EXERCISE 1

Introduction to Anatomical Terminology, Body Organization, and the Metric System

OBJECTIVES

By the end of this activity you should be able to:

- Use specific, consistent anatomical terms to describe regions of the body, body planes and sections, and directions relating to body regions
- Define the human anatomical position and state its importance to the field of anatomy
- Describe the major body cavities and name some of the major organs found within the cavities
- Understand metric measurements and perform conversions that are commonly used in anatomy and physiology

The study of human anatomy is an important component to any course in anatomy and physiology. This chapter introduces you to basic anatomy. It provides an overview of anatomical terminology and the organization of the human body, introduces you to a standard system of measurement used in all scientific fields, and includes three lessons:

- The Language of Anatomy – terminology, anatomical position, body regions, directional terms, planes and sections
- The Organization of the Body – Body Cavities
- The Metric System

THE LANGUAGE OF ANATOMY

Anatomy is the study of body structure. It uses a universal terminology to describe the location and appearance of body parts, enabling health care workers around the world to speak in a common language. The universal terms are mainly derived from Latin and Greek word parts, which become assembled like a puzzle to form new words. For example, the word *cardiovascular* is made up of the word parts *cardio* (heart), *vas* (vessel), *-ul* (small), and *-ar* (pertaining to). When the word parts are combined to form the term *cardiovascular*, the literal meaning becomes "pertaining to small vessels and the heart."

Many terms in anatomy are composed of three types of word parts. The **root** is the main word part, carrying the primary meaning of the word. In the term pregastric, the root is *gastr*, which means "stomach'. The **prefix** precedes the root and often alters its meaning. In pregastric, the prefix is *pre-*, which means "before'. The **suffix** follows the root to alter the meaning. In pregastric, the suffix is *-ic*, which means "pertaining to'. Taken as a whole term, pregastric means "pertaining to before the stomach'. A sampling of some common word parts used to form anatomy and medical terms is provided in Table 1.1. A longer list can be found in your textbook. Understanding the common word parts and how words are constructed often helps you to learn the meanings of the new words.

Table 1.1: Common Word Parts of Anatomy

Prefixes = precedes the root	Word Roots	Suffixes = follows the root
a- = without	abdomin = abdomen	-ad = toward
ab- = away	arterio = artery	-algia = painful condition
ad- = toward	cardio = heart	-ar -ic, -al, -ac, -ous = pertaining to
ante- = before	chondro = cartilage	-gen, -genic = formation, produce
anti- = against	cyt, cyto = cell	-itis = inflammation
bi- = two	dors = back	-logy = study
contra- = opposite	gastro = stomach	-lysis = destruction, break down
dys- = bad, abnormal	hemo = blood	-megaly = enlargement
epi- = above	hepat = liver	-oid = resemblance to
eu- = normal	latero = side	-oma = abnormal swelling
hyper- = excessive	medio = middle	-pathy = disease
hypo- = under, below	myo = muscle	-penia = deficiency
inter = between	osteo = bone	-scopy = process of viewing
intra- = within	pneu, pneumo, pnea = lung, breath (air)	
ipsi- = same	vas = vessel	
poly- = many		
pre- = before		
sub- = beneath		

Exercise 1.1: Terminology

Use the word parts in Table 1.1 to form anatomy terms from the meanings provided.

1. study of the heart: *Example*: cardiology
2. pertaining to the stomach: _____
3. forming from muscle: _____
4. inflammation of the liver: _____
5. preceding bone disease: _____
6. abnormal breathing: _____

ANATOMICAL TERMINOLOGY OF BODY REGIONS

The **body regions** are areas of the body that are identified during a physical examination. Many are listed and described in Table 1.2. Notice that the body regions in this list can be used in an adjectival form (ending with the suffix -al, -ar, -ic, -is), or as a noun, indicated in parentheses ( ) in the table, depending on how you choose to communicate. For example, you can say: The patient has an orbital fracture; or: The patient has a fracture in one of the bones of his orbit. Both statements use terminology correctly.

Table 1.2: Regions of the Body

PRIMARY BODY REGIONS	SUBDIVISIONS
Cephalic: pertaining to the head (cephalon)	Facial: pertaining to the face Orbital: pertaining to the eye socket (orbit) Oral: pertaining to the mouth (oris) Nasal: pertaining to the nose (nasus) Cranial: pertaining to the skull (cranium) Frontal: pertaining to the forehead (frons)
Cervical: pertaining to the neck (cervicis)	

Table 1.2: Regions of the Body

PRIMARY BODY REGIONS	SUBDIVISIONS
Trunk	Thoracic: pertaining to the ribcage (thorax) Sternal: pertaining to the breastbone (sternum) Pectoral: pertaining to the front of the chest (pectoris) Abdominal: pertaining to the anterior trunk below the ribs (abdomen) Umbilical: pertaining to the navel (umbilicus) Pelvic: pertaining to the pelvis Pubic: pertaining to the genital region (pubis) Inguinal: pertaining to the groin (inguen) Dorsal: pertaining to the back (posterior) side of the thorax or trunk Scapular: pertaining to the shoulder blade (scapula) Vertebral: pertaining to the spinal column (vertebra) Lumbar: pertaining to the lower back (lumbus/loin)
Upper Extremity: pertaining to the upper limb	Acromial: Pertaining to the shoulder (acromion) Axillary: Pertaining to the armpit (axilla) Brachial: Pertaining to the arm (brachium) Antebrachial: pertaining to the forearm (antebrachium) Antecubital: pertaining to the anterior elbow (antecubitis) Olecranal: pertaining to the posterior elbow (olecranon) Carpal: pertaining to the wrist (carpus) Manus: the hand Palmar: pertaining to the palm of the hand Digital: pertaining to the fingers (digits or phalanges) Pollicis: pertaining to the thumb (pollex)
Lower Extremity: pertaining to the lower limb	Gluteal: pertaining to the buttock (gluteus) Femoral: pertaining to the thigh (femur) Patellar: pertaining to the anterior knee (patella) Popliteal: pertaining to the posterior knee Crural: pertaining to the leg (crus or crura) Sural: pertaining to the posterior leg/calf (sura) Fibular/peroneal: pertaining to the lateral side of the leg Tarsal: pertaining to the ankle (tarsus) Pedal: pertaining to the foot (pes) Calcaneal: pertaining to the heel (calcaneus) Plantar: pertaining to the sole of the foot Digital: pertaining to the toes (digits or phalanges) Hallucis: pertaining to the great toe (hallux)

ANATOMICAL POSITION

When referring to the human body in anatomy, or in a health care setting, there is a standard position of reference which is used when describing the location of structures, conditions and injuries. This standardized position is known as the human **anatomical position**. The anatomical position is defined as the body in an erect stance facing forward. The arms are straight along the sides of the body, palms forward, and fingers pointing downward. The legs are straight or slightly apart with the toes pointing forward, feet flat. A figure in this position is illustrated in Figure 1.1.

Two other positions are often referenced in healthcare, although by definition, are not the standard anatomical position These positions describe a person in a reclined position, and include **Prone**, if the person is lying face-down, and **Supine**, if the person is lying face-up.

Exercise 1.2: Anatomical Position and Body Regions

Practice the anatomical position and the regional terms from Figure 1.1 and Table 1.2.

1. Assume the anatomical position, and have your lab partners share with you the definition to make sure you represent the correct position.
2. Working with your lab partners at your table, label the anatomical regions of the large image of the body provided, by taking turns picking anatomical names from the brown bag, reading them out loud, and placing them on the appropriate body region.

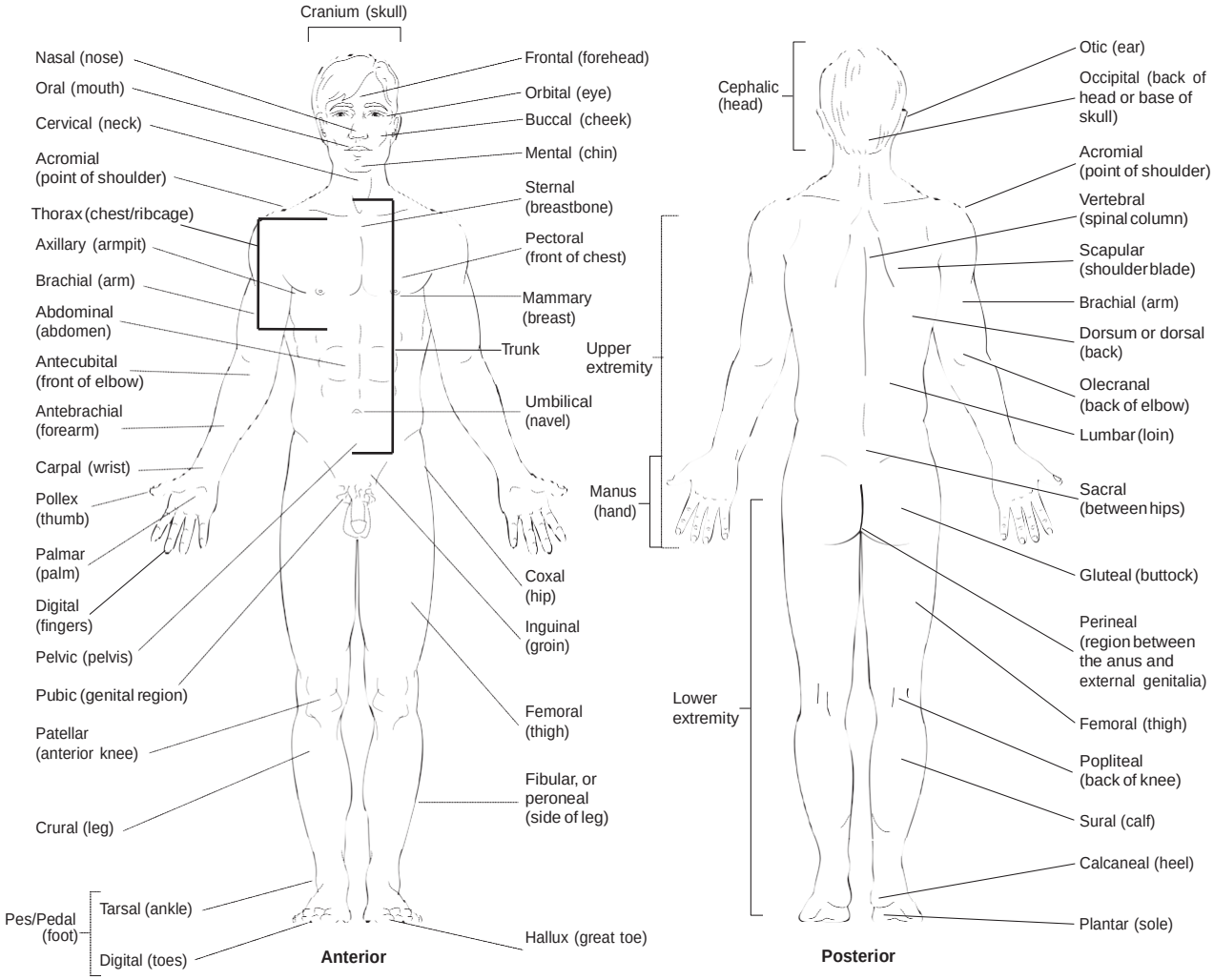

Figure 1.1 Regions of the Body.

DIRECTIONAL TERMS

A group of anatomical terms are used to describe the location of body parts. Known as **directional terms**, they are helpful because they abbreviate otherwise lengthy descriptions of where a body part is located relative to other parts, and can be used to describe clinical conditions or injuries. These terms use the anatomical position as a point of reference, and are listed in Table 1.3 and illustrated in Figure 1.2. Note that the terms have opposing meanings, such as superior and inferior. Also, when using directional terms you should include a point of reference. For example, to describe the location of the nose you would say "the nose is superior to the chin" rather than "the nose is superior."

Table 1.3: Directional Terms		
TERM	**DEFINITION**	**EXAMPLE**
Superior	Above, or in a higher position, or towards the upper part of the body. (Not used to reference the upper or lower extremities.)	The heart is superior to the diaphragm.
Cranial/Cephalic	Toward the skull/head. In humans can be used synonymously with Superior.	
Inferior	Below, or toward the lower part of the body. (Not used to reference the upper or lower extremities.)	The mouth is inferior to the nose.
Caudal	Toward the tail, relating to the tail. (In humans, toward the base of the spine.)	
Anterior	On or toward the front of the body.	The trachea is anterior to the esophagus.
Ventral	Relating to the belly side. Used synonymously with Anterior in human anatomy.	
Posterior	On or toward the back of the body.	The esophagus is posterior to the trachea.
Dorsal	Relating or pertaining to the back or spine. (Used synonymously with Posterior in human anatomy.)	
Medial	Toward the midline, which is an imaginary line that extends vertically down the middle of the body.	The heart is medial to the lungs.
Lateral	Away from the midline.	The ears are lateral to the nose.
Superficial (external)	Toward the surface of the body.	The skin is superficial to visceral organs.
Deep (internal)	Away from the surface of the body.	The heart lies deep to the ribcage.
The following two terms should only be used to describe directions on the upper and lower extremity:		
Proximal	Toward a limb's origin or point of attachment to the trunk.	The shoulder is proximal to the elbow.
Distal	Away from a limb's origin or point of attachment to the trunk.	The wrist is distal to the shoulder.

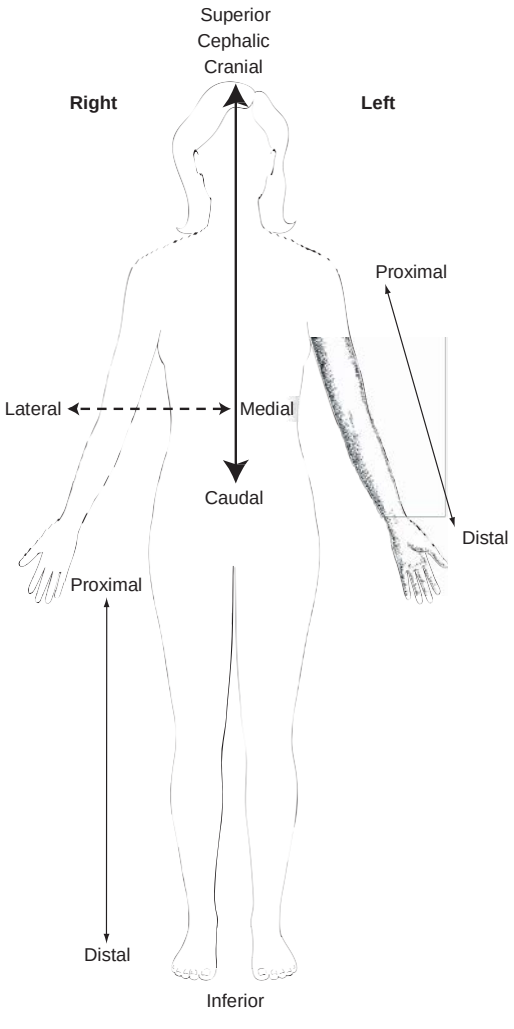

Figure 1.2

Exercise 1.3: Communication Using Anatomical Regional and Directional Terms

Your instructor will provide you with an image of a patient with a specific injury. Using complete and accurate regional and directional terminology, describe in writing, the location of the injury to your lab partner. After presenting your description, your lab partner should point to the specific injury site on his/her own body.

How accurately were you able to communicate?

When you are finished, have your lab partner describe their patient's injury to you.

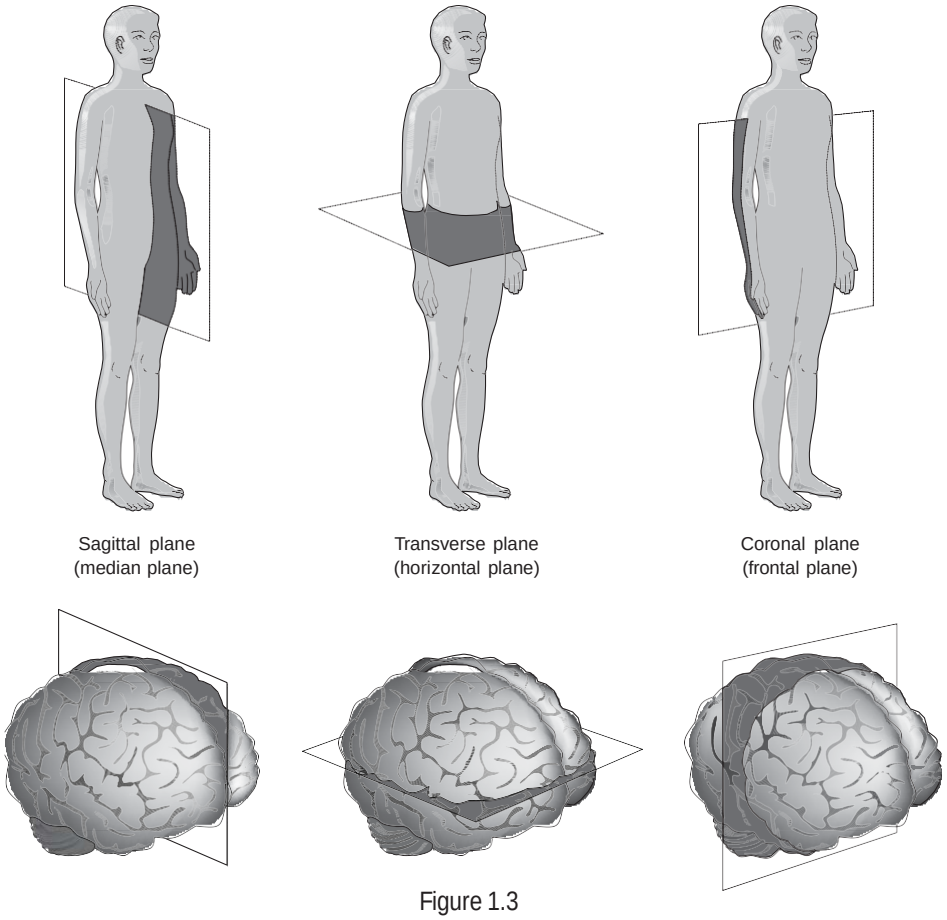

Figure 1.3

PLANES AND SECTIONS

A **plane** is an imaginary flat surface. It is useful in anatomy because it can describe how a slice, or **section**, can extend through the body. Three major planes are used in anatomy (Figure 1.3): frontal (coronal) plane, sagittal plane, and transverse plane. The **frontal or coronal plane** is a longitudinal plane that extends through the long axis of the body (that is, along the body's length), dividing the body into anterior (front) and posterior (back) portions. The **sagittal plane** also extends through the body's long axis, but it divides the body into right and left portions. A sagittal plane dividing the body into equal right and left halves is called **midsagittal**, whereas one that divides unequally is called **parasagittal**. The **transverse plane** extends perpendicular to the frontal and sagittal planes to divide the body into superior (upper) and inferior (lower) portions. A section made along the transverse plane is often referred to as a **cross section**.

Exercise 1.4: Planes and Sections

Materials:

- Play-Doh or modeling clay
- Plastic knife
- Blank paper

Using the Play-Doh (or modeling clay) provided, create three "hearts" with your lab partner(s). Using the plastic knife, section one heart along the mid-saggital plane, the next along a coronal (frontal) plane, and the third as a cross-section (along the transverse

plane). Place these sections on the blank paper, and label each one appropriately. Verify the accuracy of your sections with your instructor before continuing.

Draw an image of the resulting sections below.

Mid Sagittal	Coronal	Transverse (Cross section)

BODY CAVITIES

A body cavity is an internal space that is filled with organs and their supporting structures (blood vessels, nerves, fibrous tissues, and fluids). There are three main cavities in the human body, **cranial**, **spinal (vertebral)** and **ventral**. (Figure 1.4)

The **cranial** and **spinal cavities** are located within the posterior (dorsal) side of the body. The cranial cavity contains the brain and its associated structures, and the spinal (vertebral) cavity houses the spinal cord and its associated structures.

The **ventral body cavity** includes the spaces on the ventral side of the body, and is subdivided by the diaphragm into the thoracic cavity and abdominopelvic cavity. The **thoracic cavity** fills the chest region and contains the heart, lungs, airways, and major vessels of the heart.

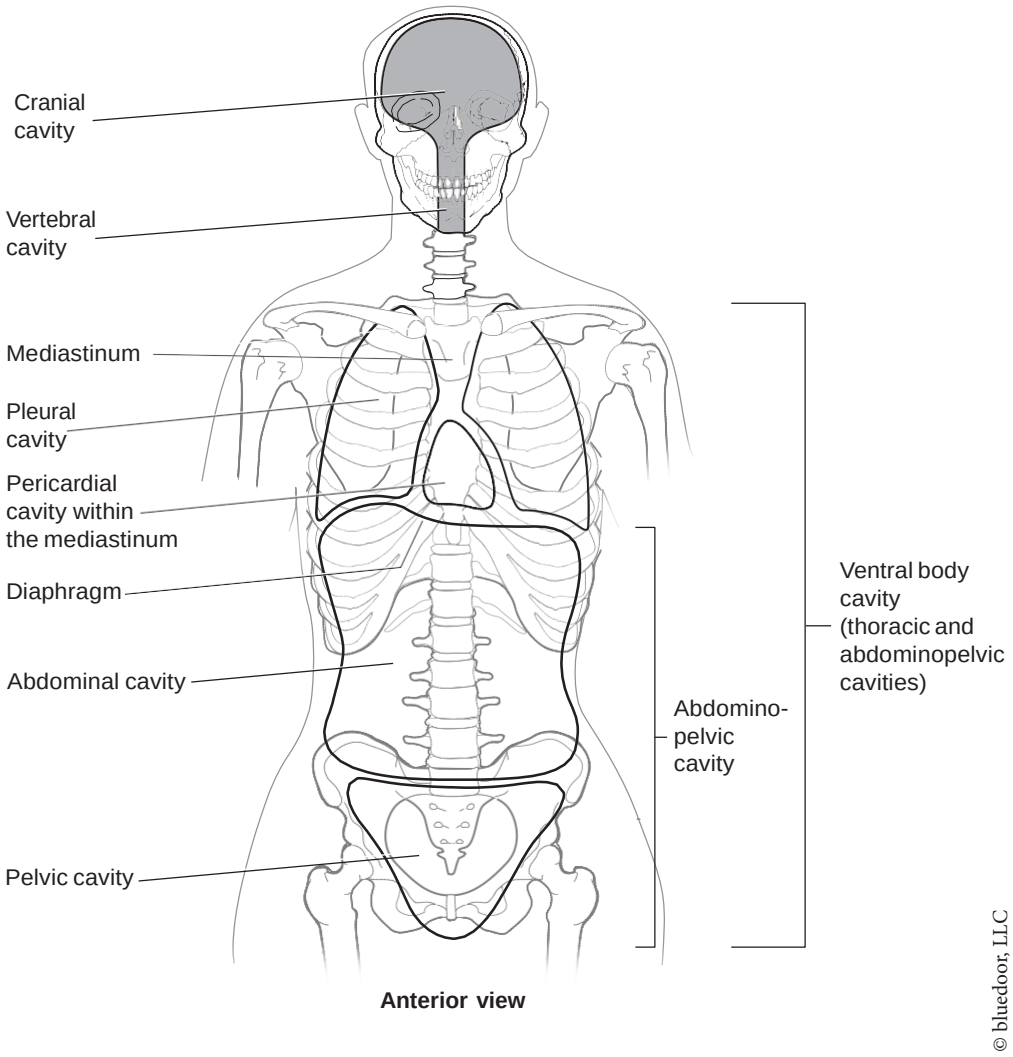

Figure 1.4

It includes several smaller cavities: two **pleural cavities**, each of which contain a lung; the **mediastinum**, which is the space between the pleural cavities containing the major blood vessels, airways (trachea, bronchi), esophagus and the thymus gland; and the **pericardial cavity**, which lies within the mediastinum and contains the heart. The thoracic cavity is separated from the abdominopelvic cavity by the muscular **diaphragm**. The abdominopelvic cavity is the large area below the diaphragm, divided into the superior **abdominal cavity** and the inferior **pelvic cavity**. The abdominal cavity houses the stomach, liver, gallbladder, pancreas, small intestine, kidneys, and part of the large intestine. The pelvic cavity lies deep within the bony pelvis and contains the reproductive organs, the urinary bladder, and the rectum.

Exercise 1.5: Body Cavities

In which body cavity (or cavities) would you find the:

a. Heart _____

b. Lungs _____

c. Liver _____

d. Uterus _____

THE METRIC SYSTEM

The metric system is a system of measurements widely accepted and utilized in all scientific communities across the globe. It provides a standard of reference for quantitative measurements.

The metric system is based on units of 10, which actually makes it easier to work with than our "American" way of measuring, which is based upon the British system of measurement. (Does anyone really know how many feet are in a mile? How many cups are in a gallon? etc.)

Metric Length/Mass/Volume:

From now on (or at least in this class), it will no longer be appropriate to use our everyday system of measuring length, mass or volume. For those of you that are not clear on what these "everyday" units are (that we will no longer be using), I offer the following examples.

Length: inches, feet, yards, miles
Mass: pounds
Volumes: tablespoons, cups, pints, quarts, gallons

Instead, we will be following the "rules of the metric game:"

1. There is a standard metric "unit" that is utilized when measuring the length, mass or volume of something.

   Standard unit of Length = **Meter (m)**
   Standard unit of Mass = **Gram (g)**
   Standard unit of Volume = **Liter (l)**

Each of these standard units has an actual size (think of the length of a meter stick, or the volume (size) of a liter bottle of water or soda.

2. We use prefixes *attached to the standard unit* to increase or decrease the value of the standard unit. The most common prefixes used, and therefore the ones you will need to know, are in **bold**:

   Mega (M) = 10^6 = 1,000,000 (one million) standard units
   Kilo (k) = 10^3 = 1,000 standard units
   Hecto (h) = 10^2 = 100
   Deca (da) = 10^1 = 10
   Deci (d) = 10^{-1} = 1/10 = 0.1
   Centi (c) = 10^{-2} = 1/100 = 0.01 standard units
   Milli (m) = 10^{-3} = 1/1000 = 0.001 standard units
   Micro (μ) = 10^{-6} = 1/1,000,000 = 0.000001 (one millionth) standard units
   Nano (n) = 10^{-9} = 1/1,000,000,000 = 0.000000001 (one billionth) standard units

Note that each of the prefixes changes the value of the standard unit by a factor of 10.

3. Sometimes it will be necessary to convert from one metric unit to another. To change from *smaller units → larger units*, you must **DIVIDE** by the appropriate factor of 10 (because there are less larger units that fit into the number).

   ie: 1 millimeter (1mm) = 1/1000 meters = 0.001 m
   5 millimeters (5mm) = 5/10 centimeters (cm) = 0.5 cm

   Note: dividing a number by a factor of 10 is the same thing as moving the decimal point to the LEFT.

   To change from *larger units → smaller units*, you must **MULTIPLY** by the appropriate factor of 10 (because there are more smaller units that go into the number).

   ie: 5 km = 5,000 m
   3 kg (kilograms) = 3,000,000 mg (milligrams) or 3 x 10^6 mg

   Note: multiplying a number by a factor of 10 is the same as moving the decimal point to the RIGHT.

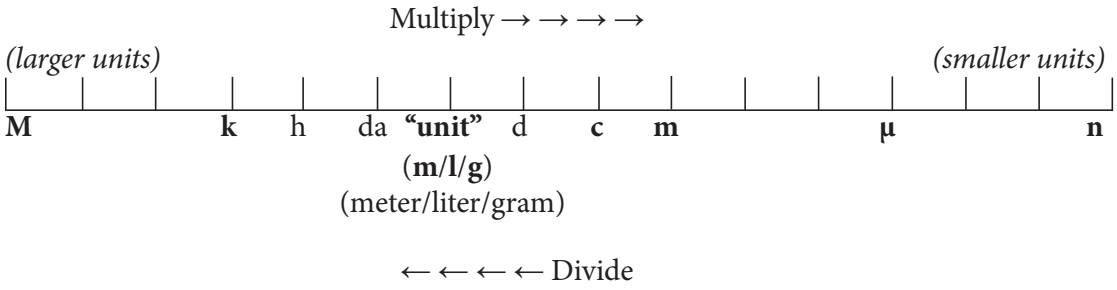

Figure 1.5

4. Conversions can be done mathematically, or can be done "visually" by using the metric scale above (figure 1.5). Note that each vertical mark ("step") along the

scale represents a power of 10. The number of "steps" between labeled prefixes indicates the number of spaces a decimal point will need to be moved, either to the right or left as indicated by the arrows, to perform the conversion.

For example, an object measures 75 cm (centimeters), but I need to express this length in millimeters (mm).

Step 1. Write the original number expressed with a decimal point (remember, if you don't see one, it is always located at the end of the number): 75 = 75.00

Step 2. Find the starting value on the scale: c for centi(meter)

Step 3. Find the end value (what you are converting to) on the scale: m for milli(meter)

Step 4. To move from centi- to milli- you would take one "step" to the right, so simply move the decimal point one place to the right, and 75.00 cm = 750.0 millimeters!

Now, what if you need to convert 75 cm to micrometers (a.k.a. microns (μm)). How many "steps" does it take to get from (c) centi- to (μ) micro- ? _____

How many places will you have to move the decimal point? _____
In which direction? _____
So, what is the answer: 75 cm =_____μm
What if you need to convert to meters? 75 cm =_____m*
*(Hint: If you don't see a prefix, you are dealing with a standard "unit.")

Exercise 1.6: Metric Measurements and Conversions

Materials (per table):

Meter stick
Metric ruler
100 ml graduated cylinder
Paper cup
Quarter (or other coin)
Metric balance (at instructor's desk)

1. Along with your lab partners, measure the shorter end of the lab table using the meter stick. Record your measurement in meters:_____m

   Convert your answer to:

   centimeters_____cm

   kilometers_____km

2. Measure the length of your lab manual in centimeters using the smaller metric ruler:_____cm

   Convert your answer to:

   millimeters_____mm

   micrometers (microns)_____μm

   nanometers_____nm

3. Partially fill the small cup with water from the sink. (Do not fill the cup completely.) Carefully pour the water into the graduated cylinder and record how many milliliters you collected:_____ml

   Convert your answer to:

   microliters_____ul

   liters_____l

4. Weigh your coin on the metric balance at the instructor's desk. Record the weight in grams_____g

   Convert your answer to:

   milligrams_____mg

   micrograms_____ug

Temperature and Pressure

For this class, we will at times be using measurements for pressure and temperature. As far as pressure is concerned, the terminology we will be using most often is as follows.

1 atmosphere (atm) = atmospheric pressure measured at sea level
1 atm = **760 mmHg** (millimeters of mercury) (which = 29.92 inches of mercury)

Temperature may also be measured in metric units (degrees Celsius (°C))

water (H_2O) boils at 100 °C (212 °F) and freezes at 0 °C (32 °F)
average body temperature is 37 °C (98.6 °F)

LAB REPORT #1

NAME _____

Lab Day _____

PART A

Analyze and define the following anatomical terms by:

a. underlining the root of each term

b. circling each prefix

c. drawing a square around each suffix

d. writing the definitions of these terms (based on your analysis) on the adjacent line.

1. Hypogastric _____
2. Polymyositis _____
3. Hemolysis _____
4. Cytomegaly _____
5. Contralateral _____
6. Osteoid _____

PART B

Match the anatomical body regions in column A with the commonly named body parts they pertain to in column B. Place the letter of your choice in the space provided.

Column A	Column B
a. antebrachial	_____ 1. wrist
b. antecubital	_____2. ankle
c. axillary	_____3. thumb
d. brachial	_____4. armpit
e. oral	_____5. fingers or toes
f. carpal	_____6. knee cap
g. cephalic	_____7. buttocks
h. cervical	_____8. forearm
i. tarsal	_____9. front of elbow
j. crural	_____10. neck
k. olecranal	_____11. arm
l. femoral	_____12. mouth
m. patellar	_____13. shin
n. pollex	_____14. back of elbow
o. digital	_____15. thigh
p. gluteal	_____16. head

PART C

Indicate if each of the following sentences makes correct or incorrect usage of the word in boldface type (assume that the body is in the anatomical position). If the sentence is correct, write "correct" in the space provided. **If the sentence is incorrect, supply a term to replace the boldfaced word that will make the sentence correct**.

1. The mouth is **inferior** to the nose. _____
2. The stomach is **superior** to the diaphragm. _____
3. Within the cervical region, the trachea is **anterior** to the esophagus. _____
4. The small intestines lie **posterior** to the kidneys. _____
5. The heart is **lateral** to the lungs. _____
6. The thoracic spine is **medial** to the scapulae. _____
7. The hand is **proximal** to the elbow. _____
8. The knee is **distal** to the ankle. _____
9. The brain lies **deep** to the skull. _____

PART D

Answer the following questions:

1. Nodding your head "yes" creates movement along which anatomical plane?

   _____

2. Leaning to the side from the waist occurs along which anatomical plane?

   _____

3. a. Which anatomical plane would best separate the brain from the spinal cord (keeping in mind that the brain is superior to the spinal cord)?

   _____

   b. If you made an actual cut (section) along this plane, you could call it a _____.

PART E

Complete the following statements:

1. The space located between the pleural cavities is called the_____.
2. The muscular structure that separates the thoracic and abdominopelvic cavities is called the_____.

3. The small intestine is located in the_____cavity.
4. The heart is located within the_____cavity.

PART F

Perform the following conversions within the metric system.

1. 200 ml =_____liters
2. 25 μm (microns) =_____mm
3. A man weighing 150 kg would weigh_____grams, or_____mg
4. 0.075 cm =_____meters

5. A cell measures 50 μm x 80 μm. What would be the dimensions of this same cell in millimeters –_____mm x_____mm
   centimeters –_____cm x_____cm
6. 5,250 meters =_____km