Earth Surface Dynamics
GEO2203

Spring 2011 Course Syllabus

Lectures: Tues. & Thurs. xx:xx – yy:yy am in Pillsbury Hall Room 110

Instructors: Jake Bailey (baileyj@umn.edu), Katsumi Matsumoto (katsumi@umn.edu), Chris Paola (cpaola@umn.edu), and Martin Saar (saar@umn.edu)

All are professors in the Dept. of Geology and Geophysics. Bailey is a geobiologist, Matsumoto is an oceanographer, Paola is a sedimentologist, and Saar is a hydrogeologist.

Office hours: By appointment but feel free to stop by during regular working hours

Website: WebVista via MyU Portal (http://myu.umn.edu)

Reading Materials:

(1) Kump, Kasting, and Crane, *The Earth System*, Pearson Prentice Hall
(2) Allen, P. A. *Earth Surface Processes*, Blackwell
(3) Additional readings on E-Reserve or their links provided in class

Grading: Homework 50%, Midterm 10%, Final Exam 20%, Labs 20%

Final Exam: May xx, day, time (place=regular classroom)

Welcome to the Earth Surface Dynamics! This course will explore the interactions and implications of geological, biological, chemical, and physical processes that shape the dynamic evolution of Earth's surface environment. In particular, this course will follow the cycling of water, carbon, and sediments through the atmosphere, land, and ocean. For example, the interaction of rain water falling on land will promote chemical weathering of rocks, which removes CO_2 from the atmosphere. The sediments and water, along with carbon in dissolved and particulate forms, will then make a long journey towards the ocean in rivers, lakes, and groundwater, as they continue to interact with the atmosphere and climate. Various physical and biogeochemical processes will impact this journey and alter the surface environment. This includes the formation of soils, erosion and deposition of sediments, exchange of carbon with the atmosphere, and transport of water and dissolved constituents underground. Upon reaching the ocean, some sediments and carbon are reworked and deposited along the coast, while some are transported to the deep ocean. Impact of geomicrobiology is seen in virtually all environments, including those with extreme pH conditions. The course concludes by examining how different linkages among geological, chemical, biological, and physical cycles maintain the Earth surface environment and how that environment has changed in the past and may evolve in the future.

A Core Course of the Earth Sciences Degree:
This course is part of the sequence of core courses for the BS degree in Earth Sciences. In particular, this is envisioned as a sophomore course and the second in the series of three "dynamics" courses. The first and third courses are the Solid Earth Dynamics and the Fluid Earth Dynamics.

Learning outcomes:
At the end of this course successful students will be able to:

- understand processes that shape the Earth's surface
- understand how linkages among geochemical, biological, and physical cycles maintain the Earth-surface environment
- understand how the Earth-surface environment has responded to change in the past and how it may change in the future

Exams:
If there is a conflict in time with another university activity, the student needs to notify one of the instructors *before* the quiz/exam is administered in order to be allowed to make it up without penalty. Sickness and family emergency are also acceptable reasons for penalty-free makeups, but this will need to be communicated without delay. Otherwise, a makeup can be given within a week of the missed quiz/exam with a *25% penalty*.

Lab and Discussion Sessions:
Every week there is a lab or discussion session according to the schedule as listed below. Some are computer-based labs, while others are hands-on and geomicrobiological or sedimentological. More details are given in a separate lab manual.

Homework:
Homework is meant to reinforce what you've been exposed to in class and will be due one week after it is assigned. Homework will lose 10% of grade per day late.

Attendance and Etiquette:
Regular attendance is expected. Cell phones must be switched off.

Academic integrity:
Academic integrity is essential to a positive teaching and learning environment. All students enrolled in University courses are expected to complete coursework responsibilities with fairness and honesty. Failure to do so can result in disciplinary action. The University Student Conduct Code defines scholastic dishonesty, which includes plagiarizing; cheating on assignments or examinations. A student responsible for scholastic dishonesty can be assigned a penalty including an "F" or "N" for the course.

Disabilities statement:
It is university policy to provide, on a flexible and individual basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities are encouraged to contact the professor.

Grades:
Final course grades will be "curved" (i.e., not based on absolute scores). As a rough guide, the top third of the class will get A's, the next third B's, and the last third C's. Students with scores significantly lower than the bulk of the last third may receive D's or F's.

Class notes:
Some class lectures will be posted on the web.

Lecture Schedule:

Week	Dates	Topics (instructor)	Reading	Lab
1	1/18 1/20	Introduction and course logistics (*all*) The interior-exterior connection: Tectonics and surface processes *(JB)*		
2	1/25 1/27	Atmospheric circulation and temperature profile *(KM)* Blackbody radiation and the greenhouse effect *(KM)*		1
3	2/1 2/3	El Nino and interannual variability *(KM)* Water transport in the atmosphere *(KM)*		2
4	2/8 2/10	Rainfall and surface water *(MS)* Surface water-groundwater interaction *(MS)*		3
5	2/15 2/17	Groundwater flow systems *(MS)* Microbial effects in groundwater *(JB)*		4
6	2/22 2/24	Soil and other terrestrial carbon *(JB)* Wetlands and methane *(JB)*		5
7	3/1 3/3	Rivers and sediment transport *(CP)* Fluvial landscapes *(CP)*		6
8	3/8 3/10	Glacier dynamics *(Guest: Ito)* Glacial landscapes *(Guest: Jennings)*		7
9	**3/15** **3/17**	**Spring Break**		
10	3/22 3/24	Coastal processes and sedimentation *(CP)* Ocean circulation; Temperature, salinity, and density *(KM)*		8
11	3/29 3/31	Ocean circulation: atmosphere-ocean interaction *(KM)* Water masses and biogeochemical tracers in the ocean *(KM)*		9
12	4/5 4/7	Deep-marine sedimentation *(KM)* Carbon cycle: photosynthesis and heterotrophy *(JB)*		10
13	4/12 413	Carbon cycle: Chemosynthesis *(JB)* Carbonates and CO_2 *(KM)*		11
14	4/19 4/21	Atmosphere-ocean-land carbon cycle *(KM)* Organic and inorganic carbon in rocks *(JB)*		
15	4/26 4/28	Synthesis week 1: Tectonics, CO_2, and climate through time *(all)*		
16	5/3 5/5	Synthesis week 2: Earth-surface environment in the Anthropocene *(all)*		
17		Final Exam		

JB=Bailey :7
KM=Matsumoto :10
CP=Paola :3
MS=Saar :3

Labs/Discussion

1. Geomicrobiology Set-up Winogradsky column and begin exploring thermodynamics with Thermodyne 1
2. Local weather – analysis of local weather data
3. Greenhouse effect –computer analysis of selective absorption of IR spectra
4. Gaia's Daisyworld –computer analysis of climate feedbacks
5. Groundwater flow and Darcy's law in a sand column
6. Water flow in streams: Stream lab at SAFL
7. Sediment transport lab at SAFL
8. Lake sediment lab – examination of a lake core from UM LacCore facility
9. Biogeochemical box modeling – basic modeling involving fluxes, reservoirs, isotopes
10. Sea level change – computer analysis of topographic data and digital elevation
11. Geomicrobiology - Winogradsky column observations and Thermodyne 2