

EEB 245 & EEB 245W
STUDY GUIDE for EXAM 1
 SPRING 2010

-Elucidation of patterns vs. elucidation of processes of evolution; general evidence types of patterns (direct vs. indirect)

Geological Time Scale and the Fossil Record

-distinction between the fossil record and the Geological Time Scale; age of earth (4.6 bya) vs beginning of Geological Time Scale (3.8 bya) (How differ? Why differ?); understand that named intervals are not regularly spaced in time; events are concentrated in most recent ~500 million years; what determines boundaries of intervals? Precambrian-dates of beginning and end; Phanerozoic Eon- date of beginning and their relationships with Eras, Periods and Epochs; **know the following intervals in their relative sequence: Eras, Periods, and Epochs (Epochs of Cenozoic only); for each Era, Period, and Cenozoic Epoch know dates of beginning and end, and major event (if discussed) marking temporal boundaries of each; 5 major mass extinction events and timing of each; examples of major taxa that went extinct as a result of each event; which is considered the greatest mass extinction and why?** What is a fossil?; distinguish biotic from abiotic types of evidence; 2 main types of fossils i.e., with organic and without organic material (inorganic) and their potential for extraction of DNA; types of inorganic fossil preservation: impression, casts/mold, petrification, carbonization, trace fossil (as evidence of past behaviors); types of organic fossil preservation: compression, amber, mummification); know how each occurs; example of each; ancient DNA- examples of ages and types of organisms from which ancient DNA has been extracted and sequenced; 3 major types of rock and type most likely to harbor fossils (and why); problems with fossil record: biased sample with respect to kinds of organisms (large, hard, numerous, more recent, etc.) most likely to be preserved and circumstances (wet periods, wet places, undisturbed areas, etc) under which fossils are most likely to be preserved; complete, continuous sequences rare, difficulties with correlations between strata, sites, etc.; Dating of Geological Time Scale and fossil record- relative dating methods (principle of superposition, index fossils & stratigraphy); absolute dating methods- major principle on which they rely; understand how parent/daughter isotope ratios are used in radiometric dating; types of rock that can be dated with radiometric methods; C14/N14 as a method of dating fossils themselves (of what age? Why?); K40/Ar40 as a method of dating rocks around fossils (of what age? Why?)

"Precambrian"

-3 Domains of life on earth (i.e. Bacteria, Archaea, Eukarya); major differences between prokaryotic and eukaryotic organisms; age of earth; formation of early atmosphere; date of earliest life (why not before that?); Why; is life considered to be monophyletic? (all organisms share nucleic acids as hereditary material, etc.); first fossil evidence of life- when? What types of fossils and organisms? Stromatolites- what are they? When did they first appear? First evidence of photosynthesis-when? What type of evidence? How does photosynthesis relate to O₂ increases in atmosphere? When were modern O₂ levels established? Why not before that? Date of first eukaryotes; characteristics of first eukaryotes; 1st unquestionable fossils of eukaryotes-what and when (i.e., acritarchs, what type of organisms were they?); Theory of endosymbiosis: What is it? What does it explain? Evidence in support of the theory (organelles have their own DNA, etc.); how does origin of mitochondria (i.e. from purple bacteria; once) differ from origin(s) of chloroplasts (i.e., originally from cyanobacteria; primary vs. secondary plastic endosymbiosis). What and when was Rodinia? Evolution of metazoa- When? Features of metazoans (=animals) (e.g., multicellular, heterotrophic, embryos, etc.) Ediacaran fauna: when? types of fossils (trace fossils- tracks, burrows, etc.)- no hard parts; types of phyla? (cnidaria, porifera, etc.) Tommotian fauna- when? First evidence of animals with hard parts; types of organisms (e.g., archaeocyathids, small shelly fauna); phyla they potentially represented?

Paleozoic Era

-**Cambrian Period:** Cambrian explosion: what was it? when was it? In what sort of environment did it occur? (shallow coastal seas, etc.); plant diversity (marine red, green, brown algae only). Burgess shale fauna: describe example of 1 extant and 1 extinct phylum; evolutionary significance of *Pikaia*; explanations for this remarkable increase in diversity; Conodonts- What were they? Why are they important? Explanation for increased diversity (i.e., evolution of predation). **Ordovician Period:** when was it? Kinds of invertebrates present (echinoderms, trilobites, eurypterids, etc.); types of vertebrates present (agnathans, ostracoderms, placoderms, elasmobranchs, bonyfish); examples of life on land- fungi, non-vascular plants (e.g., bryophytes). **Silurian Period-** when was it? kinds of organisms present in oceans, e.g. ostracoderms, placoderms, *Latimeria* (distinctive features and importance of this taxon?); animal life on land (millipedes, spiders; NO vertebrates); plant life- soil! bryophytes, and first vascular plants (*Cooksonia*). **Devonian Period:** when was it? Kinds of animals present: fishes diversified; *Ichthyostega*- what is it? why is it important? Challenges faced by first vertebrates in emerging on to land (e.g. hearing; legs and wrap-around ribs to support body and organs respectively), environmental conditions

that may have driven that change; plants- bryophytes, in vascular plants evolution of secondary xylem (i.e. wood), evolution of specialized body parts (roots, stem, leaves), spores. **Carboniferous Period:** when was it? Land dominated by rich forests consisting of what types of plants? (club mosses, lycopsids, tree ferns and gymnosperms); period is source of much of today's richest coal and oil deposits; also on land which insect groups? (dragonflies, spiders, etc.); critical event: evolution of first amniotes; amniotic egg- 4 main components and their functions; what advantage did amniotes have over other vertebrates? **Permian Period:** when was it? which plant groups found on land? Which insects (most of modern insect orders)? Amphibians diversify (e.g. *Diplocaulus*); 3 major types of amniote skulls (anapsid, synapsid, diapsid); how do they differ from one another? Know major lineages of vertebrates (extinct and extant) that exhibited each; therapsids present- what were they? *Dimetrodon*, *Lystronotus* what were they? (why are they not considered to be dinosaurs?) Era marked by greatest extinction in history of earth; distinguish taxonomic diversity from taxonomic disparity

Mesozoic Era (= Age of what type of organisms?)

-**Triassic Period:** what happened with marine invertebrates? Insect orders diversified; synapsids persisted, but didn't diversify; 2 major diapsid lineages i.e., lepidosaurs (plesiosaurs & lepidosaurs or modern "reptiles") and archosaurs (crocodiles, pterosaurs, dinosaurs and their bird descendents); third minor lineage consisting of turtles; synapomorphies (i.e., unique features) of dinosaurs- e.g. open acetabulum in hip, bipedal, warm-blooded(?), etc.; 2 lineages of dinosaurs (Ornithischia vs. Saurischia) and diagnostic characteristics of each (lizard-hipped vs. bird-hipped, carnivores vs. herbivores, etc.); know one example ornithischian and one saurischian from the Triassic Period; first pterosaurs (no head crest, long tail). **Jurassic Period:** plants: gymnosperms dominate land; most modern insect groups; frogs and synapsids present; therapsids persist, but are small and likely nocturnal; dinosaurs diversify; know at least one example of a saurischian and an ornithischian dinosaur that characterizes this period; Connecticut state fossil? (i.e. *Eubrontes*- what was it?); pterosaurs diversity; *Archaeopteryx*- What is it? Why is it important? Features it shares with dinosaurs? Features it shares with birds? To which dinosaur lineage is it thought to be related? **Cretaceous Period:** critical event: evolution and diversification of first flowering plants (on land); possible explanation for this diversification; examples of saurischian and ornithischian dinosaurs that characterize this Period; diversification of birds; how did Cretaceous pterosaurs differ from earlier pterosaurs? last fossils of *Latimeria* at this time.

Cenozoic Era (= Age of what types of organisms?) (**reminder: know sequence and approx. dates of Epochs**)

-all 3 major mammal groups present (i.e., monotremes, marsupials, placentals); general features shared by all 3 groups (e.g., hair, mammary glands, heterodonty, etc.). Diversification of the angiosperms throughout the Era. "Great American Interchange"-what was it? When was it? What were some of the results? **Tertiary Period:** climate begins to cool; know examples of key organism that appeared in each Epoch (e.g. evolution of marine mammals, horses, ungulates, carnivores). **Quaternary Period:** was punctuated by 4 major glacial events, punctuated by interglacial periods; our current status with respect to glacial and interglacial events.

Primate Evolution

Hominoid features; **early hominoid primates:** i.e., *Proconsul*, *Gigantopithecus*; age and distinctive characteristics of each; **early hominid primates:** early fossil candidates (i.e., *Australopithecus afarensis*, *Australopithecus africanus*); age, location and distinguishing characteristics of each species; robust australopithecine forms (e.g., *Paranthropus robustus*); age, location and distinguishing characteristics; what became of the robust lineage? **early Homo:** *Homo habilis*, *Homo erectus*, *Homo neanderthalensis*, *Homo sapiens*, and *Homo floresiensis*- for each species know approximate age, approximate geographic distribution, and distinctive morphological (including cranial capacity) and societal characteristics. (Note: **Hominioidea** = orangutans, gorillas and chimps as well as humans; **Hominidae**= include a number of fossil lineages, but only *Homo sapiens* remains today)