

GEL 012: Dinosaurs



Skeleton of *Triceratops* ([source](#))

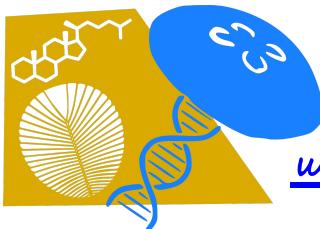
Dr. David A. Gold
University of California, Davis

Your Professor: Dr. David A. Gold



The Gold Lab c. summer 2021

- UCI - Ecology & Evolution
- UCLA - Biology
- MIT - Organic geochemistry
- Caltech - Regeneration biology
- **Molecular geobiology:** combining data from paleontology and genetics



www.DavidAdlerGold.com

Welcome to Dinosaurs!



The goals of GEL 012

- What do we really know about dinosaurs?
- What **science** teaches us about dinosaurs, and *vice versa*
- Dinosaurs as a gateway into the sciences of **geology, biology, and extinction**



A late Cretaceous landscape by Sergey Krasovskiy. ([source](#))

The goals of GEL 012

- Interpret basic datasets
 - stratigraphic maps
 - evolutionary phylogenies
- Learn the terminology needed to compare and contrast dinosaur skeletons (and connect that to biology)



A late Cretaceous landscape by Sergey Krasovskiy. ([source](#))

Course Breakdown

Grade Breakdown:

Participation:	10%
Week 3 activity:	20%
Week 6 activity:	20%
Week 9 activity:	20%
Final exam:	30%



Deinonychus antirrhopus by John Conway (source)

Course Breakdown: In-Class Activities

- **Done in-class.** To get credit, you have to do them at the allotted time. These cannot be made up.
- The first 10 activities will be worth 1 point each
- Additional activities worth 1 point extra credit (+5% max)



Deinonychus antirrhopus by John Conway (source)

Course Breakdown: Activities

- Go online Friday, due the following Monday
- Working in groups is encouraged (Discord link on CANVAS)
- Materials relate to the final exam, so make sure you know what you're doing!



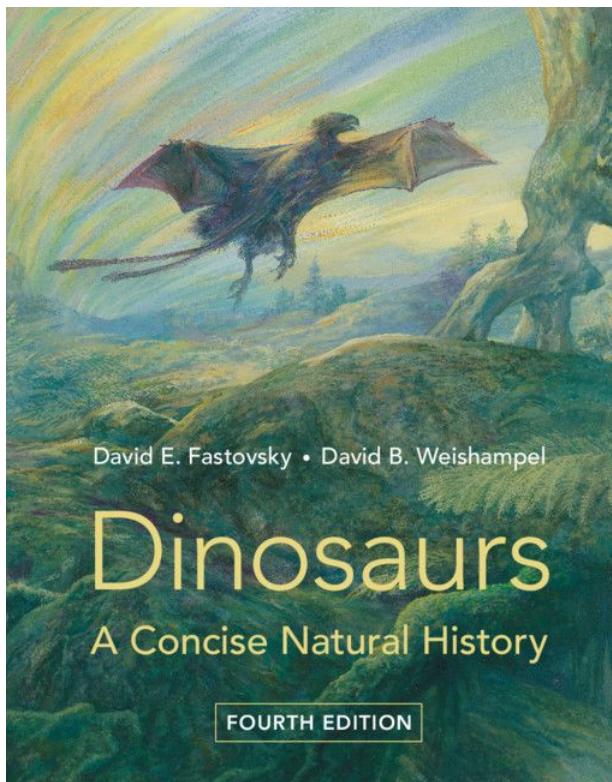
Course Breakdown: Final

- Wed. June 12 at 8:00am
- Cumulative
- Multiple choice
- Study guide week 9
- Study session week 10



Deinonychus antirrhopus by John Conway (source)

Textbook (optional)



- An excellent reference.
- Will cover and flesh out many of the ideas discussed in class
- Ideal if you want to do everything to get an “A” or just learn about dinosaurs

Fastovsky, David E., and David B. Weishampel. *Dinosaurs: a concise natural history*. Cambridge University Press, 2021.

Lecture Capture

- Uploaded in CANVAS
“Media Gallery”
- Not responsible for
problems with lecture
capture
- Not recommended as a
substitute for attending



Behind the scenes in the movie “Jurassic Park” (1993) ([source](#))

Any questions?



Styracosaurus by Kazuhiko Sano ([source](#))

Big Question of the Day

What is a dinosaur?



Illustrations by Mark Whitton ([link](#))

Defining dinosaurs



Name in a box?

=

Worth remembering

Little grey box. The scientific paper (if you want to learn more)

Dinosaur

Greek: “dino” = terrible, “saur” = lizard

- Defined by Richard Owen (1842) to classify unusual reptile fossils
- Among other traits:
 - enormous size
 - legs like elephants

Owen, R. (1842). Report on British fossil reptiles, part II. *Report for the British Association for the Advancement of Science, Plymouth*, 60-294.

Defining dinosaurs



dinosaurs (a.k.a. Dinosauria)

Greek: “dino” = terrible, “saur” = lizard

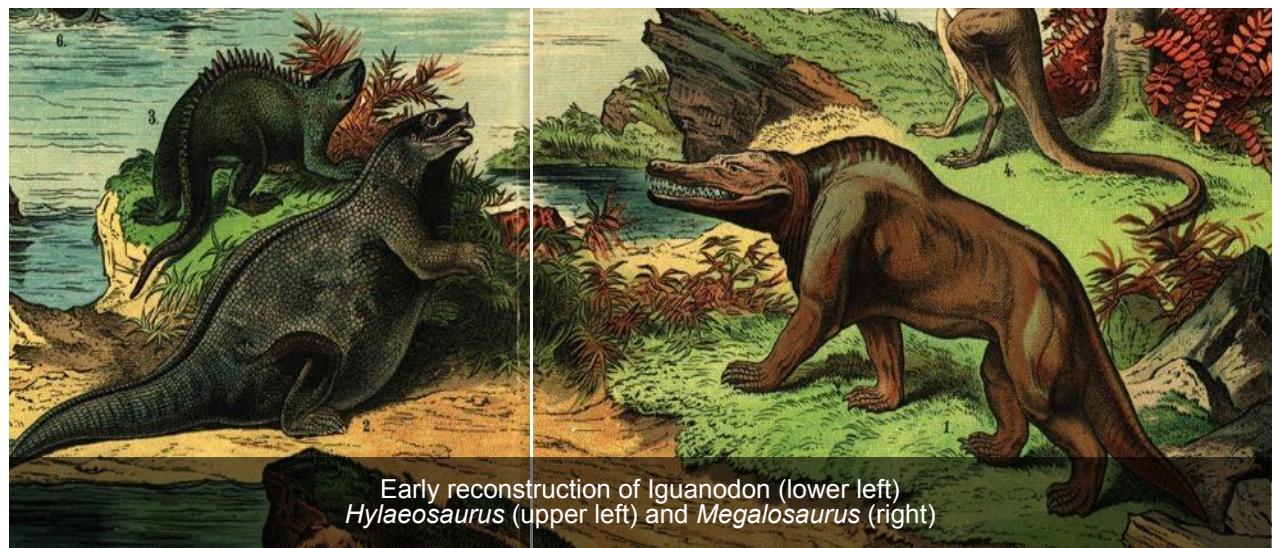
- Defined by Richard Owen (1842) to classify unusual reptile fossils
 - Among other traits:
 - enormous size
 - legs like elephants

Owen, R. (1842). Report on British fossil reptiles, part II. *Report for the British Association for the Advancement of Science*. Plymouth. 60-294.

Defining dinosaurs

“Principle and best established” representatives:

- *Megalosaurus*
- *Iguanodon*
- *Hylaeosaurus*



Early reconstruction of *Iguanodon* (lower left)
Hylaeosaurus (upper left) and *Megalosaurus* (right)

Owen, R. (1841). Report on British fossil reptiles, part II. *Report for the British Association for the Advancement of Science, Plymouth*, 60-294.

Schreiber, J.A. (1888) *Dr. Schubert's Naturgeschichte - Geologie, Mineralreich, Paläontologie*

Caveat: why do dinosaurs have such unusual names?

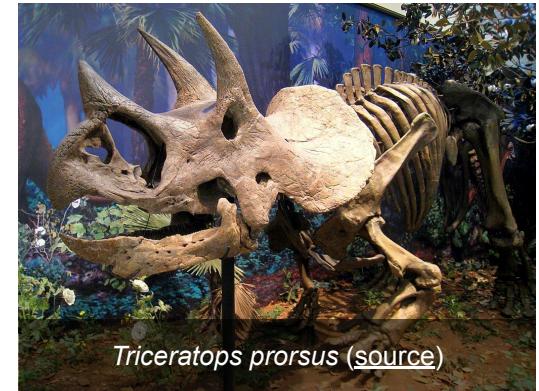
- All organisms (living and extinct) that are described by scientists have scientific names
- **Binomial nomenclature** is the formalized way of naming organisms:

Structure of **binomial nomenclature**:
Genus species

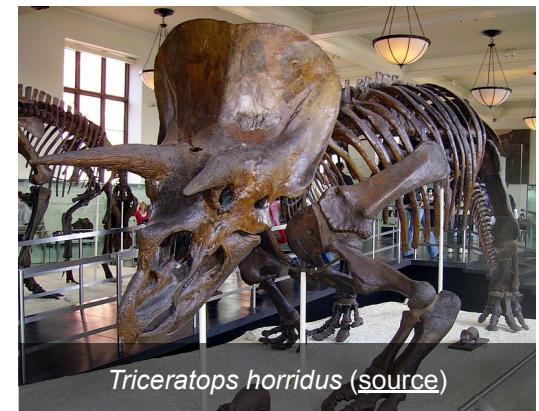


Caveat: why do dinosaurs have such unusual names?

- Closely related organisms share the same **genus** name, but have different **species** names
- Scientists have trouble agreeing on the criteria for fossil species, so dinosaurs in this class will be described at the genus level



Triceratops prorsus (source)



Triceratops horridus (source)

Caveat: why do dinosaurs have such unusual names?

- European scientists of the enlightenment (17th-18th centuries) were infatuated with ancient Greek thinkers
- Lost in the “Dark Ages” (~5th-15th centuries) but preserved by Persian and Arab scholars

Megalosaurus

Greek: ‘megas’ = great, ‘sauros’ = lizard

Iguanodon

‘iguana’ + Greek: ‘odon’ = tooth

Hylaeosaurus

Greek: “hylaios” = of the forest, ‘sauros’ = lizard

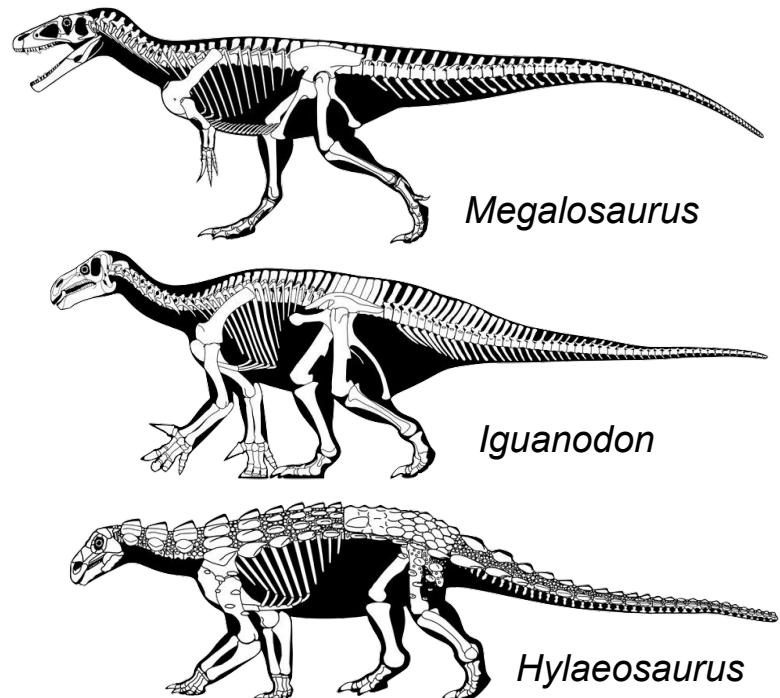
Caveat: why do dinosaurs have such unusual names?

- Most organisms have **scientific names** in Greek or Latin as a vestige of the enlightenment
- As science has gotten more diverse, so have dinosaur names



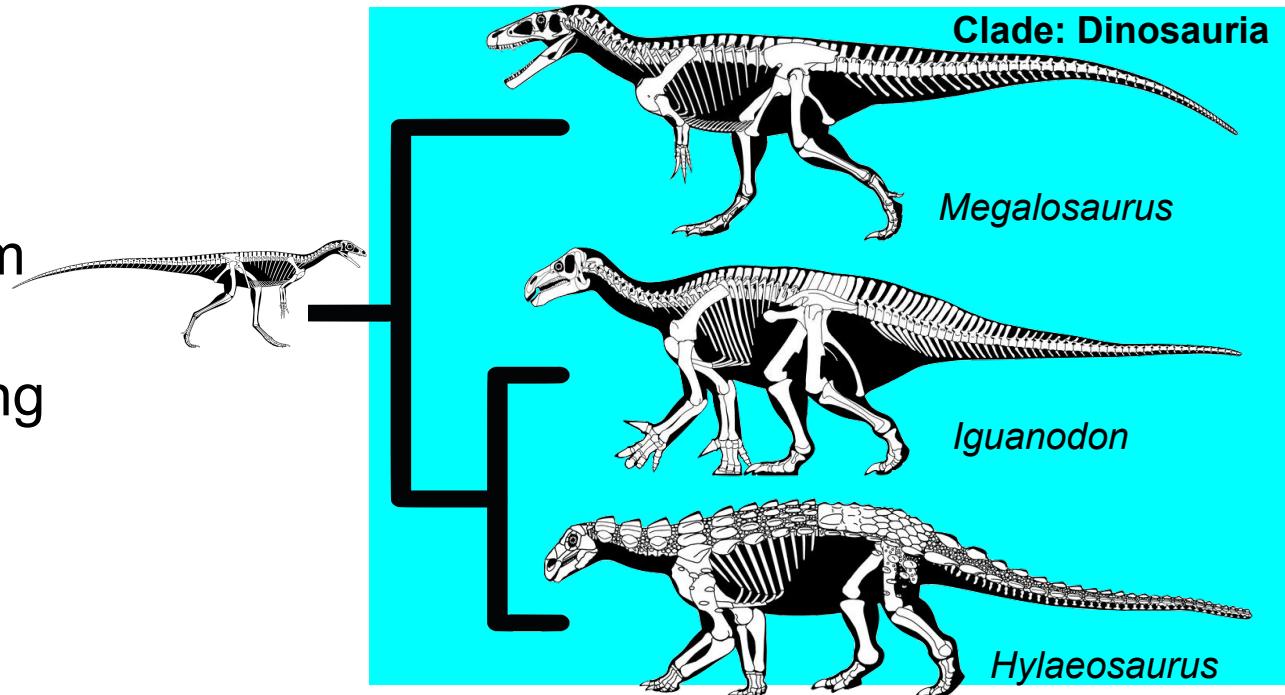
Defining dinosaurs

- The original definition grouped these three extinct organisms together based on similarities in their skeletons
- “Dinosauria” represented a “distinct tribe” grouped together for convenience



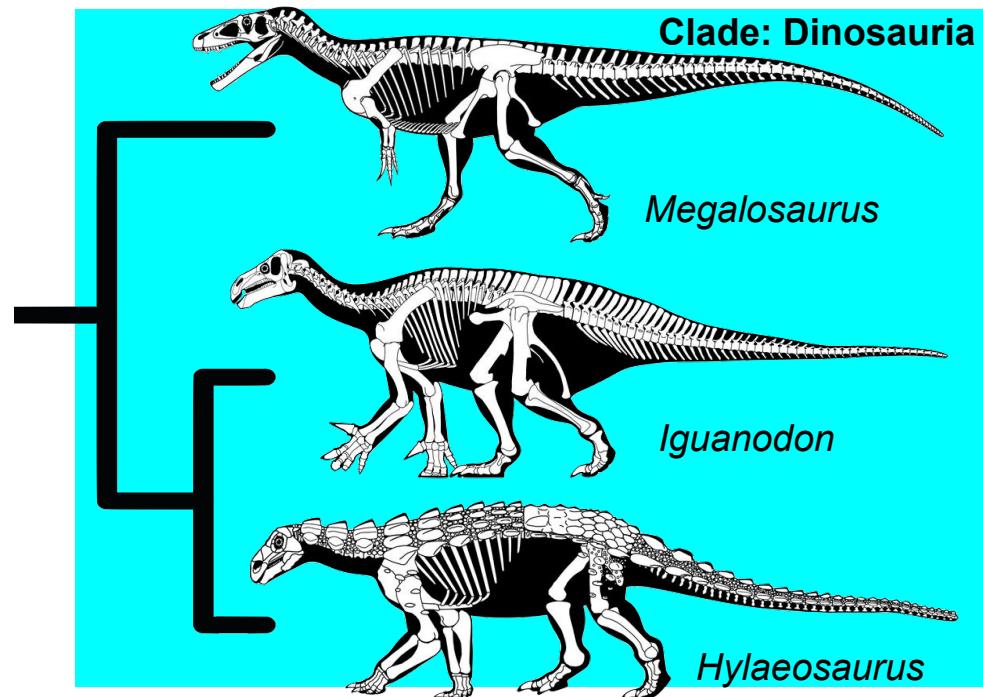
Defining dinosaurs

- Scientists now interpret these similarities as traits shared from a common ancestor, resulting in the **clade** Dinosauria



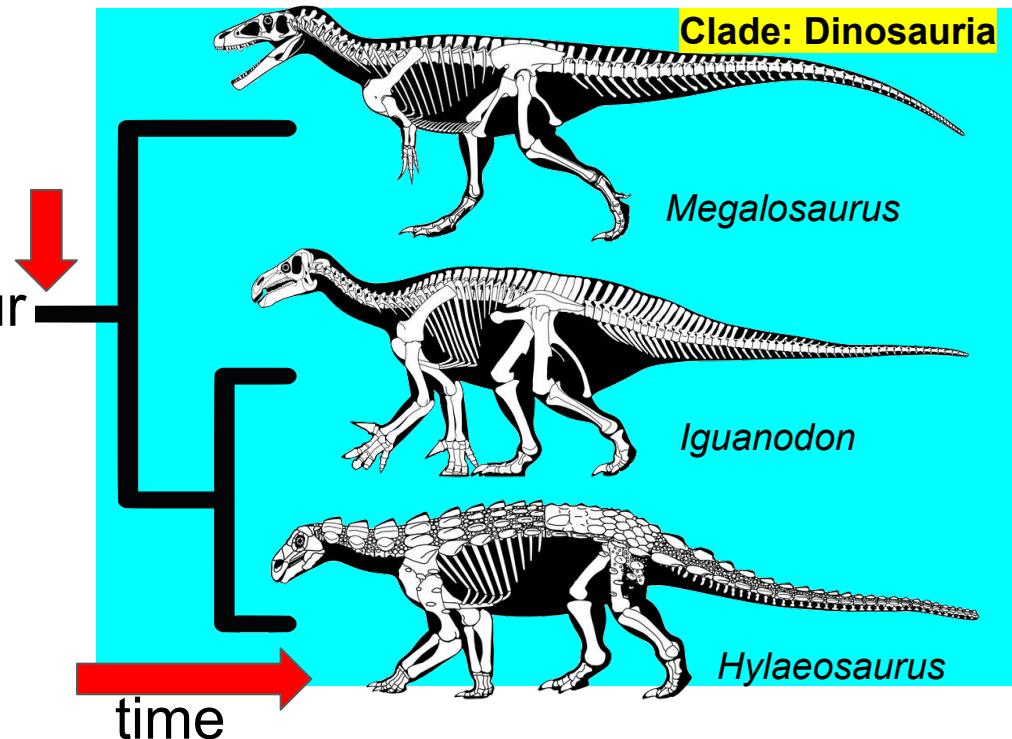
Defining dinosaurs

- **Clade:** A grouping of organisms made on the basis of their hypothesized evolutionary history, consisting of a common ancestor and all of its descendants



Defining dinosaurs

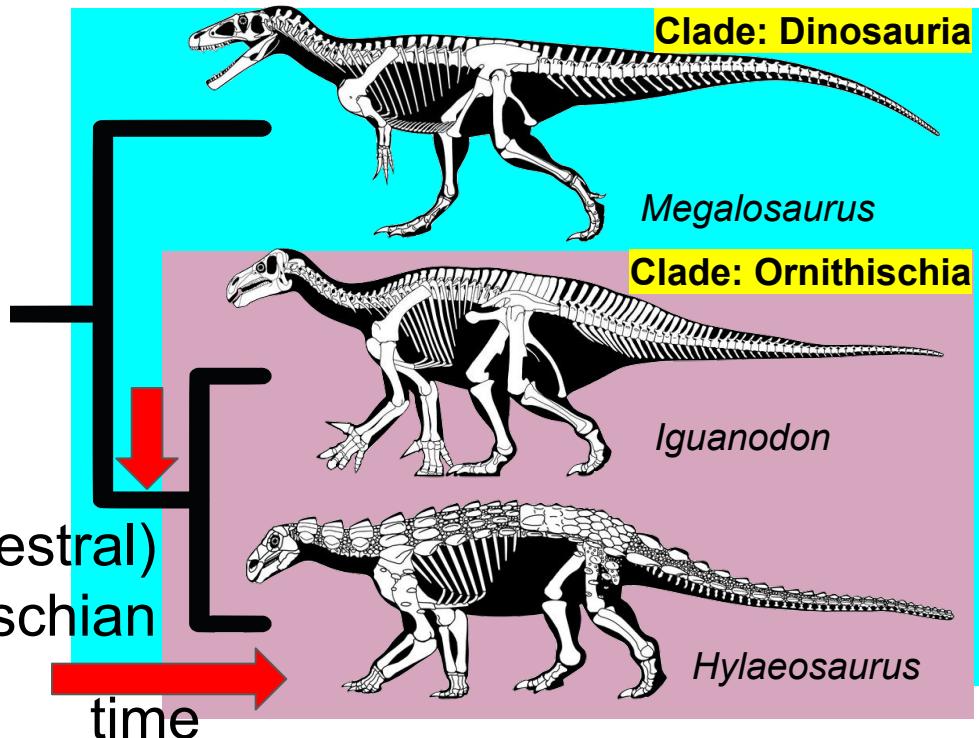
The first (ancestral) dinosaur



Defining dinosaurs

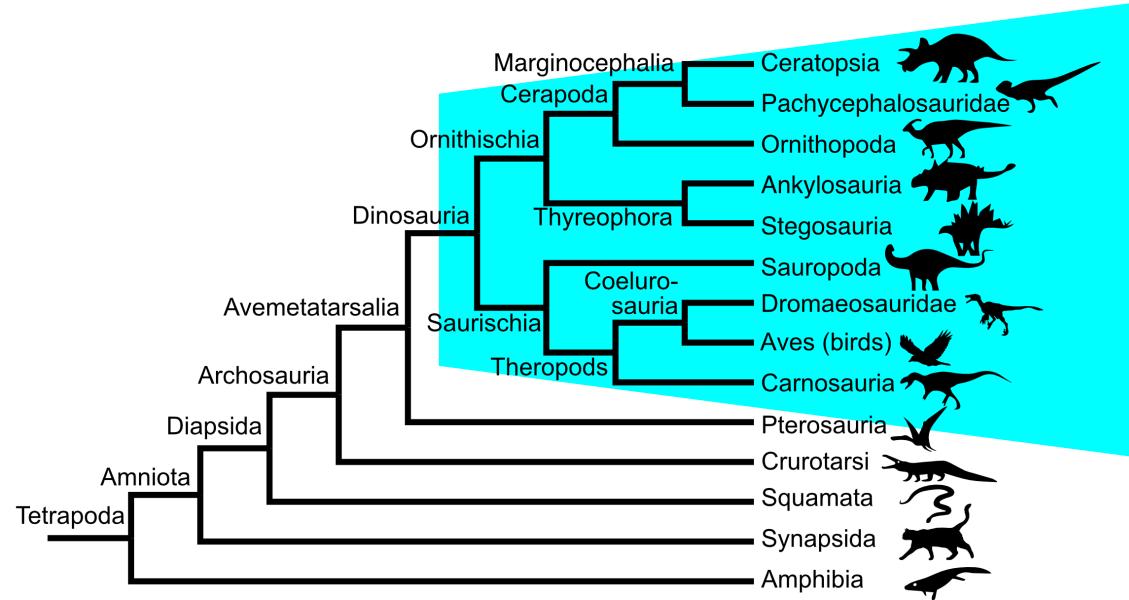
- A clade can be broken into **subclades**
- Members of the same subclade are more closely related to each other

The first (ancestral) ornithischian

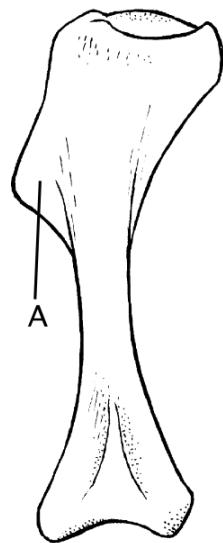


A diagram of clade Dinosauria and its relatives

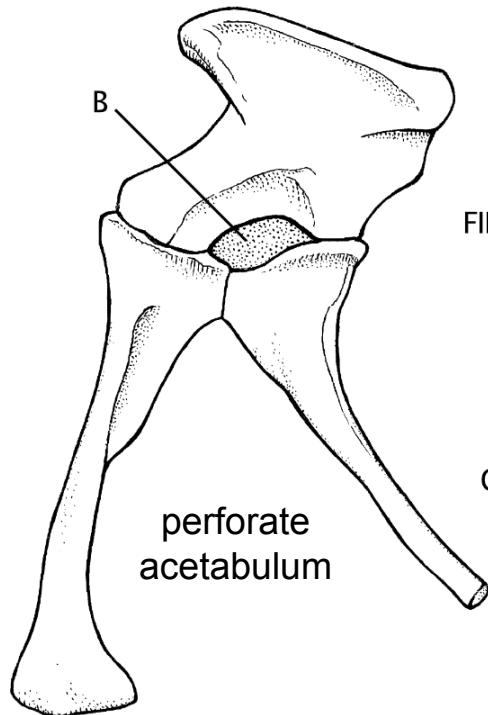
- Clades are distinguished from each other based on synapomorphies
- **Synapomorphy:** A shared, derived trait that helps define a group



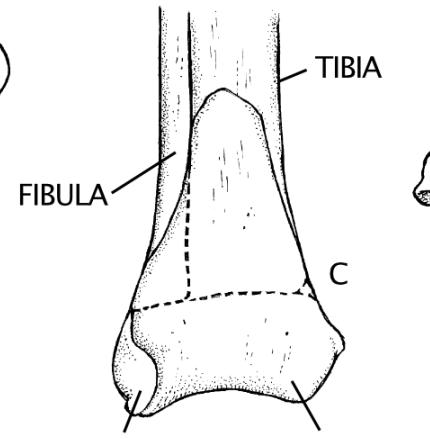
Synapomorphies of Dinosauria



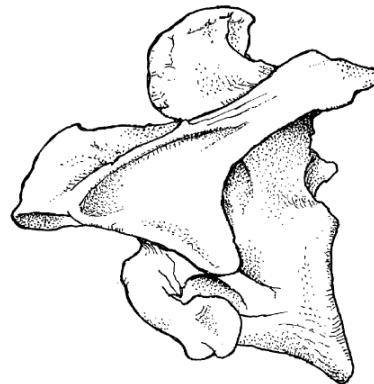
elongate
deltopectoral
crest on
humerus



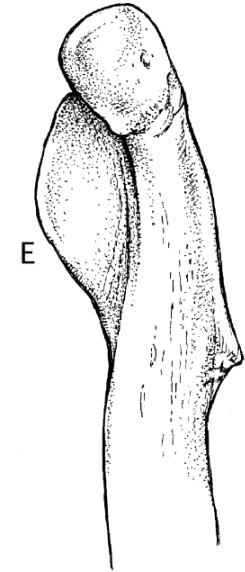
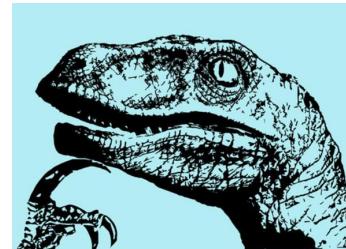
perforate
acetabulum



fibula contacts 30%
of astragalus (part
of the mesotarsal
ankle)



epiphyses on
cervical vertebrae



asymmetrical
fourth
trochanter on
femur

Let's start with something easier

Dimetrodon

Greek: “di” = two, “metr” = measure, “‘odon’ = tooth

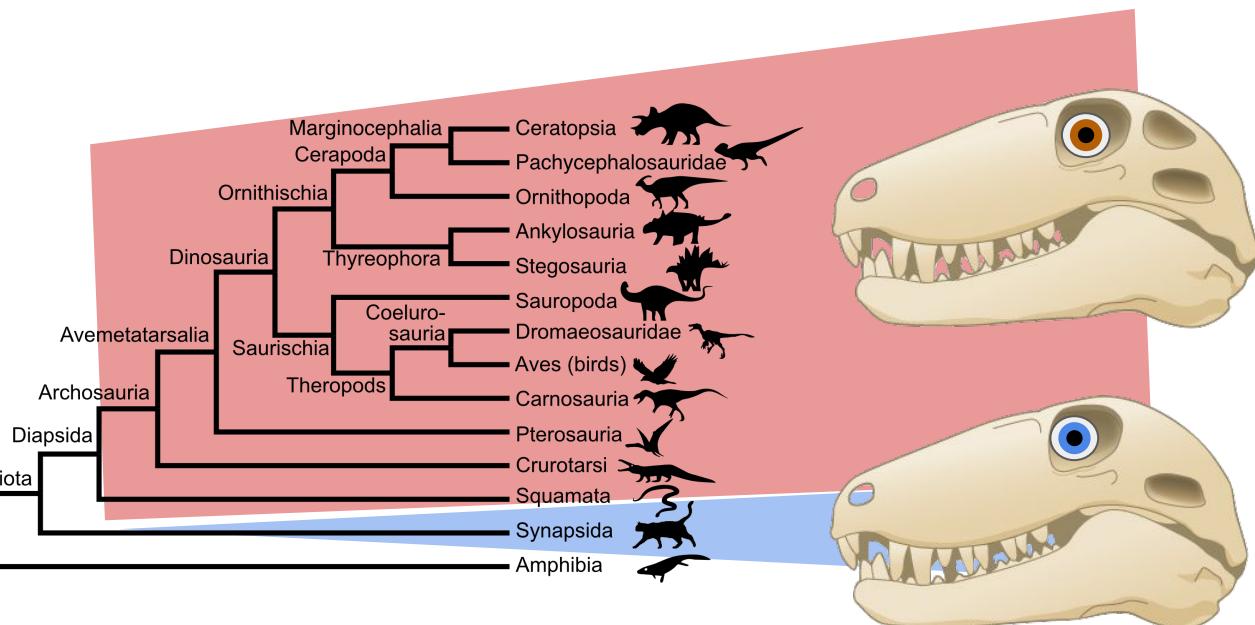
- *Dimetrodon* is commonly misidentified as a dinosaur
- But when paleontologists were describing it, they recognized that it had traits that differentiated it from dinosaurs



Dimetrodon by Mark Whitton ([source](#))

Case, E.C. (1907). Revision of the Pelycosauria of North America. Washington, D.C.: Carnegie Institution of Washington. pp. 1–176.

The number of holes in the head is a synapomorphy distinguishing the two major clades of amniotes



- The number of holes behind the eye socket is a **synapomorphy** separating synapsids (mammals) from diapsids (birds and reptiles)

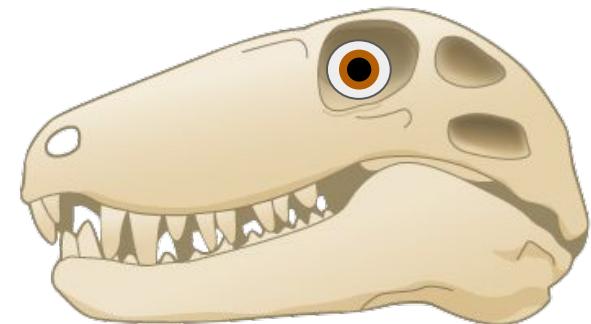
Skulls adapted from [CNX OpenStax](#).

The number of holes in the head is a synapomorphy distinguishing the two major clades of amniotes

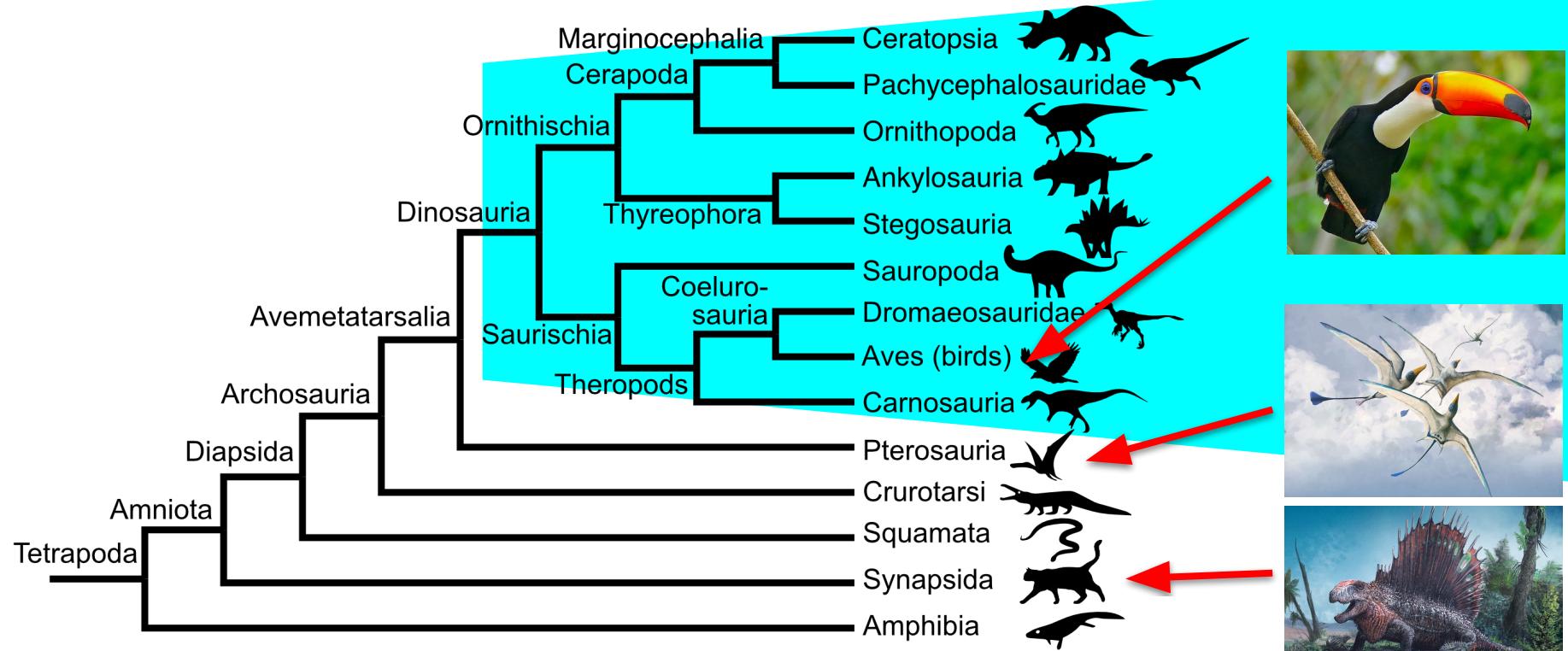
- Based on the number of holes in the skull, *Dimetrodon* is classified as a synapsid, and is more closely related to living mammals than dinosaurs



Skull of *Dimetrodon*

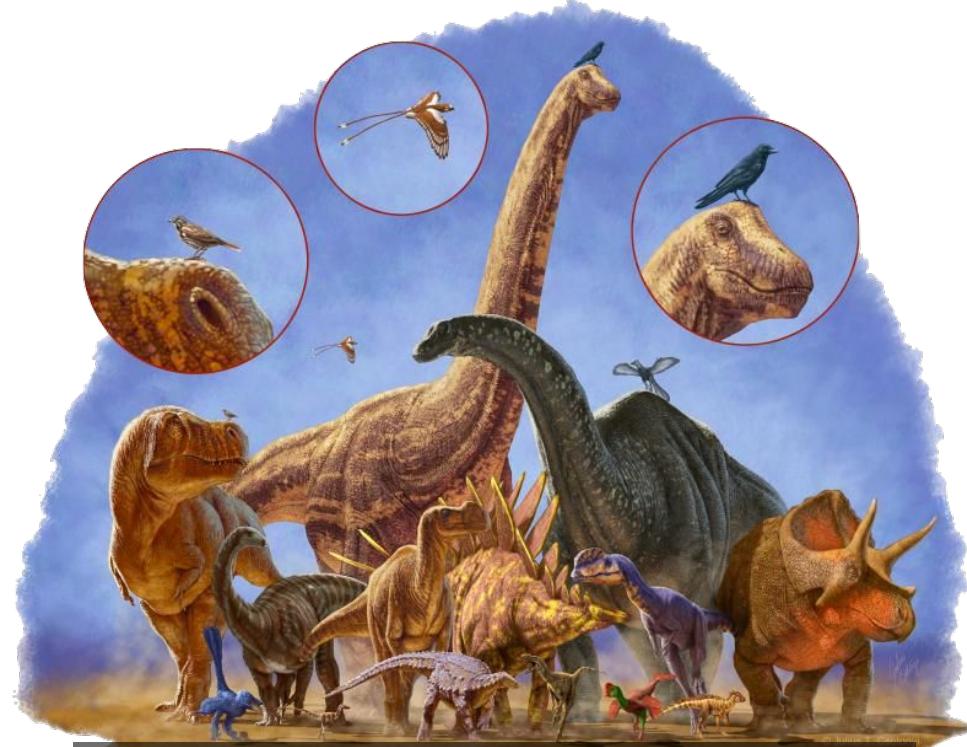


Dimetrodon is not part of the Dinosauria clade, but birds are



Conclusions

- Lifeforms are organized into **clades** based on their evolutionary relationships
- Clades are defined by **synapomorphies** (shared derived traits)
- Dinosaurs (clade **Dinosauria**) are a group of animals that share a unique common ancestor
- Not all prehistoric animals are dinosaurs, and not all dinosaurs are extinct (birds are a living subclade of dinosaurs)



Dinosaur diversity by Julius Csotonyi ([source](#))

Next Class: Science



Jurassic Park (1993; Universal Pictures) ([source](#))