

GE 441/641
Quantitative Geomorphology
4 credits

Lecture M W F 10:00 AM - 10:50 AM, Laxalt Mineral Engineering 415
Laboratory F 1:00 - 3:30 PM, LME 415 or LMR 275, door code 8541

Instructor Name: Dr. Scott McCoy
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Office Hours: Monday 11:00-11:50 or by appointment

Teaching Assistant: None
Office Location: NA

Course Description

This course introduces students to the quantitative study of processes that shape Earth's surface and the natural hazards they create. We will investigate major components of continental geomorphic systems, including hillslopes, rivers, and glaciers, using both theory and field observation. Landscapes are one of the most accessible and striking parts of a planet's geologic record. Because we live on Earth's surface, landscapes and the forces that shape them are also of considerable societal relevance. Our ultimate goal will be to understand how the major factors that shape Earth's surface – tectonics, climate, and life – create the landscapes we observe and the hazards engineers must assess and mitigate. The course is designed to be accessible to graduate and undergraduate students from a range of disciplines, including geology, engineering, environmental science and geography. As such, we do not assume an extensive geology background. The only requirements are proficiency in mechanics, a basic familiarity with calculus and differential equations, and a willingness to roll up your sleeves and make some measurements.

Course Prerequisites

MATH 181 - Calculus I (or equivalent)
PHYS 180 - Physics for Scientists and Engineers I (or equivalent)

Required Texts, Course Materials

Key Concepts in Geomorphology, 2nd edition, Bierman and Montgomery, W.H. Freeman and Company Publishers.

Optional

Geomorphology: The Mechanics and Chemistry of Landscapes, Anderson and Anderson, Cambridge University Press, 1st edition.

Course Objectives

Understanding what controls the evolution of landforms that make up the surface of the Earth and identifying associated hazards are critical for a wide range of professionals in Earth sciences and engineering. Hence, this course aims:

1. To construct a *quantitative* framework to explain how and why topography develops across a range of Earth environments.
2. To highlight the importance of geomorphology to society and develop quantitative models of Earth surface processes to meet societal needs ranging from assessing, mitigating and forecasting natural hazards, to landscape management and restoration.
3. To develop field skills to constrain engineering parameters in predictive models of Earth surface processes.

Student Learning Outcomes

1. Students will demonstrate, through analytical papers and laboratory reports, that they can write and understand basic mathematical statements describing the mechanics that generate common landforms.
2. Students will demonstrate, through analytical papers and laboratory reports, that they can look at a landscape or topographic map and determine the specific processes of erosion and deposition shaping the landforms, as well as the hazards or management concerns they present.
3. Students will demonstrate, through analytical papers and laboratory reports, that they have developed a working knowledge of geomorphic field methods that can be used throughout professional practice.

Relationship of Course Goals to ABET Student Learning Outcomes

ABET Student Learning Outcomes	Corresponding Course Objectives
1) <i>Fundamental Background and Problem Solving</i> - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1,2,3
2) <i>System and Process Design</i> - an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	2
3) <i>Communication</i> - an ability to communicate effectively with a range of audiences	1,2,3
4) <i>Ethics, Broad Education, and Social Awareness</i> - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	2
5) <i>Teamwork</i> - an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	3
6) <i>Experimental Design / Data Analysis</i> - an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	1,2,3
7) <i>New Knowledge</i> - an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	1,2,3
8) <i>Field Competency</i> - the application of geologic field proficiency to engineering practice	3

Required Work and Grading

No plus/minus grading will be used below a B-.

100%-93% = **A**; 92.9%-90% = **A-**; 89.9%-87% = **B+**; 86.9%-84% = **B**; 83.9%-80% = **B-**;
79.9%-70% = **C**; 69.9%-55% = **D**; 54.9% or below = **F**

GE 441

Science/engineering reports 80%

Class Participation 20%

GE 641

Science/engineering reports 80%

Class Participation 20%

Mandatory Field Trips (virtual or in person)

Development of field investigation skills is a fundamental part of geomorphology. We will take three one-day Saturday field trips to examine classic geomorphic localities in western Nevada and eastern California during the semester, with each trip including a mapping exercise or field measurements. These maps and measurements will be critical parts of laboratory exercises and analytical papers. Dates TBD.

If you cannot participate in the in-person trips there will be virtual options that focus on making similar observations using digital topography and imagery in Google Earth.

Science/engineering reports

During the semester you will prepare 3 (typically 5 to 10 page) scientific or engineering papers/reports. These papers will generally follow the traditional format of introduction, background, methods, results, discussion, conclusion/recommendations regarding a particular geomorphic process and its resulting landforms/hazards. The purpose of these papers is to give you an opportunity to dig into the lecture and lab material and deepen your understanding of the concepts while practicing technical writing. Most of these will be done in teams.

Laboratory

The primary purpose of the lab is to provide project-based instruction to complement the more theoretical material presented in lecture. Labs will be held most weeks. Labs will involve working with field measurements and some element of computer work in Google Earth and Excel or Python to solve equations, do analysis, and plot data and results.

Readings

Readings from the textbook or technical literature (typically 10-30 pages) will be assigned weekly and should be completed by the following class, when we will review them. I may sometimes ask you to prepare a summary of the key points in these readings.

Exams

No exams will be given.

Class participation

Willingly contribute during quizzes, class discussion and small breakout sections.

Difference between GE 441 and 641

Graduate students will be expected to achieve a deeper understanding of the material presented in lecture and lab by completing additional readings assigned throughout the semester, answering in-depth challenge questions on the analytical papers and laboratory assignments. These extra assignments are meant to be difficult enough to encourage additional independent study as well as interaction with the other graduate students, the teaching assistant, and the professor. Graduate students will be evaluated independent from undergraduates in both analytical papers and laboratory assignments and held to a higher standard in terms of quality of writing, presentation of results, and depth of discussion.

Late work

It is crucial that ALL assignments be handed in on time, so that (1) you're prepared to discuss them in class, (2) we can grade them promptly, and (3) you don't fall behind. Therefore, I will deduct 10% per day that papers are late.

Course Topics

Introduction
Landforms of the Sierra Nevada and Basin and Range
Quaternary Mapping
Digital Elevation Models (DEMs)
Chronologic methods
Large-scale topography
Glaciers and glaciated landscapes
Periglacial processes
Rock fall
Weathering and soils
Hillslopes
Landslides
Debris flows
Tectonic geomorphology
Drainage basins and channel networks
Flow mechanics
Bedrock channels
Landscape evolution
Floods

Maybe a little bit of
Alluvial channels and fans
Sediment transport
Alluvial longitudinal profiles
Meanders
Volcanic landforms
Lacustrine landforms

University Policies

Statement on Academic Dishonesty

The University Academic Standards Policy defines academic dishonesty, and mandates specific sanctions for violations. See the University Academic Standards policy: [UAM 6,502](#).

Generative AI use is permitted

In this course you are welcome to use generative artificial intelligence/large language model tools (such as ChatGPT, DALL-E, Gemini, Perplexity, etc.). Using these tools aligns with the course learning outcomes/student goals. Please be aware that many AI companies collect and store personal information. Please do not enter your confidential information as part of a prompt.

Also, please note that some of these large language models may “make up” or “hallucinate” information. These tools may reflect misconceptions and biases of specific data. Students are responsible for checking facts, finding reliable sources for, and making a critical examination of any work that is submitted.

All use of AI tools or content must be acknowledged or cited. If you do not acknowledge or cite your use of an AI tool, what you submit will be considered a form of cheating, as outlined in [UNR Academic Integrity Policy \(UAM 6,502\)](#).

Please make sure to use the appropriate guidelines for acknowledging/citing generative AI in your assignments.

- [UNR MLA Citation Guide](#)
- [UNR APA Citation Guide](#)

Additional Considerations

- [Generative AI for Research](#)

Statement on Student Compliance with University Policies

In accordance with section 6,502 of the University Administrative Manual, a student may receive academic and disciplinary sanctions for failure to comply with policy, including this syllabus, for failure to comply with the directions of a University Official, for disruptive behavior in the classroom, or any other prohibited action. “Disruptive behavior” is defined in part as behavior, including but not limited to failure to follow course, laboratory or safety rules, or endangering the health of others. A student may be dropped from class at any time for misconduct or disruptive behavior in the classroom upon recommendation of the instructor and with approval of the college dean. A student may also receive disciplinary sanctions through the Office of Student Conduct for misconduct or disruptive behavior, including endangering the health of others, in the classroom. The student shall not receive a refund for course fees or tuition.

Statement of Disability Services

Use either the traditional or online statement, in addition to the last sentence regarding third party materials.

For Traditional and Seated Classrooms:

Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the [Disability Resource Center](#) (Pennington Achievement Center Suite 230) as soon as possible to arrange for appropriate accommodations.

Statement on Audio and Video Recording

Student-created Recordings

Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped, or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

Instructor-created Recordings

Class sessions may be audio-visually recorded for students in the class to review and for enrolled students who are unable to attend live to view. Students who participate with their camera on or who use a profile image are consenting to have their video or image recorded. If you do not consent to have your profile or video image recorded, keep your camera off and do not use a profile image. Students who un-mute during class and participate orally are consenting to have their voices recorded. If you do not consent to have your voice recorded during class, keep your mute button activated and only communicate by using the "chat" feature, which allows you to type questions and comments live.

Statement on Maintaining a Safe Learning and Work Environment

The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit the [Equal Opportunity and Title IX](#) page.

Statement on Campus Closures or Delays

In the event of class cancelations or delays caused by inclement weather conditions, fire/smoke conditions, or other unforeseen emergencies, the safety and well-being of students are the University's top priority. Official notifications will be disseminated through the University website and other official channels with details related to any campus delays or closures.

In the event of a campus closure, you will be informed as to whether the class will be offered remotely or if it will be canceled. If the class is cancelled, you will receive information on how to address any missed course content.

Students facing significant impacts due to these events are encouraged to communicate with their instructor for potential accommodations.

Additional Information

- If you are sick, please do not come to class. If you must miss class due to illness, please contact me to make arrangements for any missed work or lecture materials.
- Your student fees cover usage of the [University Math Center](https://www.unr.edu/university-math-center) (https://www.unr.edu/university-math-center), (775) 784-4433; [University Tutoring Center](https://www.unr.edu/tutoring-center) (https://www.unr.edu/tutoring-center), (775) 784-6801; and [University Writing & Speaking Center](https://www.unr.edu/writing-speaking-center) (https://www.unr.edu/writing-speaking-center), (775) 784-6030. These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student.