Density of the Earth Lab

Background: Density may be defined as a measure of how much mass is contained in a given unit of volume (density = mass/volume) where mass is expressed in grams (g); volume in mL or cm^3; and density in g/mL (liquid) or g/cm^3 (solid). In other words, if mass is a measure of how much "stuff" there is in an object, then density is a measure of how tightly that "stuff" is packed together. In this lab, we will attempt to determine the density of the Earth.

As you already know, density is found by dividing the mass of an object by its volume (see above formula). Henry Cavendish is one of the first scientists that calculated the mass and density of the Earth. He accomplished this by assembling a suspended metal rod with two lead balls hanging freely. Cavendish then placed masses of metal near these balls in order to measure the force of attraction between them. Based on this experiment, he was able to determine the attraction on a mass the size of the Earth and hence determine the Earth's density; his experiment has become known as the Cavendish Experiment.

Cavendish's experiments determining the density of the Earth were published in the ***Philosophical Transactions of the Royal Society*** in 1798. By completing his experiment, he found the density of the Earth and he was able to determine the mass of the Earth (which allowed the determination of masses for other celestial objects). In addition, not only was he able to verify the universal nature of Newton's Law of Gravitation, Cavendish's results can be used to calculate the gravitational constant G. In fact, the Cavendish experiment is often described as the first determination of this constant.

Materials:

triple beam balance
rock sample of granite
rock sample of basalt
rock sample of slate
graduated cylinder
water
calculator

Procedure:

1) obtain tray of materials
2) using the triple beam balance, determine the mass of all rock samples
3) record these masses on your chart
4) using the method of water displacement, determine the volume of all rock samples
    - measure 100 mL of H_2O into graduated cylinder
    - carefully slide rock into graduated cylinder
    - record measure of displacement (volume) on your chart
5) determine the densities of the rock samples
6) answer given questions

Data Chart:

SAMPLE	MASS	VOLUME	DENSITY
Granite			
Slate			
Basalt			
Iron	**n/a**	**n/a**	**7.87 g/cm^3**

Questions:

1. Determine the average density of the three (3) rock samples. Record your result.

2. How does the density of the iron sample compare with the average density of the rock samples? Explain.

3. Add the density of iron to the average density of the rock samples and divide by two (2). This value represents the density of the Earth. Record your determined density.

4. The known density of the Earth is 5.51 g/cm^3. How does your experimental value compare with the known density?

5. What do you think might be the cause of any errors in this lab?

6. What layer(s) of the earth do the three (3) rock samples represent?

7. What layer(s) of the earth does the iron sample represent?

8. Why is it not necessary to represent the mantle in this investigation?

******When doing the lab report write-up, be sure to follow the guidelines.******