Biology 103 Laboratory Exercise – Using the Metric System

Objective

This exercise is designed to familiarize students with the metric system through the use of metric units in the measurement of familiar objects.

Introduction

To make scientific data more easily understood, scientists around the world utilize the same systems of measurement. These common systems of measurement are recognized as the International System of Units (SI). The System encompasses seven basic units of measurement only four of which are of primary interest to biology students. These four units are length, mass, volume, and temperature. These four units of measurement are convenient to use because they are based on the number ten and multiples, thereof.

Refer to the following table of commonly used units for metric conversion in completing the exercise of this exercise.

SI Fundamental Units and Derived Units for this Exercise

Physical Quantity	Unit name	Symbol
Length	meter	m
Mass	kilogram	kg
Temperature	kelvin	K
Volume	cubic meter	cm^3 or cc

Traditional Metric and SI Prefixes

Prefix	Factor	Symbol
kilo	10^3 (1,000)	k
deci	10^{-1} (0.100)	d
centi	10^{-2} (0.010)	c
milli	10^{-3} (0.001)	m

Common Units of Mass and Weight

Mass	lb	oz.	kg	g
1 pound (lb)	1	16	0.4536	453.6
1 ounce (oz)	0.0625	1	2.836×10^{-2}	28.36
1 kilogram (kg)	2.204	35.3	1	1000
1 gram (g)	2.204×10^{-3}	0.0353	0.001	1

Common Units of Length				
Length	A	in.	m	cm
1 Angstrom (A)	1	3.94×10^{-9}	10^{-10}	10^{-8}
1 inch (in)	2.54×10^{8}	1	2.54×10^{-2}	2.54
1 meter (m)	10^{10}	39.37	1	10^{2}
1 centimeter (cm)	10^{8}	0.3937	10^{-2}	1

Common Units of Volume				
Volume	mL	cm^3	qt	oz.
1 milliliter (mL)	1	1	1.06×10^{-3}	3.392×10^{-2}
1 cubic centimeter (cm^3)	1	1	1.06×10^{-3}	3.392×10^{-2}
1 quart (qt)	943	943	1	32
1 fluid ounce (oz)	29.5	29.5	3.125×10^{-2}	1

Common Units of Temperature			
Temperature	$^{\circ}K$	$^{\circ}F$	$^{\circ}C$
1 degree Kelvin ($^{\circ}K$)	1	9/5 ($^{\circ}K$) – 459.7	$^{\circ}K$ + 273.16*
1 degree Fahrenheit ($^{\circ}F$)	5/9 ($^{\circ}F$) + 255.4	1	5/9 ($^{\circ}F$ – 32)
1 degree Centigrade ($^{\circ}C$)	$^{\circ}C$ - 273	9/5 ($^{\circ}C$) + 32	1

*Absolute zero ($^{\circ}K$) = 273.16 $^{\circ}C$

Materials Needed

Measuring sticks - *Links to several different sizes of measuring sticks have been provided on the webpage for this lab exercise
Cereal box
Coffee cup
Medium-sized drinking glass
Medium-sized measuring cup
Bathroom scale
Textbook
A shoe
Thermometer
Ice

Procedure

Follow the directions for each exercise. Record your results on the data sheet.

A. Measurements of Length

Obtain a meter stick. Measure your height in centimeters. Convert this measurement to meters.

Measure the long side of this page in centimeters. Convert this measurement to meters and then to millimeters.

Measure the length of the kitchen table and record the measurement in centimeters. Convert this measurement to meters and also to millimeters.

Measure the length of your shoe and record this measurement in centimeters. Convert this measurement to meters and also to millimeters.

B. Measurements of Volume

Part 1. volume in cubic centimeters (cm^3)

Obtain a cereal box. Measure the length, width, and height of the box in centimeters. Calculate the volume of the cereal box in cubic centimeters (Volume = length x width x height).

Part 2. volume in milliliters (mL)

Obtain a coffee cup, a medium sized drinking glass, and a medium sized measuring cup.

Fill the coffee cup with water. Determine the volume of the coffee cup by pouring the water into the measuring cup (use metric scale on the measuring cup). Record the volume in milliliters. Convert this measurement to liters and kiloliters.

Fill the drinking glass with water. Determine the volume of the drinking glass by pouring the water into the measuring cup (use metric scale on the measuring cup). Record the volume in milliliters. Convert this measurement to liters and kiloliters.

C. Measurements of Mass

Weigh yourself on the bathroom scale. Record your weight in kilograms. Convert this measurement to grams.

Weigh your textbook (preferably the biology textbook; it's really heavy . . .) on the bathroom scale. Record the textbook weight in kilograms. Convert this measurement to grams.

Weigh one of your shoes on the bathroom scale. Record the weight of your shoe in kilograms. Convert this measurement to grams.

D. Measurements of Temperature

Obtain a thermometer. **Handle the thermometer with care! This is a very delicate scientific instrument. Do not shake the thermometer!**

Without touching the bulb end of the thermometer, determine the room temperature in Celsius. Record this value on the data sheet.

Next, immerse the end of the thermometer into a glass of ice water. If possible, hold the bulb of the thermometer against a melting ice cube. Record this temperature value on the data sheet.

Last, hold the bulb of the thermometer tightly in your hand for several minutes. Record this temperature value on the data sheet.

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A. Measurements of length

Your height in centimeters _____ cm

Your height in meters	_____ m	in millimeters	_____ mm		
Length of the page	_____ m	_____ cm	_____ mm		
Kitchen table	_____ m	_____ cm	_____ mm		
Shoe	_____ m	_____ cm	_____ mm		

B. Measurements of volume

Cereal box

length _____ cm

width _____ cm

height _____ cm

volume_____ cm^3

Coffee cup

_____ mL

_____ L

_____ kL

Drinking glass

_____ mL

_____ L

_____ kL

C. Measurements of mass

Your weight in kilograms	_____ kg
Your weight in grams	_____ g
Textbook weight in kilograms	_____ kg
Textbook weight in grams	_____ g
Shoe weight in kilograms	_____ kg
Shoe weight in grams	_____ g

D. Measurements of temperature

Room temperature _____ degrees Celsius

Temperature at which ice melts (Ice water) _____ degrees Celsius

External body temperature of your hand _____ degrees Celsius

Is your body warmer or colder than the room air? _____

E. Conversions

If someone weighs 52 kg, he/she weighs _____ lb.

An object may weigh 8 lb. or _____ g.

The weatherman said it would reach a high of 82 today, that equals _____ °C.

Refrigerators usually measure about 4°F. This equals _____ °C.

It is about 58 miles to Huntsville from here. How far is it in km? _____ km

A 10 k run is _____ miles.

A 2 L soft drink contains _____ oz.

An 8 oz glass holds _____ ml of water.