Fossils

B/C

Georgia Tech Event Workshop Series
2024-25

Science Olympiad at Georgia Tech®

Introductions

Akul Rana

- The Westminster Schools
- Emory BS and BBA ‘28
- Scioly for 4 years
- USESO ‘23 National Camper
- Educator at natural history museum in Georgia
- 2nd GA States in Fossils

Victor Hesu

- The Westminster Schools
- Georgia Tech BSME ‘26
- Scioly for 4 years
- Helped with 20+ tournaments
- 2nd GA States in Fossils

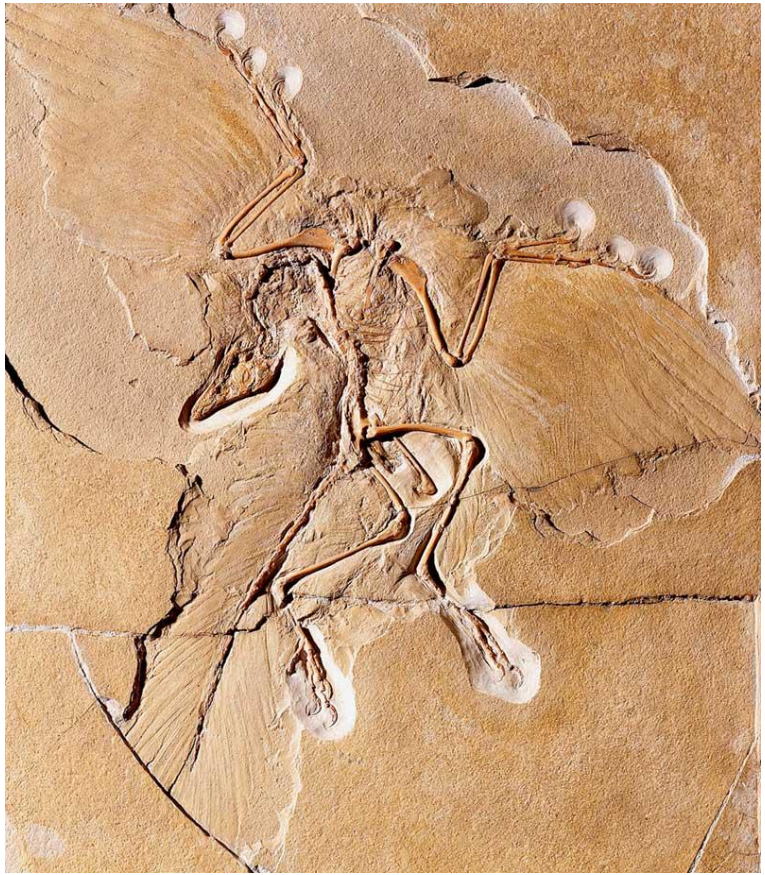
01 RULES SHEET

02 DIFFICULT TOPICS

03 COMMON QUESTIONS

04 TIPS FROM A VETERAN

05 OTHER FREE RESOURCES



The Rules Sheet

Common Topics

- Identify the fossil and be able to determine mode of preservation
- Determine past environments and ecosystems
- Determine the age of assemblages and fossils with relative and absolute dating
- Major evolutionary trends and events

What's allowed

- 1 three ring binder of any size
- Magnifying glass
- Annotated and labeled field guide
- 1 individual copy of the official list outside of binder


DIFFICULT
TOPICS

Topic 1: Teeth

- Basilosaurus

Topic 1: Teeth

- Batoidea

Topic 1: Teeth

- Mammoth vs Mastodon

Topic 1: Teeth

- Equus vs Mesohippus

Topic 1: Teeth

- Mosasaurus vs T. Rex

Topic 2: Evolution and Geologic History

- First life on earth is debated
  - Oldest evidence of life in total is a debated graphite grain inside Australian Zircon
    - Jack Hills formation
  - Oldest large scale stratigraphic evidence is in a Greenland metasedimentary layer
    - Isua Supracrustal Belt
  - **THE EARLIEST KNOWN DIRECT LIFE**(not earliest life) are stromatolites
    - Dresser Formation of the Pilbara Craton of Western Australia

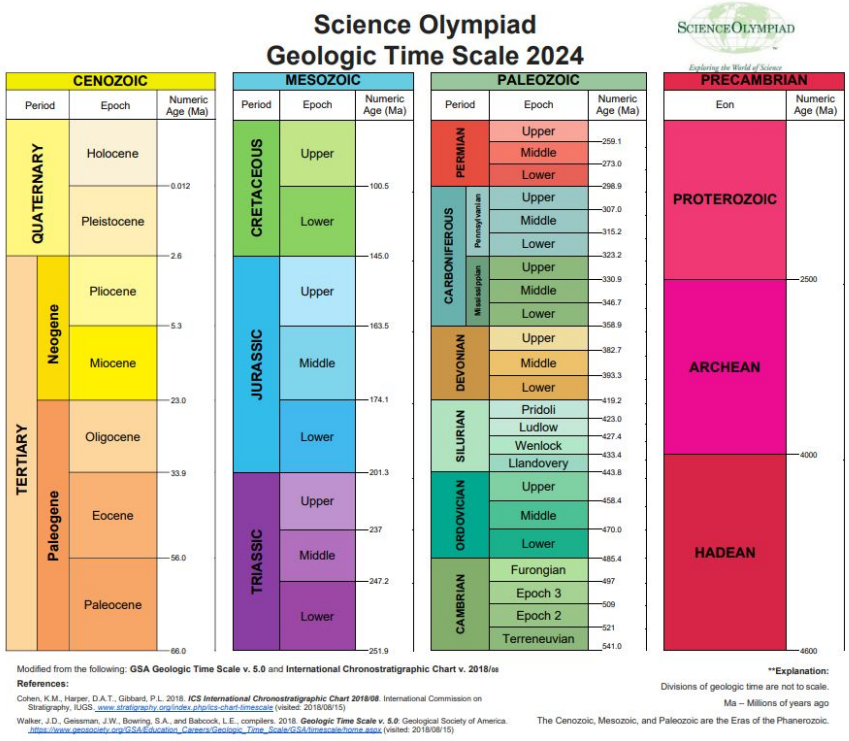
Topic 2: Evolution and Geologic History

- Stromatolites are like microbial mats that mixed with sediment and ended up getting preserved in Geyserite
  - Hypersaline environments

Topic 2: Evolution and Geologic History

- Banded Iron Formations (BIF's) also display the effects of cyanobacteria

Topic 2: Evolution and Geologic History



Modified from the following: **GSA Geologic Time Scale v. 5.0** and **International Chronostratigraphic Chart v. 2018/08**

References:

Cohen, K.M., Harper, D.A.T., Gibbard, P.L. 2018. ***ICS International Chronostratigraphic Chart 2018/08***. International Commission on Stratigraphy, IUGS. www.stratigraphy.org/index.php/ics-chart-timescale (visited: 2018/08/15)

Walker, J.D., Geissman, J.W., Bowring, S.A., and Babcock, L.E., compilers. 2018. ***Geologic Time Scale v. 5.0***: Geological Society of America. https://www.geosociety.org/GSA/Education_Careers/Geologic_Time_Scale/GSA/timescale/home.aspx (visited: 2018/08/15)

****Explanation:**

Divisions of geologic time are not to scale.

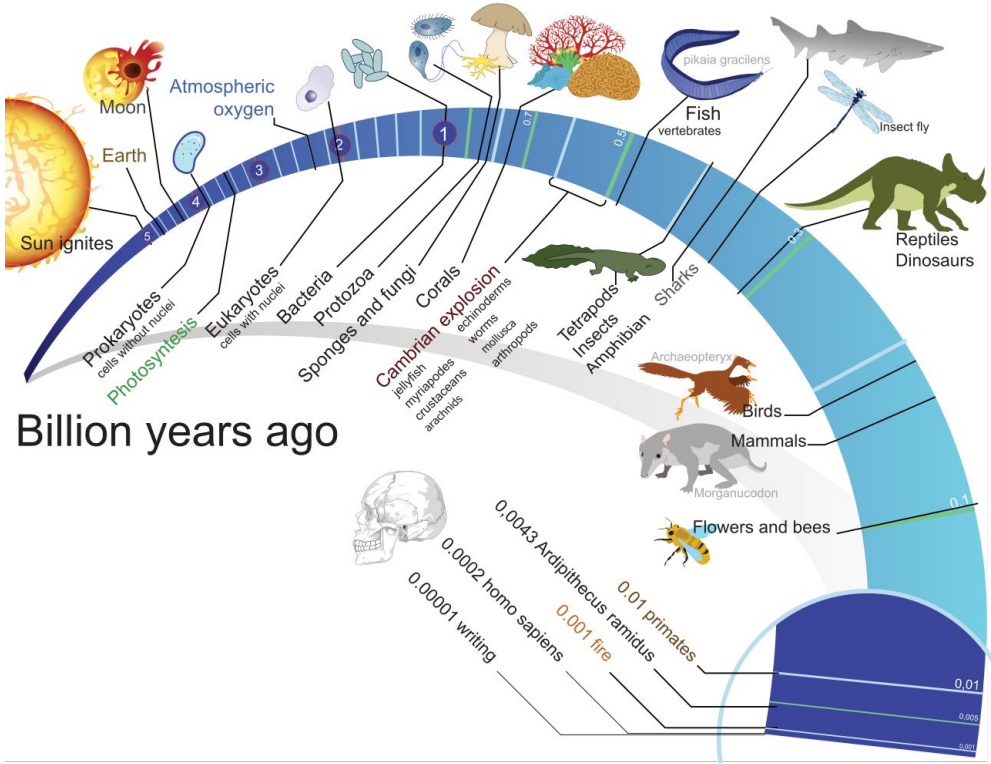
Ma – Millions of years ago

The Cenozoic, Mesozoic, and Paleozoic are the Eras of the Phanerozoic.

Topic 2: Evolution and Geologic History: Precambrian

- **Hadean**
  - Not much life stuff, earth was very hot; Defined by lack of life
- **Archean**
  - 4100 MYA: Jack Hills Graphite
  - 3800 MYA: Bacteria and Archaea's last common ancestor
  - 3000 MYA: Cyanobacteria creating free oxygens into environment
- **Proterozoic Eon**
  - 2500 MYA: Great Oxygenation (defines start of the Proterozoic)
  - By 1850 MYA: Eukaryotes and Viruses soon after
  - 750 MYA: Animalia gets on stage
  - 600 MYA: Ozone
  - 580 MYA: Start of the Cambrian explosion(mostly coral and jellies
    - Phanerozoic is defined by the diversification of Life

Topic 2: Evolution and Geologic History: Life



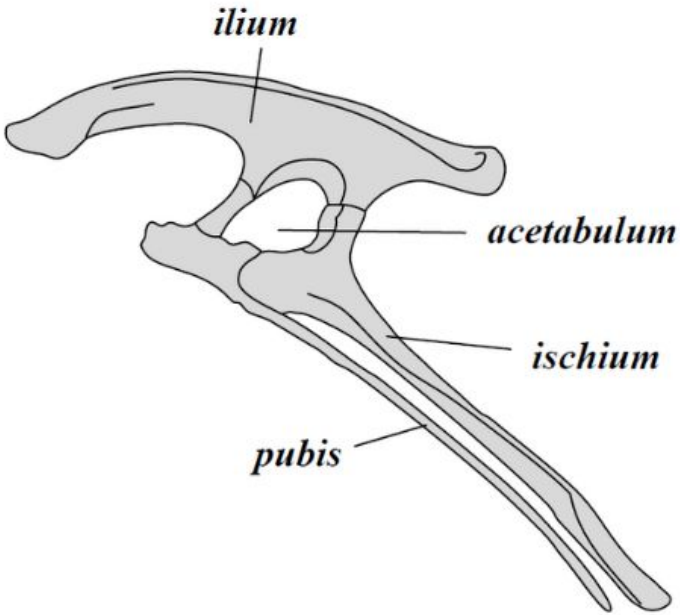
Topic 2: Evolution and Geologic History: Extinction

- **Ordovician–Silurian extinction** events (End Ordovician or O–S): 450–440 Ma at the Ordovician–Silurian transition. Two events occurred that killed off 27% of all families, 57% of all genera and 60% to 70% of all species.
- **Late Devonian extinction**: 375–360 Ma near the Devonian–Carboniferous transition. At the end of the Frasnian Age in the later part(s) of the Devonian Period, a prolonged series of extinctions eliminated about 19% of all families, 50% of all genera and at least 70% of all species.
- **Permian–Triassic extinction AKA "The Great Dying"** event (End Permian): 252 Ma at the Permian–Triassic transition. Earth's largest extinction killed 57% of all families, 83% of all genera and 90% to 96% of all species (53% of marine families, 84% of marine genera, about 96% of all marine species and an estimated 70% of land species, including insects).
- **Triassic–Jurassic extinction** event (End Triassic): 201.3 Ma at the Triassic–Jurassic transition. About 23% of all families, 48% of all genera (20% of marine families and 55% of marine genera) and 70% to 75% of all species became extinct.
- **Cretaceous–Paleogene** extinction event (End Cretaceous, K–Pg extinction, or formerly K–T extinction): 66 Ma at the Cretaceous (Maastrichtian) – Paleogene (Danian) transition interval. About 17% of all families, 50% of all genera and 75% of all species became extinct.

Topic 2: Evolution and Geologic History: 6th Extinction

- **Holocene extinction:** Currently ongoing. Extinctions have occurred at over 1000 times the background extinction rate since 1900. The mass extinction is a result of human activity, driven by population growth and overconsumption of the earth's natural resources. The 2019 global biodiversity assessment by IPBES asserts that out of an estimated 8 million species, 1 million plant and animal species are currently threatened with extinction. 50 times higher is the rate of extinction of the Pleistocene-Holocene extinction than that of any other major mass extinction.

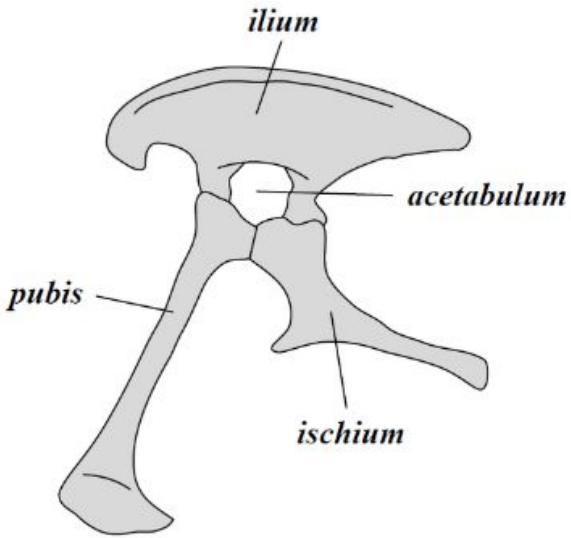
Topic 3: Bird or Reptile?: Ornithischians



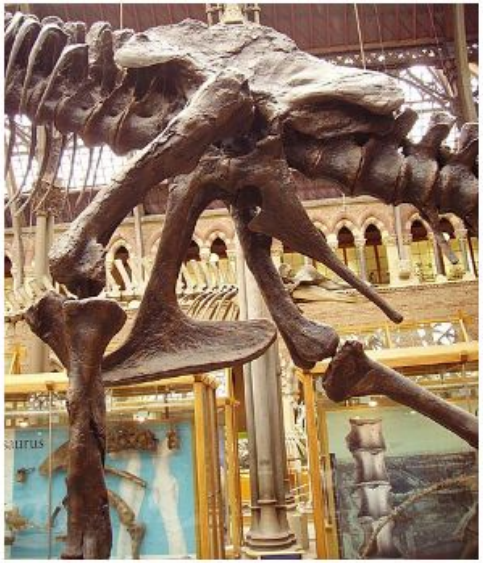
Ornithischian pelvis structure (left side)

Edmontosaurus pelvis (showing ornithischian structure – left side)

Topic 3: Bird or Reptile?: Ornithischians



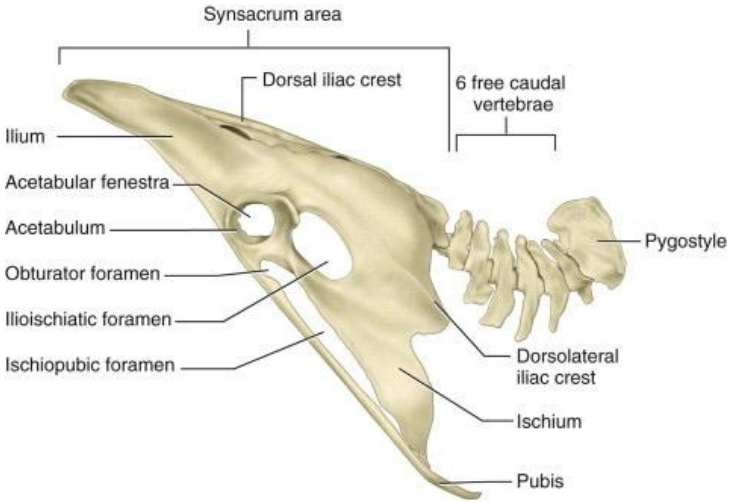
Saurischian pelvis structure (left side)



Tyrannosaurus pelvis (showing saurischian structure – left side)

Topic 3: Bird or Reptile?: Ornithischians and Birds → Convergent

- Birds actually evolved from Saurischian (not bird hips) carnivorous dinosaurs
  - The Ischium rotation had evolutionary twice



Topic 2: Evolution and Geologic History: Paleozoic

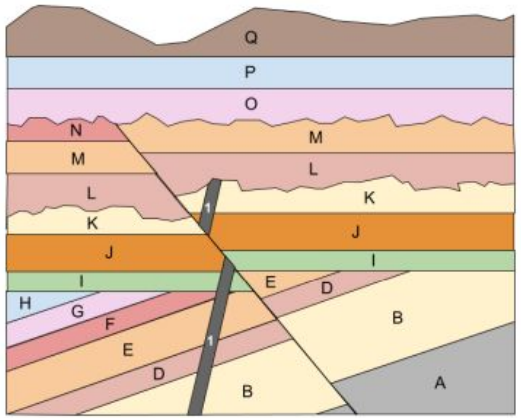
- **Paleozoic**
  - 535 MYA: Crazy diversification of invertebrates
  - 485 MYA: Vertebrates
  - 430 MYA: First agnathan fishes (IN LIST)
  - 420 MYA: First ray finned fish and land invertebrates
  - 410 MYA: First fish with teeth and nautilida
  - 395 MYA: Zachelmie Trackways: oldest terrestrial prints
  - 375-365 MYA: Tiktaalik and Acanthostega fossils were found
  - 360 MYA: First firns, and seed ferns dominate land plants
  - 350 MYA: Diversification of Amphibians

COMMON QUESTIONS

All of the following questions have been pulled from past YJI exams (which can be found on our website) or the Text Exchange on SciOly Wiki

Question 1

22. Roger the rock hound collects samples from the rock layers shown below to be radiometrically dated. After processing the samples, he obtains the data in the table to the right.



Structure	Approximate Age of Formation
A	5.5×10^8 years ago
I	3.1×10^8 years ago
K	2.7×10^8 years ago
N	2.0×10^8 years ago
O	1.1×10^8 years ago

How many millions of years ago (mya) could Structure 1 have formed?

A. 400 mya B. 300 mya C. 250 mya D. 150 mya

Question 2

a.  b.  c.

 d. 

1. (16) Identify the specimens and provide their closest modern relative:

   a.
   b.
   c.
   d.

Question 3

1. (2 points) Lots of periods are known as the "Age of" something. The following are known as the age of " "(put the most commonly known one)
   (a) (.5 point) Devonian: Age of _____
   (b) (.5 point) Mesozoic: Age of _____
   (c) (.5 point) Cenozoic: Age of _____
   (d) (.5 point) Carboniferous: Age of _____

Question 4

1. (2 points) Index fossils are very important to the field of paleontology. List 2 characteristics of index fossils in the space below.

Tips from a Veteran

- ID, ID, ID
  - You shouldn't be having to flip through your binder to identify something
- Make your own binder
  - Allows you to make your own system that is most efficient for YOU
- Practice tests!!!
  - Since fossils covers so many topics, you can use practice tests to patch up cracks

Additional Resources

Sci Oly Wiki

Wikipedia

Tarbuck Earth Science

ID bot on Discord

THANKS!