

## GEOLOGY 551 HILLSLOPE PROCESSES

### GENERAL

Geology 551 meets MW 8-9 in FH 179 and M 9-12 in Van Matre 109.

Geology 551 is an upper-division and graduate course intended for students who are interested in a deeper understanding of the processes shaping hillslopes and the evolution of hillslope form. The approach taken in this class is *not* descriptive (for that try Geology 350); it is quantitative. I emphasize an understanding of the physics and mechanics of hydrologic and erosional processes affecting hillslopes; this involves both qualitative understanding and quantitative (i.e., mathematical) analysis. I expect people enrolled in this course to have taken at least the first semester of physics (i.e., mechanics) and to have finished their calculus sequence. We will be making fairly extensive use of mathematics, but I will try to bring out the physical significance of the terms in the equations. The labs and exams will involve a substantial amount of calculation as well as logical, analytical reasoning. You should be competent with a spreadsheet.

I expect all students enrolled in the class to participate in field trips and class discussion. A part of your overall grade (see GRADING below) will depend on participation.

### TEXT

The text for the course is:

M.J. Selby: **Hillslope Materials and Processes, 2nd ed.** (Oxford Univ. Press, 1994)

### OTHER READINGS

Other required readings are indicated in the course outline or may be assigned in class. Several copies of these articles will be placed on reserve in the Geology stockroom (VMH 108) and may be checked out overnight.

### EXAMS

There will be one midterm and a comprehensive final (see syllabus.) Exams will be open book/notes, but with no collaboration with others.

The midterm will be given during the week of Oct. 13-17. It will be an open-book modified take-home exam. Specifically, I will make the midterm available in the Geology department office (FH 7) by 9AM on Monday, Oct. 13. You can pick it up anytime between then and noon, Friday, Oct. 17. Once you pick it up, you can have up to 4 hours to complete it. All midterms need to be returned to me, or to my mailbox in the department office by 4 PM on the 17th.

The final exam is officially scheduled for Dec. 15 from 8-10 AM, but I intend to use the same format as for the midterm. It will be available in the Geology office by 9AM on Monday, Dec. 15. You can pick it up anytime between then and noon, Thursday, Dec. 18. Once you pick it up, you can have up to 4 hours to complete it. All exams need to be returned to me, or to my mailbox in the department office by 4 PM on the 18th.

### GRADING

Midterm.....	15%
Final.....	25%
Labs.....	50%
Class participation.....	10%

Grades are assigned using a data-adaptive modified class-average approach using natural breaks in the score distribution as grade boundaries.

### LAB INFORMATION

The labs will consist of a mixture of lecture (to explain material/concepts), in-class work, discussion, field trips, and problem sets. You can anticipate an average of 8–10 hours of work per week on these *outside* of class. **All labs or problem sets are due at the following lab meeting unless otherwise indicated in class.** I have had problems in the past with people falling far behind and having to take incompletes, so I shall be fairly ruthless in requiring papers to be submitted by their due dates. **Late papers will be downgraded.**

The objective of the labs is to develop your abilities to conceptualize and analyze problems in surficial geology, and to give you experience with practical analytical and measurement techniques. I consider the lab work, *including participation in class discussions*, very important. You will notice that labs plus participation counts 60% of the course grade. I encourage you to work together with others in figuring things out, plotting up surveys, etc., but *I would like the analyses and conclusions drawn to be your own*, not group-think.

Our three weekend field labs – one to model material/form/process/energy relations of coastal slopes, one to survey a landslide, and one as yet undetermined – will take place as 7- hour Saturday or Sunday trips on Sept. 6, Sept. 20, and Oct. 4. These projects are too lengthy to be done in an ordinary three-hour lab. To partially compensate for this, no formal labs will be held on Sept. 1, Sept. 8, Sept. 15, and Dec 8 (see course schedule). I will be available in my office or in the lab during those times to help you individually or collectively with problems.

## SPREADSHEET USE

The labs commonly involve calculations, some of which are very tedious and time-consuming, and plotting of data. These tasks are easily carried out using a microcomputer spreadsheet, such as Excel. To ease the burden of calculation, I have prepared a number of Excel templates and macros (programs) for use in this course. These are available on-line through the 551 website. Although the calculations *could* be done by hand, I do want you to use the computer. I feel that learning to use spreadsheets and graphics programs is essential if one is to be a well-trained natural scientist.

## LAB MATERIALS

You will need the following materials for the laboratory. With the exception of the field book you should bring these materials to each lab.

Calculator with trig and log functions

Ruler-protractor with calibrations in mm (C-Thru W-43)

Ruler-protractor with calibrations in tenths and twentieths (C-Thru W-38)

Soft (2H) pencils; harder (3H or 4H) pencils

Drafting eraser (Artgum type or white vinyl)

Pencil sharpener/pointer

Red, blue, green, yellow colored pencils

Red, blue, green "Sharpie" pens

Rite-in-the-Rain field notebook (since we may be getting wet, no type but Rite-in-the-Rain is acceptable)

**Bring the notebook on field trips.**

## CLOTHING

When we go on field trips, it may be raining. Be prepared and dress accordingly. Rubber boots may be useful on some of the landslides. If it is raining on the day we survey the landslide, we will need three or four umbrellas to protect the instruments.

Geology 551  
 Andre Lehre  
 Office hrs: M 1-3, Tu 9, Th 8, Th 1  
 and by arrangement

Fall 2008  
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 826-3165  
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### GEOLOGY 551--SLOPE PROCESSES

Readings preceded by S refer to Selby: Hillslope Materials and Processes. Other readings are on reserve in the Geology stockroom.

**Geology 551 website:** <http://www.humboldt.edu/~geology/courses/geology551>

When requested on the site use: **name:** geodept **password:** students

DAY	TOPICS	READING
25-Aug	Introduction: systems and models	S Ch 1-3
25	<b>LAB 1:</b> Modeling a geomorphic system	
27	Sediment budget concepts	Dietrich 1 5-13
01-Sep	<b>Labor Day Holiday</b>	
1	Work on Lab 1	
3	Weathering processes	S Ch 8-9
6	<b>LAB 2:</b> FIELD LAB Modeling a beach-slope system (Saturday, 9-4)	
8	Weathering Processes	S Ch 8-9
8	Lab: Work on Lab 2	
10	Stress, strain and rheology; constitutive equations	S Ch 4, 7; Johnson 1
15	Strength of soil and rock	S Ch 5
15	No in-class lab (field trip on Sunday instead)	
17	Strength of soil and rock	S Ch 5
20	<b>LAB 3:</b> FIELD LAB Landslide investigation at Trinidad (Saturday, 9-4)	
22	Basic concepts of slope stability	S Ch 13; Nash 1
22	<b>LAB 4:</b> Physical properties of earth materials	
24	Stability of soil slopes	S Ch 13
29	Stability of soil slopes	S Ch 13
29	<b>LAB 5:</b> Analysis of Trinidad slope stability	
01-Oct	Stability of soil slopes	S Ch 13
4	FIELD LAB (Saturday 8-6)	
6	Debris flows	S Ch 14; Johnson 2 257-290; 291-358 (skim)
6	<b>LAB 6:</b> Landslide mapping	Reid
8	Debris flows	S Ch 14; Johnson 2 257-290; 291-358 (skim)
13	Stability of rock slopes	S Ch 6, 15, 17; Hsü
13	work on Lab 6; <b>MIDTERM this week</b>	
15	Stability of rock slopes	S Ch 6, 15, 17; Hsü
20	Creep	Carson & Kirkby
20	<b>LAB 7:</b> Soil creep and hillslope evolution	
22	Creep and colluvium	Carson & Kirkby, S Ch 10

DAY	TOPICS	READING
27	Hillslope hydrology	S Ch 11, Dunne 1
27	<b>LAB 8:</b> Hillslope hydrology	
29	Hillslope hydrology	S Ch 11, Dunne 1
03-Nov	Modeling hillslope hollows	Lehre; Dietrich 2
3	<b>LAB 9:</b> GIS approaches to predicting slope stability: SHALSTAB & SINMAP	Dietrich 3, 4
5	Modeling hillslope hollows	
10	Overland flow	S Ch 12
10	<b>LAB 10:</b> FIELD LAB Hillslope hydrology and surface erosion	
12	Overland flow	Emmett; Dunne 2
17	Overland flow	Emmett; Dunne 2
17	<b>LAB 11:</b> Hillslope erosion processes and sediment yield	
19	Gullying	Dietrich 5
24	<b>THANKSGIVING BREAK</b>	
26	<b>THANKSGIVING BREAK</b>	
01-Dec	Slope models	S Ch 10, 16; Nash 2; Pierce
1	<b>LAB 12:</b> Modeling hillslope development	
3	Slope models	S Ch 10, 16; Nash 2; Pierce
08-Dec	Magnitude, frequency, and geomorphic effectiveness	S Ch 18-19; Dietrich 1
8	No lab this week	
10	Magnitude, frequency, and geomorphic effectiveness	S Ch 18-19; Dietrich 1
17-Dec	<b>FINAL EXAM -- comprehensive-- due by 4 PM</b>	

## OTHER INFORMATION MANDATED BY HSU

### Catalog Description:

GEOL 551. Hillslope Processes (3). Quantitative and qualitative description of the mechanics of erosion and deposition on hillslopes. Develop and apply sediment budgets. Hillslope hydrology, weathering, mass movement, slope stability, sheet and rill erosion, slope development models, and techniques for field measurement of slope processes. Prereqs: GEOL 350, MATH 110, PHYX 107 (or 110), or IA. Weekly: 2 hrs lect, one 3-hr lab; may require one-day weekend field trip(s).

### Educational Goals and Student Learning Outcomes

#### Goals

- G1) Provide an earth systems approach to geologic education that fosters critical thinking and the ability to make informed decisions on scientific issues in our society.
- G2) Provide students with a strong field-based education that incorporates the evolution of the Earth and its biota, and the classification of geologic patterns and materials at varied temporal and spatial scales.
- G3) Provide students with the ability to collect, process, and interpret scientific data.
- G4) Train students in the communication of scientific information using written, oral, graphic and electronic forms.
- G5) Provide a sufficiently broad and rigorous background with depth and currency in at least one area of specialization to allow qualified students to pursue graduate study and to enter professional careers in the earth sciences.

#### Student Learning Outcomes

##### I: Technical competence

- c) locate and access appropriate sources and data from both electronic and traditional resources (G4)
- g) recognize and describe the crustal processes that create landforms (G3)
- h) demonstrate depth and breadth of knowledge and currency in one or more advanced specialty fields (area of specialization) (G5)

##### II: Scientific method

- i) recognize, appreciate and communicate scientific uncertainty (G1, G3)
- j) use, formulate and test multiple working hypotheses based on the scientific method (G1, G3)

##### III: Communication

- k) effectively communicate scientific ideas and results verbally and in writing (G4)

##### IV: Earth Science and society

- l) understand the consequences of human activities on the environment (G1)
- n) recognize how long-term processes and evolution affects the global earth system (G1, G2)

**Students with Disabilities:** Persons who wish to request disability-related accommodations should contact the Student Disability Resource Center in House 71, 826-4678 (voice) or 826-5392 (TDD). Some accommodations may take up to several weeks to arrange. <http://www.humboldt.edu/~sdr/>

**Academic honesty:** Students are responsible for knowing policy regarding academic honesty:

[http://studentaffairs.humboldt.edu/judicial/academic\\_honesty.php](http://studentaffairs.humboldt.edu/judicial/academic_honesty.php) or  
<http://www.humboldt.edu/~humboldt/catalogpdfs/catalog2007-08.pdf>

**Attendance and disruptive behavior:** Students are responsible for knowing policy regarding attendance and disruptive behavior: [http://studentaffairs.humboldt.edu/judicial/attendance\\_behavior.php](http://studentaffairs.humboldt.edu/judicial/attendance_behavior.php)

**Add/Drop policy:** Students are responsible for knowing the University policy, procedures, and schedule for dropping or adding classes. <http://www.humboldt.edu/~reg/regulations/schedajust.html>

**Emergency evacuation:** Please review the evacuation plan for the classroom (posted on the orange signs), and review [http://studentaffairs.humboldt.edu/emergencyops/campus\\_emergency\\_preparedness.php](http://studentaffairs.humboldt.edu/emergencyops/campus_emergency_preparedness.php) for information on campus Emergency Procedures. During an emergency, information can be found campus conditions at: 826-INFO or <http://www.humboldt.edu/emergency>