Pre-lab homework Lab 2: Measurements & Observations

Lab Section: ______________________ Name: ______________________

After reading over the lab, answer these questions to be turned in at the beginning of the lab!

1. Imagine you have a stick that measures 250 centimeters. (the lab introduction may help)
   • How many meters is that?
   • How many millimeters?

2. Imagine your doctor suggests you take 100 micrograms of folic acid three times a day. (This question is challenging for many students - do your best and we will go over the question in lab.)
   • How many centigrams will you take in a day?
   • How many grams will you take in a week?

3. In addition to practicing the metric system this week you will be learning to identify organisms (trees, in this case) using a dichotomous key. Biologists categorize living organisms using a system that has a hierarchy of categories. Scientists give living organisms a 2-part Latin name that tells the genus and species of an organism – these are the two narrowest categories of the biological classification system. Using section 18.3 on page 328 in your textbook fill out the names of the other categories biologists use.

   DOMAIN, __________, DIVISION/PHYLUM, ________, __________, FAMILY, GENUS, SPECIES
Lab 2: Measurements and Observations

GOALS: After successfully completing this lab a student will be able to:

• Use the metric system to measure distance, mass, and weight.
• Estimate distance, mass and weight in the metric system.
• Use a dichotomous and modified dichotomous key to sort information and identify organisms.
• Make detailed observations of the natural world.
• Use these observations and the scientific method to investigate their world.

Overview:

The United States has been officially encouraging the adoption of the metric system (the SI or International System of Units) since 1975 - although it has never caught on with the general public. Scientists all over the world use this system of measurement to communicate information in a standard way. During this lab you will be introduced to this system of measurement, and you will be given a chance to practice using it to make observations. Then you will spend some time answering a series of questions about a tree you will be assigned by your instructor. These questions, organized into a book called a dichotomous key, will help you to identify the genus and species name of your assigned tree. This exercise will also help you understand the level of detail that is needed in scientific observations. Finally you will make observations of a region on campus and use these observations to make inferences about the biology that is always around you.

Part I: The metric system

Standard prefixes and unit names in the metric system: Differences in size of measurements indicated by different words in the English system (foot, yard, mile, etc.) are indicated by different prefixes in the metric system. These prefixes have the same meaning anytime you see them and can be used with units of Liter, Gram, and Meter.

<table>
<thead>
<tr>
<th>Metric unit</th>
<th>English unit</th>
<th>Measures?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liter</td>
<td>Gallon, quart, pint, cup…</td>
<td>Volume</td>
</tr>
<tr>
<td>Gram</td>
<td>Ounce, pound, ton</td>
<td>Mass</td>
</tr>
<tr>
<td>Meter</td>
<td>Foot, yard, mile, inch</td>
<td>Distance</td>
</tr>
<tr>
<td>°Celsius</td>
<td>°Fahrenheit</td>
<td>Temperature</td>
</tr>
</tbody>
</table>
By combining the root unit names (liter, gram, meter) with their size indicating prefixes, seen on the table below, (micro, kilo…) you can communicate sizes ranging from the tiny (a single cell of 100 micrometers in length) to the huge (the Earth's circumference is about 40,000 kilometers at the equator.)

Table 1 - Common metric units and their sizes

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Prefix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giga</td>
<td>1,000,000,000</td>
<td>Centi</td>
<td>1/100</td>
</tr>
<tr>
<td>Mega</td>
<td>1,000,000</td>
<td>Milli</td>
<td>1/1000</td>
</tr>
<tr>
<td>Kilo</td>
<td>1000</td>
<td>Micro</td>
<td>1/1,000,000 or $10^{-6}$</td>
</tr>
<tr>
<td>Deci</td>
<td>1/10</td>
<td>Nano</td>
<td>1/1,000,000,000 or $10^{-9}$</td>
</tr>
</tbody>
</table>

To see the usefulness of the metric system, it helps to see some examples of how easy it is to convert from one unit to another. To convert from a larger unit to a smaller one you move the decimal to the right. For example, if you have 1 meter of string that is the same as 100 centimeters (two steps to the right) which is the same as 1,000 millimeters (one more step to the right). To convert from smaller to larger you just move the decimal the other way. 25,000 millimeters is the same as 2,500 centimeters (one step left), 25 meters (two more to the left), and 0.025 kilometers (three more to the left). The number of spaces you move the decimal just depends on the number of zeros difference in Table 1. So from milli to centi is a single decimal (one zero difference) while from milli to micro is three places.

To be able to use the metric system you need to be able to think in metric units. We will spend some time in this lab finding some common items you have a lot of experience using (a pop can, your thumb, the weight of a paperclip…) and measure them in the metric system. This will help you to become familiar with the metric system and can then be used as a handy way to estimate in the metric system too.

**EXAMPLE:**

<table>
<thead>
<tr>
<th>If you're measuring</th>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ice Water = 4°C</td>
<td>Room Temp = 25°C</td>
<td>Your Body = 37°C</td>
<td></td>
</tr>
</tbody>
</table>

Common units are degrees Celsius.
**EXERCISE A:** For this activity you will need to be able to use the scales, graduated cylinder, and a ruler. If you need help with these, please feel free to ask!

For each of the following tables you should find common things that you are familiar with and measure their weight, volume, and/or length. For each square use a different item and try to use the most appropriate units for the item you are measuring. Generally you wouldn't measure your height in millimeters or a paper's thickness in kilometers.

If you're measuring

**WEIGHT**

<table>
<thead>
<tr>
<th>Grams (g)</th>
<th>Name of item:</th>
<th>Weight:</th>
<th>Name of item:</th>
<th>Weight:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Kilograms (kg)</th>
<th>Weight:</th>
<th>Weight:</th>
</tr>
</thead>
</table>

If you're measuring

**VOLUME**

<table>
<thead>
<tr>
<th>Milliliters (ml)</th>
<th>Name of item:</th>
<th>Volume:</th>
<th>Name of item:</th>
<th>Volume:</th>
</tr>
</thead>
</table>

| Liters (l)       | Volume:       | Volume: | |
|------------------|---------------|---------|

If you're measuring

**LENGTH**

<table>
<thead>
<tr>
<th>Centimeters (cm)</th>
<th>Name of item:</th>
<th>Length:</th>
<th>Name of item:</th>
<th>Length:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Meters (m)</th>
<th>Length:</th>
<th>Length:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Kilometers (km)</th>
<th>Length:</th>
<th>Length:</th>
</tr>
</thead>
</table>
Part II: Classification and tree identification

A. During your tour of the Library you were introduced to one common classification system, the Dewey Decimal system, which is used in our library to help organize all of the books. Without this system, finding books in the library would be nearly impossible. Scientists also use a classification system for organizing living things. A Swedish naturalist, Carl Linnaeus (1707-1778), developed the most common one we use today, called the linnaean system.

During Linnaeus' time, European scientists were discovering and describing hundreds of new types of plants and animals. Linnaeus was instrumental in standardizing a binomial naming system that gave each species a unique set of names. In this system the first part of an organism's name, its genus, is the same for groups of very similar organisms (for example all of the pine trees share the same genus *Pinus*). The second part of the name, it's specific or species name, is different for each of the species in the genus. For example the ponderosa pine is named *Pinus ponderosa* while the lodgepole pine is named *Pinus contorta*. (Notice that the specific name is often an adjective that is useful in describing a species - lodgepole pine needles twist around or "contort" themselves.)

Since the time of Linnaeus, this system has been used to help organize and classify all of the different organisms that scientists have discovered, approximately 1.5 million so far. These organisms are sorted into categories based on similar characteristics. One of the useful features of classification schemes like this is that it allows the groups of organisms to be sorted much more easily than unorganized groups. One of the basic tools used to sort through these organisms is called a key. Keys are really just a series of questions that help you sort through groups of organisms until you can specifically identify the organism you are looking at. We will be using a few different types of keys throughout the term, but in today's lab we will use a dichotomous key to help us identify trees on campus.

B. Tree identification: Using your key, identify a tree assigned to you by your instructor. In the space below write out the steps you took to identify the tree.
Part III: Observation Journaling

Introduction:

The goal of this assignment is to sharpen your observational skills and to appreciate the natural world in which you live. It also will allow you to apply some of the lessons that you are learning in class to the world around you. To make this assignment as useful as possible you need to spend enough time to make detailed observations and you need to make an effort to understand what you are seeing. You can think of your journal as a progress report on the ‘experiments’ happening in the world around you at all times. Use your observations to generate questions, which you then attempt to answer. Form a hypothesis! Then, make more observations to test your hypothesis. This should sound familiar to you; it's the scientific method!

Observe → Question → Hypothesize* → Test** → New Observations

* Remember that a good hypothesis makes predictions about what you will see. Testing the hypothesis then is just a matter of seeing if those predictions occur.

** In this case your test will not be a controlled experiment but rather continued observations of your area.

The Activity: Today in lab you will be going out and making detailed observations. For each site you will be completing the following sections.

Initial Observations. Take notes on what you see, including basic information about your site.

This should include: • Date & Time of Day
• Location of the Field Site
• Weather Conditions – temperature, wind, cloud cover, precipitation...
• Type of habitat you can see.
• The Size/Layout of your site.

In addition, note the general layout of the area: location of plants, geological features, and manmade features. Then choose the focus of your observation - a single tree, the small area around your birdfeeder, an entire park, the trail to your campsite... whatever area interests you. Now observe this region, try to paint a picture of the area with your words, include sketches of interesting sights. What do you hear? smell? feel? While you make your observations ask yourself why you see what you see, and use these questions to guide some of your observations. Why are there ferns under the trees but not in the meadow? Where do you find spiders? Why are the squirrels chasing each other?
In all cases be as quantitative as possible: How big is the tree? (about 80ft.) How many birds? (25-30 starlings) How much is covered by shade? (50% covered) Get used to estimating sizes and weights of things you cannot measure by comparing them to things you know. If you are 5’5” a tree three times as tall as you is about 16’ tall.

**Reflections:** This section is the place to include all your thoughts on what you have observed. Be sure to include the questions and hypotheses (possible answers) you have in your field notes. Try to understand the forces underlying the patterns you see around you. I expect you to try to understand what you see - you don’t have to be right, just make a guess and then justify it. You should also try to relate what you see around you to what we are talking about in class. How much diversity do you see? How are these organisms the same? How are they different? Extend what we talk about in class to the world around you!

**Species list:** Understanding the diversity of the world around you is an important part of this assignment. In this section you will keep a list of the most common organisms that you observed including common and scientific names (if you know them) and a short description of the organism and the circumstances of your observation. Be sure to use your tree identification key to identify at least one tree that you observe. There are also other field guides for plants, birds and mammals that you can use if you like.

**Alternate explanation:** Some students have a hard time figuring out what goes in each section of the journal. It may help for you to think about the assignment as a mystery that you have to solve. What the mystery is, you decide (just pick something interesting in the world around you.) Then the observation section is your notebook of clues, the little facts and odd occurrences that you see. Your species section is the list of ‘players,’ people that have to do with your ‘case.’ Finally the reflection section is where you discuss your thoughts about the case. It is important to keep your ideas about what happened away from the clues (keep your reflections out of the observations), but your ideas will obviously lead you to look for specific types of clues.
Field Notes

Name of Observer: ____________________  Lab Section: ____________________

Site Location: ______________________________________________________

Date & Time of Day: ___________  Weather Conditions: _________________

________________________________

Observations:
Reflections

Name: ___________________________ Site Location: ___________________________
Include your thoughts/feelings on any subject as well as your ideas about what is happening biologically around you.

Reflections:
Species list

Name: ____________________________  Site Location: ______________________

Include enough detail to paint a basic picture of the organisms (include a sketch if you like!)

Species 1:

Species 2:

Species 3:

Species 4:

Species 5:

Species 6: