Syllabus EES 716 Earth System Science

Revised 29 September 2010

YOUR PROFESSORS: Dr. Harold C. Connolly Jr. (chondrule@haroldconnolly.com; www.haroldconnolly.com, where all of his lectures and readings can be downloaded) and Dr. Athanasios (Tom) Koutavas (tom.koutavas@mail.csi.cuny.edu).

LECTURE: Wednesday 5.00 – 7.30 PM.

COURSE GOALS: 1) Understand the philosophy of scientific investigation. 2) Develop a working knowledge and integrated understanding of Earth Systems Science as applied to Earth and other Solar System bodies. 3) Understand the fundamental principles governing interactions among the atmosphere, hydrosphere, cryosphere and biosphere, and their role in shaping and modifying the environment.
4) Understand fundamental concepts of climate and global change in the past, present and future; develop a geologic perspective for human-caused climate change. 5) Appreciate basic concepts of Earth science.

SUGGESTED TEXTBOOKS: Introduction to Planetary Science, The Geological Perspective by Faure and Mensing; Physical Geology by Plummer and Carlson; 21st Century Astronomy by Hester et al.
Global Warming: Understanding the Forecast, David Archer, Blackwell Publishing. Cosmochemistry, Harry Y. McSween Jr. and Gary R. Huss, Cambridge University Press.

JOURNAL ARTICLES: Assigned reading will be given one week before they are discussed in class. Readings listed below are subject to change.

ORAL PRESENTATIONS AND RESEARCH PROJECT: Students are required to give a 12 minute presentation on a research project of their design during the course. The project must be new research and can be related to any topic discussed in class or as part of their Ph. D. research. Research proposals must be submitted to the professor for approval.

ATTENDANCE: Attendance to all classes is mandatory. You will be tested primarily on lecture materials—books are supplements to lectures. Each week we will review one or more papers from a referred journal or conference abstract volume. You will be responsible to hand in a short, one page summary of the critical issues within the assigned paper(s) and be prepared to discuss the paper(s) in class. If you have any questions or need help, ask one of your professors. If you are having difficulties, talk with us.

ACADEMIC HONESTY: Cheating will not be tolerated. Also, please turn off all cell phones and beepers during class. This syllabus provides a general plan for the course and deviations may be necessary.

Week	**Topic**
1 (1 September)	Introduction – Some basics (team)
2 (15 September)	Solar System formation, meteorites, planet formation, isotopes, minerals. Background reading: Weisberg et al., Systematics and evaluation of meteorite classification in Meteorites and the Early Solar System II, 2006; Connolly, Refractory inclusions and chondrules: Insights into a protoplanetary disk and planet formation in Chondrites and the Protoplanteary disk, 2005; Kita et al., Constraints on the origin of chondrules and CAIs from short-lived and long-lived radionuclides. Additional suggested readings to be found on Prof. Connolly's webpage. Article: Davis, Early Solar system chronology, Science 325, 951-952, 2010 and Villeneuve et al., 325, 985-987, 2010.
3 (22 September)	Solar System formation, meteorites, planet formation. Article: Bouvier and Wadhwa, The age of the solar system redefined by the oldest Pb-Pb age of a meteoritic inclusion, Nature Geosciences, 22 August 2010, 1-5.
4 (29 September)	Finish Solar System formation and then a lecture on isotope geochemistry, both stable and radiogenic). Article: Connolly and Love, The formation of chondrules: petrologic tests of the shock wave model, Science 280, 62- 67 and Shu et al., Toward an astrophysical theory of chondrites, Science 271, 1545-1552.
5 (6 October)	Begin lectures on active Earth systems: Plate tectonic and physical geology systems

	Ciesla et al., Outward transport of high-temperature materials around the midplane of the solar nebula, Science 318, 613-615 and Nakamura et al., Chondrulelike objects in short-period comet 81P/Wild 2, Science 321, 1664-1667.
6 (13 October)*	Continue lecture on plate tectonic, physical geology systems Article: Hirschmann, Ironing out the oxidation of Earth's mantle, Science 325, 544-546, 2009 and Kelley et al., Water and the oxidation state of subduction zone magmas, Science 325, 605-607, 2009.
7 (20 October)	Life on Earth up to Cenozoic Article: Marshall and Jacobs, Flourishing after the end-permian mass extinction, Science, 325, 1079-1080, 2009 and Brayard et al., Good genes and good luck: ammonoid diversity and the end-permian mass extinction, Science 325, 1118-1121, 2009.
8 (27 October)*	**Earth's climate system: overview and fundamental concepts:** Blackbody radiation, energy balance, greenhouse effect, climate forcings, climate sensitivity, the role of sun/volcanoes/greenhouse gases/aerosols, climate feedbacks. Article: Hansen, J., et al., Earth's Energy Imbalance: Confirmation and Implications, Science 308, 1421-1435, 2005
9 (3 November)	**Ocean-atmosphere circulation:** structure and circulation of the atmosphere, coriolis effect, geostrophic balance, wind-driven circulation, thermohaline circulation, upwelling, El Nino-Southern Oscillation, Monsoons Articles: Rahmstorf, S., Ocean circulation and climate during the past 120,000 years, Nature 419, 207-214, 2002. McPhaden J., et al., El Nino as an integrating concept in Earth Science, Science, 314, 1740-1745, 2006.
10 (10 November)	**The global carbon cycle:** carbon reservoirs and fluxes, long-term carbon cycle and plate tectonics, volcanic outgassing and silicate weathering, glacial-intergalcial CO_2 cycles and the role of the ocean, the anthropogenic perturbation, Keeling curve, carbon uptake by the ocean and the terrestrial biosphere. Article: Falkowski, P., et al., The global carbon cycle: a test of our knowledge of the earth as a system, Science 290, 291-296, 2000.
11 (17 November)	**Major climate events and trends during the Cenozoic – last 65 Million Years:** Late Paleocene Thermal Maximum, Eocene climatic optimum, Antarctic glaciation, Northern Hemisphere glaciation, Plio-Pleistocene cooling Articles: Zachos, J., et al., Trends rhythms and aberrations in global climate 65 Ma to present, Science 292, 686-693, 2001. Crowley, T. J., and Hyde, W. T., Transient Nature of late Pleistocene climate variability, Nature, 456, 226-230, 2008.
12 (24 November)	**Pleistocene ice ages:** Milankovitch cycles, Dansgaard-Oeschger oscillations, Heinrich Events, records from deep-sea, ice-core and speleothem deposits, role of thermohaline circulation, bipolar seesaw, tropical processes, ITCZ, ENSO and monsoons Articles: Ahn J., and Brook E.J., Atmospheric CO_2 and climate on millennial timescales during the last glacial period, Science 322, 83-85, 2008. Anderson, B., et al., Wind-driven upwelling in the Southern Ocean and the Deglacial Rise in Atmospheric CO_2, Science 323, 1443-1448, 2009. Denton, G., et al., The Last Glacial Termination, Science 328, 1652-1656, 2010.
13 (1 December)	**Human forcing of climate and Global Warming:** Climate of the Holocene and last 2 millennia. Medieval Warm Period and Little Ice Age,

	IPCC and the "Hockey Stick" controversy, instrumental temperature records, temperature from tree-rings, corals, glaciers and boreholes, modeling and projections. Article: National Research Council report on "Surface Temperature Reconstructions of the last 2,000 years", 2007, pp. 5-24
14 (8 December)	Presentations (team)
Final Exam Period (TBA)	Final Exam (team)

***THESE TWO LECTURES ARE SWITCHED.**

EVALUATION AND FINAL GRADE: (1) Final exam = 50%, (2) journal assignments and class participation in discussions of journals = 20%, (3) oral presentations + written report = 30%.