Geology 101 Name(s):

Lab 1: Maps and geologic time

Note: On all labs, you may work in small groups. You may turn in one lab for all of the group members; make sure that everyone who should get credit is listed! For exams, you may use the labs as a reference, but you may not share labs during the exam — please keep a copy of the answers for your own use.

Raised relief map of Mt. Rainier

These maps make the idea of elevations and **contours** more tangible — follow any of the *brown-line* contours; they should form a level path.

1. a. On a map such as this, how can you tell where the glaciers are?

b. In which direction do the glaciers flow on this map? This is sort of a trick question.

c. In what sort of geographic feature do the glaciers lie? Hint: Look *downstream*.

d. So if the glaciers disappeared, what would be left behind (geographically) on the mountain?

2. What is the **vertical exaggeration** on this map? Does this mean that the mountains are **taller** than they ought to be for the scale of the map, or **shorter**?

Crater Lake, Oregon topographic map (1956)

Topographic maps (or "topo sheets") show a representation of an area, and use contour lines to depict elevations, but there is much more information than just elevations, as you'll see...

3. What is the scale of this map? Meaning, one inch equals ____________ inches, which equals how many miles?

4. What is the longest distance across the lake? Hint: You *could* use a ruler, but that's not the easiest way to do it.

5. What would Crater Lake's lake bottom area look like, if the lake were drained completely? In other words, would the bottom be flat? Would it have mountains?

6. What evidence is there on the map of Crater Lake's **volcanic** origin?

Mt. St. Helens (1981) topographic map

7. Who produced this map? Of all the topo maps you are using in this lab, this has the most recent date. How come (specifically, why aren't we using the 1950s era map)?

8. What is the longest distance across the **caldera**? Hint: is the scale of this map the same as the previous map? So how does this caldera's size compare to Crater Lake's size?

9. If the north side of Mt. St. Helens had not collapsed, what could have happened to the caldera? Hint: See previous map.

10. Apart from the obvious 1980 event, how do you know that Mt. St. Helens has a volcanic origin? Hint: You may wish to look at a larger map in the southwest corner of the room.

11. Why didn't the Mt. St. Helens eruption of 1980 affect the upper Cowlitz River valley (where State Route 12 runs)? Hint: look at the Mt. Rainier raised relief map.

12. What is the *highest* **elevation** on the map? What is the *lowest* elevation on the map? Include **units**. Hint: the highest elevation is typically the peak that the map is named after, but how do you figure out the lowest elevation?

13. What is the **latitude** and **longitude** of the Mt. St. Helens crater? Include **units** and **compass directions**.

14. What is the slope of the inner wall of the **caldera**? What is the slope of the **southern flank** of the mountain? Which is *steeper*? Report slopes as a **percent slope** (calculate this by picking two contour lines on the slope, then find the difference in elevation between the two lines, divide by the lateral distance between the two lines and multiply the result by 100).

North Cove, Washington quadrangle (1956 and 1995)

15. As you may have heard on the news the other day, this area (known also as "Washaway Beach") has been eroding rapidly over the past couple weeks. Since 1956, the coastline has steadily eroded back to the town of North Cove (on the northern part of the map) and Highway 13A (now called Highway 105). Using the blue line which defines the **shoreline**, calculate the **rate** of coastal erosion here.

16. What changes have been forced on human usage of this area?

17. a. Judging by the shape of Leadbetter Point spit, what is the direction of the **longshore drift** (the larger map may also help answer this question)? Therefore, where is the most likely source of sediment for the creation of Willapa Bay?

b. So, ultimately, what is causing the coastal erosion of North Cove?

Geologic Map of Washington

Geological maps have a different emphasis than topographical maps. Though the topography might lurk in the background of a geological map, it may be hard to figure out exactly where you are on a geological map!

18. Note the column headed "Geologic Units" to the right of the map. By what **two** characteristics are the geologic units divided into different colors?

19. Locate north Seattle. Write the **two-letter** designation of the local geologic unit. What is the apparent dominant **geologic force** that has shaped this area (hint: read the unit description and guess what the second letter of the designation stands for)?

20. Note the large portion of the colored areas on the map that have a “Q” as the first letter of that geologic unit. Give a **reason** that there is so much “Q” area.

21. Note the “Explanation” of symbols at the bottom of the map. A “**contact**” is a line along which two geologic units meet. A “**fault**” is a breakage in the rocks along which movement has occurred.

Are all the faults shown on the map **active**? Explain your answer; **sketch** a portion of the map that illustrates your answer. Hint: Do some of the faults seem to terminate abruptly when the color of the geologic unit changes? What does this indicate about the “brokenness” of the color without the fault and what does this imply about the fault?

The geological time scale

The geological time scale was developed over the course of the last three centuries as a means of identifying times when distinct assemblages of organisms lived. Over the next few weeks, we will discuss how this timescale was developed and calibrated. For now, though, it is enough to notice that most timescales (such as the one attached to this handout) seem to show different periods of the Earth’s history as being approximately the same length. Let’s see how true this is.

For this lab, you will need:
- Some partners
- One or two meter stick(s)
- A length of masking tape
- A calculator
- A pen which will write distinctly (without smearing) on the tape
- The geologic time scale handout (**our timescale**)
- The 1983/1999 geologic time scale handout (**GSA timescale**)

Lay out a piece of masking tape down the length of a table. This will represent 4.6 billion years of Earth's history; therefore, mark one end as "0 million years (the present)" and the other end as "4600 million years (Earth's origin)".

(The difficult part) Using a calculator (or by hand), mark all the numerical ages listed on our timescale **proportionally** on the length of tape. For instance, the boundary between the Cambrian and the Proterozoic is at 545 million years. 545/4600 = .118 = 11.8% of Earth history. Let's say your tape is 6.7 meters long. Then multiply the proportion of Earth history times the length of the tape: 0.118 × 6.7 meters = 0.79 meters, so you would draw a line 0.79 meters (79 centimeters) away from the "0" end of the tape, and label one side "Cambrian" and the other side "Proterozoic".

When you are done, answer the following questions:

22. What type of **event** do you suppose defines these boundaries between times you have just drawn? Hint: If all the species *between* the boundaries stayed roughly the same, then *at* the boundaries...

23. Why do you suppose there are different levels of divisions? In other words, how does the answer to question 1 allow for **eons**, **eras**, **periods** and **epochs**? On your tape timescale, indicate the larger groupings as best as you can (for instance, draw a large bar that connects the **Cretaceous, Jurassic** and **Triassic** periods into the **Mesozoic** era).

24. a. Are there any finer **subdivisions** of time beyond epochs? (Hint: look at the 1999 Geologic Time Scale) What are they?

b. Do the periods on our timescale that don’t seem to be divided into epochs (such as the Cretaceous period) actually have epochs? If so, why didn’t I include them on our timescale?

25. The **Quaternary period** is recognized to be the time when more or less modern humans (that is, mammals with an upright stance and certain brain volume) were the dominant species on Earth. What **percentage** of all geologic time does this represent?

26. In comparison, the dinosaurs "ruled" the Earth during the Mesozoic era. What percentage of all geologic time does this represent? How does this value compare to human “dominance”?

27. Some paleontologists at the University of Chicago have proposed that the Milky Way may be the cause of the answer to question 22. Apparently, matter in the Milky Way is distributed unevenly; there are areas of dense gas and dust clouds separated by areas of lesser density. The solar system, in its orbit around the center of the Milky Way, intercepts a dense area of galactic dust on a regular basis. When we encounter such a dense area, larger bodies on the edge of the solar system (such as large comet nuclei) are perturbed and fall toward the Sun, and also the Earth, initiating the answer to question 1. During the **Paleozoic era**, how often (in millions of years) on average did this occur?

28. What is the **average recurrence interval** of the comet bombardment in the Mesozoic and Cenozoic eras (ignore the Quaternary period — we’re still in it)? Is the “recurring comet swarm” hypothesis reasonable, numerically?

29. Now look at the "1983 Geologic Time Scale/1999 Geologic Time Scale" handout. The column headings (the four across the top) are the **eras**. Each era is divided into **periods**, then further divided into **epochs** and, finally, subdivided into **ages**. In sixteen years, list **three** differences between the two time scales. Why, in fact, do the numbers keep changing?