




This course introduces students to the skin of the Earth, examining soil as both a geological material and a natural resource. We will explore the awesome complexity of soils from molecular- to landscape-scale and examine the particular problems soils pose to human-landscape interaction. Lecture and discussion topics include the formation, physics, chemistry, ecology, and sustainable management of the world's soils. Laboratory exercises incorporate field description, laboratory analysis, and large-scale research questions. One weekend field trip is required. Prerequisite: GEOS 316.

Course Goals

-  to provide students with an understanding of soil diversity and complexity,
-  to enable students to interpret soils and their attendant temporal and spatial systems,
-  to emphasize the importance of soils in global sustainability, and encourage the development of effective soil-ecological management practices.

Course meets for

lecture

MWF 11-11:50 in Dennis 324

Professor: Cynthia Fadem
Email: fademcy@earlham.edu
Phone: 765.983.1231

laboratory

M 13-15:50 in Dennis 324/333

Office: Dennis 329
Office Hours: by appointment/drop-in

Required text:

Brady, N.C., and Weil, R.R. (2010). Elements of the Nature and Properties of Soils, 3rd edition. Prentice Hall, Boston. (ISBN 978-0-13-501433-2)

Assessment

Grades

40% Laboratory assignments (11)	90-92 – A-	≥93 – A	
10% Seminar leadership	80-82 – B-	83-85 – B	86-89 – B+
24% Term paper	70-72 – C-	73-75 – C	76-79 – C+
16% Written Examination (2)	60-62 – D-	63-65 – D	66-69 – D+
10% Class participation (10)		≤59 – F	

Policies

Open door: Students should feel free to write/talk to the instructor at any time regarding course material or life in general.

Academic integrity: Students are expected to abide by Earlham's policy on academic integrity (<http://www.earlham.edu/curriculumguide/academics/integrity.html>).

Accommodation: For information on disabilities legislation compliance or to discuss academic accommodation, contact the Academic Enrichment Center (<http://www.earlham.edu/~sas/support/>, 765.983.1341). Students with college-accommodated disabilities not facilitated by the AEC are encouraged to meet with the instructor as soon as possible so appropriate arrangements may be made.

Attendance: Students are expected to attend all class meetings. Should a student miss a lecture, it is the student's responsibility to obtain notes from a fellow student. Students are never excused from assignments; however, there are cases in which a make-up or alternative assignment/exam would be provided:

- In the case of regularly-scheduled laboratories, absence will be accepted for illness with a doctor's note ONLY.
- In the case of a weekend laboratory (field trip), absence will be accepted for illness with a doctor's note or religious obligations. *If the student will be missing a weekend laboratory for a religious obligation, s/he MUST notify the instructor at least one week prior to the scheduled laboratory.*

Due dates: Students may always turn in assignments early. Late assignments will incur a 10% per day penalty. All assignments are issued with due dates, which are also listed in the syllabus schedule and on our Moodle site.

Curves: Written exams will be curved by a quantity sufficient to make the mean 75% if necessary.

Discussion & Seminar Readings:

Amundson, R., Richter, D.D., Humphreys, G.S., Jobbágy, E.G., and Gaillardet, J. (2007). Coupling between biota and earth materials in the Critical Zone. *Elements* 3:327–332.

Anderson, S.P. (2012). How deep and how steady is Earth's surface? *Geology* 40:863-864.

Anderson, S.P., von Blanckenburg, F. and White, A.F. (2007). Physical and chemical controls on the Critical Zone. *Elements* 3:315–319.

Bautista, F. and Zinck, J.A. (2010). Construction of an Yucatec Maya soil classification and comparison with the WRB framework. *Journal of Ethnobiology and Ethnomedicine* 6:7-18.

Brantley, S.L., Goldhaber, M.B., and Ragnarsdottir, K.V. (2007). Crossing disciplines and scales to understand the Critical Zone. *Elements* 3:307–314.

Carvalho, J., Dias, R., Pinto, C., Leote, J., and Mendes-Victor, L. (2008). A soil classification for seismic hazard assessment and mitigation of the Algarve. Proceedings of the 14th World Conference on Earthquake Engineering, October 12-17, Beijing, China. <http://www.14wcee.org/Proceedings/isy7/main.htm> (last accessed 11 Jan 2011).

Dominguez, S., and Kolm, K.E. (2005). Beyond water harvesting: A soil hydrology perspective on traditional southwestern agricultural technology. *American Antiquity* 70:732-765.

Dugmore, A.J., Gísladóttir, G., Simpson, I.A., and Newton, A. (2009). Conceptual models of 1200 years of Icelandic soil erosion reconstructed using tephrochronology. *Journal of the North Atlantic* 2:1-18.

Lai, H.-Y., Hseu, Z.-Y., Chen, T.-C., Chen, B.-C., Guo, H.-Y., and Chen, Z.-S. (2010). Health risk-based assessment and management of heavy metals-contaminated soil sites in Taiwan. *International Journal of Environmental Research and Public Health* 7:3595-3614.

- Lehmann, J. (2007). Bio-energy in the black. *Frontiers in Ecology and Environment* 5:381–387.
- Montgomery, D.R. (2007). Soil erosion and agricultural sustainability. *Proceedings of the National Academy of Sciences* 104: 13268–13272.
- Robinson, D.A., Abdu, H., Jones, S.B., Seyfried, M., Lebron, I., and Knight, R. (2008). Eco-geophysical imaging of watershed-scale soil patterns links with plant community spatial patterns. *Vadose Zone Journal* 7:1132–1138.
- Sandor, J.A., Norton, J.B., Homburg, J.A., Muenchrath, D.A., White, C.S., Williams, S.E., Havener, C.I., and Stahl, P.D. (2007). Biogeochemical studies of a Native American runoff agroecosystem. *Geoarchaeology* 22:359–386.
- Shamshuddin, J., and Fauziah, I.C. (2010). Alleviating acid soil infertility constrains using basalt, ground magnesium limestone and gypsum in a tropical environment. *Malaysian Journal of Soil Science* 14:1-13.
- Trumbore, S.E., and Czimczik, C.I. (2008). An uncertain future for soil carbon. *Science* 321: 1455-1456.
- Vingiani, S., Righi, D., Petit, S., and Terribile, F. (2004). Mixed-layer kaolinite-smectite minerals in a red-black soil sequence from basalt in Sardinia (Italy). *Clays and Clay Minerals* 52: 473–483
- Wilson, M.J. (2004). Weathering of the primary rock-forming minerals: Processes, products and rates. *Clay Minerals* 39:233–266.

Schedule

Date		Topic	Type	Reading	Assignment	Due Date	
Aug	22	W	Lecture				
	24	F	Lecture	Ch. 1			
	27	M	Lecture				
	29	W	Lab		Lab 1	3 Sept	
	31	F	Lecture	Ch. 3			
Sept		Seeing Soils	Seminar	Wilson, 2004	Seminar 1		
	3	M	Lecture	Ch. 2			
		Lab			Lab 2	10 Sept	
	5	W	Lecture	Ch. 4			
	7	F	Seminar	Anderson et al., 2007; Dugmore et al., 2009	Seminar 2		
	10	M	Lecture	Ch. 14			
		Lab			Lab 3	17 Sept	
	12	W	Lecture				
	14	F	Lecture	Paper - proposal due			
	17	M	Lecture	Ch. 6			
		Lab			Lab 4	24 Sept	
	19	W	Lecture				
	21	F	Seminar	Bautista & Zinck, 2010; Carvalho et al., 2008	Seminar 3		
24	M	Lecture	Visit from Bob Hirsch				
	Lab		Review	Lab 5	1 Oct		
26	W	Lecture	Visit from Jennifer Robinson				
28	F	Exam 1					

Date			Topic	Type	Reading	Assignment	Due Date	
Oct	1	M	The Soil Solution	Lecture	Ch. 5			
				Lab		Lab 6	8 Oct	
	3	W		Lecture				
	5	F		Seminar	Dominguez & Kolm, 2005; Sandor et al., 2007	Seminar 4		
	8	M		Field Trip			Lab 7	15 Oct
	10	W		Paper - outline due - no class				
	12	F		Early Semester Break - no class				
	15	M		Lecture				
				Lab		Lab 8	22 Oct	
	17	W		Lecture	Ch. 9			
	19	F		Seminar	Robinson et al., 2008; Vingiani et al., 2004	Seminar 5		
	22	M		Lecture	Ch. 8			
				Lab		Lab 9	12 Nov	
	24	W		Lecture	Ch. 7			
	26	F		Seminar	Lai et al., 2010; Shamshuddin & Fauziah, 2010	Seminar 6		
29	M	Paper - first draft due - no class						
31	W	Lecture						
Nov	2	F	Living Soil	Lecture	Ch. 10			
	5	M		GSA - no class				
	7	W						
	9	F		Seminar	Amundson et al., 2007; Montgomery, 2007	Seminar 7		
	12	M		Lecture	Ch. 11			
				Lab		Lab 10	26 Nov	
	14	W		Review				
	16	F		Exam 2				
	19	M		Fall Break - no class				
	21	W						
	23	F						
	Dec	26		M	Sustaining Soils, Sustaining Ourselves	Lecture	Ch. 12	
			Lab			Lab 11	3 Dec	
28		W	Lecture	Ch. 13				
30		F	Seminar	Brantley et al., 2007; Lehmann, 2007		Seminar 8		
3		M	Lecture					
			Lab			Final Lab - field trip		
5		W	Lecture	Ch. 15				
7	F	Seminar	Anderson, 2012; Trumbore & Czimczik, 2008	Seminar 9				
13	R	Paper - final draft due						