Metric System, Microscope and Cell structure

Lab Learning Objectives:

Students should be able to:

1.1 The Metric System
   • State and use metric units of measure for length and volume.
   • State and use metric units of measure for weight.

1.2 Use of the Compound Light Microscope
   • Name and give the function of the basic parts of the compound light microscope.
   • List, in proper order, the steps used for bringing an object into focus with the compound light microscope.
   • Calculate the total magnification.
   • Describe how the slide of the letter e provides information on the inversion of the image in the compound light microscope.

1.3 Microscopic Observations
   • State two differences between onion epidermal cells and human epithelial cells.
   • Identify plasma membrane/cell wall, nucleus and cytoplasm.

1.4 Human (Animal) cell structure
   • Identify the structures of a human (animal) cell.
   • Identify and state the functions of the organelles of an animal cell.

1.5 The plasma membrane
   • Define and describe the process of diffusion as exemplified by the experimental procedure used here.
   • Define isotonic, hypertonic and hypotonic solutions and give examples in terms of solute concentration.
   • Predict the effect of these solutions on red blood cells.

Task 1: Using the metric system.

The standard system of measurement in science is the metric system. The advantage of this system is that the units increase or decrease in powers of ten. Because of this, calculations are easier using this system.

During this task you will learn the most common units used in science to measure length, volume and weight. The basic unit for length is the meter (m), the basic unit for volume is the liter (l) and for weight is the gram (g). Prefixes are short names attached to the front of a unit, without a space, which represent multiples of the unit.
1. Using a ruler, measure the length in centimeters of the wooden box in front of you: length ______________, width __________, depth ________.

![Diagram of a box with dimensions L, W, D]

2. The volume of the wooden block can be expressed in cubic cm³ or milliliters. Multiply length x width x depth = ________________ cm³ or cm³.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Prefix</th>
<th>Power of Ten</th>
<th>Ordinary Notation</th>
<th>Largest</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>giga</td>
<td>$10^9$</td>
<td>1 000 000 000</td>
<td>↑</td>
</tr>
<tr>
<td>M</td>
<td>mega</td>
<td>$10^6$</td>
<td>1 000 000</td>
<td>↑</td>
</tr>
<tr>
<td>k</td>
<td>kilo</td>
<td>$10^3$</td>
<td>1 000</td>
<td>↑</td>
</tr>
<tr>
<td>h</td>
<td>hecto</td>
<td>$10^2$</td>
<td>100</td>
<td>↑</td>
</tr>
<tr>
<td>da</td>
<td>deka</td>
<td>$10^1$</td>
<td>10</td>
<td>↑</td>
</tr>
<tr>
<td>m</td>
<td>Basic unit*</td>
<td>$10^0$</td>
<td>1</td>
<td>↓</td>
</tr>
<tr>
<td>d</td>
<td>deci</td>
<td>$10^{-1}$</td>
<td>0.1</td>
<td>↓</td>
</tr>
<tr>
<td>c</td>
<td>centi</td>
<td>$10^{-2}$</td>
<td>0.01</td>
<td>↓</td>
</tr>
<tr>
<td>mm</td>
<td>milli</td>
<td>$10^{-3}$</td>
<td>0.001</td>
<td>↓</td>
</tr>
<tr>
<td>μ</td>
<td>micro</td>
<td>$10^{-6}$</td>
<td>0.000 001</td>
<td>↓</td>
</tr>
<tr>
<td>n</td>
<td>nano</td>
<td>$10^{-9}$</td>
<td>0.000 000 001</td>
<td>↓</td>
</tr>
<tr>
<td>p</td>
<td>pico</td>
<td>$10^{-12}$</td>
<td>0.000 000 000 001</td>
<td>↓</td>
</tr>
</tbody>
</table>

3. Using Table 1:
   - 1 μm (micrometer) = ______________ m (meters).
   - How many μm are in 1 mm? ______________.
   - How many nanometer are in 1 mm? ______________.
   - 12 mm equals how many cm? ______________.
   - 980 mm equals how many m? ______________.

4. Using Table 1:
- 10 mg (milligram) = _____________ g (grams).
- How many µg are in 10 mg? _______________.
- How many nanograms are in 10 mg? _______________.
- 140 mg equals how many g? _______________.
- 1500 g equals how many kg? _______________.

**STOP**
Do not continue until your TA checks your progress

**Task 2: Microscopy**

1. **Microscope**: Familiarize yourself with the parts of the light microscope using the lab manual on your table (pgs. 14-15). Fill in **Figure 2.4 “Compound light microscope”** and answer questions 1 and 5.

2. **Total magnification** = the power of the ocular lens X the magnification of the objective lens. Complete The Total Magnification Table:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Ocular Lens</th>
<th>Objective Lens</th>
<th>Total Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanning power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil immersion</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Microscope use**
   1. Read “**Rules for Microscope Use**” (pg 15).
   2. Familiarize yourself with focusing the microscope (pg 16).

   4. Perform “**Observation: Inversion**” (pg 16)
   Draw the letter “e” from the slide as you can see it with the naked eye. Then, following instructions of your TA, place the letter "e" in you microscope. How does the letter "e" appear now?

<table>
<thead>
<tr>
<th>1. Naked eye</th>
<th>2. Looking through ocular lens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Move the slide to the right.
- Where does the letter appear to move? ________________________.
- Why does this happen? ________________________.
- What is the name of this property? ________________________.
4. Read "Human Epithelial Cells" (pg. 20).

Your TA will show you slides of "Human Epithelial Cells". Draw some human and plant cells, indicating the nucleus, cytoplasm and cell membrane or cell wall.

STOP Do not continue until your TA checks your progress

Task 3. Diffusion Demonstration.
Your TA will set up the following experiments.
1. Diffusion through a semi-solid and diffusion through a liquid.
   Use the demonstration to answer the following questions:
   - What is faster? ________________________________
   - Why? ________________________________

Task 4. Osmosis and Tonicity Demonstration.
1. Learn about Osmosis and Tonicity at
   http://www.tvdsb.on.ca/westmin/science/sbi3a1/Cells/Osmosis.htm

Your TA will set up the following experiments.
2. Potato piece in hypotonic (water), hypertonic (10 % NaCl) and isotonic (0.9% NaCl) solutions.
   Use the demonstration and the instructor’s explanations to answer the following questions:
   What happens to the potato in a hypotonic solution? ________________.
   What happens to the potato in a hypertonic solution? ________________.
   What happens to the potato in a isotonic solution? ________________.

3. Tonicity in red blood cells.
   - Hypotonic (regular water) + few drops of sheep blood
   - Hypertonic (10 % NaCl) + few drops of sheep blood
   - Isotonic (0.9% NaCl) + few drops of sheep blood
   Shake the tube.
     - Which tube allows you to read through it? ________________________________.
     - Why? ________________________________

Task 5: Cell Structure.
Identify and learn the functions of the organelles in human (animal) cells (pgs 38-39).
<table>
<thead>
<tr>
<th>Organelle</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleus</td>
<td></td>
</tr>
<tr>
<td>Cytoplasm</td>
<td></td>
</tr>
<tr>
<td>Mitochondria</td>
<td></td>
</tr>
<tr>
<td>Ribosomes</td>
<td></td>
</tr>
<tr>
<td>Golgi Apparatus</td>
<td></td>
</tr>
<tr>
<td>Lysosome</td>
<td></td>
</tr>
<tr>
<td>Endoplasmic Reticulum</td>
<td></td>
</tr>
</tbody>
</table>

Before you leave, make sure your table is **CLEAN** and you placed the microscopes in the cabinet, with the **lower power** objective lens in place.

**STOP**  Do not leave until your TA checks your table is clean.

**Task 5: HOMEWORK ASSIGNMENT**

1. You are **required** to send your TA an email before your next scheduled lab. If you don’t send it, you will get a zero on the first quiz.
   2. Attain materials listed in the syllabus from the FIU bookstore. Be sure to get the lab coat, safety glasses and your lab book if you didn't already buy it.
   3. Make sure that you **download** and **answer** the [Take Home Quiz](http://bioserv.fiu.edu/~biolab/labs/2023/mainwebpage/safety_rules.htm) and hand it in to your TA at the next lab.