Geomorphology (Geosci/Geog 320). Spring, 2018.

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Office: 207 Science Hall
Office Hours: 11:00AM-12 Noon, Tuesday; 1-2PM, Wednesday; or by appointment.

Course website: Log in to access the password-protected Canvas site at:
https://canvas.wisc.edu/courses/80605
Material posted there will include the syllabus, lab materials, assigned readings, copies of lecture slides, and an online gradebook.

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. For each important area of geomorphology (processes and landforms related to streams, for example), we'll start with an in-depth look at the most important processes involved. We will then discuss selected important and/or interesting landforms those processes create.

This is a three credit course. The credit standard for this course is met by the expectation of at least 135 hours of student engagement in learning activities, including two 50-minute lectures per week, labs, independent work on lab projects, field trips, and other required work.

Learning Outcomes:
Through this course, students will be able to:

- Understand and explain at a basic level how Earth surface processes shape landforms and create natural hazards, and how they respond to changing climate and human land use.
- Apply their knowledge of Earth surface processes to interpret new observations of processes, landforms and natural hazards.
- Become familiar with how geomorphologists use equations and quantitative models to represent geomorphic processes and acquire the ability to use some of those equations/models to solve realistic problems at a basic level.

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. The math used in this course is at the level of typical algebra and trigonometry courses.

Lab: Lab exercises provide experience with basic tools used in geomorphology. These may 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. There is also a **lab project** that you will work on in groups in March and April. Your lab grade will be based on assignments and the project; there will not be separate lab exams or quizzes, but lecture exams may have questions on some concepts covered in lab.

Field Trips: There are **two** required one-day field trips this year, 8AM-5PM on Saturdays. I have tentatively scheduled these for **Saturday, April 7, and Saturday, April 21.** ***Please let me know right away of major conflicts with these dates***, such as field trips in other courses that will affect several students in this class. ***The dates will be finalized in the second week of the semester.*** These are important components of the course, as the only times we'll be able to look at and discuss landforms and geomorphic processes in the field. A required assignment will be associated with each trip.

Readings. There is no required textbook. There will be required readings available on the course Canvas site. 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). It is **not** required, but if you want to do background reading on course topics, this is a good book for that.

Grading: There will be three exams and one quiz 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 quiz (65% total, 19% for each exam and 8% for the quiz), and the overall lab grade, including the project (35%). 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. The ***exams*** are each focused on material covered since the previous exam, mostly focusing on lecture material, but with questions on assigned readings and on concepts covered only in labs (I will try to make clear what kind of lab material may appear on exams, but if you're not sure, ask). Exam format will be a mixture of multiple choice, short answer, and short essay questions, usually with one to three problems that involve calculations. The **quiz** is similar to exams but a little less than half as long and comes at the end of the semester.

Graduate Students: To earn graduate credit for this course you will need to work individually on a lab project with more depth than required for undergrads. The research problem and expectations for each graduate student project will be worked out individually; please schedule time to meet with me to discuss this.

Course Topics and Reading Assignments (***Exam and quiz dates are fixed***; lecture topic schedule may be adjusted as needed. ***Readings*** may be added or substituted for those here, but this will be done well before the reading is assigned).

1/24, first part of 1/29. Introduction to the course and basic methods and tools of geomorphology. Linking landforms and processes. Measuring erosion and deposition.

Second part of 1/29, 1/31. Weathering and soils. *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 had 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

2/5, 2/7, 2/12. Hillslope processes, part 1. Mass wasting and related slope-dependent processes.

2/14. Hillslope processes, part 2. Infiltration, runoff, and rainsplash. *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.

2/19. Exam 1. Covers lecture and lab topics from start of class through lecture on 2/14 and labs on 2/13-2/16. Also covers all assigned readings up to this point in the course.

2/21, 2/26. Water flow, erosion, and sediment transport: Basic processes and physical principles.

2/28, 3/5, 3/7, 3/12. Fluvial processes, part 1: Slopewash, channel initiation and drainage network development. Discharge and the hydrograph. Floods and flood frequency. Drainage basin characteristics, climate, tectonics, and sediment yield (covered to the extent permitted by time available).

3/14. Fluvial processes, part 2. Channel patterns and floodplains. *Required reading:* Simpson, C.J., and Smith, D.G. 2001. The braided Milk River, northern Montana, fails the Leopold-Wolman discharge-gradient test. Geomorphology 41: 337-353. This research paper deals with a case study of a long-standing question in geomorphology: Why streams have meandering or braided channel patterns. Many of the best-known explanations for braided channels don't work in the case studied here, but one clearly does. As the authors described their study area and their results, they use many of the concepts on fluvial processes that we discuss in lecture. I will add notes to the paper to help with some of the more technical parts.

3/19. Exam 2. Covers lecture and lab material, from lecture on 2/21 through lecture on 3/14, and from labs on 2/20-2/23 through labs on 3/13-3/16. Also covers all assigned readings since Exam 1.

3/21. Fluvial processes, part 3. The graded stream, aggradation and incision, terraces, response of the alluvial system to climate change and tectonics.

4/2, 4/4, 4/9. Glacial processes: Types of glaciers, mass balance of glaciers, ice flow, erosion, sediment transport, and deposition. Erosional glacial landforms formed in bedrock

4/11, 4/14, 4/16. Drumlins and depositional glacial landforms (quick overview, then focus on glaciofluvial landforms as a case study). Glaciated landscapes. *Required reading:* 1. Dott and Attig, *Roadside Geology of Wisconsin*, pages 21 through 28. 2. A second reading *to be announced*, on glaciofluvial processes The first of these readings is a quick introduction to the glaciation of Wisconsin. The second one will be a single longer article or a couple of shorter ones that discusses the glaciofluvial processes and resulting landforms, possibly using the Kettle Moraine as an example.

4/18. Exam 3. Covers lecture and lab material, from lecture on 3/21 through lecture on 4/16, and from labs on 3/20-3/23 through labs on 4/10-4/13. Also covers all assigned readings since Exam 2

4/23, 4/25. Eolian processes and landforms. *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.

4/30 Coastal processes: Two or three case studies, time permitting.

5/2. Quiz. Covers lecture material from 4/23 through 4/30, and any lab material covered after 4/13.

No exam during final exam week.