ESCI 2203 Earth Surface Dynamics

Spring 2014 Course Syllabus

Lectures: Mon. & Wed. 11:15 am -12:30 pm in Pillsbury Hall Room 110

Labs: 9:05-11:00 am Friday (sec. 1) and 11:15am-1:10pm Friday (sec. 2) 1:25-3:20pm (sec. 3) Pills 105

Instructors:	**Email:**	**Office:**	**Phone:**
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Lab TAs:	**Email:**	**Lab sections:**
Robert Dietz	dietz070@umn.edu	TBA
Cindy Frickle	frick066@umn.edu	TBA

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

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

Reading Materials:

(1) Kump, L. R., Kasting, J. F. and Crane , R. G. (2010), *The Earth System* 3/e*,* Pearson Prentice Hall, 408 p.
(2) Additional readings on E-Reserve or their links provided in class

Reserve Reading Materials on Moodle

(1) Broecker, W. (1991) The great ocean conveyor, *Oceanography*, 4, 79-89.
(2) Killops and Killops, (2005) *An Introduction to Organic Geochemistry*.
(3) Zachos, J.C. and others (2005) Rapid acidification of the ocean during the Paleocene-Eocene Thermal Maximum, *Science*, 308, 1611-1615.
(4) Anderson and Anderson, (2010), *Geomorphology: The Mechanics and Chemistry of Landscapes*.

Grading: Quizzes 35% (online), Final Exam 30%, Labs 35%

Final Exam: 1:30 p.m.–3:30 p.m., Friday, May 16 (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 interactions with microorganisms, 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. 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.

About the lecturers: Jones is an instructor and Matsumoto and Paola are professors in the Dept. of Earth Sciences. Jones is a geomicrobiologist, focusing on the interplay between biological and geochemical processes. Matsumoto is a theoretical carbon cycle scientist with training in geochemistry and oceanography. Paola is a sedimentary geologist focusing on physical processes of sedimentation, especially in rivers.

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 and Quizzes:
Quizzes will be administered online via the moodle course website, and the final exam will be in class during the designated final exam period. 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:
Most weeks 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. Additional details will be provided in class.

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	1/22	Introduction and course logistics (*all*)		
2	1/27 1/29	Daisyworld: System, feedbacks, and Gaia *(KM)* Basic ideas: mass balance, flux, residence time *(CP)*	Kump 2 Kump 8	1[#]
3	2/3 **2/5**	Blackbody radiation and the greenhouse effect *(KM)* Lapse rate and convection in the atmosphere *(KM)*	Kump 3 Kump 3	2
4	2/10 2/12	Coriolis force *(CP)* Atmospheric circulation *(CP)*	Kump 4 Kump 4, AA 11, 16	3
5	2/17 **2/19**	Surface ocean circulation *(CP)* Deep ocean circulation *(CP)*	Kump 5	4
6	2/24 2/26	Tracers and water masses in the ocean *(KM)* Introduction of biological processes; chemosynthesis *(DJ)*	*Broecker (91) Killops 3.2	5
7	3/3 **3/5**	Photosynthesis and primary production *(DJ)* Respiration and heterotrophy *(DJ)*	Killops Ch. 3.3	6
8	3/10 3/12	Organic carbon burial, preservation, petroleum *(DJ)* Biogeochemistry in the ocean water column *(KM)*	Killops 3.3 Kump 8	
9	3/17-19	**Spring Break**		
10	3/24 **3/26**	Weathering and soil formation *(DJ)* Ocean carbon cycle *(KM)*	Kump 8 Kump 8	7
11	3/31 4/2	Sediment production *(CP)* Erosional systems *(CP)*	Kump 8; AA 3,7 AA 11	8
12	4/7 **4/9**	Coastal systems *(CP)* Deep ocean sedimentation *(CP)*	AA 16 Kump 8	9
13	4/14 4/16	Carbonate compensation and deep sea sedimentation *(KM)* Carbon and water in lakes *(DJ)*	*Zachos et al. (05) Kump 8	10
14	4/21 **4/23**	Biogeochemical sulfur cycling *(DJ)* Case study: Rise of free O_2 in the atmosphere *(DJ)*	TBA Kump 11, Killops 1.4	11
15	4/28 4/30	Case study: Hothouse Earth *(DJ)* Case study: Glacial-interglacial global change *(KM, CP)*	Kump 12 Kump 14	12
16	5/5 **5/7**	Case study: Anthropocene and global change 1 *(all)* Case study: Anthropocene and global change 2 *(all)*	Kump 15-16 Kump 19	
17	5/16	Final Exam, Pills 110, 1:30 p.m.-3:30 p.m.		

Bold dates : quizzes (30 min online via Moodle)

**Reserve readings – these will be made available in a timely manner ; many will be posted on Moodle.*
Kump : Kump et al. (2010) ; AA : Anderson and Anderson (2010) ; Killops : Killops and Killops (2005)

Labs/Discussion

1	1/26	Lake core sediment coring – ***SUNDAY*** 1/26 (LacCore)
2	1/31	Splitting core (LacCore/DJ)
3	2/7	Smear slide analysis (LacCore/Amy Myrbo)
4	2/14	Daisyworld computer lab (KM)
5	2/21	Radiation budget and greenhouse effect computer lab (KM)
6	2/28	Ocean data lab (KM)
7	3/7	Winogradsky columns (geomicrobiology) (DJ)
8	3/14	Lake biogeochemistry (DJ)
9	**3/21**	**Spring Break**
10	3/28	Grain size and settling: sediment cores (CP)
11	4/4	Geomorphology and topography (CP)
12	4/11	Analysis of Winogradsky columns (DJ)
13	4/18	Literature analysis in prep for final lab write-up (all)