Introduction to Earth Systems Science

Lecture: 2 two-hour lectures per week
Lab: 1 two-hour lab per week

Course Description and Objectives:

This course is an introduction to Earth Systems Science. Earth Systems Science is the study of the complex interrelationships between materials and energy in the atmosphere and in the solid, fluid, and living Earth. Systems Science also involves the study of human interactions with these natural systems. In this course, we will investigate the fundamental processes that drive these systems, focusing on the measurement, representation, and response to change over time. These topics will be presented within the context of a global perspective. During the course we will solve quantitative problems and use mathematical models to describe and assess the impact of humans on Earth's systems.

In the lab, we will have an opportunity to observe, measure, and model these systems. The lab activities will be presented in the framework of problems to be solved, and will involve critical thinking in addition to using the language of mathematics. To help us evaluate the interactions between Earth's systems, we will become familiar with Microsoft Excel spreadsheets and the STELLA Earth systems simulation software.

After taking this course you will be able to:

1) Use the tools and working terminology of systems science.
2) Demonstrate an understanding of Earth's atmospheric, solid, fluid, and living systems and how they respond to change.
3) Evaluate the impact of humans on natural systems.
4) Solve quantitative problems as they pertain to Earth systems.
5) Communicate information about natural processes and natural systems in a quantitative format.

Assessment:

5 scheduled quizzes:	5% each of the final grade (each worth a possible 25 pts.)
8 labs*:	35% of the final grade (worth a possible 175 pts.)
1 Mid-Term exam:	12% of the final grade (worth a possible 60 pts.)
1 Final exam:	20% of the final grade (worth a possible 100 pts.)
class participation**:	8% of the final grade (worth a possible 40 pts.)
Total:	100% (total of a possible 500 points)

* individual labs vary from 20 to 25 pts.
** based on 5-6 "pop quizzes"

To complete this course with a satisfactory grade you must carefully follow directions, complete all assignments on time, be prepared for the quizzes, demonstrate

a mastery of geographic tools, knowledge and concepts through performance on exams and participation in class. Any late lab assignments will be penalized (-4 pts each day late) and NOT accepted after three calendar days! Quizzes cannot be made-up under any circumstances! However, in the event that a student misses a quiz, all is not lost. On the last day of the quarter there will be a 25 point comprehensive Generic Makeup Quiz. Any make-up exams must be arranged in advance with me, and only under very extenuating circumstances. During the course of the quarter there will be 5 or 6 "pop" quizzes (each worth a possible 5 to 7 points). These will occur at times randomly selected by the instructor (announced only on the day the "pop" quiz is given) and are based on material from the text, lecture and/or videos shown in class.

Students who are found cheating (defined as the unauthorized use of notes or obtaining answers from other students) on a quiz or exam forfeit that quiz or exam (receive 0 points). Any student who assumes personal credit for the work of another person on any assignment shall be deemed to have committed plagiarism and forfeit that assignment (receive 0 points). A second offense will result in a failing grade for the course.

Students are asked to turn off cell phones or other disruptive sound emitting devices when entering class. If this becomes a reoccurring problem students will be asked to leave the classroom.

Students with disabilities who have accommodation needs are required to contact the Services for Students with Disabilities and the instructor during the first week of class.

Required Materials:

Robert Christopherson, *Elemental Geosystems,* Prentice Hall, (5th ed) 2007.

Course Reader.

Occasionally, short articles on contemporary issues or events relating to the current discussion will be distributed in class. You will be expected to read these! Several articles and maps will also be placed on reserve in the library for your interest.

Course Outline:

Week One Introduction to Earth Systems: definition of a systems approach; key systems terminology; illustrated examples of basic systems; measurement and orders of magnitude.

Lab Activity 1: Travel and traffic conceptual model

Week Two Solar Energy and the Earth: earth/sun relationships; characteristics of solar radiation; patterns of insolation and energy distribution; atmosphere and surface energy balances.

Lab Activity 2: Energy balance in the atmosphere

Week Three Atmospheric Composition and Processes: structure and composition of the atmosphere; greenhouse effect; cloud formation; adiabatic processes; precipitation.

Lab Activity 3: Make a cloud; Evaporation measurement and back-of-the-envelope calculation (Excel)

Week Four Atmospheric Circulation: pressure and wind belts.
Hydrologic Cycle: major reservoirs; transport processes; water resources.

Lab Activity 4: Mass balances and evaporation / precipitation (STELLA model)

Week Five Ocean Circulation: ocean composition and salinity; wind-driven and thermohaline circulation; the oceanic "conveyor belt."

Lab Activity 5: Greenland ice melting case study (Excel)

Week Six Rock Cycle: composition and structure of the earth's interior; plate tectonics; geochemical fluxes.

Lab Activity 6: Geochemical tracers and the rock cycle (Excel)

Week Seven Ecosystems and Energy: food webs and trophic levels; biomass; interspecific relationships; biological response to human impacts.

Lab Activity 7: Simulated ecosystem

Week Eight Population Dynamics: competition for resources; carrying capacity; exponential growth; population density.

Lab Activity 8: Simulated ecosystem part 2 (STELLA)

Week Nine The Carbon Cycle: carbon compounds; major reservoirs and fluxes; greenhouse effect; fossil fuels; human impacts.

Lab Activity 9: STELLA model of climate change

Week Ten Biodiversity: concept of a species; speciation; species dispersal; habitat fragmentation; human impacts.

Lab Activity 10: Biodiversity survey (Excel)
