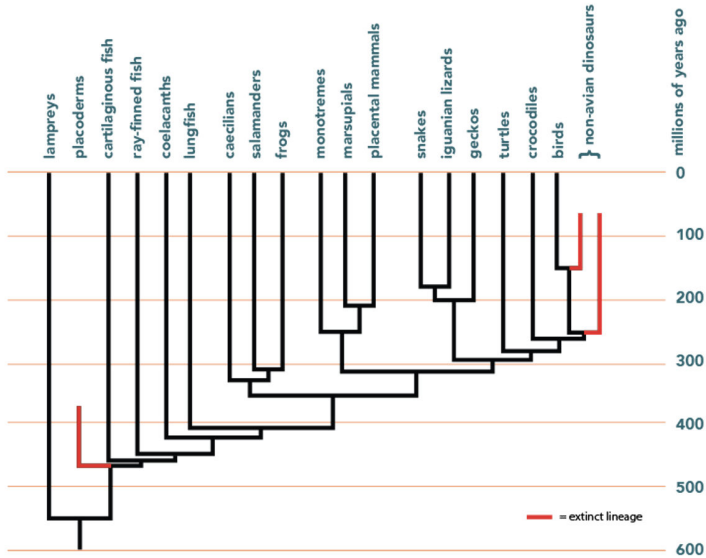




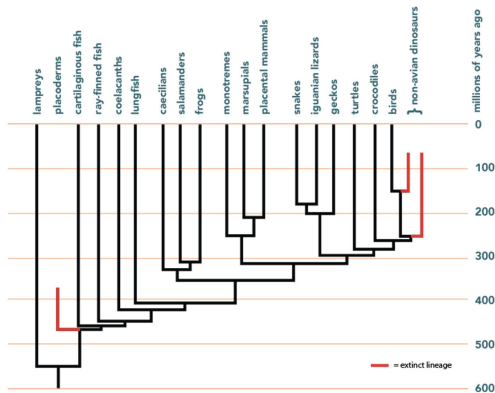
Evolutionary Origins

Dr. Ethan Linck
Office: 305 Lewis Hall

Are reptiles a clade without birds?



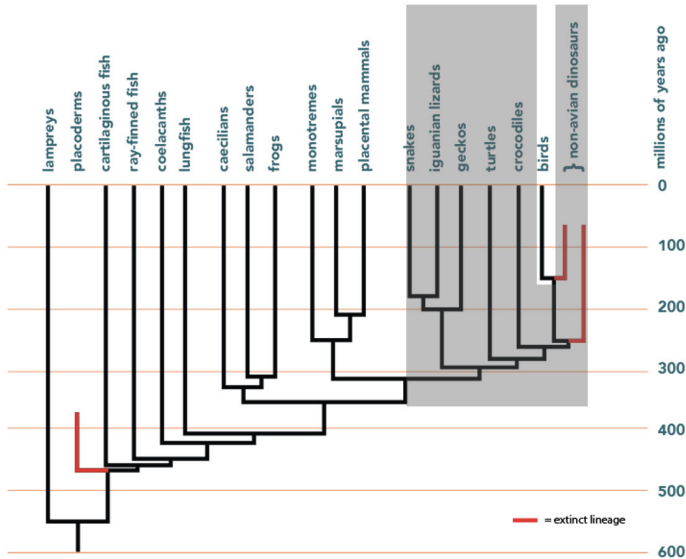
Are reptiles a clade without birds?



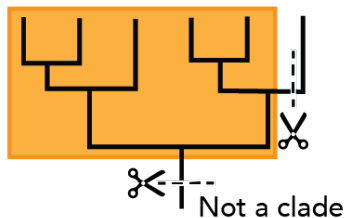
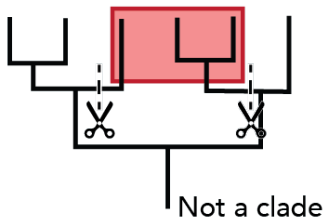
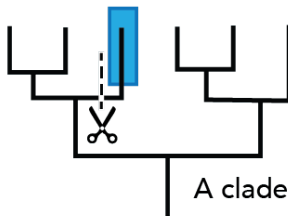
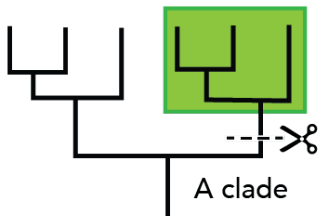
(Berkeley: Understanding Evolution)

- a) Yes
- b) No

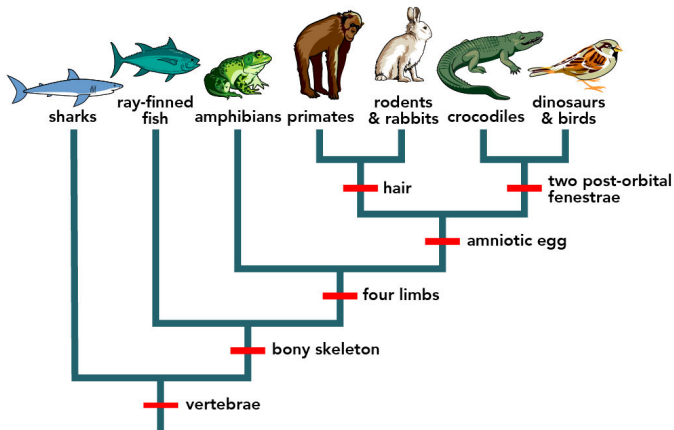
Reptiles and dinosaurs would be *paraphyletic* without birds



Review: Paraphyletic groups exclude some descendants

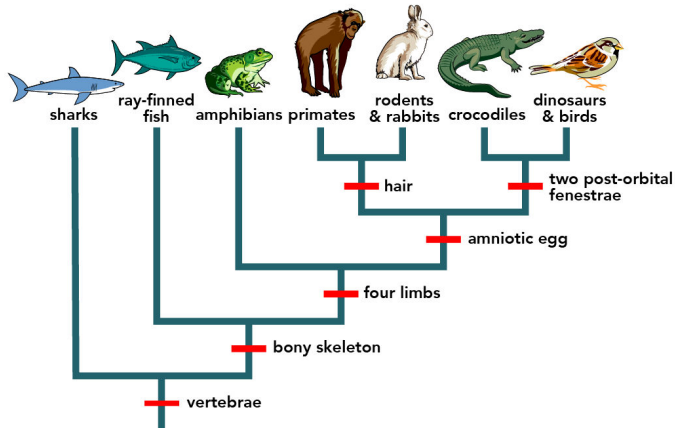


Review: Apomorphies define clades



(Berkeley: Understanding Evolution)

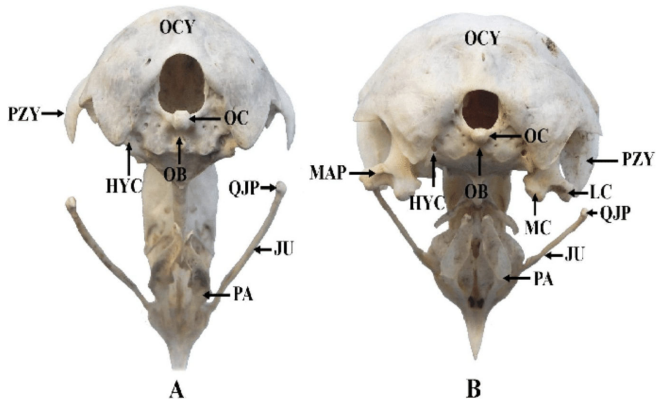
Trait polarity



- ▶ Basal traits: evolved earlier; shared by all
- ▶ Derived traits: evolved later; define subclades

Derived traits in reptiles / birds: occipital condyle

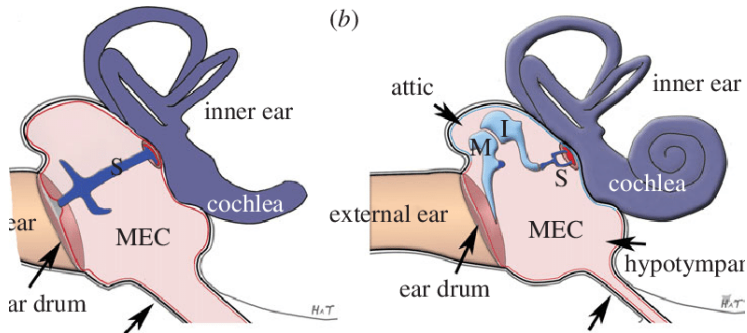
- ▶ 1 “ball & socket” vs 2 in mammals



(Choudhary et al. 2021)

Derived traits in reptiles / birds: stapes

- ▶ 1 middle ear bone vs. 3 in mammals

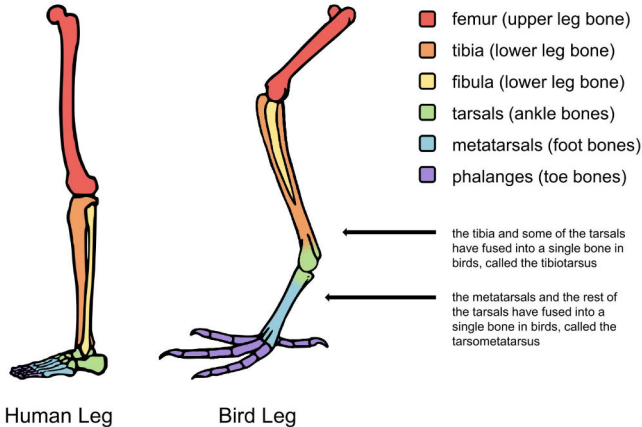


(Tucker 2017)

Derived traits in reptiles / birds: ankle position

- ▶ within tarsal bones vs. between tibia and tarsi in mammals

Comparison of Bird Leg Bones to Human Leg Bones



Which of the following are apomorphies for reptiles?

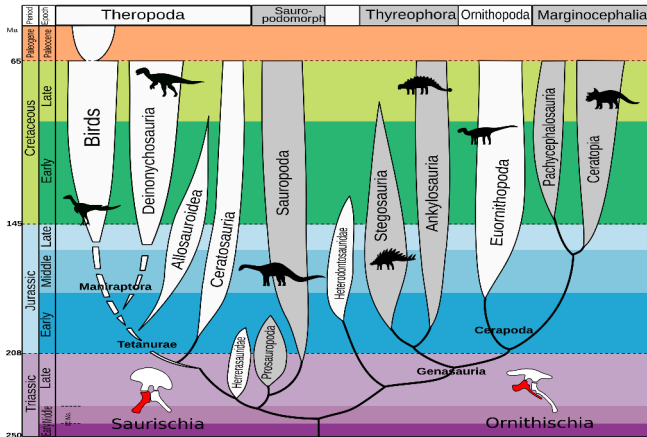


(*Varanus komodoensis*)

- a) amniotic egg
- b) two post-orbital fenestrae
- c) one middle ear bones
- d) a, b, and c
- e) b and c

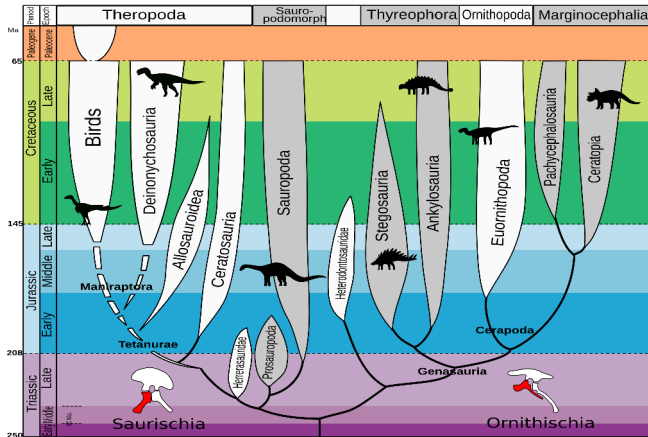
Birds are “reptile-hipped” theropod dinosaurs

- ▶ Triassic, Jurassic, and Cretaceous **periods** belong to the Mesozoic **era**
- ▶ Modern birds survived K-Pg boundary, continued evolving in Tertiary and Quaternary **periods** in current Cenozoic **era**



Evolution both makes new lineages and occurs within them

- ▶ **Cladogenesis:** lineage splitting through speciation; gives rise to new clades
- ▶ **Anagenesis:** evolutionary change within a lineage without speciation



Archaeopteryx lithiographica: A transitional form



- ▶ Lived ca. 150 mya (late Jurassic); discovered 1861 in Germany and ended up at London NHM
- ▶ Like modern birds, had hallux + asymmetrical flight feathers on wings + feathers on tail
- ▶ Unlike modern birds, had teeth and long bony tail

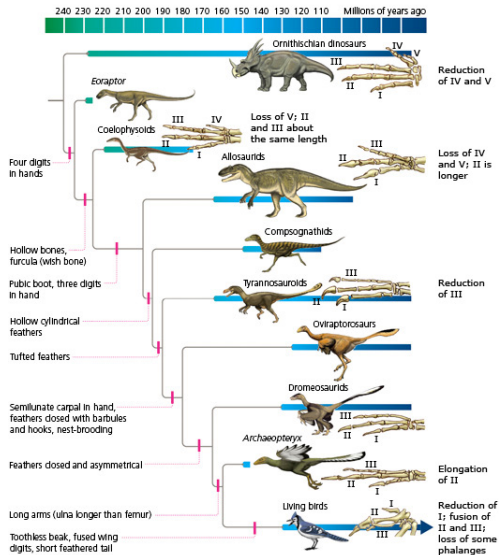
Jehol biota in china fills in Mesozoic gaps



(*Gansus zheni* by Stephanie Abramowicz in "Birds of Stone")

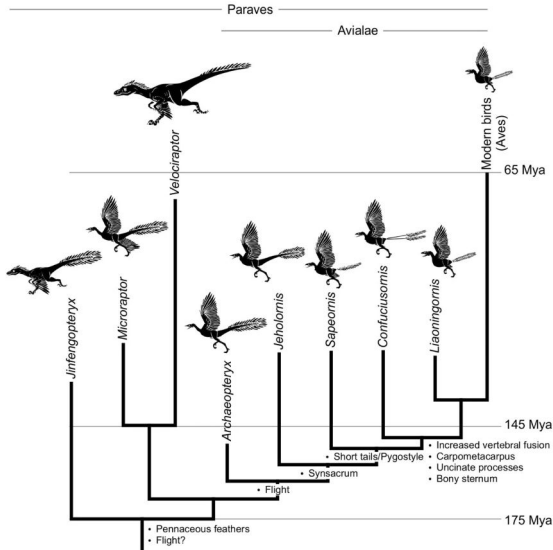
- ▶ Transitional fossils from ca. 135 - 121 mya (early Cretaceous); discovered 1861 in Germany and ended up at London NHM
- ▶ Diverse taxa and traits including structural color

Hollow bones and feathers evolved early



(Berkeley: Understanding Evolution)

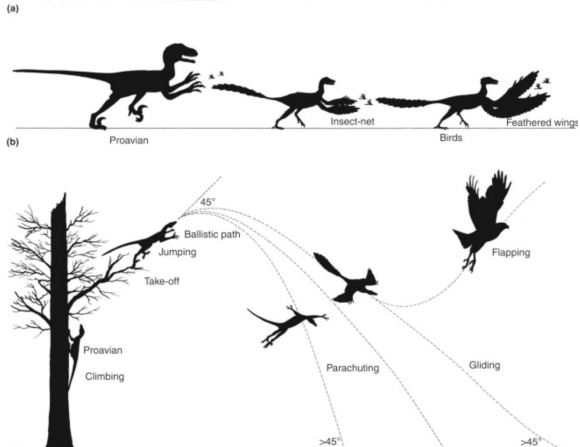
Most modern bird traits present by 145 mya



(Rashid et al. 2014)

Cursorial versus arboreal hypotheses for flight

- ▶ **Cursorial:** a running start (chukars do this)
- ▶ **Arboreal:** climbing, then gliding, then flapping
- ▶ Likely a mix!



Which of the following places derived bird traits in the order they evolved?



- a) hollow bones, feathers, four digits in hand, toothless beak
- b) toothless beak, four digits in hand, feathers, toothless beak
- c) feathers, toothless beak, hollow bones, four digits in hand
- d) four digits in hand, hollow bones, feathers, toothless beak

References

- ▶ Title Slide Paleoart: *Caihong juji* (Velizar Simeonovski), *Confuciusornis sanctus* (Franz Anthony) *Archaeopteryx lithiographica* (James Reece)
- ▶ Choudhary, O. P., Kalita, P. C., Arya, R. S., Rajkhowa, T. K., Kalita, A., & Doley, P. J. (2021). Morphometric and radiographic characteristics of the skull in crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*). Indian Journal of Animal Research, 55(4), 426-432.
- ▶ Tucker, A. S. (2017). Major evolutionary transitions and innovations: the tympanic middle ear. Philosophical Transactions of the Royal Society B: Biological Sciences, 372(1713), 20150483.

References

- ▶ Rashid, D. J., Chapman, S. C., Larsson, H. C., Organ, C. L., Bebin, A. G., Merzdorf, C. S., . . . & Horner, J. R. (2014). From dinosaurs to birds: a tail of evolution. *EvoDevo*, 5(1), 25.
- ▶ Feduccia, A. (2016). Bird Flight Origins. *Encyclopedia of Evolutionary Biology*.