GEL 25 Final Exam Study Guide spring, 2025

The final exam on **Wednesday, June 11 from 10:30-12:30** is cumulative and will cover material from the first day of class through the last class on Wednesday, June 4 (i.e., lecture notes 1ABC through 09). The exam will be in our classroom. You'll have 2 full hours to take the exam.

I'll expect you to understand the most salient points of the pre-midterm materials but I likely won't ask highly specific questions about the pre-midterm topics. My suggestion would be to browse those notes and images just to refresh your memory.

The exam will consist of 40 multiple-choice and true-false questions. The exam is closed-book, so no notes or other materials. The multiple-choice questions will be very similar in style and difficulty to those you've seen on the quizzes and midterm.

There will be 4 wrong answers and 1 right answer for each multiple-choice question. (No "best" answer, only a right answer.)

Bring a scantron 2000, a pencil and a clean eraser.

- have the scantron filled out with your ID number and name before coming to class.

Don't be late! The Registrar tells me that I don't have to give the exam to students who arrive late.

To study – You have lots of resources to use to understand the material – class, lecture notes and images, lecture videos, and the textbook.

1) The **lecture notes and images** that I provide are your primary sources of information. I suggest you study by reading the notes while scrolling through the images to tie the two together. The images help you to visualize what the notes are saying, rather than trying to memorize the words on the notes.

   Pay attention to any numbers that are provided in the notes, but don't memorize them (unless they are in bold or on the list of key terms). You do want to know the ages of the boundaries between the main geologic eras.

2) **Build the chronologic table** of when main events happened in the American West and within each geologic province. I gave you a skeleton of this in a recent class that you can complete as you comb through your notes and images. This is the fourth dimension of time that I'd like you to understand, beyond the three dimensions of space that we talk about regarding the landscape and underlying geology.
3) **Review the lecture videos** as necessary. If there's a topic that you're confused about, find that part of the lecture videos to hear about it again. Remember that the class on Death Valley is in Zoom cloud recordings (not in Media Gallery with the lecture capture videos).
4) **Strategically read the textbook**. If you've been keeping up with the reading, then you probably have a much better understanding of many of the things that I talk about in class. The relevant material in the textbook expands upon what is taught in class and should give you a deeper understanding of many of the concepts and events that we've discussed.
5) **Study with a friend**. Being able to verbally explain specific concepts is a very effective way to understand a topic. Even if you study by yourself, **speak out loud** to explain certain concepts. You'll be surprised at what you actually know versus what you think you know.

Finals week tips:

1) *Be organized and systematic* in using the notes, images, textbook, and lecture videos. If you've been studying week-to-week, then you're ahead of the game.
2) *Stick to your priorities.* Say **no** to distractions.
3) *Build in moments of relaxation.* Take regular short breaks, exercise, and get enough sleep.
4) *Be confident.* By now you've hopefully built up a good set of study habits.

This is a big class and the opportunities for cheating are ripe. Please don't do it. If you get caught it's just an embarrassing situation for everyone and a huge hassle in the long run. Student Judicial Affairs is not a fun place.

Post-Midterm Terms and Concepts to Understand for the GEL 25 final exam

(Rather than memorize the definition of each of these terms, try to relate them to one another to tell a larger story. Use the images from lecture to visualize each of these concepts and to group related concepts.)

Cascade Range plate tectonics plates tectonics convection currents convergent plate boundary subduction deep ocean trench volcanic mountain chain magma Cascadia subduction zone stratovolcanoes pyroclastic eruptions volcanic ash lava flows **Mt. Rainier NP** alpine glaciers zone of accumulation zone of ablation volcanic mudflows (lahars) **Crater Lake NP** caldera Mt. Mazama events of caldera eruption cinder cone pyroclastic fall	**Lassen Volcanic NP** volcanic dome Brokeoff volcano 1915 eruption pyroclastic flow cinder cone Strombolian eruption hydrothermal features hot springs fumaroles **Sierra Nevada province** fault normal fault offset (aka displacement) tilted fault-block uplift igneous rocks intrusive vs extrusive environments plutonic vs volcanic processes rocks vs minerals granite pluton Sierran batholith ancestral Sierra Nevada modern Sierra Nevada Farallon oceanic plate

Yosemite NP
role of jointing
exfoliation jointing
domes
rockfalls
talus
Pleistocene Ice Ages
Holocene
continental ice sheets
alpine glaciers
glacial-interglacial phases
Last Glacial Maximum
U-shaped valleys
hanging valleys/waterfalls
glacial erratics
glacial abrasion
striations & glacial polish
origin of Half Dome

Sequoia-Kings Canyon NP
metamorphic rocks
slate, schist, gneiss
cirques
arêtes
glacial plucking
tarn lakes
paternoster lakes

Rocky Mountains province
North American Cordillera
compressional tectonic stress

Glacier NP
continental divide
(meta)sedimentary rocks
mudcracks & ripple marks
stromatolites
folds
thrust faults
Laramide orogeny
flat-slab subduction
timing of initial uplift of Colorado Plateau
glacial flour

Basin and Range province
basin
range
Great Basin
internal drainage
playas & 'sinks'
extensional tectonic stress
normal faulting
tilted fault-block mountains
evidence for active extension
tectonic model for extension

Death Valley NP
rain shadow effect
desert pavement
flash floods / debris flows
alluvial fans
playas and playa lakes
evaporite salts
badlands
sliding stones

Grand Teton NP
Snake River
relief
rocks of the Tetons
gneiss
Teton Fault
role of earthquakes
fault scarps
moraines, terminal moraines

Yellowstone NP
supervolcano
caldera eruptions
ash-fall tuff, ash-flow tuff
heat flow
hydrothermal features
geysers
hot springs
sinter
ice cap
horns

San Andreas parks Coast Ranges province San Andreas 'fault system' transform plate boundary strike-slip faults shear stress fault offset **Pinnacles NP** large-scale offset of SAF talus caves **Point Reyes NS** origin of Pt Reyes granites coastal erosion sea cliffs, sea arches sea stacks estuary post-glacial marine transgression	

Questions that you should be able to answer from the notes, images, textbook, and lecture

- *What are the major differences between landscapes and rocks of the Colorado Plateau and those of the Cascades geologic province?*
- *What is the energy source behind the motion of tectonic plates?*
- *Broadly speaking, why do earthquakes and volcanoes occur in linear patterns across the Earth?*
- *Can you describe the processes that occur along subduction zones? Can you draw and label a subduction zone?*
- *What are some of the main geographic features of subduction zones, both on land and beneath the sea?*
- *What drives the explosive eruptions of stratovolcanoes?*
- *What is a pyroclastic eruption? What is pyroclastic debris?*
- *What is the age and dominant component of Mount Rainier?*
- *How do alpine glaciers work? What are the two main zones on an alpine glacier and how does the movement of alpine glaciers respond to changes in climate?*
- *What is one of the major volcanic hazards of Mount Rainier that would affect nearby towns? How do lahars form?*
- *How does the volcanic eruption at Crater Lake NP differ from those of the other national parks of the Cascades?*
- *What is the tectonic setting of the Pacific Northwest that controls volcanism in the Cascades? How does it relate to the tectonic setting of the ancestral Sierra Nevada?*
- *How does the volcano at Lassen Volcanic NP differ from those in the rest of the Cascades? What were some of the volcanic processes that occurred during the most recent eruption of Lassen*

Peak? What other volcanic hazards can you add to the list based on information from other national parks and monuments of the Cascades?

- *How do hot springs and fumaroles operate at Lassen Volcanic NP?*
- *What's the difference between the ancestral Sierra Nevada and the modern Sierra Nevada in terms of their tectonic settings, ages, and styles of uplift?*
- *What is the tectonic origin of the Sierran batholith? What is a batholith and how does granite form from magma?*
- *Describe the sequence of events that led to the formation of the modern Sierra Nevada. Begin with the Mesozoic ancestral Sierra Nevada and move forward through time to the present.*
- *How do events in the Sierra Nevada geologic province relate in time to events on the Colorado Plateau? Can you sketch a bullet point list of the chronology of events that affected both the Sierra Nevada and Colorado Plateau through time?*
- *How do the four major processes/features that influence the landscapes of Yosemite NP combine to form the famous Half Dome?*
- *Describe 3 common landforms left behind by glacial erosion. Describe the two main processes by which alpine glaciers modify the bedrock of a region.*
- *How do metamorphic rocks differ from igneous rocks? Which parks are characterized by metamorphic rocks?*
- *What do the metamorphic rocks in Sequoia-Kings Canyon NPs tell us about the ancestral Sierra Nevada prior to the intrusion of magma of the Sierran batholith?*
- *How do the mountains in Glacier NP differ from those in the Basin and Range in terms of their style of uplift? What is the age and name of the main uplift in the Rocky Mountains? How did the tectonic setting of the Laramide orogeny differ from that of the earlier setting that formed the ancestral Sierra Nevada?*
- *Can you describe three different types of uplift? That is, how are mountains made in the American West? (Think about specific provinces and how uplift occurred in each.)*
- *Describe how different features in the metasedimentary rocks of Glacier NP reveal the depositional setting during the Precambrian.*
- *How does the Basin and Range geologic province differ from the Great Basin hydrologic province?*
- *Why is the crust of the Basin and Range province so thin? What features of the modern landscape suggest that the Basin and Range is geologically active?*
- *What types of desert landscape features are formed by wind in Death Valley NP? What types of features are formed by water?*
- *How are the mountains of the Grand Tetons similar to the Sierra Nevada? How are they different in terms of composition and age?*
- *Describe the process by which lakes are formed along the base of the Grand Tetons.*
- *How is Yellowstone NP similar to Crater Lake NP? How do the two parks differ?*
- *What are the main rock types that form the foundations of Yellowstone NP? What are the processes involved in their formation?*
- *Why is the San Andreas transform plate boundary considered to be a zone, rather than a single fault line?*
- *How do strike-slip faults form?*
- *What is the role of earthquakes in the motion along the San Andreas fault?*
- *What types of rocks dominate Pinnacles NP? What do they tell us about motion along the San Andreas fault?*

- *How does the San Andreas fault relate to Point Reyes National Seashore?*
- *How did the granite rocks of Point Reyes NS get to their current location?*
- *How do sea cliffs, sea arches, and sea stacks form?*
- *What is an estuary? How did the main estuary at Point Reyes form in response to the post-glacial marine transgression of the last 18 thousand years?*