

## GEOLOGY 103: INTRODUCTION TO EARTH SYSTEM SCIENCE AND THE ENVIRONMENT

This course emphasizes an integrated approach to studying the Earth. The focus will be on interactions between geologic, biologic, and atmospheric processes. We will begin with a discussion of the systems approach, and how it might be applied to studying the geosphere, hydrosphere and biosphere. The course will become increasingly integrative as we progress, focusing on biogeochemical cycling (for example, the carbon cycle) and how humans are influencing interactions within the Earth system (global warming, stratospheric ozone depletion, land use changes, etc.).

The course will meet in large group twice weekly (Tuesdays and Thursdays, from 10:00 to 11:30). I will assume that you can read appropriate background material on your own, so I will make an effort to elaborate upon and go beyond material covered in the text during class. There will be occasional unscheduled quizzes on the reading at the beginning of class. In addition, laboratory sessions (Wednesday, Thursday or Friday, from 1:00 to 4:00) of less than 25 students will allow for active learning, usually in groups. The course also includes a mandatory overnight field trip (18–20 October), together with projects to be completed before and after the trip, and a term project. In place of midterms and a final, three equally-weighted “synthesis exercises” will be administered. These will test your ability to apply what you have learned to new situations, and will be completed during class, except for the last, which will be self-scheduled.

### **Some Details:**

#### *Field Trip: and Field Trip Project*

A mandatory 3-day field trip is scheduled for 18–20 November. This trip will cost each student about \$50.00 for accommodations and food. We will leave at 1:00 PM on Friday, 18 October and return around 6:00 PM on Sunday, 20 October. Mark your calendars! The emphasis will be on energy resources: Pennsylvania is the main source of hard coal (anthracite) in the world and we will observe the effects of coal mining and burning on the local environment. We will also observe several other means of generating electricity, and will discuss their relative environmental impacts. Prior to the field trip students will work in groups to prepare background information on the various sources of energy, for publication via WWW pages (students need not format the material for the WWW). After the field trip, we will devote a class period to learning the basics of WWW publishing, and each student will prepare a summary report making recommendations for future energy use, in a format suitable for WWW publication (and we *will* publish them on our own course page!). These projects will take the place of laboratory exercises for the weeks immediately preceding and following the field trip.

### ***Term Project:***

The course project will consist of an investigation of some aspect of the interaction between humans and the atmosphere, hydrosphere, biosphere or geosphere. The project is to be a group effort by students working in groups of three to five. The goal is to convey real scientific and social *content* in an exciting and engaging manner to a lay audience. Projects can take almost any form, as long as they meet these goals: posters (see previous efforts on the walls of Park Hall); videos, written papers, performances, art, WWW pages, etc. Each topic investigated should include a discussion of the issue, scientific background information, comments on current policy and policy implications, and recommendations for future action. You will be asked to turn in a *brief* proposal and an outline of your project, at specified dates during the semester. The projects will be presented in a public forum in Thomas Great Hall, open to the public. The public presentations will be held on Thursday, 6 December, from 1:00 to 4:00 PM—mark your calendars!.

### ***Lab:***

The main purpose of the lab exercises is to learn how to acquire data and to solve problems relating to environmental processes. We will use a combination of data gathering and analysis techniques, and will undertake some simple computer modeling exercises. Lab exercises have been gathered into a laboratory manual, which you must purchase on your first day of lab. It is important that you prepare for lab by reading through the appropriate exercise, and bringing whatever special materials you may need. Most labs require the use of a notebook, pens and pencils (maybe a variety of each), a calculator, and a ruler (metric).

### **Books:**

#### ***Required:***

Mackenzie, F.T., and Mackenzie, J.A., 1995, *Our changing planet*: Englewood Cliffs, New Jersey, Prentice Hall, 387 p.

Laboratory Exercise Manual (available on first day of lab)

#### ***On Reserve:***

Barron, E.J., 1996, *Climatic variation in Earth history*: Global Change Instruction Program: Sausalito, CA, University Science Books, 25 p.

Ennis, C.A., and Marcus, N.H., 1996, *Biological consequences of global climate change*: Global Change Instruction Program: Sausalito, CA, University Science Books, 53 p.

Few, A.A., 1996, *System behavior and system modeling*: Global Change Instruction Program: Sausalito, CA, University Science Book, 100 p.

Jacobsen, J.E., 1996, *Population growth*: Global Change Instruction Program: Sausalito, CA, University Science Books, 43 p.

*Also of interest: (on reserve)*

- Schlesinger, W. H., 1991, Biogeochemistry: An analysis of global change: San Diego, Academic Press, 443 p.
- Silver, C. S. and DeFries, R. S., 1990, One Earth one future: Our changing global environment: Washington, D.C., National Academy Press, 196 p.
- Gore, A., 1992, Earth in the balance: Ecology and the human spirit: New York, Penguin Books, 407 p.

**Grading:**

Labs : (average of all labs)	40% (~4.5% each)
Project (including proposal and outline)	15%
In-class quizzes	5%
Pre-Field Trip WWW material	5%
Post-Field Trip WWW page	5%
Synthesis Exercises (AKA midterms, final):	30% (10% each)

**Dates of Interest:**

First Synthesis Exercise	1 October
Pre-Field trip WWW material due	15 October (end of Fall Vac)
Field Trip	18-20 October
Post-field trip WWW material due	31 October
Project proposal due	5 November
Second Synthesis Exercise	12 November
Project outline due	19 November
Project Due	5 December
Project Presentation	6 December

Third Synthesis Exercise (AKA, Final) will be self-scheduled

## GEOLOGY 103: INTRODUCTION TO EARTH SYSTEMS AND THE ENVIRONMENT

### Syllabus

- Tue, 3 Sep Introduction to course; Origins (*Mackenzie & Mackenzie, Chp. 1*)  
 Thu, 5 Sep Introduction to systems, cycles and models (*Few, 1996—reserve*)  
 LAB 1: Topographic maps
- Tue, 10 Sep Earth Materials: Elements, Isotopes, Minerals, Rocks and the Rock Cycle (*Mackenzie & Mackenzie, Chp. 2*)  
 Thu, 12 Sep Plate tectonics (*Mackenzie & Mackenzie, Chp. 2*)  
 LAB 2: Rocks and minerals
- Tue, 17 Sep Weathering, soils, mass wasting, and sedimentation (*Johnsson, in press—reserve*)  
 Thu, 19 Sep Geologic hazards  
 LAB 3: Chemical weathering rates
- Tue, 24 Sep The geology of economic minerals and fossil fuels (some information can be found in Chp. 6 of *Mackenzie & Mackenzie*,)
- Thu, 26 Sep Earth's Energy budget; The hydrologic cycle (*Mackenzie & Mackenzie, Chp. 3*)  
 LAB 4: Stream hydrology, erosion rates, and flood recurrence
- Tue, 1 Oct **Synthesis Exercise I**  
 Thu, 3 Oct Atmosphere structure and Circulation (*Mackenzie & Mackenzie, Chp. 3*)  
 LAB 5: Modeling the hydrologic cycle
- Tue, 8 Oct Ocean structure and circulation (*Mackenzie & Mackenzie, Chp. 3*)  
 Thu, 10 Oct Ecosystem Components (*Mackenzie & Mackenzie, Chp. 4*)  
 LAB 6: Energy transfer through the biosphere
- Tue, 15 Oct Fall Vacation (NO CLASS)  
 Thu, 17 Oct Population Ecology (*Mackenzie & Mackenzie, Chp. 4*)  
 NO LAB
- Fri-Sun 18-20 Oct: FIELD TRIP**
- Tue, 22 Oct Biogeochemical cycles (*Mackenzie & Mackenzie, Chp. 5*)  
 Thu, 24 Oct Biogeochemical cycles (*Mackenzie & Mackenzie, Chp. 5*)  
 LAB 7: WWW publication; field trip summaries
- Tue, 29 Oct Human population dynamics [Bosbyshell] (*Mackenzie & Mackenzie, Chp. 6; Jacobsen 1996—Reserve*)  
 Thu, 31 Nov Energy and resource use and global change [Bosbyshell] (*Mackenzie & Mackenzie, Chp. 6; Jacobsen 1996—Reserve*)  
 NO LAB
- Tue, 5 Nov Soils/Land use changes (*Mackenzie & Mackenzie, Chp. 7, 8*)  
 Thu, 7 Nov Evaluating land use changes: remote sensing and geographical information systems (*Mackenzie & Mackenzie, Chp. 7*)  
 LAB 8: Soil Erosion

Tue, 12 Nov **Synthesis Exercise II**

Thu, 14 Nov Water and ground water resources (*Mackenzie & Mackenzie, Chp. 8*)

LAB 9: Porosity, permeability, and ground water flow

Tue, 19 Nov Global climate change: Paleoclimatology (*Barron, 1996—Reserve*)

Thu, 21 Nov Global climate change: Global warming (*Mackenzie & Mackenzie, Chp. 10; Ennis and Marcus, 1996*)

LAB 10: Urban planning

Tue, 28 Nov Atmospheric pollution (*Mackenzie & Mackenzie, Chp. 9*)

Thu, 30 Nov Thanksgiving Vacation (NO CLASS)

NO LAB

Tue, 3 Dec Environmental economics and public policy (*Mackenzie & Mackenzie, Chp. 11*)

Thu, 5 Dec The ozone hole and the Montreal Protocol: An example of international cooperation

NO LAB

**PROJECT PRESENTATIONS: 6 December**

Tue, 10 Dec Ethical Questions: Open Discussion