

Name: _____

GEOL 431: Vertebrate Paleobiology
Homework 1: Geologic Time & Phylogenetics
Due 2/18/19

Part 1: Biostratigraphy

The following chart is modified from:

Reumer, J.W.F. 1995. The effects of paleoclimate on the evolution of Soricidae (Mammalia, Insectivora), pp. 135-147 in Vrba, E.S., G.H. Denton, T.C. Partridge & L.J. Burkle (eds.), *Paleoclimate and Evolution, with Emphasis on Human Origins*. Yale Univ. Press.

This chart on the next pages is a summary of the stratigraphic ranges of a number of fossil species of shrews (small insectivorous mammals), identified by the names in italics. The solid black lines in the main body represent the age range for each species (the dotted lines for possible age ranges based on less-diagnostic fossil specimens). EPOCHS refer to the standard epochs from the Geologic Time Scale; MN Zones, Mammal Stages, N.W. European Stages, and Mediterranean Stages refer to specialized local stratigraphic subdivisions. Under PALEOMAGNETISM, black indicates magnetically normal and white indicates magnetically reversed.

1) You have discovered a fossil site that contains the following species: *Sorex bor*, *Sulimskai kretzoi*, *Deinsdorfia kardosi*, and *Mafia csarnotensis*. Using the chart from the previous page, indicate the possible age range for that fossil site, in terms of: [2 pts]

Epoch:

MN Zone:

Mammal Zone:

NW European Zone:

2) You discover another site in which you find fossils of *Pelenyia hungarica*, *Sorex minutus*, and *Corcidura kornfeldi*, as well as pollen corresponding to Mediterranean pollen zone P IV. Using the chart, indicate the possible age range in terms of: [2 pts]

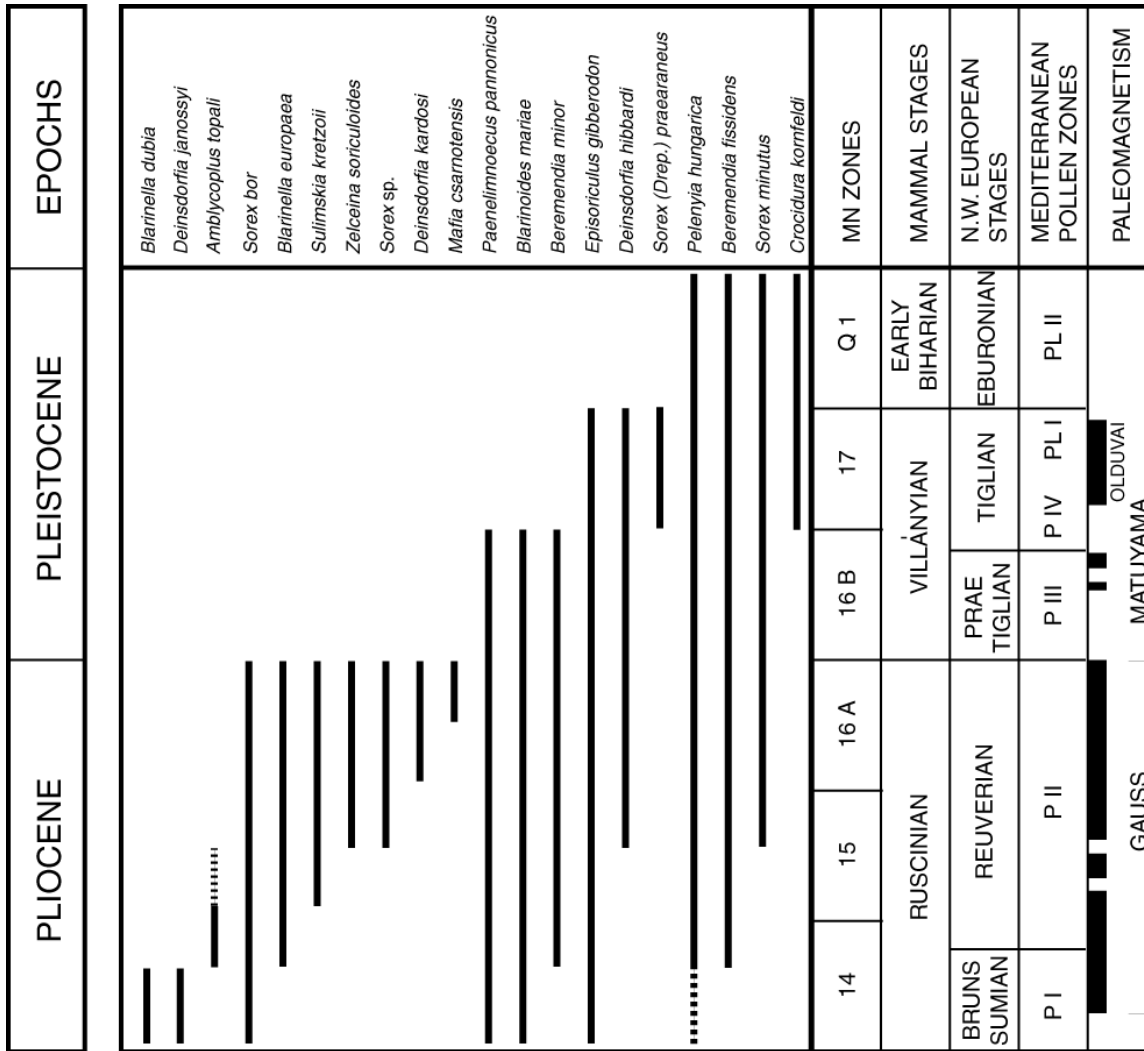
Epoch:

MN Zone:

Mammal Zone:

NW European Zone:

Extra Credit) A paleomagnetic reading of the site in number 2 discovers that it was deposited during a magnetic reversed condition. Does this help refine the total length of possible times in which it could have been deposited? Explain [+1 pt]



The graphic on the following page comes from:

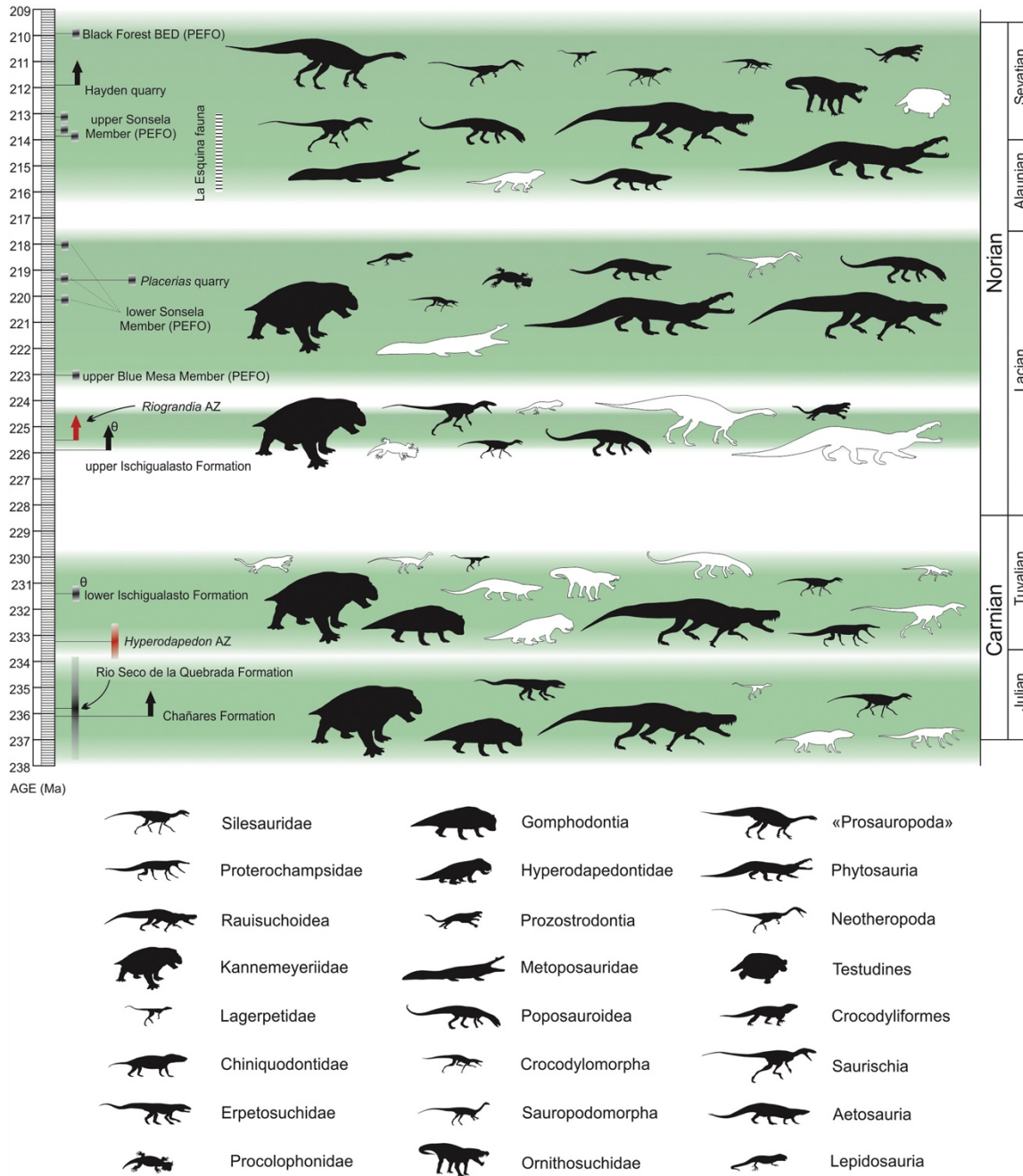
Langer, M.C., J. Ramenzani & A.A.S. Da Rosa. 2018. U-Pb age constraints on dinosaur rise from south Brazil.

Gondwana Research 57: 133-140. Doi: 10.1016/j.gr.2018.01.005

<https://www.sciencedirect.com/science/article/pii/S1342937X18300327>

This summary figure shows (from left to right) the age in millions of years ago (Ma); the age dates of various sites at the Petrified Forest National Monument (often, but not always, indicated by “PEFO”) in the American Southwest and some localities from Argentina and Brazil; generalized ranges for assemblages of taxa (shown as the green shades); silhouettes of some of the fossil terrestrial vertebrates (in white for their oldest known occurrences, in black if also known from older sites); and the geologic Stage and Substage.

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3) During which interval (range of geologic dates as well as Stage and Substage) do the most first appearances show up, as **estimated by total number of new groups**? [2 pts]

4) During which interval (range of geologic dates as well as Stage and Substage) is there the fewest number of new appearances, in total number of new groups, as **estimated by fraction of new groups to old groups**? [2 pts]

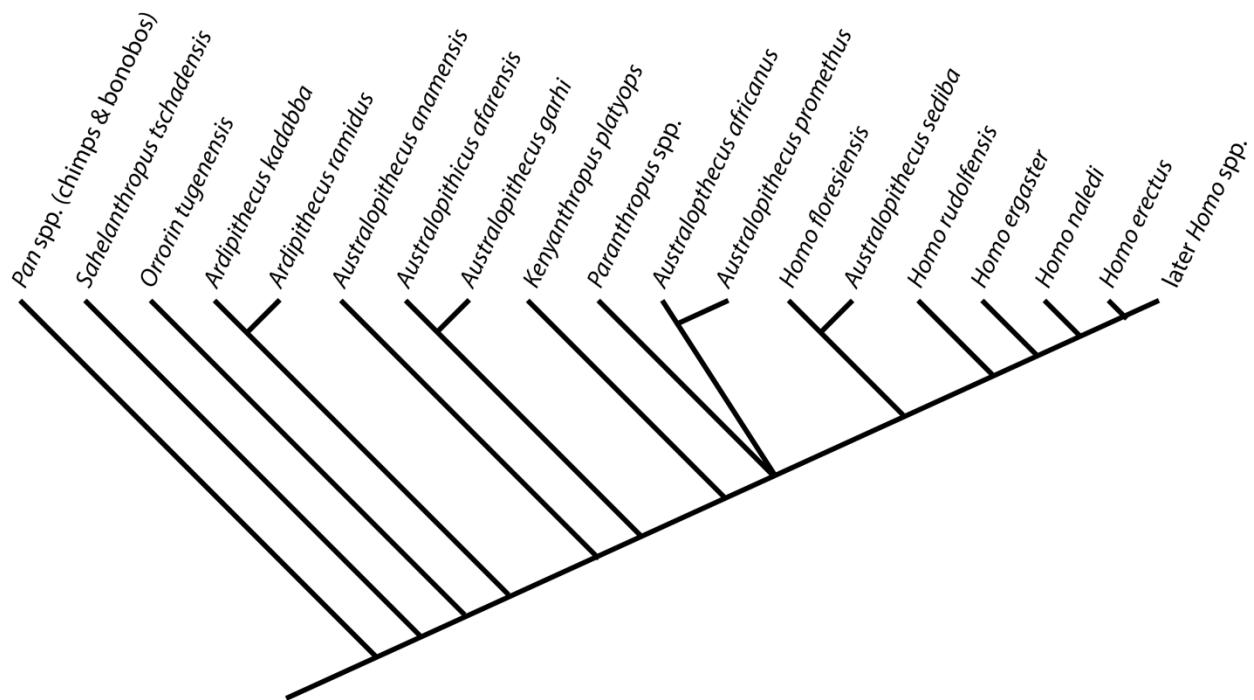
Part II: Interpreting Cladograms

Below is a cladogram of the Hominini (the chimp + human clade). *Pan* spp. and *Homo sapiens* (within “late *Homo* spp.”) are still extant; all other taxa listed are extinct. (“spp.” = “multiple species”). It follows traditional taxonomic assignment of the species as used by paleoanthropologists, and a topology modified from:

Dembo, M., D. Radovčić, H.M. Garvin, M.F. Laird, L. Schroeder, J.E. Scott, J. Brophy, R.R. Ackermann, C.M.

Musiba, D.J. de Tuijter, A. Ø. Mooers & M. Collard. 2016. The evolutionary relationships and age of *Homo naledi*: an assessment using dated Bayesian phylogenetic methods. *Journal of Human Evolution* **97**: 17-26. Doi: 10.1016/j.jhevol.2016.04.008

<https://www.sciencedirect.com/science/article/pii/S0047248416300100>



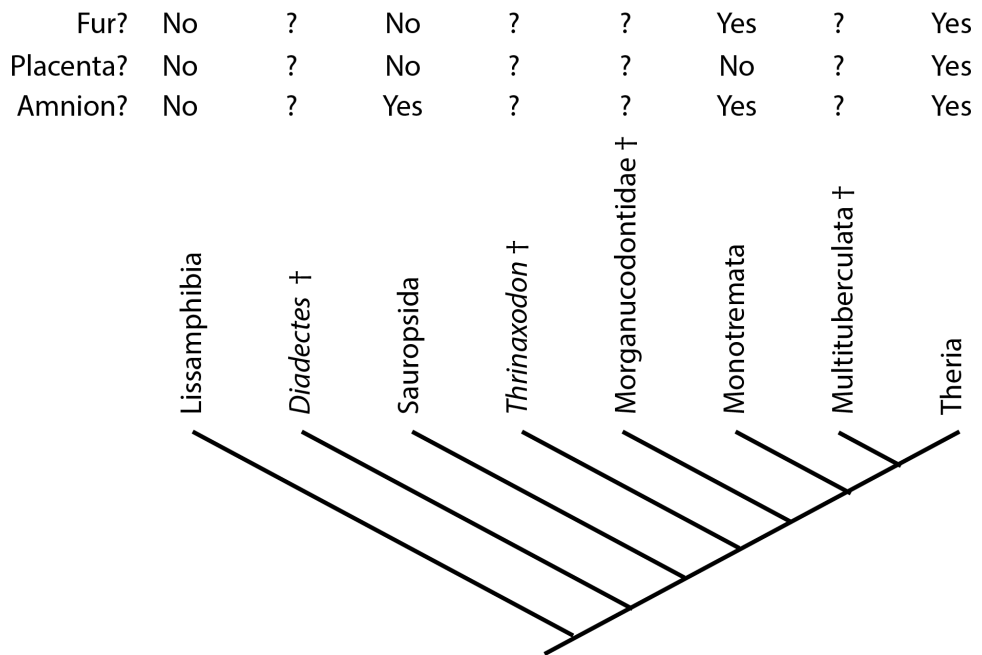
5) “Hominina” is the clade comprised of *Homo sapiens* and all taxa closer to us than to *Pan*. (In other words, it is the total-group of humans). Indicate the position of Hominina on the above cladogram. [1 pt]

6) As shown on this cladogram, which genera are **monophyletic** (i.e., comprised of an ancestor and all of its descendants)? List them. [2 pts]

7) *Homo* as shown on this cladogram is not monophyletic. What simple change (there are several possible) of genus assignment(s) could you make that would render *Homo* a monophyletic grouping? Describe that change. [2 pts]

8) *Australopithecus africanus* is the type species of the genus *Australopithecus* Dart 1925. What species (list all) that would be in the most inclusive **monophyletic** *Australopithecus* (that is, all species that form a clade of *Australopithecus africanus* and all taxa closer to it than to *Homo sapiens* Linnaeus 1758). [1 pts]

The cladogram to the right is a simplified look at the extant terrestrial vertebrates and a few extinct one (marked with a † after the name). The observed presence or absence of fur, a placenta, and amnion is shown. These features rarely preserve in the fossil record.



Consult the information about phylogenetic inference and the extant phylogenetic bracket. Recall the levels of phylogenetic inference:

- Level I: both extant bracketing taxa share the same state; extinct taxon is inferred to share the same character state as both.
- Level II: one extant bracketing taxa shows one state, the other shows a different one; extinct taxon is inferred to share character state with one or the other of the extant bracket.
- Level III: extinct form is inferred to have character state not found in either extant taxon.

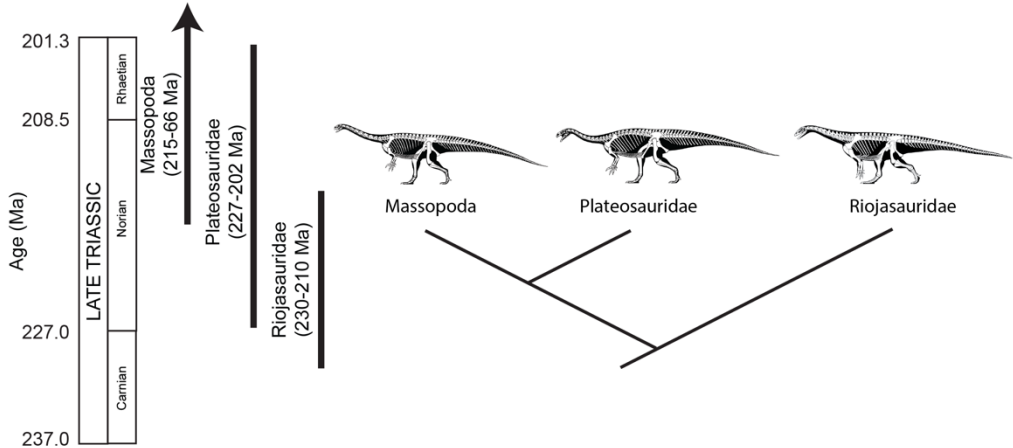
Indicate the level of inference for each of the following [1 pt each]:

- 9) *Diadectes* has fur present: _____
- 10) Multituberculata has a placenta: _____
- 11) *Diadectes* has an amnion: _____
- 12) Morganucodontidae has fur: _____

Extra Credit) Sometimes spectacular preservation can make fossils actual function exactly like an extant taxon, given that the fossil confidently shows the presence of absence of a trait. Let us say that a spectacular *Lagerstätte* reveals that *Thrinaxodon* has fur. What does that do for your answer to question 12? [+1 pt]

Part III: Minimum Divergence Time

To the right is the stratigraphic ranges (with numbers of the ranges listed, and Epoch and Stage listed) for three groups of long-necked plant-eating dinosaurs, and the cladogram of their relationships.



13) What would be the minimum divergence date (and in what Stage) for Massopoda and Plateosauridae? [1 pt]

14) What would be the minimum divergence date (and in what Stage) for Riojasauridae and the group of Plateosauridae + Massopoda? [1 pt]