Geography 329. Landforms and Landscapes of North America. Spring 2009
DRAFT—check for any changes in finalized version, first week of classes.

Instructor: Joe Mason 207 Science Hall mason@geography.wisc.edu

Office Hours: Tuesday, 9:00-10:00 AM; Wednesday, 2:30-3:30 PM; or by appointment.

Introduction to the course. This course is an introduction to the evolution of North American landscapes over geologic time. The focus is on some of the continent's most interesting and distinctive landscapes, where the results of tectonic and geomorphic processes are particularly well displayed. Although the same basic processes have shaped all of these landscapes, the results in each case are unique. Each region has its own set of landforms, soils, vegetation, lakes and streams, aquifers, and own "look" and character. These characteristics often have a strong influence on a region's human land uses, environmental problems, and natural hazards. One of the most important ideas underlying this course is that none of these distinctive landscapes can be understood without considering their long-term evolution. Each records a sequence of change over geologic time that can include past and present motion of the lithospheric plates, cataclysmic volcanic eruptions, changes in the stream network, glacial erosion, and major fluctuations of climate and vegetation.

The same things could be said about landscapes around the world, but in many ways the regions of North America covered in this course offer a unique opportunity to learn about the processes that shape landscapes over time. In part, this is because geologists and geographers exploring North American landscapes have so often used them to develop and test the basic concepts we use to understand landscape evolution. For example, during the late 1700s and early 1800s geologists debated the idea that great mountain ranges have been uplifted and then destroyed by erosion over the Earth's history. As it turned out, landscapes of North America contain spectacular evidence that this is true. The required text, *Annals of the Former World*, by John McPhee, makes this connection between North American landscapes and the development of plate tectonics and other "big ideas" of Earth science. Through his travels with a series of geologists, McPhee also conveys the value of actually going out into these landscapes, and spending enough time there to really start to understand them. My hope is that after taking this course, you have the opportunity to visit the real landscapes we discuss, and try out the ideas covered in this course for yourself.

Prerequisites and expectations. Doing well in this course will require both careful note-taking in lecture *and* careful study of the assigned readings. The readings do not simply repeat lecture material, and you will need to use them, either in studying for tests or in completing homework assignments (I will make it clear which portions of the readings may be covered on each of the exams). I will assume that you have had an introductory course in physical geography or physical geology, but I am also well aware that you may need a review of many of the concepts covered in that course. At the start of the semester, I will review basic concepts of plate tectonics. Later in the term, I will also refresh your memory on glacial and fluvial processes and landforms. I will briefly discuss the geologic timescale, rocks, and minerals, but *I expect you to review these topics in more detail by completing the assigned readings*. If you don't understand a concept discussed in lecture or the readings, *ask for an explanation*.

Course Learn@UW site

I will post material related to the course on the password-protected Learn@UW site, including *useful links* (such as those needed for homework), lecture slides, the syllabus, homework assignments, updated reading lists, and outlines of exam topics. Exam and homework scores will be available through the Learn@UW grade list.

Textbook and other assigned readings. The required text (*Annals of the Former World*, by John McPhee, ISBN 0-374-51873-4) is not a traditional textbook. It will often take you to an important idea by a very roundabout path, with lots of detours. This is actually the way science works and I think that's one of the reasons McPhee wrote the book in the form he did. I have assigned specific sections as required reading, but if you have the time and interest, go ahead and read the book straight through.

I am also assigning a short U.S. Geological Survey publication, *This Dynamic Earth: An Introduction to Plate Tectonics*, available on the web at http://pubs.usgs.gov/publications/text/. This is an excellent overview of plate tectonics, with many useful illustrations. Finally, you may find it very useful to look through the web-based lessons called WebGeology, at the University of Tromso, Norway: http://ansatte.uit.no/kku000/webgeology/ . The lessons on minerals, rocks, volcanoes, deformation of rocks, plate tectonics and mountain-building are all very good (you can also teach yourself Norwegian or Russian by using this site…).

Other readings will be on electronic and paper reserve through the Geography Library. These are mainly short selections from textbooks and other sources. ***Note:*** I will sometimes use illustrations from these readings in lecture, and if you have a copy with you it should help in note-taking (I will announce ahead of time which readings to bring with you). A few of the readings will be highly technical, and I've assigned them only because they contain good illustrations. In that case, I will let you know that reading the text is optional.

Grading. The course grade will be based on two exams (30% each), and several homework assignments (40% total). The exams will include a combination of short-answer and multiple-choice questions, mostly related to lecture material. Before each exam, I will hand out an outline of the topics to be covered. The homework assignments will include short essays answering specific questions, and completion of maps or diagrams. The homework assignments will often refer to readings in the book by McPhee, other assigned readings, and/or web sites. You will be able to redo the first homework assignment to improve your initial grade.

Overview of the lecture topics. Tectonic and igneous processes have played a major role in shaping all of the landscapes that will be discussed, but their effects are much clearer in regions where there are still active plate boundaries, faults, and volcanoes. Therefore, we will start with the relatively young and tectonically active landscape of Cascadia (British Columbia, Washington, Oregon, and northern California), at the boundary between two converging lithospheric plates. We will then move south and east across the mountain ranges and basins of the western U.S., where we will often need to consider a much longer and more complicated history of changing plate boundaries. Nevertheless, in the western U.S. many faults and volcanic centers are active now or have been active in the past few million years, and major landforms like the Grand Canyon are still quite young (in a geologic sense). We will spend several lectures on the rise and decay of the Rocky Mountains, and the debris from those mountains that is now spread across both the nearby basins and the Great Plains to the east. We will then jump east across the continent to the old mountain ranges of the Appalachians, no longer at an active plate boundary but recording a long history of converging and diverging plates during the Paleozoic and Mesozoic eras. Finally, we will turn to the Midwestern US and the Canadian Shield, where the present landscape records events near both ends of the geologic timescale, including tectonic processes in the Precambrian and glacial erosion and deposition within the last two million years.

Lecture and exam schedule. The exam dates listed are fixed, but the schedule of lecture topics is tentative. A separate ***reading list*** for the semester will be handed out on the first day, and is also available from the course website.

1/20, 1/22, 1/27. Introduction to the course. Review of geologic timescale, rocks, and minerals (*not covered in detail in lecture, students will need to do assigned readings on these topics*). Basic concepts of plate tectonics. Faulting and folding, fold and thrust belts. Isostasy and mountain-building processes. Volcanism and major types of volcanoes.

1/29, 2/3. Cascadia. Plate tectonic setting of the Pacific Northwest. Anatomy of a subduction zone. History of major Cascades volcanoes. Formation of coast ranges and Puget/Willamette lowlands. Climate and vegetation contrasts across the coast ranges and Cascades. Salmon, big trees, and landscape history. Volcanic and seismic hazards.

2/5, 2/10, 2/12. Columbia Plateau, Snake River Plain, and the Yellowstone Region. Mantle plumes, flood basalts, and calderas. Glaciation and the Missoula Floods.

2/17. Big Picture 1: Long-term tectonic evolution of the western Cordillera and California. Accreted terranes. Fold and thrust belts. Cretaceous subduction zone and batholiths. Change from convergent to transform boundary.

2/19. California: Evolution of the Sierra Nevada and Central Valley; gold, and impacts of gold mining

2/24, 2/26. Basin and Range. Extension, development of fault-block mountains, fans and pediments, pluvial lakes, hot springs and salt flats, Basin and Range biogeography.

3/3. Exam 1

3/5, 3/10. Big Picture 2. Laramide Orogeny, anatomy of a Laramide uplift, post-Laramide erosi on. Uplift, climate change, and erosion in the Late Cenozoic.

3/12, 3/24. The Colorado Plateau. Paleozoic and Mesozoic bedrock. Eocene lakes. History of the Colorado River (why the Grand Canyon?). Intrusions and volcanic activity. Powell, Gilbert, and Dutton: The Colorado Plateau and the development of geomorphology.

3/14-3/22 Spring Break

3/26, 3/31, 4/2. The Rocky Mountains, Intermontane Basins, and Great Plains. North to south variation of the Rockies, Cenozoic volcanic activity, the Rio Grande Rift, Post-Laramide erosion, basin-filling and volcaniclastic sedimentation. Drainage development; antecedent vs. superimposed streams. Alpine glaciation and the Rocky Mountain high country today. The Ogallala Formation and formation of the High Plains surface. Long-term erosion of the Plains. Dunes and dust on the Plains.

4/7. Big Picture 3. The Atlantic margin and formation of the Appalachian Mountains.

4/9, 4/14, 4/16, 4/21. The Appalachians, Piedmont, and Coastal Plains. Transect: Coastal Plain, Piedmont, Great Valley, Blue Ridge, Valley and Ridge, and Allegheny Plateau. Cycles of erosion vs. dynamic equilibrium. Drainage development, water and wind gaps.

4/23. Big Picture 4. Precambrian evolution of the North American Craton, and the Mid-Continent rift. Basins and arches of the Midwest, the Baraboo Range, and the Sioux Ridge. Epicontinental seas and Paleozoic to Mesozoic rocks of the mid-continent. **Interior Low Plateaus.**

4/28, 4/30. Big Picture 5. The Laurentide Ice Sheet and continental-scale patterns of ice flow, erosion, and deposition. Sculpting of the Great Lakes basins, the northern Great Plains, and the Canadian Arctic. Variation of glacial landforms across the mid-continent. Drainage rearrangement as a result of glaciation. Why the Driftless Area?

5/5. Glacial and Post-Glacial Great Lakes. Lake Agassiz and other proglacial lakes and their outlets. Isostatic rebound and lake-level history.

5/7 Exam 2 [no exam during finals week]