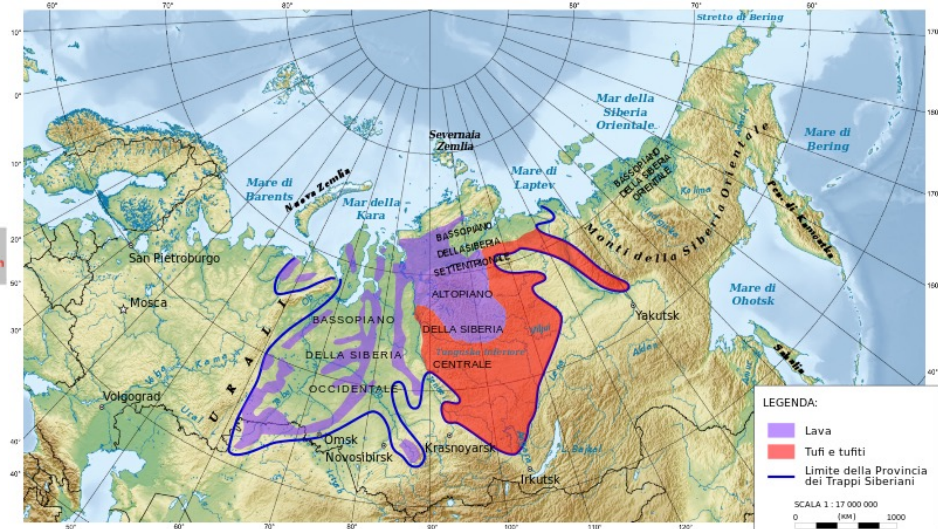
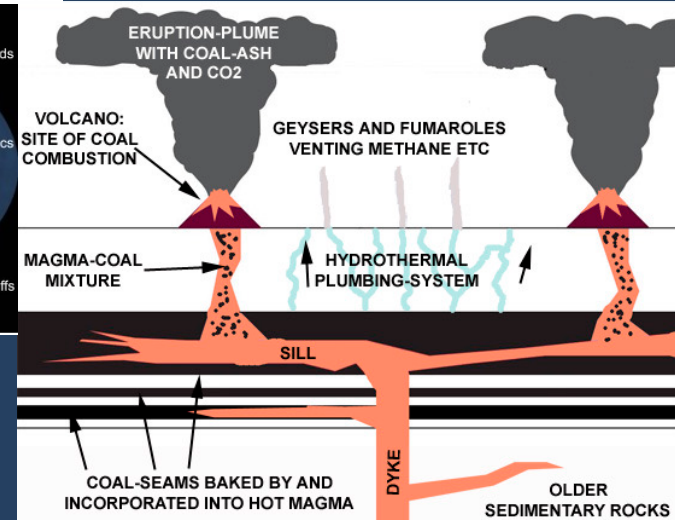
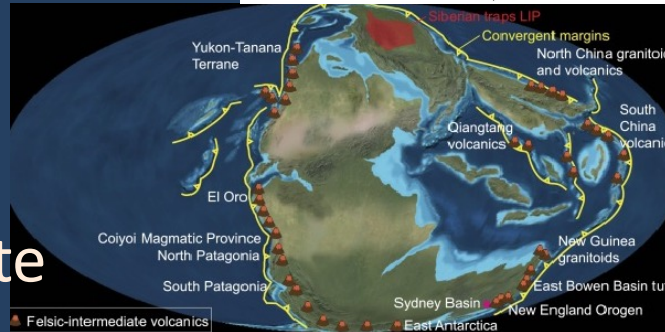
Permian (250Ma)

Surface Temperature

C

-4 0 4 8 12 16 20 22 24 26 28 30 32 36 40

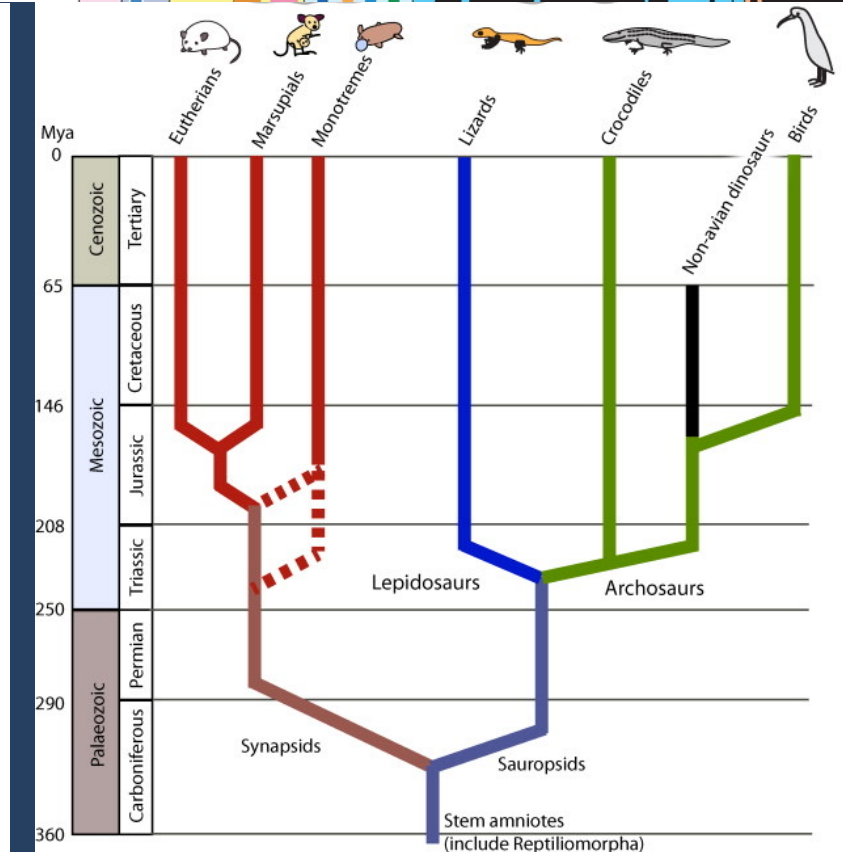
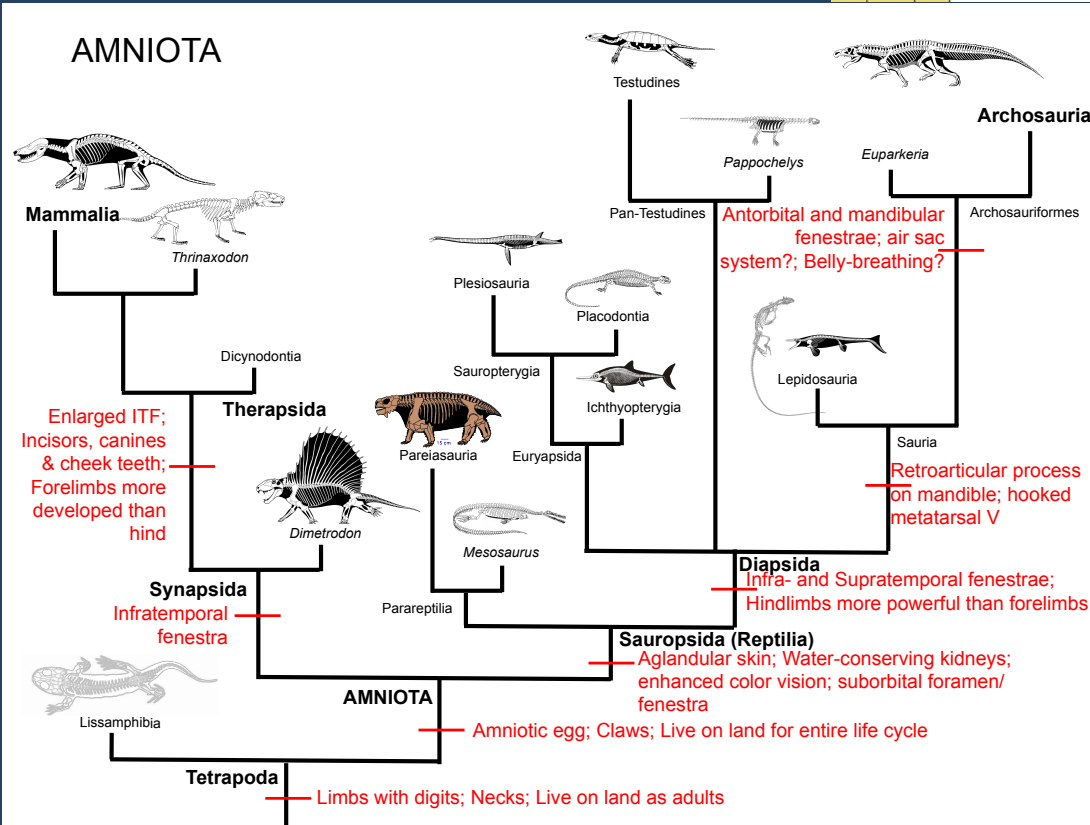
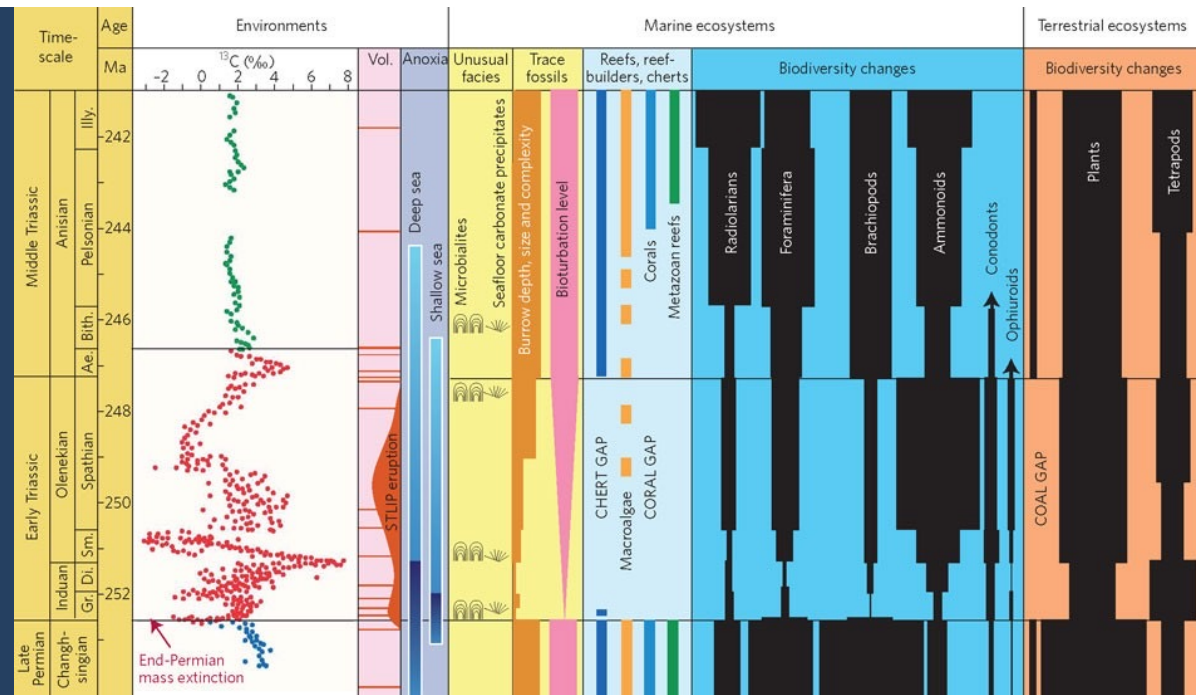
-
- The diagram illustrates the assembly of the supercontinent Pangaea during the Paleozoic Era. At the top, a map shows the continents of North America, South America, Africa, Europe, Asia, and Australia converging into a single landmass labeled 'Pangaea'. To the right, two upward-pointing arrows are labeled 'CO₂', indicating a rise in atmospheric carbon dioxide levels. Below the map, a large orange area is labeled 'Warming and Oxygen loss'. The bottom section of the diagram shows a cross-section of the Earth's surface and subsurface. The surface is labeled 'Tropics' at the bottom. The subsurface is divided into two layers: 'Fossils' (top) and 'Model' (bottom). The 'Fossils' layer contains illustrations of various Paleozoic organisms, including trilobites, graptolites, and other marine life. The 'Model' layer shows a cross-section of the Earth's crust and mantle, with a black line representing the boundary between them. The diagram also shows the formation of the supercontinent Pangaea and the resulting climate changes, including warming and oxygen loss.



Reptilian

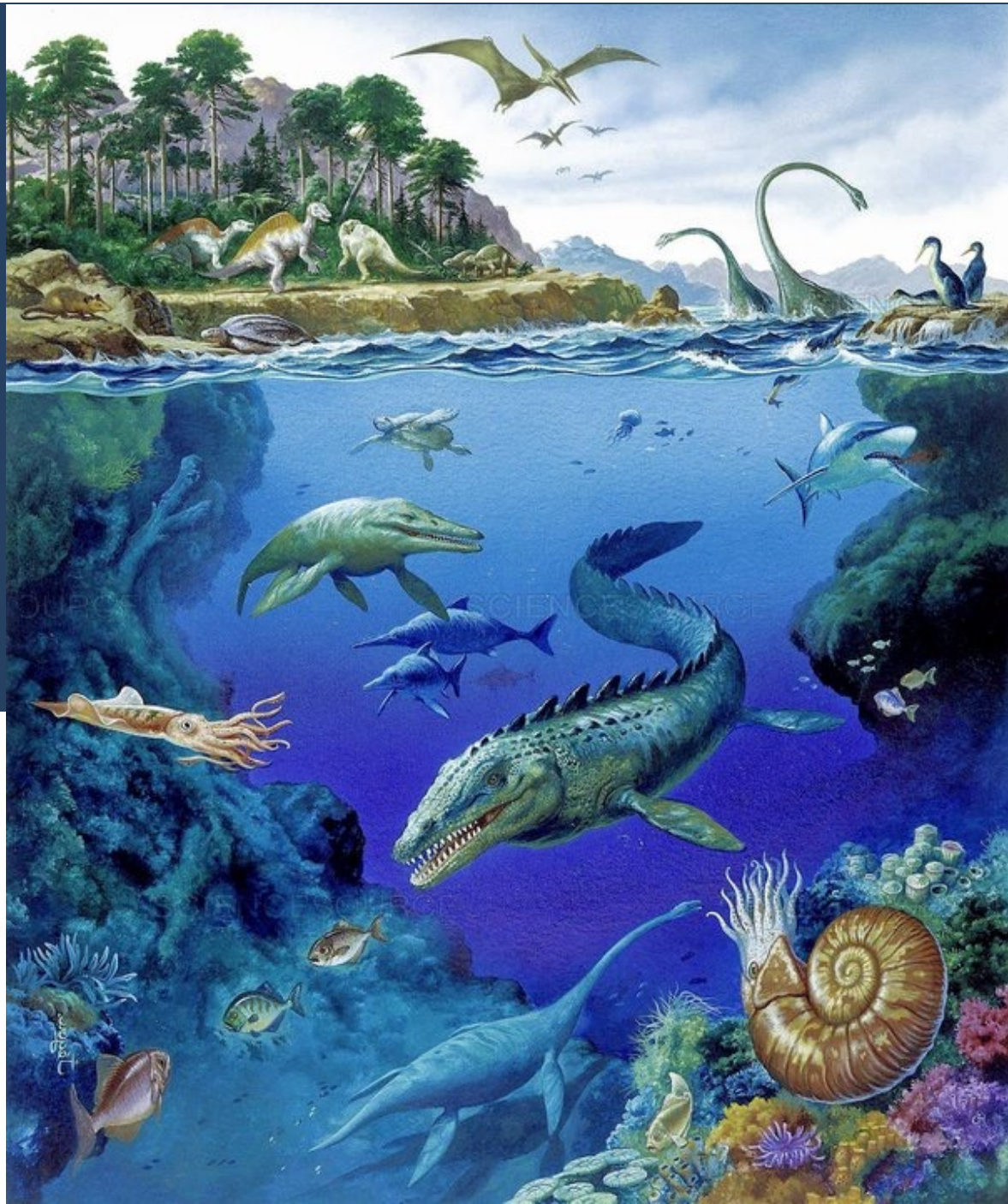
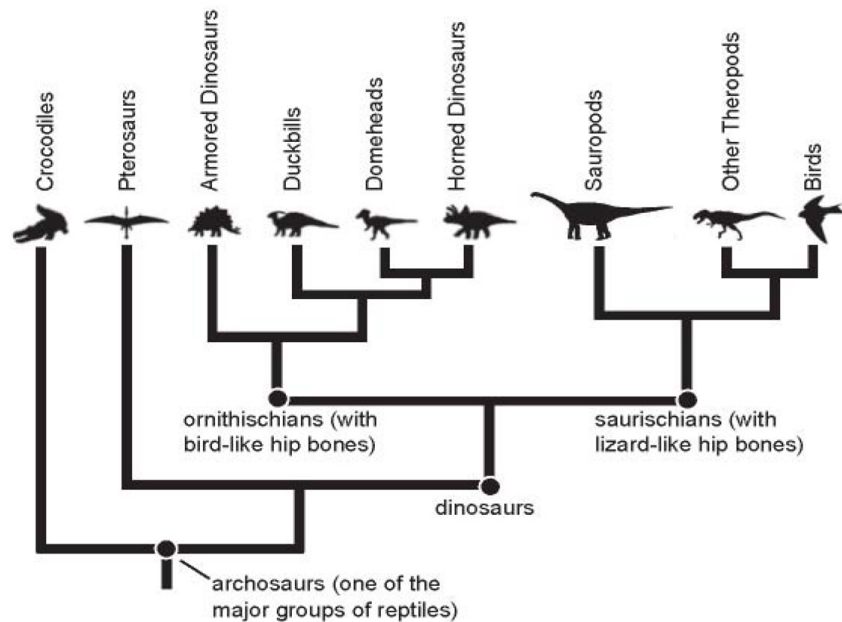
Diversification

- Sauropsida = Reptilia
- Many sauropsida adapted to Pangaea desertification
- Extinction: 80% early reptilia
- Most forests died



Mesozoic Reptiles

- Plesiosaurs
- Ichthyosaur
- Mosasaurus
- Dinosaurs
- Pterosaurs
- Synapsids
- Crocodiles
- Alligator
- Lizards
- Tuatara
- Snakes
- Turtles



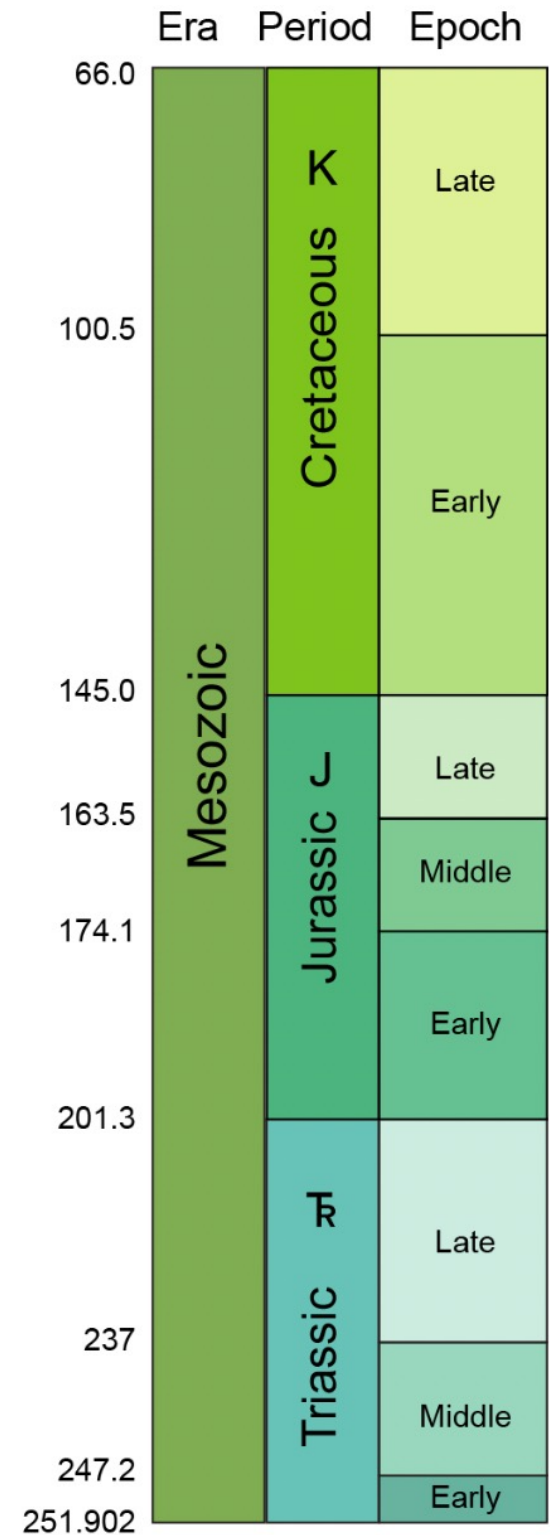
The Age of the Reptiles

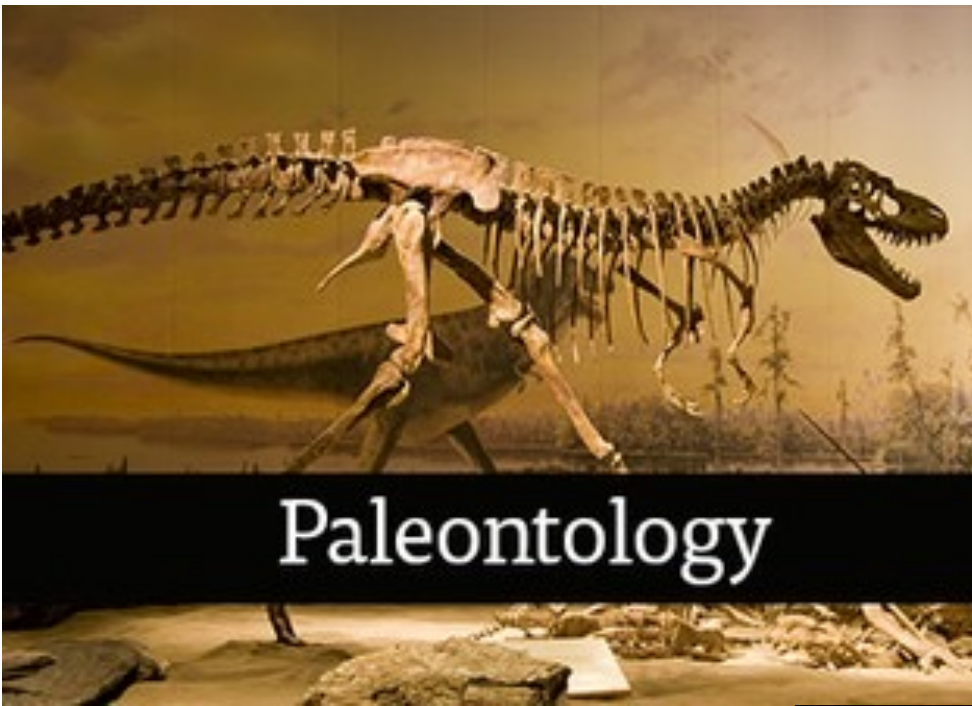
186 million years long

Began & ended with Mass Extinctions



Age (Ma)





Paleontology



A historical
science focused
on the study of
ancient life



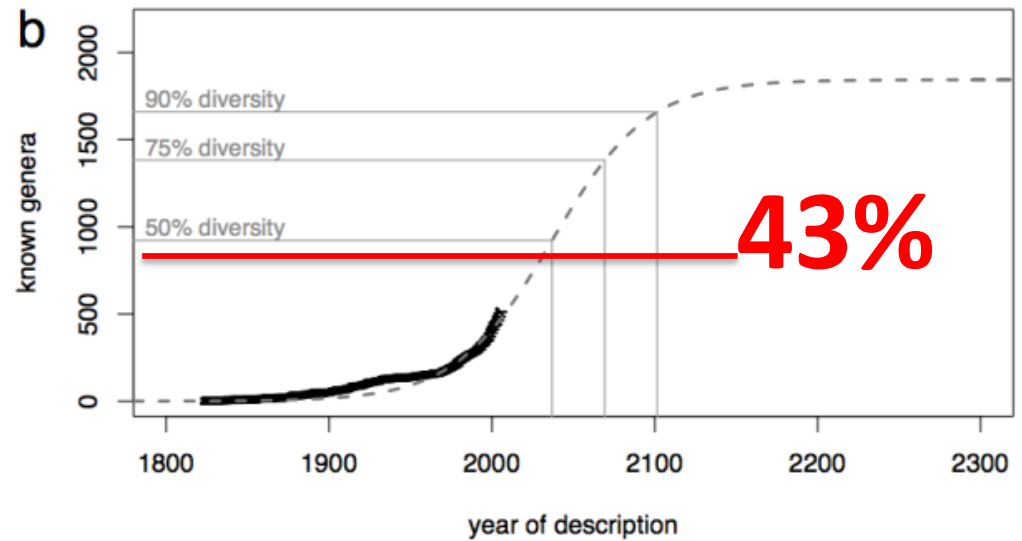
Fossils

- **Body Fossils:** *wood, bones, shells, etc.*
- **Lagerstätten Environments:** *preserve soft tissues*
- **Trace Fossils:** *include tracks, burrows, coprolites, & marks left by feeding*
- **Geochemical Evidence:** *organic molecules*



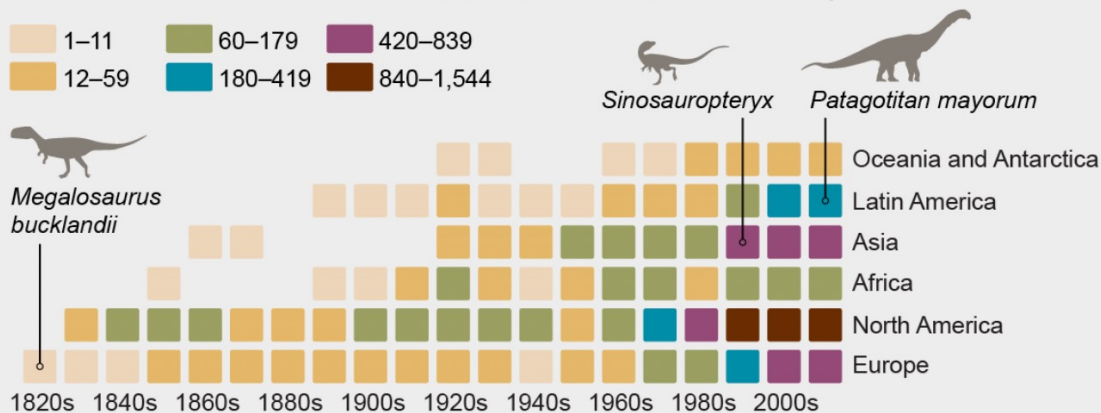
Dinosaur Bias

- First discovery in 1824
- 15-20 new dinosaur/year
- ~50 new species/year = golden age of dinosaur discovery
- ~11,000 fossils discovered
- Currently >900 dinosaur genera, 43% of estimated total
- Many fewer pterosaur & marine reptile fossils discovered



When Fossils Have Been Uncovered

Some 10,851 dinosaur fossils—tallied on the map and in this time line—have been documented since 1824, including everything from a single femur bone to an entire skeleton. In recent decades discoveries have accelerated in Latin America, Asia, North America and Europe.



Next Week

- Which reptiles survived the Permian-Triassic extinction?
- How did reptiles diversify?
- Focus on the Triassic Period
- What did the “firsts” major reptilian families look like?



Upper Triassic
220 mya

