GEO 422K - Course Goals and Objectives

GEO 422K Course Goals - The course is set up as a one semester survey of the entire subject of paleobiology, the use of once-living fossils now preserved in rocks to interpret the history of the earth's surface and its biota. The lecture part of the course (3 hrs./week & 55% of the grade) covers the more general and theoretical parts of the course material. Lectures use a topical approach to describe what fossils are, how they are used to date geologic features, interpret past environments, and study changes observed in the history of life. We will do this by discussing theories, looking at examples, and debating controversial topics. The laboratory part of the course (4 hrs./week & 45% of the grade) should give you more practical and "hands-on" experience working with actual fossils. It includes a phylum-by-phylum survey of important fossil groups of invertebrates, vertebrates, plants, and microfossils that emphasizes the identification, morphology, way-of-life, and geologic record of these groups. The two field trips allow you to collect fossils in the field, then prepare, identify, and interpret the collected specimens back in the lab, and write reports summarizing the information you have learned. The course has enough written work with field trip reports and an abstract project to qualify as one of the Writing Component Courses (W) you will need to graduate. Paleobiology will help prepare you for a career in soft-rock geology where you may need to use or evaluate paleontological data.

GEO 422K Course Objectives (Lecture) -

<u>1st lecture</u> - You should learn what fossils are, how and where they are preserved, major biases that affect the fossil record, how fossil and living organisms compare, how many fossil taxa are known from different groups, and how good the stratigraphic ranges of fossil species are for correlation.

<u>Next 3 lectures (Biostratigraphy)</u> - You should learn why fossils are useful for telling time, how biozones differ from teilzones and range zones, what index and facies fossils are and how they differ, how accurate correlation is using biostratigraphic zones, how time and time-rock units differ from rock units; how regional zones and their boundaries are set up and named, how correlation indices (such as Simpson's Index) are used, what Shaw range diagrams show about deposition in local sections; what major problems hinder correlation between widely-separated areas, what biomeres are and how they originated in Cambrian trilobites, and what the ranges of major groups are in the fossil record.

<u>Next 3 lectures (Organisms and Environments)</u> - You should learn the basic needs of organisms, what a niche is, where organisms live and how they acquire nutrients and energy, how "way-of-life" descriptors are used; what environments are available for organisms, where do different marine organisms live in a ramp or platform setting; what are the objectives and methods of paleoecologic analysis and how is this type of analysis done, and how homology, analogy, and the paradigm method are used.

<u>Next 4 lectures (Communities, Trace Fossils, Reefs, and Biogeography)</u> - You should learn what communities are, how to recognize them in the fossil record, how r-selection generalists differ from K-selection specialists, how ecologic succession works, what processes happen in ecologic vs. geologic time, where different fossil communities are found on a marine shelf using different models (Ziegler vs. Broadhead); what trace fossils are, what they indicate about the organisms that made them, how the different types are correlated with different water depths; how do banks, reefs, and mud mounds form, what framework organisms have built them, and how do you tell core from flank facies; what factors controlled the geographic distribution of fossil organisms; how diversity gradients have been used to

interpret past climates, how the island equilibrium model works and how it has been applied to the fossil record, and what happened to organisms living on a terrane or continent that had a glancing or head-on collision with another continent during plate movement.

Next 2 lectures (Classification and Speciation) - You should learn how organisms are classified in a Linnaean hierarchy, how biological species are defined, how the correct name of a fossil organism is determined; how phyletic gradualism differs from punctuated equilibrium, and which of these speciation models is most common in the fossil record.

Next 2 lectures (Evolution and Extinction) - You should learn how higher taxa are chosen, how classification philosophies (phenetic, cladistic, and evolutionary) differ from each other, how monophyletic, paraphyletic, and polyphyletic groups differ, how higher taxa originate during an adaptive radiation, what large-scale evolutionary patterns are commonly found in fossil groups, what living fossils are; when mass extinctions occur in the fossil record, how they differ from normal background extinction, and what causes have been proposed for different mass extinctions.

Next 2 lectures (Size, Shape, and Growth) - You should learn how skeletons grow during ontogeny, why surface-to-volume problems appear during growth and how organisms have solved these problems, how the allometric equation $Y = CX^k$ works and what the various values of k imply, how ontogenetic changes (recapitulation and paedomorphosis) occur during phylogeny and why these may be important; how Raup modeled the growth of a geometrically coiled shell using 4 factors (W, T, D, and S), what range of shell shapes can be produced by varying these factors, and how closely real organisms agree with or deviate from this simple model.

Next 2 lectures (Precambrian Life and Models in Paleobiology) - You should learn how early organisms appeared and diversified in the Middle and Late Precambrian as the environment changed, how eucaryotes may have originated from procaryotes by endosymbiosis, when metazoans first appeared in the Ediacaran and then underwent a huge radiation (the ‘Cambrian Explosion’) at the beginning of the Phanerozoic; what features a scientific model should have, the range of models used in paleobiology, and how Raup, Gould, Schopf, and Simberloff modeled diversity of lineages in the fossil record as a stochastic process

Five lectures near end (Paleontologists and Their Work and Extraordinary Fossils) - You should learn how early echinoderms diversified during their two initial Paleozoic radiations (Sprinkle's work); how Sepkoski modeled the diversification of marine metazoans and the sequential replacement of 3 different evolutionary faunas, and how Sepkoski and Sheehen modeled colonization of marine shelf environments as repeated onshore to offshore migrations; what extraordinary fossils are, where they occur in the fossil record, and what special conditions produced these rare occurrences; why Bakker thinks dinosaurs were warm-blooded and the evidence for and against this controversial idea; and Martin's overkill model for how human migrations caused the extinction of large mammals and birds in the latest Pleistocene.