Department: GEOL

Course No.: 105

Credits: 4

Title: Earth and Life Through Time

Contact: Robert Thorson

Content Area: CA3 Science and Technology- Lab

Catalog Copy: GEOL 105. Earth & Life Through Time (Lecture + Lab). Both semesters. Four credits. Three class periods and one three-hour lab. Not open to students enrolled in or having passed GEOL 103. History of planet Earth, emphasizing how rock, air, water, and life interact at different scales to produce the earth's crust, landforms, life systems, natural resources, catastrophes, and climatic regimes. Provides a scientific context for human-induced global change. Includes laboratory component (see GEOL 107).

Course Information:
A. Course description that includes course goals and objectives. Presents a survey of geology at the introductory level within the emerging perspective of Earth System Science, which recognizes the importance of "life" as both an important geological material (i.e. wood, reef, gas, plankton, fiber) and as an important bio-geochemical process (largely microbial). The basic message is that even though the course emphasizes the traditional "rock" based geology, the importance of life processes in the rock cycle is kept in mind; ie. "No rocks, no ecosystem...No ecosystem, no rocks."

b. Specify exam formats, nature and scope of weekly reading assignments, nature and scope of writing assignments, problem sets, etc. The lecture component of the course will count for 70% of the course grade. It will be evaluated principally with in-class exams composed of: (1) multiple choice questions; a mixture from nationally normalized test banks and those written during the semester for the class, (2) at least one essay question per exam (probably two) graded subjectively by TA's under the supervision of professors, and (3) 10-20% for a class project under specific formats. The remaining 30% of the course grade will be based on a co-equal mixture of lab quizzes and lab reports.

c. Major Themes, issues, topics, etc. to be covered. History of planet Earth, emphasizing how rock, air, water, and life interact at different scales to produce the earth's crust, landforms, life systems, natural resources, catastrophes, and climatic regimes. Provides a scientific context for human-induced global change. Includes laboratory component.

Meets Goals of Gen Ed: GEOL105 will address all seven of the goals for general education, with a special emphasis on Goals #2, #5, and #7.

#1 - Becoming more articulate. This will take place during labs and field trips, in which all students will be required to participate in group discussions and to prepare written assignments.

#2 - Intellectual breadth and versatility. As Will Durant once quipped Civilization exists by geological consent. Geology is a pervasive influence in our daily lives because: (a) earth history produced the physical geography that constrained the development of regional culture, (b) geological processes regulate our climate and control our susceptibility to natural hazards, and (c) the energy and materials for our lifestyle are of geological origin.

Historically, the gradual emergence of the a scientific, rather than a theistic, world view in western thought came about largely through geological discoveries involving: (a) the age of the earth, (b) the re-interpretation of material (sedimentary rock) originally thought to have been deposited by Noah's flood, (3) the proof that life had undergone catastrophic extinctions, and (4) humans are a product of organic evolution.

#3 Critical Judgment. There is no original "sacred" text for geology in general, and the history of life in particular. Instead, the "text" of deep time is the sum total of the minerals, rocks, fossils, and fuels whose origins have been interpreted by observation, induction, hypothesis testing, and judgment. Having spent a semester handling and thinking about such material cannot help but enhance a student's judgment about really important things.

#4 - Moral sensitivity. Geology -- with its emphasis on linkages and limits -- provides a very broad context in which to assess how human morality influences landscapes and other life systems. There are many examples from earth history in which an evolutionary novelty (a.k.a. "invention") caused permanent, irreversible, global changes. In a similar vein, two evolutionary novelties in the human lineage -- hyper-intelligence and consciousness -- have given us the ability to dominate other ecosystems, and to contemplate the effects of our actions, as well. No other creature has been thus empowered.

#5 Era and Society. We live in a materialist epoch. A rare, but very true bumper sticker for geologists is the one that reads "this car and the road, courtesy of the mining industry. The same can be said for our buildings, and most of our prized objects. Large-scale use of fossil fuels began in the middle of the 19 th century and will likely be over by the middle of the next. It was this energy that allowed the extraordinary-- never before in geologic history -- growth in human population and consumption. A consequence of this energy use is greenhouse-enhanced climate warming, which we will be adapting to long after that energy supply runs out. The environmental tasks for the next century will be dominated by adjustments to reduced use of traditional material and energy resources.

6 Cultural Diversity. The unity of all global processes soil erosion, earthquakes, volcanoes, ocean basins is the common backdrop for the diversity of historical outcomes reflected by the position and character of continents and oceans. Unique cultural developments evolved in very specific regions in response to geographic isolation and ambient environmental conditions, all of which are contingent outcomes of geology. Beneath regional culture is physical geology, which, in turn, is the child of geology.

#7 Lifelong education. Unlike the object of bird-watching, geology cannot fly away. Ditto for most wildlife, which will run and hide, unless caged. Once the origins of landscape and material culture

become known, most students begin to see the world in a completely different way, something that stays with them their entire lives. The only subject as synthetic as earth history is art history. Both integrate their side of C.P. Snow's two cultures.

CA3 Criteria:

#1 Body of Knowledge. Geology emerged as a unified science in the early 19th century, when the layer-cake, study of "natural history" (a.k.a. evolutionary biology) merged with "hard-rock" mineralogy (a.k.a.physical chemistry) to contribute to problems involving the origin of the earth and its terrain (ocean basins, mountains, continents, shorelines), which are essentially geophysical in nature.

#2 Nature of Scientific Inquiry. Geology contributes uniquely to this objective, because earth history is an experiment that cannot be run again, and because most of the earth is inaccessible. Hence, induction and hypothesis generation are well developed tools. For example, understanding the core-mantle boundary requires -- on the part of a student -- that they believe something not on the basis of their senses or on hearsay, but on the power of a good scientific argument. Three examples of how geology has influenced scientific inquire are presented: (1) Historically, evolutionary theory derived largely from what is now a geological sub-discipline, paleontology. Darwin, who worked at a time when biology and geology were unified, credited Charles Lyell's *Principles of Geology* as the bedrock for much of his thinking. (2) The combination of field geology and lab-geophysics (especially seismology, heat flow, magnetism, and gravity) gave us the ability to see our planet as a single enormous machine that endlessly cycles matter into, and out of the crust, vis a vis plate tectonics. (3) This set the stage for understanding global climate change which had been realized from the study of sedimentary layering (stratigraphy), but not understood.

#3 Unresolved Questions. The best way to describe unresolved questions is to ask them. Exactly how will our planet adjust to the climate warming? When will we run out of fossil fuels? What will happen if a large meteorite strikes the earth? Will earthquake prediction ever succeed? If geology can explain "heaven and earth," by which we mean the origin of the atmosphere, oceans, the earth's crust, and the origin(s) of life as physical chemistry, then what role is left for a creator?

#4 Continued learning. A basic course in geology provides a student with knowledge that can be used and added to throughout their life. We are all part of the planet earth, and our lives will be profoundly affected by our interaction with the planet. An introductory course in geology can provide the first step in what will undoubtedly be a life-long learning experience. Without such a course, the learning experience is likely to be more painful and full of surprises.

CA3 Lab Criteria: -Lab sections will meet in classrooms dedicated to the course, and capable of holding up to 24 students each. We will schedule labs in the evenings as well as during the day in an attempt to accommodate the maximum number of students needing sections, and to meet their schedules. Most of these sections (we anticipate between 10 and 12) will be taught by Teaching Assistants, working under the close supervision of a geology faculty member designated as lab coordinator. One or more (depending on demand) sections will be designated as honors sections, and taught exclusively by faculty. These are exclusively hands on activities. During separate lab sessions, students will handle and

identify minerals, rocks, fossils, hydrologic apparatus, aerial photographs, GIS software, and maps. Two of the lab periods are devoted to pedestrian field trips to drumlins, outcrops, landfills, marshes, stone walls, streams, and museums, all of which are available on campus. Please refer to the attached lab syllabus for details. (NB- one hasn't been supplied. A.H.)

Role of Grad Students: -Most of these sections (we anticipate between 10 and 12) will be taught by Teaching Assistants, working under the close supervision of a geology faculty member designated as lab coordinator. One or more (depending on demand) sections will be designated as honors sections, and taught exclusively by faculty. Graduate students will also be used to grade the essay components of tests and projects under the supervision of the same faculty who serve as lab coordinator.

Supplementary Information : This proposal was developed: in response to GEOC's request for re-designed courses; with Dean MacKinnon's concern that we re-vitalize our 100-level instruction; and with our department's need to maximize staffing flexibility at the 100 level (we are down to 8 faculty positions, only 3 of whom have regularly taught at the 100 level).

The essence of our three proposals for GEOL 103, 105, and 107 is to combine/replace two existing courses (GEOL 102-Introductory Geology and GEOL 101-Environmental Geology) that have been taught for the past 30 years, and which formerly satisfied the Group VIII boldface and Group VIII non-boldface) requirements under the old GenEd system, respectively. Based on discussions with GEOC committee members, we anticipate that GEOL 103 (lecture only) and 105 (lecture + lab) will satisfy the new GEOC Group 3 requirements, for two science courses, one without a lab (GEOL 103) and one with a lab (GEOL 105), only one of which can be taken in a single department. The four credit GEOL 105 will also serve as the foundation course for 200-level geoscience courses; its higher standard for content will be upheld in the lab component, listed separately as GEOL 107.