Name:____ Student/Lobo ID: __________________
Course/Sec: _______________________________________ TA Name: ________________________

Metric Conversions and Scientific Notation
Essential Academic Skill Enhancement (EASE) workshop series

This workshop reviews the basics of conversions between measurement systems and proper scientific notation that is fundamental to accurate problem solving in STEM fields.

Science is often conducted in a number of different measurement systems depending on discipline or geographic region. In order to effectively communicate scientific findings, scientists often must convert between different systems of measurement using conversion factors. This workshop will give an overview of common conversion factors between the English and metric systems, and will go over the method behind accurate conversions in the biological sciences. Scientific notation is the way of writing and manipulating numbers that are too large or small to be written in the decimal form. We will discuss normalized notation or exponential notation (e.g., $ax10^b$) and how to use scientific notation effectively without losing precision, how to estimate ending digits in calculations, and *briefly discuss common bases (e.g., base 10 is normally used in scientific notation, can also use base 2).*

We will discuss:

- fundamental units of the two measuring systems
- use of integers in scientific notation
- significant figures
- estimation of final digits
- base forms
- precision, accuracy, and uncertainty

VOLUME (APPROXIMATE)		VOLUME (APPROXIMATE)	
1 teaspoon (tsp)	= 5 milliliters (ml)	1 milliliter (ml)	= 0.03 fluid ounce (fl oz)
1 tablespoon (tbsp)	= 15 milliliters (ml)	1 liter (l)	= 2.1 pints (pt)
1 fluid ounce (fl oz)	= 30 milliliters (ml)	1 liter (l)	= 1.06 quarts (qt)
1 cup (c)	= 0.24 liter (l)	1 liter (l)	= 0.26 gallon (gal)
1 pint (pt)	= 0.47 liter (l)		
1 quart (qt)	= 0.96 liter (l)		
1 gallon (gal)	= 3.8 liters (l)		
1 cubic foot (cu ft, ft^3)	= 0.03 cubic meter (m^3)	1 cubic meter (m^3)	= 36 cubic feet (cu ft, ft^3)
1 cubic yard (cu yd, yd^3)	= 0.76 cubic meter (m^3)	1 cubic meter (m^3)	= 1.3 cubic yards (cu yd, yd^3)

Assessment:

1. How many liters are in 2.64 pints?
   1.2408 OR 1.2571 depending on which conversion factor you use
2. Convert: 4.79 kl = ? ml.
   4,790,000 ml
3. Scientific notation:
   a. Approximate number of cells in the human body is 37,000,000,000,000 cells **3.7×10^{13}**
   b. Approximate size of a human skin cell is 0.00003 meters **3.0×10^{-5} meters**
4. Accuracy, Precision, and Uncertainty:
   a. Precision: are the values 12.01 in, 12.00 in, 11.99 in, and 12.00 in precise?
      YES, they are all close together
   b. What is the uncertainty of the above values – both average and range?

$$\frac{\sum_{i=1}^{n} |x_i - \bar{x}|}{n}$$

$$(x_{max} - x_{min})/2$$

   Average uncertainty = (|12.01-12|+|12-12|+|11.99-12|+|12-12|)/4 = 0.005
      Thus the ruler measures **12.00 ± 0.005**
   Range of uncertainty = (12.01-11.99)/2 = 0.01
      Thus, the ruler measures **12.00 ± 0.01**
   c. Accuracy: are the values above accurate if the known length is 30 cm (11.81 in)?
      NO (although in the real world, you'd have to do a statistical test and obtain a p-value to determine this)
5. Significant Figures, uncertain figures, and rounding:
   a. 13.214 + 234.6 + 7.0350 + 6.38 = **261.2**; only 1 uncertain figure (#)
   b. 0.00435 x 4.6 = **0.020**; least number of significant figures, in this case 2.
   c. 4503.67 + 34.90 x 5.724 = 4503.67 + 199.77 = **4703.44**
      Multiplication first, then round answer to least sig. figs. before doing addition. But, as a result of the exception to sig. figs. you can increase to 5 sig. figs. since the answer has a preceding 1, but there was not a preceding 1 in the original problem.
   d. 6.1625 x 2.00 = **12.32**; don't forget about the exception to rounding when dropping a 5 with no other non-zero digits, thus you around to the closes even digit.