

Geomorphology (Geosci/Geog 320). Spring, 2012.

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Office hours: Monday, 11:00 AM to 12:00 Noon; Tuesday, 1:00-2:00 PM, or by appointment.

Course website: see Learn@UW page for syllabus, readings, lecture slides, and other course material

Overview of the course: Geomorphology is the study of landforms and landscapes and the processes that have shaped them. It is a basic science, driven in part by curiosity about the landscapes in which we live. Geomorphology also has important practical applications, however, and is essential to understanding many natural hazards and many forms of environmental change. An understanding of geomorphic processes is directly relevant to fields such as geotechnical and environmental engineering, sedimentology, soil science, and archaeology. Modern geomorphology is often highly quantitative, but direct observation of processes and landforms in the field is still an essential component of geomorphological research.

In this course, we will generally follow a sequence from process to form, starting with an in-depth look at a particular group of geomorphic processes, followed by discussion of the landforms those processes create and their importance in interpreting long-term landscape development.

Prerequisites. One of the following: Geosci [Geol] 100, 101, 106, 109 or Geog 120, 127. Familiarity with concepts and terminology covered in those courses is assumed.

Field Trips: Students are required to attend two one-day, Saturday field trips, scheduled on **4/14** and **4/28**. For each trip, there will be a graded assignment you will need to complete during the trip. On each trip, we may also collect some data that will be used in a lab exercise. *Be ready to leave at 8 AM* on the day of the trip (location to meet will be announced); we will return to Madison by 5 PM. Bring a lunch and be prepared for the weather. If you have unavoidable scheduling conflicts with either scheduled trip, *let me know early in the semester.*

Lab: Lab exercises provide experience with basic tools used in geomorphology. These include a) visualization and interpretation of landforms and landscapes, using maps, digital elevation models and other GIS data, and remotely sensed images; b) collection of data in the field and lab; c) calculations used to interpret processes and forms from field and lab data; d) use of simple numerical models of geomorphic processes. A schedule of lab exercises will be provided. Your lab grade will be based on assignments; there will not be lab exams or quizzes but any lab material may be covered in exams.

Grading. There will be four exams during the semester, given during regular lecture periods. There will *not* be a final exam during finals week. The course grade will be based on the exams and (70% total), and the lab and field trip assignments (30%). There

is no extra credit. If unavoidable circumstances prevent you from taking an exam, discuss this with the instructor beforehand, if at all possible, or immediately afterward. Make-up work can only be arranged if this is done in a timely fashion.

Exam format will be a mixture of multiple choice, short answer, and short essay questions. Exams 1-3 will be held on Mondays, to make sure everyone has enough time to finish the exam. Exam 4 covers less material than 1-3. *Labs will start at about 3:45 PM on Mondays when exams are held.*

The exams are based on **lecture, lab, and the required readings**. The readings will be placed on electronic reserve in the UW-Madison library system (you can access them from your MyUW page). You are responsible for material covered in the required readings, while the optional readings are for additional background if you see a need for it. I have placed the following textbook on reserve: *Process Geomorphology*, by Dale F. Ritter, R. Craig Kochel, and Jerry R. Miller (Prentice Hall, ISBN 0-697-34411-8; Waveland Press, ISBN 13:978-1-57766-461-1). I have assigned a few readings from this text; beyond those sections, you may want to look at other parts of this book if you want more in-depth information on a topic.

Course Topics and Reading Assignments (*Exam dates are fixed; lecture topic schedule may be adjusted as needed*).

1/23, 1/25. Introduction to the course. Linking landforms and processes. Measuring erosion and deposition, and dating erosion surfaces and deposits *Required reading:* Leopold, L.B., Wolman, M.G., and Miller, J.P., 1964, *Fluvial Processes in Geomorphology*, Chapter 2, Geomorphology and the Field Problem, p. 10-23. *Notes on the reading:* The purpose of this reading is to illustrate the kind of questions that geomorphologists can ask about landforms and the processes that produce. Don't worry about the details. *Optional reading:* Schaetzl and Anderson, *Soils: Genesis and Geomorphology*, pages 596-605 and 612-618. *Notes on the reading:* Background on dating methods.

1/30 Weathering and soils. Where does sediment come from? *Required reading, on reserve:* Schaetzl and Anderson, *Soils: Genesis and Geomorphology*, pages 32 through 40. *Notes on reading:* This reading will give you a quick overview of how we describe and interpret soil profiles; much of this should be review if you have Geog 120 or 127 or a basic soils course. The master horizon definitions covered in Table 3.1 will be discussed *in lab*, and you *are* responsible for knowing these; look over Table 3.2 and Figure 3.5, but you are *not* responsible for the detailed information presented there

2/1, 2/6, 2/8. Hillslope processes, part 1. Mass wasting.

2/13. Exam 1. Covers lecture and lab material, 1/23 through 2/8.

2/15, 2/20, 2/22. Hillslope processes, part 2. Runoff, rainsplash, slopewash and creep. Hillslope form. *Required reading, on reserve:* Dunne and Leopold, *Water in*

Environmental Planning, pages 255 through 274. *Note on reading*: This is an excellent, straightforward summary of the different types of runoff and where they occur.

2/27, 2/29. Fluvial processes, part 1: Discharge and the hydrograph. Floods and flood frequency. Channel initiation, drainage network development, and stream capture. Drainage basin characteristics, flood hydrology, and sediment yield. *Optional reading, on reserve*: Thornbury, W.D., 1969, *Principles of Geomorphology, 2nd Ed.*, p. 147-154 (start at “Shifting Stream Divides”). *Note on reading*: More background on stream network development and stream capture.

3/5, 3/7. Fluvial processes, part 2: In-channel flow, sediment transport, bedforms, and channel patterns. *Required reading, on reserve*: Ritter et al., *Process Geomorphology*, p. 214-225 (start at “Channel Patterns”). *Note on reading*: Covers more or less the same material as the lectures, though with a little different emphasis and organization.

3/12. Exam 2. Covers lecture and lab material, 2/15 through 3/7

3/14, 3/19. Floodplains, aggradation and incision, terraces, response of the alluvial system to climate change and tectonics. Alluvial fans. *Required reading, on reserve*: Leopold, L.B., Wolman, M.G., and Miller, J.P., 1964, *Fluvial Processes in Geomorphology*, p. 316-332. *Note on reading*: A detailed discussion of floodplain processes and landforms. The authors had a great deal of influence on how geomorphologists interpret floodplains. The points made here are still valid for many floodplains, although we now know that some streams and their floodplains don't fit this model. *Optional reading, on reserve*: Ritter et al., *Process Geomorphology*, p. 248-259 (start at “Alluvial Fans”). *Note on reading*: More background on lecture material.

3/21. Glacial processes, part 1: Types of glaciers, mass balance of glaciers, and ice flow.

3/26. Glacial processes, part 2: Glacial erosion, sediment transport, and deposition.

3/28, 4/9, 4/11. Glacial landforms and glaciated landscapes. *Required readings, on reserve*: 1. Dott and Attig, *Roadside Geology of Wisconsin*, pages 21 through 28; 2. Carlson, A.E., Mickelson, D.M., Principato, S.M., and Chapel, D.M., 2005, The genesis of the northern Kettle Moraine, Wisconsin. *Geomorphology* 67: 365-374.

4/14. Saturday field trip, leave at 8AM and return by 5PM.

4/16. Exam 3. Covers lecture and lab material, 10/18 through 11/10.

4/18, 4/23. Wind, dunes, and dust: Eolian geomorphology. *Required reading*: Bagnold, R. A. 1941. *The Physics of Blown Sand and Desert Dunes*. Pages 10-13; 90-92 (“Immobility of Settled Dust and Loess”), and 167-171. *Notes on the reading*: These short excerpts from a classic work of geomorphology should give you a taste of how Bagnold used careful observations of wind-driven sand and dust, in the field and wind tunnels, to ultimately understand the formation of dunes and dust deposits.

Understanding Figure 3 and the equations on the lower part of page 171 is *not* important for this course.

4/25, 4/30. Coastal processes and landforms. *Required readings, on reserve:* 1. Ritter et al., *Process Geomorphology*, p. 264-269 (start at “Deltas”), 2. Nelson, S.A., and Leclair, S.F., 2007, Katrina’s unique splay deposits in a New Orleans neighborhood, *GSA Today* 16:4-10. *Note on readings:* Reading 1 provides more depth on the classification of deltas covered in lecture. Reading 2 is a case study combining concepts from fluvial and coastal geomorphology.

4/28. Saturday field trip, leave at 8AM and return by 5PM.

5/2. The big picture: Tectonics, climate, and erosion.

5/7. Discussion of lab projects. Summing up and review.

5/9. Exam 4 (held on last class day).

No exam during final exam week.