Study Guide: Lecture Exam 3 - Covers Chapters 1-7, 9,10 (old material) and 13,14,16,18,15,8 and Interlude F,D (new material) in text (Essentials of Geology), lecture and lab material

Exam rules: The class is very large (>230 students) so there will be some measures taken to discourage cheating. This exam will be 65 multiple choice questions worth 130pts. Approximately 2/3 of the questions will cover new material and the remaining 1/3 of the questions will be a review from exams 1 and 2 material, the exam is computer graded. Expect questions over ~10 slides, similar to the previous exams. Use photos and figures in lecture text review slides to study for slides.

- Please use # 2 pencil, this works best to blacken in the bubbles on the form
- No hats, if you wear a hat the brim will need to be turned backwards
- No sunglasses
- No talking during the exam
- No cell phones, pagers, or other electronic devices.
- No electronic translators are allowed - a paper dictionary is okay if checked by instructor before the exam
- **Please bring your WSU ID, your ID will be checked when you hand in your exam**

Chapter 1 – Earth in Context

- Understand the workings behind the scientific method. What are the different steps and the balances and checks associated with the scientific method.
- The Earth began to differentiate forming a stratified Earth. How does density change with depth? What are these zones (not necessary to memorize depths)? How are these zones (Fig 1.1) grouped to form the Geodynamo System and Plate Tectonic system? Which one makes up the tectonic plates? Which zones are strong and which ones are weak or ductile?
- How old is the Earth?
- What is the theory of plate tectonics? What is the driving force behind plate tectonics?

Chapter 2 – The Way the Earth Works: Plate Tectonics

- What type of plate boundary do earthquakes occur at? What type of plate boundary do volcanoes occur at?
- What are the three main types of plate tectonic boundaries and any subdivisions of each? What are the plate motions relative to each other? What are the stresses associated with each? Are there any features associated with these boundaries (mid-ocean ridge, trench, subduction zone, rift, volcanoes)?
- Identify the plate tectonic settings for real world examples of the different type of plate boundaries and hot spots (location or mountain range)? (Iceland, Mid-Atlantic Ridge, East African Rift, Red Sea, Cascade Mtn, Andes Mtn, Himalayas, Hawaii, Yellowstone, Aleutians Island Chain, Japan, Gulf of California, Sea of Cortez), San Andreas fault)
- What determines which plate will subduct?
- What are hot spots? Where would you find them? Do they create or destroy oceanic or continental crust? What feature/landform do you find above them?

Chapter 3 – Patterns in Nature: Minerals

- What is a mineral?
- What are mineral polymorphs? What are the polymorphs of carbon? (as discussed in class)
- What is the most abundant mineral group in the crust?

Chapter 4 – Up from the Inferno: Magma and Igneous Rocks

- How are igneous rock formed? What are the two types of igneous rock? How does the location where they cool affect the speed of cooling and there crystal size?

- Understand and be able to **use** (or recognize in slides) the following terms: plutonic, volcanic, intrusive, extrusive, aphanitic, phaneritic, porphyritic, pegmatitic, glassy, vesicular, pyroclastic. What does each texture indicate about the rate of cooling?

Chapter 5 – The Wrath of Vulcan: Volcanic Eruptions

- Be able to discuss any of the following: Mt. Rainier and Hawaii, in terms of the dominant landform (composite and shield volcano), eruptive style, composition of magma/lava, viscosity of magma/lava, type of plate boundary. Describe the volcanic hazards associated with Mt. Rainier, WA.

Interlude B – A surface Veneer: Sediments and Soil

- What is weathering and erosion, how do they differ?
- Be familiar with the different types of chemical (hydrolysis, oxidation, dissolution) weathering and physical weathering?

Chapter 6 – Pages of Earth's Past: Sedimentary Rocks

- What is sediment and where does it come from?
- What are the 3 classes/categories of sedimentary rock and under what conditions do they form?
- For clastic rocks be able to recognize sorting and rounding differences? What do these textures indicate about the sediment transport distance? How is the sorting, rounding and size of particles affected by the agent of transport (wind, water, ice)?
- What are sedimentary structures? Be familiar with the different types of sedimentary structures and what information they provide?
- How does sediment become a sedimentary rock? What is lithification?

Chapter 7 – Metamorphism: A process of Change

- What are the controlling factors of metamorphism?
- What are the main types of metamorphism (regional, contact, shock), where do they occur geologically and what type of plate boundary are they associated with them (if any)?
- What is foliation? What pressure condition is needed for its development? What other factor determines if a rock will develop a foliation? Will a limestone or sandstone parent rock develop foliation under directed pressure (and a high temperature)? Why or why not?

Chapter 10 – Deep Time: How Old is Old? and Interlude E: Memories of Past Life: Fossils and Evolution

- Know the difference between absolute and relative dates, and how they're determined.
- Know and understand(be able to apply) the principles of relative dating (original horizontality, superposition, cross-cutting relationships, etc)
- Know each type of unconformities (each type), what do they represent and how they form.
- Geologic Time Scale: You **<u>DO NOT</u>** need to memorize all of it. You should know the names and ages of the Eons (Precambrian) and Eras (Paleozoic, Mesozoic, and Cenozoic). You should be able to put them in relative order from oldest to youngest.
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Chapter 9 – Crags Cracks, and Crumples: Crustal Deformation and Mountain Building and Interlude F (Box F.1)

- Be able to recognize all structures presented as a map or a cross-section view given the age relationship and strike and dip symbols of the units. Be able to name the type of structure (horizontal or plunging anticline or syncline, reverse or other fault types), the type of stress involved, the strain type and the type of plate boundary where each would form.

Chapter 13 – Unsafe Ground: Landslides and Other Mass Movements

- Know the controlling force of mass wasting (gravity)
- Know the important factors in mass wasting (earth material, water content, slope
- Review the types and rates of movement (e.g., creep compared to rock avalanche)

- Understand the different types of mass wasting and their causes (e.g., creep, slump, rock avalanche, mud flow, rock slide, debris flow, debris avalanche)
- Know the effects of deforestation on mass wasting
- Understand the difference in stability for rock layers – beds parallel a valley slope and those beds which dip into the valley wall.
- What are the triggers for mass wasting? Can human activity trigger mass wasting? How?

Chapter 14 – Running Water: The Geology of Steams and Floods

- How do rivers and streams fit into the hydrologic cycle (run off verses infiltration)? What are the different water reservoirs? Be able to place them in order from largest to smallest.
- How are materials transported in rivers and streams?
- What are stream divides and drainage basins?
- Be able to recognize the difference between stream channel types (straight, meandering, braided).
- Be able to recognize the different stream drainage patterns and what each tells you about the underlying rocks. (dendritic – flat lying or composed of similar materials, etc.)
- Describe how velocity changes within a meandering stream. How does this lead to the formation of point bars and cut banks? How do meandering streams change over time? How do oxbow lakes form? What are meander scars?
- Be able to use (and recognize units of) the following terms: velocity, gradient, discharge.
- Recognize and explain how the following form: floodplain, levees, terraces, alluvial fans, deltas.
- If a flood has a recurrence interval of 20 years, what is the % chance that this magnitude flood will happen this year? What about the next year? (This applies to 5, 10 or any flood event)

Chapter 16 – Hidden Reserve: Groundwater

- Be able to describe the hydrologic cycle.
- List the factors that control the rate of groundwater recharge (infiltration).
- Be able to **use** the following terms as related to lecture **and** lab: unsaturated zone, saturated zone, water table, porosity, permeability, aquifer, confined aquifer, aquitard, artesian well, and recharge.
- Consider the following 6 rock/sediment samples. Which sample/samples have high or very high porosity? Which has the **highest** permeability? Which sample/samples would be most likely to form aquifers? Which sample/samples would form aquitards?

  Sample A – well-sorted, coarse-grained unconsolidated sediments.
  Sample B - very poorly sorted unconsolidated sediments.
  Sample C - highly fractured basalt
  Sample D - unfractured granite
  Sample E - unfractured mudstone /shale
  Sample F - very well cemented sandstone
- Explain when and why the following occur: cone of depression, subsidence, saltwater intrusion
- What is the difference between hot springs and geysers? What heats the water of hydrothermal activity? What is the source (plate boundary or hot spot) of heat for the geysers of Yellowstone?
- What is karst? How is it related to groundwater? In which rock type does karst **most** commonly form? Describe the features of karst (below and above the earth's surface). What is dissolution? What are speleothems? How do they form? Speleothems are made of which mineral? How does it form caves? How do stalactites differ from stalagmites? How do collapse sinkholes form?
- What are some possible sources for groundwater pollution that you may see in a rural or urban setting?

Chapter 15 – Restless Realm: Oceans and Coasts

- How do we know what the seafloor is like? Explain how man has been able to map the seafloor.

- How does the seafloor change as one travels from Atlantic coast if New England to the divergent plate boundary at the Mid Atlantic Ridge. Where would you find the coastal plain, continental shelf, continental slope, continental rise, abyssal plain, abyssal hills and rift valley?
- Have portions of the continental shelf ever been exposed at the surface? If so, when might this occur and how might this change its surface? Does the continental shelf area have any economic importance? Please explain.
- Identify the type of mass movement of sediment which occurs along the continental slope and rise. What submarine features do they give rise to?
- How do waves form? What factors would increase a waves' height? Understand and be able to explain the following terms: wavelength, wave height, and wave period.
- Be familiar with the major parts of a beach profile (figure 15.10). What is the swash zone? What causes breakers (breaking waves) in the surf zone? What is a long shore current? And how does it move sediment? What are rip currents and why are they dangerous to swimmers? What do you need to do to escape one?
- Explain what causes ocean tides on earth. Why are tides higher at some locations?
- Be able to identify some erosional coastal landforms (wave cut - cliffs,- platform, - terrace, sea stacks, sea arch), and depositional coastal landforms (tombolos, sand spits, barrier islands).
- How do seasonal changes affect beach profiles? Man-made structures like groins, breakwaters, jetties are used to prevent beach erosion. In general what is there affect where there constructed? And the affect down-current (down coast) of the structures?

Chapter 18 – Amazing Ice: Glaciers and Ice Ages

- What are glaciers?
- Describe the two main types of glaciers and the environment in which they form. Be able to recognize modern examples of each.
- How does the abundance of glacial ice affect sea level? Explain using the hydrologic cycle.
- Be able to distinguish the following features as erosional or depositional. In addition, which features indicate alpine/valley glaciation? Which features indicate continental ice sheets? (i.e. be able to recognize and know the processes that form them. They may be in the form of slides or other figures). **Features:** Cirque, Arete, Horn, Hanging Valley, U-Shaped Valley, Fjord, Lateral Moraine, Medial Moraine, Terminal Moraine, Ground Moraine, Recessional Moraine, Kame, Esker, Drumlin, Kettles, Striations, Erratic, Till. Use text figures 18.11 and 18.16 for review.
- Ice ages have occurred (or are occurring) on earth during which geologic periods? What evidence supports this hypothesis?
- What factors are believed to cause ice ages (long-term causes)?
- What factors cause the glacial and interglacial fluctuations within ice ages? (i.e. describe the three astronomical factors that affect the amount of solar radiation striking the earth.)
- Consider the video, "*The Great Floods*". Briefly explain how the Channeled Scablands formed. Be sure to include which type of glaciation was involved. What key geologic feature (sedimentary structure) indicates the volume of water that was involved in flooding?
- What is the Palouse loess and how did it form?
- Be able to put the following events that formed the Palouse region in relative order: the formation of the Palouse Loess, the formation of the Columbia River Basalts, the formation of the Channeled Scablands.
- Consdier the video, "The Little Ice Age, Big Chill". What are some of the consequences of a small change in the temperature on humankind? What factors contributed to the advance of the Little Ice Age? Could global warming lead into global cooling and the onset of a glacial advance?

Chapter 8 – A Violent Pulse: Earthquakes

- Draw a diagram illustrating the difference between the focus and the epicenter of an earthquake.
- Describe the differences between P and S waves (velocity, type of motion)
- How does Moment-Magnitude differ from the Richter scale?
- Describe the different effects of earthquakes (tsunami, liquefaction, etc.)

- Is it possible to experience a tsunami, without feeling an earthquake? Explain your answer.
- Understand the relationship between earthquakes and plate tectonics.
- How are mid-plate earthquakes explained?
- From the video, "*The Day the Earth Shook*"describe the similarities and differences between the Kobe and Northridge earthquakes. Geologically, why were there more fatalities in the Kobe earthquake? How are P and S waves used to prevent additional fatalities from train accidents? What is liquefaction?

Interlude D – Seeing Inside the Earth

- Describe the differences between P and S waves (velocity, type of motion, ability to move through solids and liquids, etc.). What do seismic waves tell us about the earth's interior?
- How does the velocity of both P and S waves change as they move through the earth?
- What are earthquake shadow zones? What causes P wave shadow zones to form? What causes S wave shadow zones to form?
- What do seismic waves tell us about the Earth's interior?

+ any other questions from additional videos, in-class assignments or special topics.