SCB203: HUMAN BIOLOGY I

THE METRIC SYSTEM

LAB #2

The metric system is based on decimals, the same way that money is. That is, the units of the metric system are in tens, hundreds or thousands. The system is used in all parts of the world to measure volumes, lengths, areas and weights. The metric unit for length is the meter (m). It is separated into 100 smaller units called centimeters (cm). The prefix centi- in centimeters means $1/100^{th}$, just as a cent is $1/100^{th}$ of a dollar. Each centimeter is separated into ten smaller units called millimeters (mm). The prefix milli means $1/1000^{th}$ since there are a total of 1000 millimeters in a meter.

Exercise 1

Using the meter stick, measure the length of your thumb from the webbing to the tip. Express the answer first in millimeters (mm) and then in centimeters (cm) (For example 120 millimeters is equivalent to 12 centimeters since there are 10 millimeters per centimeter).

Length of thumb in mm = _____

Length of thumb in cm = _____

Now measure in cm the intra-optical distance of your partner (Have your partner stare straight ahead and measure the distance between his or her pupils). The intra-optical distance is measured by optometrists to determine the proper distance between lens centers in glasses.

Intra-optical distance in cm = _____

Calculate the surface area of the bottom of your shoes by measuring them at their widest and longest points. Multiply these two figures to get the area.

Length in cm _____ **x Width in cm** _____ **= Area** _____ **(cm^2)**

The answer will come out in square centimeters (cm^2), which is one of the metric measurements for area. Others would be square millimeters (mm^2), and square meters (m^2). (If you divide your weight by your answer, you would have a measurement of the amount of pressure applied to the floor by your foot).

Exercise 2

The unit of volume for the metric system is the liter (L) for liquids and gases and the cubic meter (m^3), for solids. There are 1000 milliliters (ml) in 1 Liter (L).

One use of volume measurements in physiology is to measure the amount of air transpired by an individual in a single breath. Take one of the balloons provided and exhale a normal breath into it (Try not to force the air out of your lungs but just exhale normally). Immerse the balloon in a large battery jar, and estimate the rise of water level using the scale marked on the side of the jar. This displaced volume is exactly equal to the volume of what you have immersed, and if you haven't stuck your hand in as well should give a fairly accurate measurement of the air you have expelled in one breath. This volume measurement is called the tidal volume and is usually around 500ml.

Now take three or four deep breaths and exhale one breath completely into the balloon. (Force as much air out as possible). Place this in the water and measure its displaced volume. This measurement is your vital capacity. It is used only in emergency conditions or in heavy exercise. Smokers and city-dwellers tend to have low vital capacities, which means they have poorer capacity for responding to emergencies.

Tidal volume in ml = _____

Vital capacity in ml = _____

Exercise 3

The unit of weight in the metric system is called the gram (g). There are 1000 grams in a kilogram (kg) and 1000 milligrams (mg) in a gram.

You can convert from pounds (lb) to kilograms (kg) by using the formula:

$$\frac{\text{Pounds}}{2.2} = \text{kilograms}$$

Calculate your weight in kilograms by dividing it by the number 2.2 (lying is permitted where necessary.)

$$\frac{\text{Your weight in pounds}}{2.2} = \text{Your weight in kilograms}$$

Weight in kilograms = _____

Convert your answer into grams.

Your weight in kg x 1000 = your weight in grams

Weight in grams = _____

Convert your answer in to milligrams.

Your weight in grams x 1000 = your weight in milligrams

Weight in milligrams = _____

Exercise 4

Density is a way of relating weight and volume. A ball of cotton and a piece of iron, even though they are of equal volume, will weigh differently. This is due to the difference in their density.

Weigh your 10ml-graduated cylinder on your metric balance. This is called taring your balance and the weight you measure is called the tare or empty weight.

Add to the tared cylinder 10ml of water and weigh it again. Subtract the tare weight from this weight. The result will be the weight if the water.

Since we now know the volume of the water (10ml) and its weight, we can calculate the density.

$$\text{Density of water} = \frac{\text{Weight of the water}}{\text{Volume of water}}$$

The answer will come out in grams per millimeter (g/ml), which is a unit of density. Repeat the experiment using 10ml of ethyl alcohol. Are the densities of water and ethyl alcohol the same?

Density of water in g/ml = _____

Density of ethyl alcohol in g/ml = _____

How would you be able to measure your own body's density? You would need to know your weight and your volume. How could you estimate your body's volume?