Course Description
Spring. 4 credits.
Lectures: MWF 10:10 2146 Snee
Lab: W 2:30-4:00 2146 Snee

This course examines the history and evolution of the Earth from biological, chemical, and physical perspectives on three time scales: (1) the first 4 billion years with particular emphasis on the origin of the Earth, its layers and life; (2) the past 600 million years, particularly the motion of tectonic plates, changing climate, and evolving life; and (3) the last 20 million years, particularly the drastic climate changes that have occurred and the emergence of man. Three instructors, Professors William White, Bryan Isacks, and Warren Allmon will cover, respectively, the geochemical, geophysical/tectonic and paleontological approaches to earth history.

Prerequisites: Math 112 or 192 and Chem 207 or equivalent.

Web Site:
http://www.geo.cornell.edu/eas/education/course/descr/EAS302/EAS302home.html

Check the web site for labs, assignments, announcements, lecture outlines and handouts, etc.

Instructors
William White 4112 Snee, 5-7466 (white@geology.cornell.edu)
Bryan Isacks 3120 Snee, 5-2307 (bl1@cornell.edu)
Warren Allmon Paleontological Research Institute and 2104 Snee, 273-6623 (wda1@cornell.edu)

Teaching Assistant: Jacob Moore, 4144 Snee, 5-9576, jcm86@cornell.edu

Grading based on weekly lab assignments (30%), prelim (30%), and final (40%).

Text and Readings
Required Text: Steven M. Stanley, Earth System History, 2nd edition Freeman, 2005
Recommended Supplements:
Kump, Kasting, and Crane: The Earth System, Prentice Hall, 1999

Additional Readings
Brown, Hawkesworth, and Wilson, Understanding the Earth, a New Synthesis, Cambridge, 1992
Brown and Mussett The Inaccessible Earth
MacDougall, J. D., A Short History of Planet Earth, Wiley, New York
Syllabus

Darwin, C., 1845. The Voyage of the Beagle (particularly Chapter 17 on the Galapagos).
Darwin, C., 1859. The Origin of Species

Additional reading assignments will be made from materials placed on reserve in Carpenter (Engineering) Library. Three books we will use in particular will be:
- Brown and Mussett *The Inaccessible Earth*, and
- Gould, *Wonderful Life*.

An additional resource is White, *Geochemistry*, a draft textbook available online. Copies of some materials will be placed in the reading room of Snee Hall.

Outline and Schedule

I. Physical and Chemical Evolution of the Earth

L1. Overview and Introduction (WW/HA) Jan 24

Required Reading:
*Stanley, Earth System History* Chap. 1
Recommended: Kump, Kasting, and Crane, *The Earth System* Chap. 1 and 2

A. The Origin and Early History of Earth

Required Reading: *Stanley, Chapter 11, pp 245-260*

L2. Our Unique Planet; Cosmic Origins (WW) Jan 26
Lab 1 *Putting the Earth in Context: Our Cosmic Neighborhood* (WW) Jan 26
  Recommended: Kump et al, Chap 8 and 9; White, Chap 10
L4. Formation of the Earth & Her Sisters (WW) Jan 31
L5. The Earth in cross-section: what’s down there and how we know (BI) Feb 2

Lab 2 *Radioactive Decay and Geologic Time* (WW) Feb 2
  Required Reading for Lab 2: Stanley, Chapter 6, pp 139-144
L6. Early History of the Earth and Moon (WW) Feb 4
L7. Geochemical Interlude: Isotope Geochemistry (WW) Feb 7
L8. Isotope & Trace Element Geochemistry; Formation of the Core (WW) Feb 9
Lab 3. *Introduction to Mineralogy* (WW) Feb 9
  Required Reading for Lab 3: Stanley, Chapter 2
L10. Formation and Evolution of the Atmosphere (WW) Feb 14
Syllabus

B. Continental Drift, Seafloor Spreading and Plate Tectonics

Required reading: Stanley, Chapters 8 and 9
Recommended: Kump et al. Chapt. 6; USGS online publication, The Dynamic Earth: The Story of Plate Tectonics

L11. Plate Tectonics Revolution: how it came about (BI) Feb 16
Lab 4 Virtual Geomagnetic Poles (BI) Feb 16
L12. Geomagnetism and paleomagnetism (BI) Feb 18
L13. Magnetic reversals and seafloor spreading (BI) Feb 21
L14. The seafloor as a tape recorder of the past 200 million yrs (BI) Feb 23
Lab 5 Closing the Atlantic: rotations on a sphere (BI) Feb 23
L15. Tectonic systems of the past 200 Ma (BI) Feb 25
L16. Continental tectonics (BI) Feb 28

C. Magmatic Processes and Chemical Evolution of the Earth

Recommended Reading: Brown et al., Chap. 5, Magma generation in the Earth, Brown and Musset, Chapt. 7, The mantle and oceanic crust, Chapt. 8, The dynamic mantle, Chapt. 9, Evolution of the mantle
L17. The Mantle and Oceanic Crust (WW) Mar 2
Lab 6 Introduction to Petrology (WW) Mar 2
L18. Subduction and Subduction-related Volcanism (WW) Mar 4
L19. Prelim Review Mar 7
L20. Mantle Plumes and Oceanic Islands (WW) Mar 9
Lab 7 PRELIM EXAM Mar 9

II. Co-evolution of Life and the Earth System

A. The Origin and Early History of Life

Required reading: Stanley, Chapter 11 pp 262-270; Chapter 12
L22. no class! Mar 14
L23. Archean Life (WA) Mar 16
Lab 8 Proterozoic Life (WA) Mar 16

B. Biostratigraphy and Evolution

Required Reading: Stanley, chapters 6 and 7

L24. Introduction to Biostratigraphy (WA) Mar 18

SPRING BREAK March 19-27

L25. Biostratigraphy (WA) Mar 28
Lab 9 Fossils (WA) Mar 30
L26. Introduction to Evolution Mar 30

C. Phanerozoic Life
   Required Reading: Stanley, chapters 13-18
L27. The Paleozoic I - Life in the Sea (WA) Apr 1
L28. The Paleozoic II - Life on Land (WA) Apr 4
Lab 10 Evolution (WA) Apr 6
L29. The Mesozoic and Cenozoic (WA) Apr 6
L30. Mass Extinctions (WA) Apr 8
L31. The Mesozoic and Cenozoic(WA) Apr 11

D. The Earth’s Climate System and Geochemical Cycles
   Required reading: Stanley, Chapter 10
   Recommended Reading: Kump et al. Chap 3, 4, 8
L32. Introduction to the Earth’s Climate System and History (WW) Apr 13
Lab 11 Visit to the Paleontological Research Institute (WA) Apr 13
L33 Geochemical Cycling and Ocean Chemistry (WW) Apr 15

D. Paleoclimates and the Cooling Earth
   Required reading: Stanley, Chapter 19
L34. The Isotope Record of Climate Change (WW) Apr 18
L35. Climate and the Global Carbon Cycle (WW) Apr 20
Lab 12. Introduction to Geochemical Modeling (WW) Apr 20
L36. The Neogene I: From the Greenhouse to the Icehouse (WA) Apr 22
L37. The Neogene II: Life and Climate in the Sea (WA) Apr 25
Lab 13. Modeling the Carbon Cycle (WW) Apr 27
L38. The Neogene III: Life and Climate in the Sea, continued (WA) Apr 27

C. Climate and the Evolution of the Man and the Modern Biosphere
   Required Reading: Stanley, Chapter 20
L39. The Neogene IV: Life and Climate on Land (WA) Apr 29
L40. Pleistocene climate and terrestrial topography(BI) May 2
L41. The Neogene V: Human Evolution (WA) May 4
Lab 14. Field Trip: Glacial Geology of the Ithaca area (WA) May 4
L42 Synthesis and Review (WW, WA, BI) May 6

Final Exam: Friday, May 13, 3:00–5:30 PM