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 (bli1@cornell.edu)
Warren Allmon Paleontological Research Institute and 2104 Snee, 273-6623 (wda1@cornell.edu)

Teaching Assistant: Julie Pett-Ridge, 4144 Snee, 5-9576, jcp38@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 ed. Freeman, 2005
Recommended Supplements:
Kump, Kasting, and Crane: The Earth System, Prentice Hall, 2004
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
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/WA) *Jan 23*

**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 285-305*

L2. Our Unique Planet; Cosmic Origins (WW) *Jan 25*

**Lab 1 Putting the Earth in Context: Our Cosmic Neighborhood** (WW) *Jan 25*
Recommended: Kump et al, Chap 8 and 9; White, Chap 10

L3. Meteorites & Formation of the Solar System (WW) *Jan 27*

L4. Formation of the Earth & Her Sisters (WW) *Jan 30*

L5. The Earth in cross-section: what’s down there and how we know (BI) *Feb 1*

**Lab 2 Radioactive Decay and Geologic Time (WW) Feb 1**
Required Reading for Lab 2: Stanley, Chapter 6, pp 164-169

L6. Early History of the Earth and Moon (WW) *Feb 3*

L7. Earth Composition; Trace Element Geochemistry (WW) *Feb 6*

L8. Isotope Geochemistry; Formation of the Core (WW) *Feb 8*

**Lab 3. Introduction to Mineralogy (WW) Feb 8**
Required Reading for Lab 3: Stanley, Chapter 2

L9. Origin and Evolution of the Continents *Feb 10*

L10. Formation and Evolution of the Atmosphere (WW) *Feb 13*
B. Continental Drift, Seafloor Spreading and Plate Tectonics

Required reading: Stanley, Chapters 8 and 9; see also the CD-ROM in Stanley text, Earth System History 1.0 with animations of continental drift and seafloor spreading.

Recommended: Kump et al. Chapt. 6; USGS online publication, The Dynamic Earth: The Story of Plate Tectonics

Lab 4 Virtual Geomagnetic Poles (BI) Feb 15
L11. Plate Tectonics Revolution: how it came about (BI) Feb 15
L12. Geomagnetism and paleomagnetism (BI) Feb 17
L13. Magnetic reversals and seafloor spreading (BI) Feb 20
L14. The seafloor as a tape recorder of the past 200 million yrs (BI) Feb 22
Lab 5 Closing the Atlantic: rotations on a sphere (BI) Feb 22
L15. Tectonic systems of the past 200 Ma (BI) Feb 24
L16. Continental tectonics (BI) Feb 27

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

Lab 6 Introduction to Petrology (WW) Mar 1
L17. The Mantle and Oceanic Crust (WW) Mar 1
L18. Subduction and Subduction-related Volcanism (WW) Mar 3
L19. Prelim Review Mar 6
L20. Mantle Plumes and Oceanic Islands (WW) Mar 8
Lab 7 PRELIM EXAM Mar 8

II. Co-evolution of Life and the Earth System

A. The Origin and Early History of Life

Required reading: Stanley, Chapter 11 pp 306-311; Chapter 12
L22. no class! Mar 13
L23. Archean Life (WA) Mar 15
Lab 8 Proterozoic Life (WA) Mar 15

B. Biostratigraphy and Evolution

Required Reading: Stanley, chapters 5, 6 and 7

L24. Introduction to Biostratigraphy (WA) Mar 17

SPRING BREAK March 18-26

L25. Biostratigraphy (WA) Mar 27
Lab 9 Fossils (WA) Mar 29  
L26. Introduction to Evolution Mar 29

C. Phanerzoic Life

Required Reading: Stanley, chapters 11, 13-17
L27. The Paleozoic I - Life in the Sea (WA) Mar 31
L28. The Paleozoic II - Life on Land (WA) Apr 3
Lab 10 Evolution (WA) Apr 5
L29. The Mesozoic and Cenozoic (WA) Apr 5
L30. Mass Extinctions (WA) Apr 7
L31. The Mesozoic and Cenozoic(WA) Apr 10

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 12
Lab 11 Visit to the Paleontological Research Institute (WA) Apr 12
L33 Geochemical Cycling and Ocean Chemistry (WW) Apr 14

D. Palaeoclimates and the Cooling Earth

Required reading: Stanley, Chapters 18 & 19
L34. The Isotope Record of Climate Change (WW) Apr 17
L35. Climate and the Global Carbon Cycle (WW) Apr 19
Lab 12. Modeling the Carbon Cycle (WW) Apr 19
L36. The Neogene I: From the Greenhouse to the Icehouse (WA) Apr 21
L37. The Neogene II: Life and Climate in the Sea (WA) Apr 24
Lab 13. TBA (WA) Apr 26
L38. The Neogene III: Life and Climate in the Sea, continued (WA) Apr 26

C. Climate and the Evolution of the Man and the Modern Biosphere

Required Reading: Stanley, Chapters 19 and 20
L39. The Neogene IV: Life and Climate on Land (WA) Apr 28
L40. Pleistocene climate and terrestrial topography(BI) May 1
L41. The Neogene V: Human Evolution (WA) May 3
Lab 14. Field Trip: Glacial Geology of the Ithaca area (WA) May 3
L42 Synthesis and Review (WW, WA, BI) May 5

Final Exam: Wed., May 17, 9:00–11:30 AM