Name_____

You will not start this work before you are prepared for it. First you will need information on it to complete your writing this assignment, so take good notes and hang onto it.

Density and Isostasy

It doesn't matter which order you do Parts I and II in, so just choose one to get started on.

PART I: Density of different types of rocks

Although the earth has many different kinds of rocks, some are more common than others and can be considered the main constituents of the crust. In order to get a feel for the range of densities that occur within average rock types, you will measure several rock samples to get an idea of the variation in density on the earth. **Weigh and measure 1 sample each of granite, basalt, and peridotite.** Fill in the table below and write your data on the board so we can gather class measurements and find averages. Use the electronic balance to weigh the samples, and use water displacement to measure the volume. (Remember that **1 mL = 1 cm³**). To get density, then, all you have to do is divide the sample mass by its volume.

	Basalt	**Granite**	**Peridotite**
Sample mass (g)			
Original water volume (ml)			
Volume of water and rock (ml)			
Volume of rock (cm³)			
Density of rock (g/cm³)			
Class average density (g/cm³)			
Number 1-3, from least-most dense			
Which component of the earth?*			

* your choices are continental crust, oceanic crust, and mantle

PART II: Isostasy and the buoyant force

In this part of the lab, you will measure some of the properties of wood floating in water and then compare it to processes happening in the earth's crust and mantle. Choose two of the different types of wood, measure their mass (using the balance) and volume (using a ruler), and write your measurements in the **table below** and on the board. Then float your block of wood in a tub of water and measure the amount of each block that is above and below the equilibrium water line.

Type of wood ^¨	Mass (g)	Height (cm) H_{total}	Width (cm)	Length (cm)	Volume (cm³)	Density (ρ) (g/cm³)	X* ρ_{wood}/ρ_{water}**	Height above water H_{above} (cm)	Height below water H_{below} (cm)	Y* H_{below} / H_{total} ***

^ You need to measure two wood types, but you should record data for several other wood types to include on your graph. All you need to record for those is X and Y.
* These are the columns you will graph. The values in these columns should be expressed as decimals.
** The density of water is 1 g/cm³
*** H_{total} should come from the third column.

1. Graph columns X and Y on the next page. Label your axes, graphing the column labeled X on the x-axis and Y on the y-axis. Based on the graph, describe the relationship between the density ratios and the height ratios.
2. Write an equation that expresses how the density of the wood block relates to the height of the block below the equilibrium line. The only thing on the left-hand side of the equation should be H_{below}. (Remember: The wood block is floating in equilibrium when it has displaced a volume of water that has the same mass as the entire wood block. If the wood block is 80% as dense as water, than 80% of the block will sit below the water line.)

3. Now rewrite the equation so that it is solved for the height of the wood block **above** the equilibrium line.

4. Describe how the wood block measurements would change if the block were floating in a tub of honey instead of water. What would you expect to see and why?

PART III: Density, Isostasy and Global Topography

Now let's relate this to the earth. Recall from your reading that seismic evidence indicates that oceanic crust has an average thickness of ~ 5 km, while continental crust averages ~30 km thickness.

5. Using the average density of basalt that the class measured and the equation you generated in question 3, calculate how high basalt floats in the mantle (in km). Show your work.

6. Likewise, using the average density the class measured for granite, calculate how high granitic crust sits in the mantle (in km) if its average thickness is 30 km. Show your work.

7. What is the difference (in km) between these two calculations?

8. Now look at the figure on the next page. How does your answer from previous question compare to the difference between the average elevation of continents and ocean floors? Based on all of your results, explain why the earth has a bimodal topography as shown on the histogram.

9. Again using your equation, calculate the thickness of the crust in the Andes, assuming they are made largely of granite and have an average elevation of 5 km **above sea level**.

10. Based on what you now know about crustal thickness and isostasy, sketch a cross section on the back of this handout showing what you would expect the crust to look like in an east-west cross-section across South America. Include approximate crustal thicknesses; try to draw it to scale.
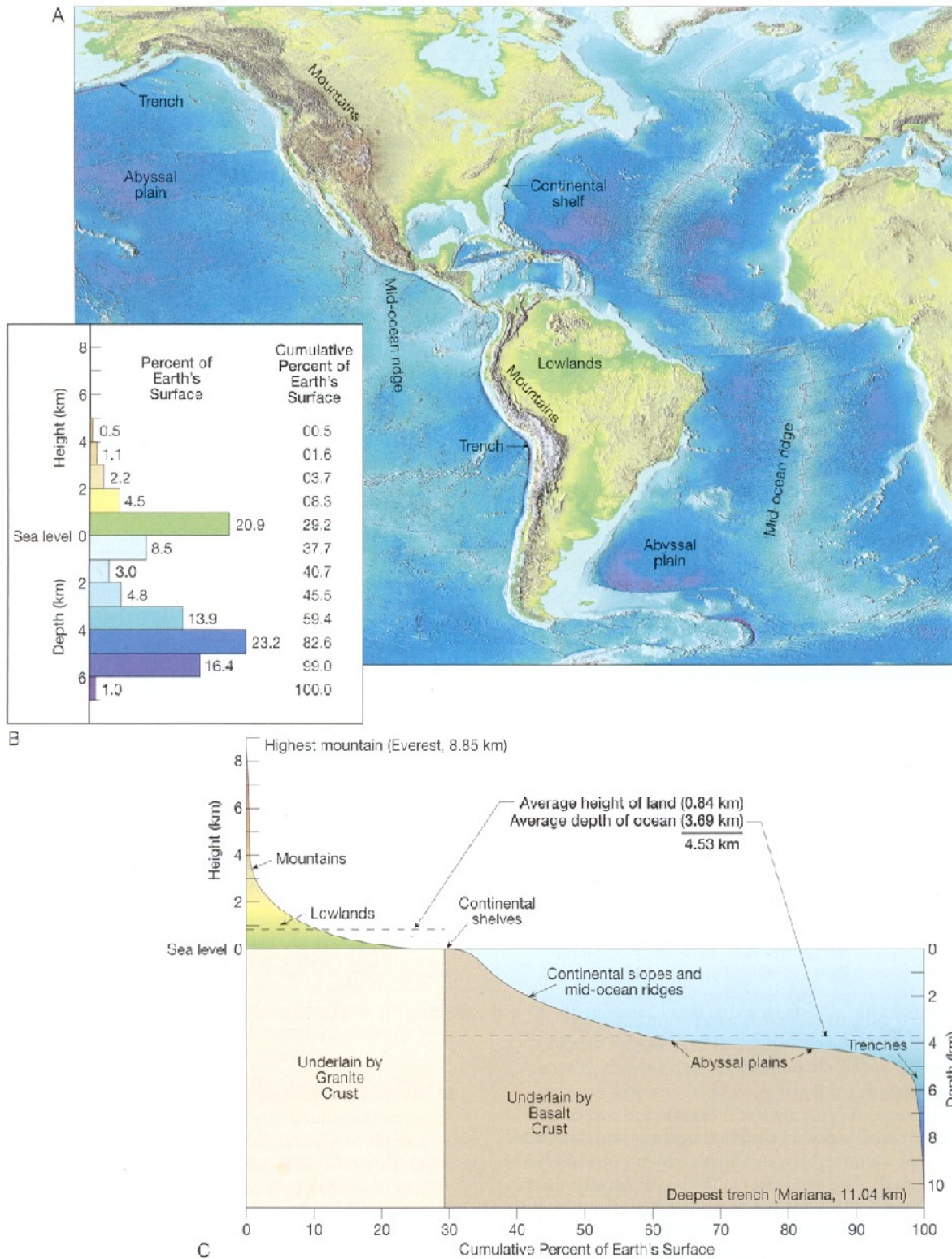
A. Topographic map of a portion of the earth. **B.** Histogram showing frequency of elevations in 1 km increments. **C.** Hypsographic curve showing cumulative percent of earth surface elevations. from *Laboratory Manual in Physical Geology, AGI/NAGT, 2003, Richard M. Busch, ed.*