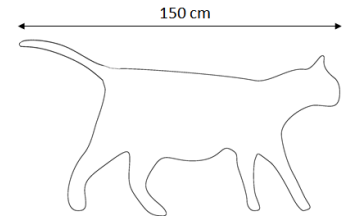


Lab Section: _____ Name: _____

Pre-lab Homework Lab 2: Measurements & Observations

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

1. Imagine you have a new pet cat that measures 150 centimeters from tail to nose.



- Is this a big cat? Yes/No

Conversions: (show your work)

- How many meters is the cat from tail to nose? (show your work)
- How many millimeters is the cat from tail to nose? (show your work)

2. Your doctor suggests you take 100 milligrams of ascorbic acid (vitamin C) three times a day.

This question is challenging for many students- do your best and we will go over the question in lab.

*You may need to remind your instructor. Again show your work

- How many centigrams will you take in one day? (show your work)
- How many grams will you take in one week? (show your work)

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 two-part Latin name that tells the genus and species of an organism—these are the two narrowest categories of the biological classification system. Using your textbook, fill out the names of the other categories biologists use. Or Google “Linnaean Hierarchy”, the scheme named for its creator, the father of taxonomy, Carl Linnaeus.

DOMAIN, _____, PHYLUM, _____, _____, FAMILY, GENUS, SPECIES

Intentionally left blank

Name: _____

Date/Lab time: _____

Lab 2: Measurements and Observations**LAB SYNOPSIS:**

It is important to know the metric system as we will be using it throughout the quarter (in both lecture and lab).

This lab is divided into 3 separate topics:

- **Part 1. The Metric System**
You will practice using and converting within the metric system.
- **Part 2. Dichotomous Keys**
You will practice identifying a tree using a dichotomous key.
- **Part 3. Field Observations**
You will use your observation skills and the scientific method to explore the world around you.

Part 1: The Metric System

OBJECTIVES: 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.
- Make conversions within the metric system.

Overview:

The metric system is a system of measurement used by most of the world and all of science. Only three countries still use the “English system”; the US, Myanmar, and Liberia. All other countries have adopted the metric system. Why has science and most of the world adopted the metric system?

1. **Only one basic unit for measurement** for each physical quantity.
2. **Easy.** It is easy to use.
3. **Decimal based.** It is easy to make conversions.
4. **Standardized.** Since everyone in the world uses the same standards of measurement, exchange of goods and technology is seamless.

When will the US adopt the metric system?

Fill in table 1 for the standard units of measurement used in the metric system and for the English system.



Table 1: Comparison between standard metric and English units. (see table 2 for metric units)

Measurement	Metric unit	English unit
Volume		
Mass		
Distance		
Temperature		

English units

Did you remember to use all the English units include pecks, barrels, fathoms, teaspoons, tons????????? Notice that there is not a single standard unit in the English system.

Most of you, those that grew up in the US, are familiar with the English system. Right??? Quickly now, how much do you weigh, in oz.? How tall are you, in miles?

Note: it is not always easy to convert between units of the English system. And you probably need a calculator.



Table 2. Metric units. There are single standard units in the metric system

Measurement	Metric unit	Examples
Volume	Liter (l)	1l = the volume of a one liter soda
Mass	Gram (g)	1g ≈ weight of a paper clip
Distance	Meter (m)	1m ≈ 1 yard
Temperature	Celsius or Centigrade	Water freezes at 0°C and boils at 100°C

Ease of converting within the metric system

It is easy to make conversions within the metric system using defined prefixes. For example if you weigh 78kg = 78,000g, If you are 181cm tall that equals 1.81m. Essentially, conversions are done by simply moving decimal points.

The most common prefixes are **micro, milli, centi and kilo**. These are the ones you will be expected to know. (See table 5 for a more extensive list of prefixes). Note: you may already be familiar with some of these.



micro (μ) = 1/1,000,000 of the unit

How many μm are in 1m? _____ 1μm is very small. A bacteria cell is ~ 1μm long
There are 1000μm in 1mm

milli (m) = 1/1,000 of the unit

How many mm are in 1m? _____ 1mm is small. 1mm is about the width of ..
There are 10mm in 1cm

centi (c) = 1/100 of the unit.

How many cents are in \$1? _____
How many cm are in 1m? _____ 1cm is about the width of your fingernail.
There are 100,000cm in 1km



kilo (k) = 1,000 times the unit

How many km are in 1m? _____ 1km is big. 1km is a little over half a mile.
It takes you about 20 minutes to walk 1 kilometer.

The metric system was originally set up based on qualities of water. Thus, it is also easy to make conversations between the units for water.

Table 3. Metric conversations for qualities of water.

Distance	Volume	Mass
1 cm ³ =	1 ml =	1 g

So a 2 liter soda (mostly water) will weigh ~2 kilograms

Learning the metric system

There are many ways to learn a new system of measurement. Some learn best by conversion tables (see table 4). Some learn the metric system by comparison to common objects (see exercises). However, the best way to learn the metric system is by practice. (See exercises)

Table 4. Conversion chart between English and metric system. To convert from the Metric unit to U.S. Customary units divide rather than multiply by the factor.

When you know:	Multiply by:	To find metric units:
Pound	0.454	Kilograms
Ounce	31.103	Gram
Yard	0.914	Meter
Feet	0.305	Meter
Inch	2.54	Centimeter
Inch	25.4	Millimeter
Gallon Liquid	3.785	Liter
Quart Liquid	0.946	Liter
Pint Liquid	0.473	Liter
Temp. Fahrenheit	(°F - 32) x 0.556	Temp. Celsius

For example, if you weigh 160 lbs. X 0.454 = 72.6 Kg

Table 5. Conversions within the metric system using the prefixes

Prefix	Symbol	multiplier	sci notation (from the standard)	Decimal pt. shift from the standard
exa	E	1,000,000,000,000,000,000	10 ¹⁸	3 to the right
peta	P	1,000,000,000,000,000	10 ¹⁵	
tera	T	1,000,000,000,000	10 ¹²	
giga	G	1,000,000,000	10 ⁹	
mega	M	1,000,000	10 ⁶	
kilo	k	1,000	10 ³	
hecto	h	100	10 ²	
deka	da	10	10	
standard				
deci	d	0.1	10 ⁻¹	
centi	c	0.01	10 ⁻²	
milli	m	0.001	10 ⁻³	
micro	μ	0.000 001	10 ⁻⁶	
nano	p	0.000 000 001	10 ⁻⁹	
pico	f	0.000 000 000 001	10 ⁻¹²	
femto	a	0.000 000 000 000 001	10 ⁻¹⁵	
atto		0.000 000 000 000 000 001	10 ⁻¹⁸	

For ex. a cup of coffee ~250 ml

To convert to the standard (liters) you would move the decimal point 3 to the left 250,

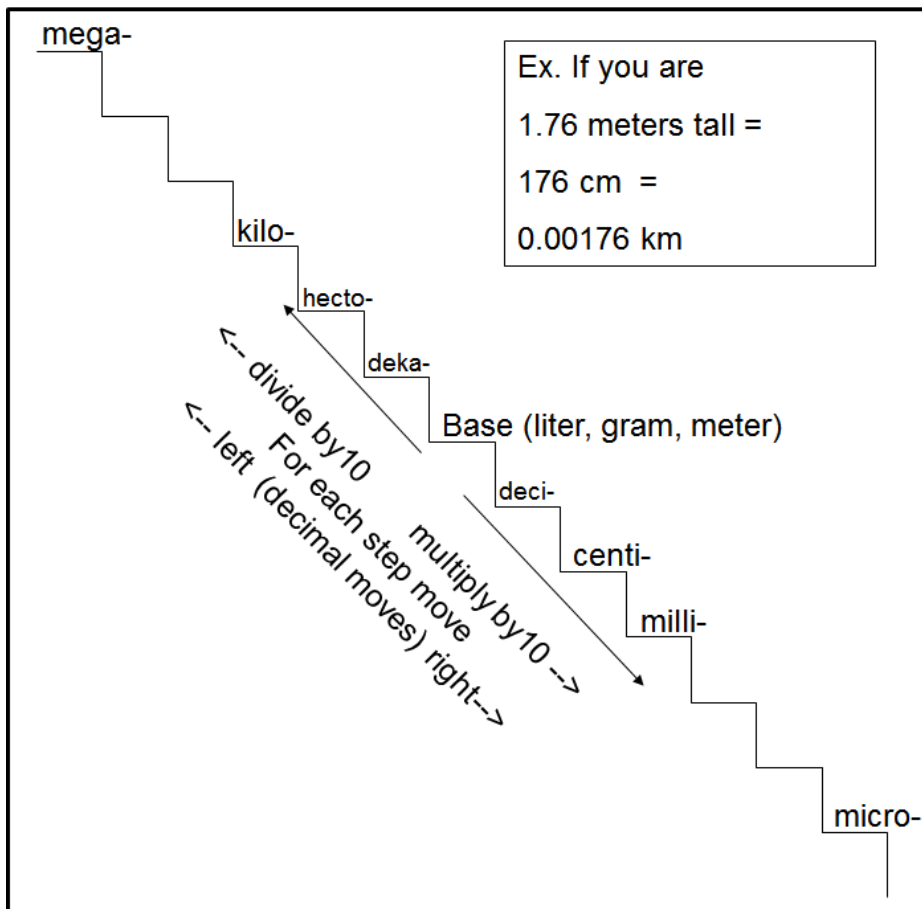
So 250 ml = 0.25 liters

Some people learn the metric system prefixes using a step chart. For example, if you are 176 cm tall, to determine how tall you are in meters you take two steps up the chart. That means you move the decimal point 2 places to the left. So, 176 cm (176.) = 1.76 m

Notice it is just a matter of moving decimal places to convert within the metric system.

Using the step table, how tall would you be in millimeters (mm)?





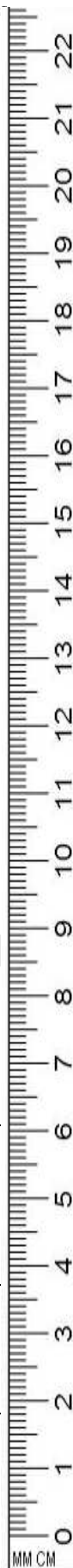
Exercise 1: Practice Making Conversions

Use one of the methods for conversions to do the following. If time is short, this might be done as homework. If so, skip to Exercise 2



Distance conversations

From PCC Cascade to PCC Sylvania	17.8 kilometers (km)	Meters (m)	Centimeter (cm)	Millimeters (mm)
Size of a red blood cell	25 micrometers (μm)	Millimeters (mm)	Meters (m)	Centimeter (cm)





Weight conversions

Of a low dose aspirin	82 Milligrams (mg)	Grams (g)	Centigram (cg)	Microgram (µg)
Portland zoo's elephant Rose-Tu	3175 kilograms (kg)	Grams (g)	Milligrams (mg)	Megagrams (Mg)



Volume conversions

Olympic sized swimming pool	2498 liters (l)	Kiloliters (kl)	Milliliters (ml)	Centiliters (cl)
Raindrop	100 microliters (µl)	Milliliters (ml)	Liters (l)	Kiloliters (kl)

Exercise 2: Measuring using the Metric System

For this activity you will need to be able to use the top-load balance, graduated cylinder, pipet & pipet pump and a metric 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**

The FDA recommends limiting sodium intake to 2.3 grams per day. That is equal to 5.8 grams of table salt (NaCl). Measure out 5.8 g of table salt. Does that seem like a lot of salt?

Common units are Grams (g)	Name of item (table salt):	Name of item (your choice):
	Weight of salt: → 5.8 g	Weight:
Common units are milligrams (mg)	Name of item (table salt):	Name of item (your choice):
	Weight in mg: Convert 5.8 g to mg	Weight:



If you're measuring: **VOLUME**

Using a graduated, measure out 70 ml of water. This is the volume of fat you should limit yourself to on a daily basis. We are using water instead of oil as oil is a big mess to clean up. Does that seem like a lot of fat? _____

Using a graduated pipet, measure out 3.8 ml of water, that is the volume of saturated fat (like butter) you should limit in your diet. (see description below on use of the graduated pipet)

Common units are Milliliters (ml)	Name of item (volume equivalent of fat): Volume of water: 3.8 ml	Name of item (your choice): Volume:
Common units are Liters (l)	Name of item (volume equivalent of fat): Volume: Convert 3.8 ml to liters	Name of item (your choice): Volume:

To use a **pipet pump**, press the **plunger** almost all the way down, leaving (a little gap). Then attach a pipet to the bottom of the body: (use the small blue pumps for 1 ml pipets and the larger green pumps for 5 ml and 10 ml pipets).

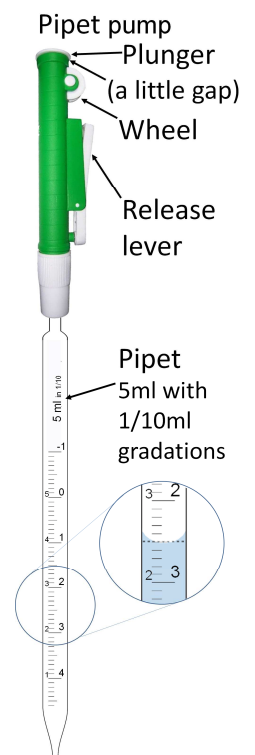
Note the numbering on the right side vs. the left side of the pipet: These numbers make it easy to do both forward and backward pipetting. (Figure)

For forward pipetting, fill the pipet by submerging the tip in the liquid and using the plastic **wheel** to dial the plunger upward until the liquid reaches the desired volume marked on the pipet.

Because water is both adhesive and cohesive, it forms a meniscus. Always measure volume from the bottom of the meniscus. (For example, to deliver 2.5ml see figure)

If your pipet pump lacks a release lever: To deliver the liquid, press the plunger all the way down. Making sure all liquid is dispensed.

If your pipet pump has a release lever: To deliver the liquid, press the **release lever** on the side of the pipet. Note: some liquid will remain in the tip of the pipet. To deliver the entire volume, press the plunger all the way down.



If you're measuring: **LENGTH** (make sure you are using the metric side of the ruler!)

Measure out 1 stride (step) in cm. (from the toe of one step to the toe of the next)

Common units are Centimeters (cm)	Name of item (1 step) : Length: How long was your stride in cm?	Name of item (your choice): Length:
Common units are Kilometers (km)	Name of item (1 step): Length: Convert your stride to km	Name of item (your choice): Length:

Challenge question: some recommend taking 10,000 steps each day. How many km is that for you?

Part 2: Classification of Organisms and the Use of a Dichotomous Key

OBJECTIVES: After successfully completing this section, a student will be able to:

- Use a simple dichotomous key to sort information and identify organisms.

Overview:

The Linnaean System of Classification is used by scientists to organize the ~1.9 millions species that have so far been name and described. Named after the “father of taxonomy”, Carl Linnaeus (1707-1778), this system classifies organism based on shared characteristics.

The Linnaean System is hierarchical, classifying organisms into narrower and narrower groupings using the following:

Domain → Kingdom → Phylum → Class → Order → Family → Genus → Species

Linnaeus was instrumental in standardizing a binomial naming system that gave each species a unique two-part name. 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, its 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 sometimes an adjective that is useful in describing a species: lodgepole pine needles twist around or "contort" themselves.)



Pinus contorta

Dichotomous keys

A dichotomous key is a useful tool in identifying organisms (butterflies, trees, mushrooms, etc.). It works by offering a series of 2 alternatives at each step. The single choice leads to further alternative choices, narrowing down options till you have identified a particular species.

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.

Exercise 1: Tree Identification

Using your key, identify two trees (one conifer & one broadleaf) from those provided in class.

Rules for writing scientific names. The genus portion is always uppercase, the species portion is always lowercase, and the name is underlined, with a space between the genus and species.

ex. Pinus contorta

In the space below, write out the steps you took to identify the tree.



Species identified? (make sure to use the scientific name!)
And to format correctly!

Species identified? (make sure to use the scientific name!)
And to format correctly!

Find an online version of the dichotomous key at http://oregonstate.edu/trees/dichotomous_key/index.html

Part 3: Observation Journaling

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

- Make detailed observations of the natural world.
- Use these observations and the scientific method to investigate their world.

Overview:

Henry David Thoreau, Lewis and Clark and Charles Darwin were all naturalists, acute observers of the natural world. Recall the scientific method begins with observations. From your observations you can generate questions, which you then attempt to answer, i.e. form a hypothesis!

Recall the steps of the scientific method:

1 2 3* 4** 5 6 7
 Observation → Question (Problem) → Hypothesis → Test → Analyze Results → Conclusions → Document/Peer Review

*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 goal of this assignment is to sharpen your observation skills and provide you with an opportunity to appreciate the role of science in observing the natural world. 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.

The Activity:

During lab today, weather permitting, the class will be going outside and making detailed observations. Additionally, you may be asked to complete this assignment on your own time.

For each site you will be completing the following sections (initial observations, reflections and a species list)

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. (forest, yard, playground, etc.)
- The size/layout of your site. (sketch a map if you like!)

In addition, within the general layout of the area, note: (you might sketch a map)

- Location of plants
- Geological features
- Manmade features
- Any unusual features (smell, sound, activity, etc.)

Then choose a focus for 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, and 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. Example; 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? (~ 80ft. 25m) How many birds? (25-30 European 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 1.7m tall, a tree three times as tall as you is about 5m tall. If you have not yet adopted the metric system use the English system.

Reflections:

This section is the place to include all of 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!

Organism 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 (grass, trees, crows, etc.). You can just use the organism's common name, but remember each species also has a scientific name.

Recall, the tree dichotomous key was a handy way to identify tree. There are also other field guides with dichotomous keys for plants, birds, mammals, mushrooms, etc.

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 organism section is the list of "players", individuals that have to do with your "case". Finally, the reflections 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: _____

Initial Observations: Refer to previous pages for guidance as to what types observations are expected, however do not feel limited.

Reflections

Name: _____ Site Location: _____

Recall observations leads to questions. What kinds of question do you have relative to your observations? Include your thoughts/feelings on any subject as well as your ideas about what is happening biologically around you. Recall a tentative answer to a question is a hypothesis. What kinds of hypotheses could help explain your observation/questions?

Organism List

Name: _____ Site Location: _____

Include enough detail to paint a basic picture of the organisms (For example what is the organism located or doing). (include a sketch if you like!) (recall, you can give common names or scientific names)

Organism 1:

Organism 2:

Organism 3:

Organism 4:

Organism 5:

Organism 6: