

Chemistry of Our Environment

Experiment #2

Density

In today's experiment we will need to use a measuring device called a Vernier Caliper.

Now we will use this newly learned technique to measure a property of matter, called density. But first we need to learn how to calculate density.

Part A: Relationship between mass and physical dimensions:

- 1) Select several ball bearings of different sizes.
- 2) Using Vernier calipers, measure the diameter of each of the ball bearings, as accurately and precisely as you can.
- 3) Measure the mass of each of the ball bearings using the balances.
- 4) Using a graphing program or a spreadsheet, enter the mass and diameter data for each ball bearing. We will do this as a class.
- 5) Calculate the volume of each ball bearing, using the formula: $V = 4 / 3 (\pi r^3)$.
- 6) Calculate the surface area of each ball bearing, using the formula: $S = 4\pi r^2$.
- 7) Prepare graphs of mass vs diameter, mass vs. surface area, and mass vs. volume. Determine a regression line (best straight line) for each graph.
- 8) Which straight line seems to be the best representation of the data?
- 9) From the slope of this best straight line, determine the density of the ball bearings.
- 10) Determine the formula for density, from the formula of slope.
- 11) Discuss the validity of the formula for density, including an explanation of why density for a substance in liquid or solid form is the same, regardless of the size of the sample.

Part B: Density of an Unknown Liquid:

In our determination of the density of the bearings, the volumes were expressed in mm^3 , which is a volume unit for solids. A more common unit for the volume of solids is cm^3 . In chemistry, the usual volume unit for liquids is the milliliter, mL. Since $1 \text{ cm}^3 = 1 \text{ mL}$ exactly, the 2 volume units are really the same.

- 1) Place a clean, dry 25 mL graduated cylinder on a balance and tare the balance so that it reads 0.000.
- 2) Add 10-15 mL of your unknown liquid to the graduated cylinder.
- 3) Immediately, accurately measure the volume of the liquid.
- 4) Also, record the mass of the graduated cylinder with the liquid, without delay. This is the mass of the liquid.
- 5) Using the formula for density, calculate the density of the unknown liquid.