GL/GG 257
Soils, Geology and the Environment
Fall 2009 Syllabus

Meeting Times and Places:

Lecture: BIH 417, MWF 9:05 – 9:55
Lab: BIH 419, Tues 1:30-4:15 (often in the field)

Instruction:

Peter Crowley Ryan, BIH 429, 443-2557
e-mail: pryan@middlebury.edu
Office Hours: M-W-F 10:00 – 11:00 or by appointment

Text:

Birkeland PW. 1999. Soils and Geomorphology. (3e) New York: Oxford Univ. Press, 430 p.

Reserve Readings … are located on the shelf in BIH 417.

Birkeland PW. 1999. Soils and Geomorphology. (3e) New York: Oxford Univ. Press, 430 p.

Brady NC, Weil RR. 2002. The Nature and Properties of Soils. Prentice-Hall, 960 p.

Dixon JB, Schulze DG (eds.). 2002. Soil Mineralogy with Environmental Applications. Soil Science Society of America Book Series no. 7, 866 p.

Gardiner DT, Miller RW. 2008. Soils in Our Environment (11e). Pearson-Prentice Hall, 600 p.

Hausenbuiller RL. 1985. Soil Science: Principles and Practice. Dubuque, IA: WC Brown, 610 p.

McBride MB. 1994. Environmental Chemistry of Soils. New York: Oxford Univ. Press, 406 p.

Munn and Singer. Soils: An Introduction. Upper Saddle River, NJ: Prentice Hall, 429 p.

Plaster EJ. 1997. Soil Science and Management. Albany, NY: Delmar Publishers, 402 p.

Troeh FR, Thompson LM. 1993. Soils and Soil Fertility. New York: Oxford Univ. Press, 462 p.

Course Content and Objectives:

The study of soils encompasses a wide range of disciplines and foci. While traditional soil classes have been taught in agronomy departments and agricultural colleges for many decades, the focus of this course will be different than most soil courses. We will begin by covering some of the basic principles taught in all soils classes—soil profiles, pedons, classification, and common soil characteristics. From there we will explore factors involved with soil formation, largely weathering processes and products. We will assess effects of parent material, climate, time, erosion, biota, and topography on soil formation. Once you have become familiar with these fundamental principles, we will examine numerous case studies ranging from interpretations of paleoclimate and soil origins to climate change and environmental contamination. Classroom meetings will largely be lecture-oriented with a healthy dose of participation on your part. Labs will be hands-on and designed to provide opportunities for you to (1) examine soil properties via lab and field-oriented exercises, (2) generate and interpret data and present results in both oral and written formats, (3) gain experience in laboratory and instrumental analysis (e.g. nutrient extractions, mineralogy preparation, XRD, ICP-AES), and (4) develop field skills.

Accordingly, the primary objectives of this course are as follows: (1) to provide a broad-based introduction to important topics in the intersecting fields of soils, geology and environmental studies; (2) to conduct in-depth analysis of selected issues; (3) to carry out field- and lab-based activities that complement and supplement lecture materials while also providing opportunity for critical thinking and practical application; (4) to provide a varied learning environment consisting of lecture, group activities, discussion, student presentations, practical exercises, and varied means of testing and evaluation.

Critical Thinking Objective

Students should approach all topics in this course from a critical thinking perspective. Critically assess what is being presented in the class. Does it make sense? Does it relate to something? Can you come up with an analogy that will better illustrate the point? Be an active thinker. Participate. The depth at which you learn is directly related to the degree to which you work at figuring it out yourself. If I merely stand in front of the room and monotonously lecture with no interaction, no discussion, and no practical application, then you probably will only understand the materials at a basic level. Lectures will be interactive, and you will be expected to be an active participant. In addition to lecture, we will conduct experiments using various geologic instruments, and we will analyze real data sets in order to understand and illustrate certain topics. Such activities will provide you with important skills as well as opportunities to approach problems from a scientific perspective. Be curious. Whether in the classroom, lab, or the field, make observations, ask informed questions, and do not be afraid to take chances.

Evaluation/Grading

Exam questions will require that you are able to interpret and understand material, rather than just being able to regurgitate it. You will be assessed on class participation, both in terms of amount and content, so make sure to attend class.

LABS 1-6………………………………………………………	15 %
2 HOMEWORKS (week 4, 10) ...…………………..…………	15 % (2 x 7.5 %)
EXAM 1 (50 min, in-class)…………...………………………….	15 %
LAB PROJECT (weeks 7 – 12).………………………………….	20 %
PARTICIPATION……………………………………………….	15 %
EXAM 2 (take-home exam during finals period)…………………	20 %

Participation includes attendance, participation in classroom discussions, field observations and discussions, and asking questions and making observations in class. Effectively, this is another way that you can demonstrate to me the depth of your knowledge of the topics covered in class and lab.

Late Assignments will be docked 10% per week day late (i.e. if a lab report or homework assignment is due on Thursday and you submit it the following Tuesday, your maximum possible grade for that assignment is 70%).

Week	M class	Tu Lab	W class	F class	Due dates
1 Sep7	Class Intro, soil profile nomenclature. Ch 1	Topographic transect of regional soils (parent material, climate, topography factors)	Soil-forming factors. Soil Taxonomy Ch2	$S = f(Cl,O,R,P,T)$ and soil taxonomy…cont. Profile development index (PDI) ... to be used as a tool in field analysis of soils.	
2 Sep14	PDI. Global-regional distrib of soil orders; weathering Ch 3	Soils in old growth vs. historically-logged forest. (Organism/biotic factor)	…cont. Ch 3	Physical and chemical weathering *Munroe et al 2007*	
3 Sep21	Chem weathering, evolution of soil through time (P,T) Ch 3, 7	USDA Soil Surveys, map units. Terrace lab. (Time factor)	Weathering products Ch 4,7	Soil minerals, nutrients, ion exchange. Ch 4 *Ryan and Huertas 2009*	
4 Sep28	Soil minerals, nutrients, ion exchange Ch 4	Wetland soils. (~Cl, O, R, P…)	Soil profile development, rates. Ch 5, 6	Rates, chronosequences Ch 8 **HW1 DUE** Fri 10/2 at 9:05 am	
5 Oct5	Chronosequences, paleoclimate (Cl) Ch 10	Exam Review.	Paleoclimate, CO_2 over geological and recent time scales	**EXAM 1** **Friday in Class**	
6 Oct12	BREAK	BREAK	Soil as C sink/ source, climate change. Ch 10. *J Article*	Soil as C sink/ source, climate change. Ch 10. Group Project Lab Intro/Objectives	
7 Oct19	Independent work (GSA …)	GROUP PROJECTS Begin lab work	Independent work	Toposequences (R) Ch 9	
8 Oct26	Sodium, irrigation, cause and effect	Tropics (CR) Semi-arid (MT) Warm temperate (VA) …?	Soils - archeology; Ch 11 (p. 333→) *J articles*	Soils & fault motion; Ch 11 (p. 326→) *Nelson et al. (2003)*	
9 Nov2	Chem. principles, soil biogeochem, nutrient cycles. GM Ch 4	Physical separation, cation exchange chemistry, bulk soil chemistry, clay mineralogy	Chem. principles, soil biogeochem, nutrient cycles. GM Ch 4	Soil Ecology (O) Nutrients, agriculture GM Ch 5	
10 Nov9	N/P Cycles, pollution GM Ch 9, 15	(XRD, ICP, SEM)	Organic pollutants—quick O-chem primer. *Hand-out*	Organic pollutants in soil. GM Ch 15 *J article*	**HW2 DUE** Fri 11/13 at 10:10am
11 Nov16	Organic pollutants in soil & remediation.	GROUP PROJECTS … data analysis.	Acid deposition and soils. BB	Acid deposition and soils. GM Ch 8 *J article*	
12 Nov23	Sulfide weathering, AMD, toxic-trace elements in soil	Presentations on results of group projects	THANKS-GIVING	THANKSGIVING	
12 Nov30	Toxic-trace elements in soil	Presentations on results of group projects	Case studies.	Last day of classes – review, evaluations. **EXAM 2** = take-hone final.	

GM = Gardiner and Miller (2008)