Happy Summer,

After a little rest, recovery, and recreation this summer, I would like you to do some summer work in preparation for Honors Anatomy & Physiology. You will use a free online text book and some videos as your resources. I **expect this work to take you about 8 hours total, if you are working in an undistracted way**. My goal in assigning this work is to eliminate class time dedicated to areas which should be a review for you, so that we will have more time to explore all of the body systems through lab work, dissection, case study analysis, projects and other activities.

OpenStax free online text: <u>https://openstax.org/details/books/anatomy-and-physiology</u>. You should access this text and bookmark it on your computer. You should freely make use of it throughout this summer work, as necessary. It has a detailed table of contents as well as a search tool.

This summer work has four main topics:

- A. A brief survey about yourself
- B. Intro to A&P / Orientation to the human body. For this, you will do a lab and watch a video.
  - 1. You can complete this lab at home, using your own body, a friend, or someone in your household to locate the body regions and structures as indicated in the procedure. You may consult the OpenStax text for more detail if needed. Read the lab carefully and complete the lab worksheet.
  - Amoeba Sisters video with worksheet, introducing the human body systems -<u>https://www.youtube.com/watch?v=nnjmrrQ6xOs</u>
- C. Review of the Cell This involves watching 3 Amoeba Sisters Videos and completing the worksheets
  - 1. Introduction to Cells <u>https://www.youtube.com/watch?v=8IlzKri08kk&t=5s</u>
  - 2. Osmosis <a href="https://www.youtube.com/watch?v=laZ8MtF3C6M&t=1s">https://www.youtube.com/watch?v=laZ8MtF3C6M&t=1s</a>
  - 3. Transport <u>https://www.youtube.com/watch?v=Ptmlvtei8hw</u>
- D. Review of Chemistry as relates to A&P.
  - 1. A general review in which you answer a variety of short answer and multiple choice questions on various chemistry topics as relates to cells. You should use the Openstax Text and the video links within the assignment.
  - 2. Amoeba Sisters Enzyme review video with worksheet: <u>https://youtu.be/RB4P1HTmwLc</u>

All work will be due on Tuesday, September 6, 2022. We will have a test on this material sometime later that week. Test dates will be posted by September 1. It is strongly suggested that you complete this work with the intent to learn, and not just to get it done.

I fully realize that many answers to all the world's questions can be found through quick internet searches. I would like to point out that when you answer a question this way, *you are not learning*. To do well in A&P, you will need to be able to apply knowledge that you have reviewed and learned this summer. The knowledge that you continue to acquire when we begin class in the fall will build on itself continuously. If you are not working your brain and thinking about *why and how* molecules, cells, tissues, and organs work, you will have a harder time remembering what you are learning. Many people think that succeeding in A&P is all about *memorizing*. That is really NOT true, despite that fact that you will need to do some memorization. Rather, success in A&P comes from thinking about processes, discerning cause and effect and applying your knowledge effectively to solve problems. In view of this, I strongly encourage you to view all videos carefully and with an eye and ear for detail. **Take notes**. Think about the video questions and what they are really asking. When you are reading, *read for understanding*, not just to find the answer. Again, **take notes**.

If you need guidance in any way, please email me: <u>gonzalezc@maryvale.com</u> Thanks, Mrs. Gonzalez

Tell me about you			
Your (full) name:	Your grade:		
Why did you choose this class? What do you hope to get out of it?			
What topic(s) do you most look forward to learning about? Why?			
What topic(s) or activities most concern or intimidate you? Why?			

This packet is meant to be a review. As you work, please complete this table, with as much detail as you think is appropriate. Please be honest, as this will help me determine what we need to review with more depth. Use additional paper if needed:

Topics I was very comfortable with	Topics that seemed unfamiliar or brand-new. Give specific assignment and question numbers.

# Directions: You should use the Openstax Anatomy & Physiology textbook and the videos linked within this document as the resources for this activity.

TEXTBOOK: https://openstax.org/details/books/anatomy-and-physiology

1. Diagram a carbon atom with an atomic number of 6. Label a proton, electron, neutron and nucleus. Draw one of carbon's isotopes and explain what makes it an isotope. *If you are working electronically, please make a drawing on separate paper, take a picture of it and insert a cropped and formatted picture here.* 

2. Define <u>covalent bond</u> and show (in a diagram) the bonding that would form between carbon and 4 hydrogens. Represent all electrons and somehow designate which atom "owns" each electron.

**3.** Define <u>ionic bond</u> and demonstrate how bonding occurs between sodium and chlorine. Again, indicate the origin of each electron.

Watch these two Bozeman Science videos about pH and buffering: <u>https://youtu.be/Xeuyc55LqiY</u> <u>https://youtu.be/rlvEvwViJGk</u>

- 4. Define the term pH and explain what it means.
  - a. Define acid in terms of  $H^{\scriptscriptstyle +}.$  Define acid in terms of protons.

b. Define **base** in terms of  $H^+$ . Define acid in terms of protons.

c. Why can acids and bases be defined in terms of protons?

5. Explain the difference between two solutions of pH=1 and pH=6. Explain the difference between two solutions of pH=8 and pH=14.

6. Explain how pH relates to proton availability.

7. What is the job of **buffers**?

### 8. Define the terms

a.	buffer solution
b.	weak acid
с.	conjugate base

9. Explain how chemical buffering works, using the 3 terms from #8.

10.	Consider the following chemical ed	quation:

$CO_2 + H_2O$	$\leftarrow \rightarrow H_2CO_3$	$\leftarrow \rightarrow$ H+ +	HCO <sub>3</sub> <sup>-</sup>
002	· / II2003	<b>\</b> / / / / / /	

a.	Name each compound.
b.	Identify the weak acid.
C.	Identify the weak conjugate base.
d.	If more $CO_2$ enters the reaction, what will be the impact on pH? Why?
e.	Consider the reaction in reverse. If more acid is added to the system, what will be the impact on CO <sub>2</sub> ? Why?

### Use your OpenStax textbook to complete the following review.

11. the periodic table of the elements, elements in a single column have the same number of electrons that can participate in a chemical reaction. These electrons are known as "valence electrons." For example, the elements in the first column all have a single valence electron—an electron that can be "donated" in a chemical reaction with another atom. Explain the role of these electrons in determining what an atom can "do".

12. Watch this video (<u>https://www.youtube.com/watch?v=b7TdWLNhMtM</u>) to observe the formation of a disaccharide. What happens when water encounters a glycosidic bond?

					4
13.	a. b.	Tog calcium, m oxygen, ca	ether, just four elements make up more than nagnesium, iron, and carbon alcium, iron, and nitrogen	95 c. d.	percent of the body's mass. These include sodium, chlorine, carbon, and hydrogen oxygen, carbon, hydrogen, and nitrogen
14.	a. b.	T electron atom	he smallest unit of an element that still retain	s th c. d.	e distinctive behavior of that element is an elemental particle isotope
15.	a. b.	protons neutrons	The characteristic that gives an element its d	istir c. d.	nctive properties is its number of electrons atoms
16.	a. b.	H <sub>2</sub> O <sup>2</sup> H	Which of the following is a molecule, but <i>not</i> a	a co c. d.	pmpound? H <sub>2</sub> H <sup>+</sup>
	Ex	plain why:			
17.	are	e linked with	A molecule of ammonia contains one atom c า	of ni	trogen and three atoms of hydrogen. These
	a. b.	ionic bond nonpolar c	s covalent bonds	c. d.	polar covalent bonds hydrogen bonds

- **18.** When an atom donates an electron to another atom, it becomes c. nonpolar

d. all of the above

- a. an ion
- b. an anion
- 19. Which of the following statements about chemical bonds is true?
  - a. Covalent bonds are stronger than ionic bonds.
  - b. Hydrogen bonds occur between two atoms of hydrogen.
  - c. Bonding readily occurs between nonpolar and polar molecules.
  - d. A molecule of water is unlikely to bond with an ion.
- **20.** The bonding of calcium, phosphorus, and other elements produces mineral crystals that are found in bone. This is an example of a(n) \_\_\_\_\_ reaction.
  - a. catabolic
  - b. synthesis

- c. decomposition
- d. exchange

- **21.**\_\_\_\_\_ reactions release energy.
  - a. Catabolic
  - b. Exergonic

- c. Decomposition
- d. Catabolic, exergonic, and decomposition
- 22. Which of the following combinations of atoms is *most likely* to result in a chemical reaction?
  - a. hydrogen and hydrogen
  - b. hydrogen and helium
- c. helium and helium
  - d. neon and helium
- Chewing a bite of bread mixes it with saliva and facilitates its chemical breakdown. This 23. is most likely due to the fact that .
  - a. the inside of the mouth maintains a very high temperature
  - b. chewing stores potential energy
  - c. chewing facilitates synthesis reactions
  - d. saliva contains enzymes

Which of the following is most likely to be found evenly distributed in water in a homogeneous 24. solution? a. sodium ions and chloride ions c. salt crystals b. NaCl molecules d. red blood cells **25.** Jenny mixes up a batch of pancake batter, then stirs in some chocolate chips. As she is waiting for the first few pancakes to cook, she notices the chocolate chips sinking to the bottom of the clear glass mixing bowl. The chocolate-chip batter is an example of a . a. solvent c. solution b. solute d. suspension What body liquid is most similar to the batter? **26.** A substance dissociates into  $K^+$  and  $CI^-$  in solution. The substance is a(n). a. acid c. salt b. base d. buffer **27.**  $C_6H_{12}O_6$  is the chemical formula for a \_. a. polymer of carbohydrate c. hexose monosaccharide b. pentose monosaccharide d. all of the above 28. \_\_\_\_\_ What organic compound do brain cells primarily rely on for fuel? c. galactose a. glucose b. glycogen d. glycerol **29.** A pentose sugar is a part of the monomer used to build which type of macromolecule? a. polysaccharides c. phosphorylated glucose b. nucleic acids d. glycogen **30.** A phospholipid . a. has both polar and nonpolar regions b. is made up of a triglyceride bonded to a phosphate group c. is a building block of ATP d. can donate both cations and anions in solution **31.** In DNA, nucleotide bonding forms a compound with a characteristic shape known as a(n). a. beta chain d. double helix b. pleated sheet c. alpha helix **32.** The ability of an enzyme's active sites to bind only substrates of compatible shape and charge is known as c. subjectivity a. selectivity d. specialty b. specificity

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**33.** The most abundant elements in the foods and beverages you consume are oxygen, carbon, hydrogen, and nitrogen. Why might having these elements in consumables be useful?

### Amoeba Sisters Video Recap: Enzymes

1. In the box below, please illustrate an enzyme and 2. Enzymes are typically which type of **biomolecule**? substrate. Label the following key words in your illustration: enzyme, substrate, and active site. 3. Describe the effects that enzymes can have on substrates. In order to function efficiently, enzymes need to be at an ideal **pH** and **temperature**. DeNaturedIIII Different enzymes have different ideal pH and temperature conditions. If the pH or temperature is extreme for a particular enzyme, it can even **denature** an enzyme, which can prevent it from binding and acting on its substrate. For the following two Temp scenarios, name the variable (temperature or pH) that is affecting the function of the enzyme. A) ATP is produced by cellular respiration in your human body cells. There are a variety of enzymes that work to produce ATP, but one of those enzymes is called phosphofructokinase-1. This enzyme is sensitive to blood acidity. Blood can become more acidic if a patient is in respiratory distress. 4. Variable affecting enzyme function: The Amocha Sisters So, uh...you like liver, huh? B) A popular lab that can be performed by students is to test the reaction rate of catalase enzyme when it acts on the substrate hydrogen peroxide. Catalase has the ability to break down hydrogen peroxide. Catalase can be found in beef liver from the grocery store! However, if the beef liver is boiled first, the catalase will not be able to break down hydrogen peroxide. 5. Variable affecting enzyme function: \_\_\_\_\_



# Real Life Enzyme Scenarios

Please fill in the chart for every real life scenario listed below. Some boxes have been filled in for you!

Scenario	Identify Enzyme:	SubStrate Identify Substrate:	Illustrate the Scenario (label <u>enzyme</u> and <u>substrate</u> in illustration):	Describe the relationship between the substrate and enzyme in the scenario.
Lactase is an enzyme that breaks down a sugar found in dairy products known as lactose. Some people are lactose intolerant, and this can be due to not having enough lactase production. People who are lactose intolerant may not feel well after eating foods containing lactose.	6.	lactose	7.	8.
An enzyme called glucocerebrosidase breaks down a glycolipid in the body known as glucocerebroside. However, in a genetic disease known as Gaucher's disease, the body does not produce enough glucocerebrosidase. Therefore glucocerebroside can build up in the body and this can cause serious side effects such as anemia and swelling of the liver and spleen.	9.	10.	11.	12.
Pancreatitis is an inflammation of the pancreas which can damage pancreatic tissue. The pancreas produces digestive enzymes such as amylase and lipase. These enzymes assist in breaking down certain food biomolecules. In this disorder, enzyme production from pancreatic tissue may be stopped.	13.	14.	15.	Since the pancreatic tissue can be damaged in this disorder, the production of the enzymes in this tissue (amylase and lipase) may be disrupted as well. This would affect the ability to break down certain types of food biomolecules (substrate).



Amoeba Sisters Video Recap: Cell Transport			
The cell membrane is important for maintaining homeostasis, because it controls what enters and leaves a cell. 1. Sketch the phospholipid bilayer of a cell membrane below and label the polar heads and nonpolar tails.	<ul> <li>2. What is simple diffusion?</li> <li></li></ul>		
4. "Moving with the flow" (i.e. going with the concentration grathed direction of flow in passive transport. Show this in the diagon right by <b>drawing in 10 total circles (to represent molecules)</b> . You decide a certain amount to place on the left vs. the right side and viewing the arrow indicating the direction of movement. Label concentration side and low concentration side.	adient) is ram on ou must fter the high		
Endocvtosis	and Exocvtosis		
5. Are <b>endocytosis</b> and <b>exocytosis</b> forms of passive or active tra	ansport?		
6. Give a scenario where a cell may need to perform a form of e	endocytosis.		
7. Give a scenario where a cell may need to perform a form of e	exocytosis		





## **Traveling Molecules**



# For the following scenarios, determine whether the molecules in the scenario are moving by (S) simple diffusion, (F) facilitated diffusion, or (A) active transport.

8. \_\_\_\_\_ For water to travel across the cell membrane at a substantial rate, the water molecules travel through protein channels known as **aquaporins**.

9. \_\_\_\_\_ While water molecules are polar, they are also very small. One fact not mentioned in the video is that some water molecules are able to squeeze directly through the phospholipid bilayer due to their small size.

10. \_\_\_\_\_ Charged ions are traveling through a cell membrane with the concentration gradient.

11. \_\_\_\_Cells lining the gut need to take in glucose, but at a certain time, the concentration of extracellular glucose is lower than the concentration already stored in the cells.

12. \_\_\_\_\_At a certain time, glucose is in a high concentration outside of a cell and needs to travel through the membrane into the cell.

# Facilitated Diffusion via a Protein Channel Active Transport via a Protein Channel For the below image, label the 13. polar area and 14. nonpolar area on the diagram. For the below image, label the 17. polar area, and 18. nonpolar area. Draw in 15. protein channel and 16. molecules that would represent a potential concentration gradient in facilitated diffusion via a protein channel on the diagram. Draw in 19. protein channel and 20. molecules that would represent a potential concentration gradient in active transport via a protein channel on the diagram. Image: State Sta



# Amoeba Sisters Video Recap of Osmosis

1. The below picture represents <b>diffusion</b> of molecules. Place the following labels in the diagram: <b>high</b> <b>concentration</b> , <b>low concentration</b> , and <b>an arrow</b> showing the direction that the molecules would travel before equilibrium is reached.	<ul> <li>2. Osmosis is a type of diffusion, but it involves the movement of water. Similar to diffusion, osmosis is the movement of molecules (water molecules if osmosis) from a high concentration to a low concentration.</li> <li>The video clip explains that you can also look at water as moving to a</li> </ul>	
	concentration of <b>solute</b> molecules. Why can it also be viewed this way?	
<ul> <li>3. Osmosis Scenario: The video clip mentioned a disaster scenario of a saltwater fish being placed in fresh water.</li> <li>What would occur if, instead, a freshwater fish was placed in saltwater?</li> <li>Your answer needs to have an arrow indicating the direction of water flow in osmosis, a label for "hypertonic," and a label for "hypotonic."</li> </ul>	<ul> <li>4. Osmosis Scenario: Fluid movement into the brain after traumatic brain injury can result in dangerous brain swelling.</li> <li>One treatment that can be used in some of these cases is adding a saline. You need to decide whether this blank should be the word hypertonic or hypotonic. Remember, you are trying to reduce the excessive fluid in the brain.</li> </ul>	
	Explain your answer:	



Do you like gummy bears? We do!	Viewpoints:	6. Whose viewpoint is correct in the
They are one of our favorite snacks, though we (try) to eat them in moderation because they are high in sugar. Consider that your sister is in a foul mood and decides to dump your gummy bears in your ice water about 20 minutes before you get	<ul> <li>A) Your sister said that the sugar left the gummy bears, because the gummy bears were hypertonic compared to the water.</li> </ul>	viewpoint column? A good answer has a good defense! <b>Defend your</b> <b>answer,</b> and also give reasons why the other explanations are incorrect.
home.	<ul> <li>B) Your friend Joe said that water traveled into the</li> </ul>	
The gummy bears are greatly enlarged by the time you get home! Your sister and some friends have different viewpoints for what	gummy bears, because the gummy bears were hypertonic compared to the water.	
showing the enlarged gummy bears	C) Your friend Suzy said the	
in a cup of water. Place the labels "hypertonic" and "hypotonic" in your diagram. One label should be	bears, because the gummy bears were <b>hypotonic</b>	
for the gummy bears and one label	compared to the water.	
should be for the water.	<ul> <li>D) Your friend Will said that water traveled into the</li> </ul>	
5.	gummy bears by osmosis, because the gummy bears	
	were <b>hypotonic</b> compared to the water.	

### The Gummy Bear Mystery

### Hypertonic, Hypotonic, or Isotonic? Oh My!

These red blood cells have all been placed in different solutions! Based on their appearance after being placed in these solutions for a period of time, place on each line (A) for **hypertonic**, (B) for **hypotonic**, or (C) for **isotonic**.





### Amoeba Sisters Video Recap: Introduction to Cells

Directions: For each statement, write a "P" if it best applies to **prokaryotes only**, "E" if it best applies to **eukaryotes only**, and "both" if it applies to **both prokaryotes and eukaryotes**.



13. The **cell theory** makes several fascinating statements about cells! What are three statements mentioned in the video that are included in the cell theory?



## A Tour Inside the Cell!

Let's do a recap of the structures discovered inside the cell after the video tour! Fill in the below chart to help you organize what was visited! Remember there are more functions and structures that you can discover online.

Structure or	Makes Me Think of	Function(s):	*Type of Cell?
Organelle on the	wakes we mink oj	i unction(s).	*Is it in both prokarvotes and
Tour:	(provide an illustration or analogy!)		eukarvotes? Or just eukarvotes?
	(p. e		
Cell Membrane	14.	15.	16.
Cytoplasm	17.	18.	19.
Ribosome	20.	21.	22.
Nucleus	23	24	25
indicus	25.	27.	23.
Fadaalaamia	26	27	20
Reticulum (Rough	26.	27.	28.
and Smooth)			
Golgi apparatus	29.	30.	31.
Mitochondria	32	33	Fukarouta Calle (in both
(Singular:	52.	55.	animal and blant cells)
Mitochondrion)			(and the plant ceus)
Call Wall	24	25	20
	34.	35.	30.
Chloroplast	37.	38.	39.
Vacuole	40.	41.	42.
1		1	1



# VISIBLE BODY® Back to Basics: The Human Cell

Sweat the small stuff with this study guide on the various parts and functions of a eukaryotic cell.





# www.visiblebody.com

# There's a great line in the 1992 animated movie *Fern Gully* that really encompasses this eBook:

# "We're worlds within worlds."

Despite their small size (you'd need a microscope to get a good look), cells are amazingly complex and constantly busy.

Your entire body is made up of cells, all programmed to perform specific functions.

# Let's take a look at the inner workings of one!

Let's begin with cytosol, which is a gel-like substance that is mostly water, with various dissolved and suspended components, like glucose, proteins, and amino acids.

Cytosol is also known as intracellular fluid (ICF) and is the fluid component of cytoplasm.

# Fun Fact:

While it is known that cytosol is mostly water, what isn't known is its structure and properties within cells.

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# The **plasma membrane** is a flexible, semi-permeable barrier that separates the cell interior from its surroundings.

The barrier is constructed of a phospholipid bilayer, and its components allow for certain materials to pass in and out of the cell.

Proteins embedded within the phospholipid bilayer carry out the specific functions of the plasma membrane, including selective transport of molecules and cell-cell recognition.





# Nucleus

# Smooth endoplasmic reticulum

# Peroxisome

# Lipid bilayer

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# Mitochondria

Plasma membrane

Rough endoplasmic reticulum



# The **nucleus** is a large organelle that contains the cell's genetic information.

The **nucleolus** is the largest structure within a nucleus, and contains a cluster of protein and ribonucleic acid (RNA). It is involved with ribosome formation and the ribosomal RNA synthesis.

# Fun Fact #1:

Most cells have at least one nucleus, and some (like mature red blood cells) have none at all!

# Fun Fact #2:

Nucleus is Latin for "little kernel" and its first recorded use in terms of cells was in 1831.

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# The **endoplasmic reticulum (ER)** is a network of membrane-enclosed sacs that package and transport materials for cellular growth and other functions.

Smooth endoplasmic reticulum

•



Rough endoplasmic reticulum





# and phospholipids, as well as many other metabolic processes.

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**Smooth ER** extends from the rough ER and synthesizes lipids, steroids,



**Rough ER** plays an important role in the packaging and synthesis of proteins. It is "rough" due to the ribosomes that stud the ER membrane.

# **Ribosomes** contain more than 50 proteins and a high concentration of ribosomal RNA. Their main function is protein synthesis; these proteins are used by the cell, the plasma membrane, or structures outside the cell.



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# Some ribosomes float freely in the cytosol.

# Some ribosomes are bound to the ER.

The **Golgi complex** consists of 3 to 20 curved cisternae (flattened, membranous sacs), and it acts as a processing hub for proteins produced in the endoplasmic reticulum.

Enzymes in the cisternae modify the proteins and pack them into **transfer vesicles**, which then transport them to different areas in the cell.



![](_page_25_Picture_0.jpeg)

# www.visiblebody.com

**Mitochondria** (sing. mitochondrion) are famously known as the powerhouses of a cell. Using the oxygen taken in by the cell, mitochondria produce ATP, a molecule used as fuel for energy.

Depending on the type of cell and its function, there can be anywhere from a few hundred mitochondria to several thousand.

# Fun Fact:

In Madeleine L'Engle's 1973 young adult novel A Wind in the Door, the main characters travel inside a mitochondrion named Yadah, and interact with fictional sentient structures called "farandolae."

Lysosomes contain digestive enzymes that break down substances consumed by the cell and recycle waste.

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![](_page_26_Picture_2.jpeg)

![](_page_26_Picture_3.jpeg)

**Peroxisomes** process and neutralize toxins within the cell.

![](_page_27_Picture_0.jpeg)

A universe of anatomical and physiological visuals and reference texts at your fingertips! www.visiblebody.com

### Amoeba Sisters Video Recap: The Eleven Human Body Systems

1. Remember that your body is made up of millions of cells! Cells that work together and perform various functions depending on their cell type. It is important to understand that cells are a part of an organism's levels of organization. Fill in the following chart and draw a picture that represents each level.

![](_page_28_Figure_4.jpeg)

Each body system has many functions. In fact, each system has many more functions than what a seven minute video clip can cover! Below is a list of major overall body system functions. In each box, write the name of the body system that **best** fits the description. The wording is not necessarily identical to the video clip---you may need to think about these!

2. Protects from water loss and outside environment:	3. Major role in hormone production:
4. Major role in gas exchange:	5. Excretes waste material and very important for homeostasis:
6. Provides active defense against pathogens:	7. Involved in the mechanical and chemical breakdown of food:
8. Allows for movement:	9. Provides ability to reproduce
10. Transports gases and nutrients:	11. Supports the body with structure:
12. Coordinates involuntary and voluntary responses:	

![](_page_28_Picture_7.jpeg)

![](_page_29_Figure_2.jpeg)

Remember that organ systems do not work in isolation! They work together as a team. In the following scenarios, select at least two organ systems that would certainly be working together for the scenario. Then, illustrate a cartoon that represents it! #15 has a place for you to create your own scenario.

Scenario:	Body Systems Directly Involved (Give at Least 2)	Cartoon
13. Ouch! You step on a tack and jerk away without even thinking. Then you decide to pick up the tack and place it back in a desk drawer.		
14. You drink two cans of your favorite sugary soda, even though you know this is not healthy for you. You have to run to the bathroom before the next class period starts.		
15.		

![](_page_29_Picture_5.jpeg)

# The Language of Anatomy

exercise

ost of us are naturally curious about our bodies. This fact is amply demonstrated by infants, who are fascinated with their own waving hands or their mother's nose. Unlike the infant, however, an anatomy student must learn to identify body structures formally.

This exercise presents some of the most important anatomical terms you will be using to describe the body and introduces you to **gross anatomy**, the study of body structures you can see with your naked eye. As you are becoming familiar with this **anatomical terminology**, you will have a chance to examine the three-dimensional relationships of body structures using illustrations and models.

# **Anatomical Position**

**Objective 1:** Describe the anatomical position verbally or by demonstrating it.

When doctors refer to specific areas of the human body, they do so relative to a standard position called the **anatomical position**. In the anatomical position, the human body is erect, with head and toes pointed forward and arms hanging at the sides with palms facing forward (see Figure 1.3 on p. 4).

## Activity: Demonstrating the Anatomical Position

Stand and assume the anatomical position. Notice that it is not particularly comfortable because you must hold your hands unnaturally forward instead of allowing them to hang partially cupped toward your thighs. ■

# **Surface Anatomy**

**Objective 2:** Demonstrate proficiency in using terms describing body landmarks, directions, planes, and surfaces.

· Body surfaces provide a number of visible landmarks that can be used to study the body. Several of these are described on the following pages.

# Before You Begin:

- Read the chapter on anatomical terms in your textbook.
- Scan the exercise for the objectives you will be expected to accomplish during this laboratory session.

## Materials

- Human torso model (dissectible)
- Human skeleton
- Demonstration area:
  - Station 1: Sectioned and labeled kidneys (three separate kidneys uncut or cut so that (a) entire, (b) transverse, and (c) longitudinal sectional views are visible).
  - *Station 2*: Three separate bananas, uncut or cut so that (a) entire, (b) transverse, and (c) longitudinal sectional views are visible.

# Activity: Locating Body Landmarks

## **Anterior Body Landmarks**

Identify and use anatomical terms to correctly label the following regions in Figure 1.1a:

**Abdominal:** The anterior body trunk region inferior to the ribs

Antecubital: The anterior surface of the elbow

Axillary: The armpit

Brachial: The arm

Buccal: The cheek

**Carpal:** The wrist **Cervical:** The neck region **Coxal:** The hip

**Deltoid:** The roundness of the shoulder caused by the underlying deltoid muscle

**Digital:** The fingers or toes

![](_page_31_Picture_1.jpeg)

(a) Anterior

(b) Posterior

![](_page_31_Figure_4.jpeg)

Femoral: The thigh Fibular: The side of the leg Inguinal: The groin Mammary: The breast Manus: The hand Nasal: The nose Oral: The mouth Orbital: The bony eye socket (orbit)

Patellar: The anterior knee (kneecap) region
Pelvic: The pelvis region
Pubic: The genital region
Sternal: The region of the breastbone
Tarsal: The ankle
Thoracic: The chest
Umbilical: The navel

### **Posterior Body Landmarks**

Identify and appropriately label the following body surface regions in Figure 1.1b:

Cephalic: The head

Gluteal: The buttocks or rump

**Lumbar:** The area of the back between the ribs and hips; the loin

**Occipital:** The posterior aspect of the head or base of the skull

**Popliteal:** The back of the knee

Sacral: The area between the hips

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Scapular: The scapula or shoulder blade area

**Sural:** The calf or posterior surface of the leg

Vertebral: The area of the spinal column ■

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# Body Orientation and Direction

Study the terms below, referring to Figure 1.2. Notice as you read that certain terms have a different meaning for a four-legged animal than they do for a human.

**Superior/inferior** (*above/below*): These terms refer to the location of a structure along the long axis of the body. Superior structures appear above other structures, and inferior structures are always below other body parts.

Anterior/posterior (*front/back*): In humans the most anterior structures are those that are most forward—the face, chest, and abdomen. Posterior structures are those toward the backside of the body.

**Medial/lateral** (*toward the midline/away from the midline or median plane*): Medial structures are closer to the body midline than are lateral structures.

The terms described above assume the person is in the anatomical position. The next four pairs of terms are more absolute. They do not relate to a particular body position, and they have the same meaning in all vertebrate animals.

![](_page_32_Picture_7.jpeg)

### Figure 1.2 Anatomical terminology describing body orientation and direction in a human.

**Cephalad/caudad (caudal)** (toward the head/toward the tail): In humans these terms are used interchangeably with superior and inferior. But in four-legged animals they are synonyms of anterior and posterior respectively.

**Dorsal/ventral** (*backside/belly side*): Meaning "back," the term *dorsal* refers to the animal's back or the *backside* of any other structures. The term *ventral*, meaning "belly," always refers to the belly side of animals. In humans the terms *ventral* and *dorsal* are used interchangeably with the terms *anterior* and *posterior*, but in four-legged animals *ventral* and *dorsal* are synonymous with *inferior* and *superior* respectively.

**Proximal/distal** (*nearer the trunk or attached end/farther* from the trunk or point of attachment): These terms locate various areas along the body limbs or an elongated organ such as the intestine. For example, the fingers are distal to the elbow; the knee is proximal to the toes.

**Superficial/deep** (toward or at the body surface/away from the body surface or more internal): These terms locate body organs according to their relative closeness to the body surface. For example, the skin is superficial to the skeletal muscles.

## Activity: Practicing Using Correct Anatomical Terminology

Before continuing, use a human torso model, a skeleton, or your own body to specify the relationship between the following structures.

- 1. The wrist is \_\_\_\_\_\_ to the hand.
- 2. The trachea (windpipe) is \_\_\_\_\_\_ to the spine.
- 3. The brain is \_\_\_\_\_\_ to the spinal cord.
- 4. The kidneys are \_\_\_\_\_\_ to the liver.
- 5. The nose is \_\_\_\_\_\_ to the cheekbones.
- 6. The chest is \_\_\_\_\_\_ to the abdomen. ■

# **Body Planes and Sections**

The body is three-dimensional. So, in order to observe its internal parts, it often helps to make use of a **section**, or cut made along an imaginary surface or line called a **plane**. There are three planes of space (Figure 1.3), or sections, that lie at right angles to one another.

**Sagittal plane:** A plane that runs lengthwise or longitudinally down the length of the body, dividing it into right and left parts, is a sagittal plane. If it divides the body into equal parts, right down the median plane of the body, it is called a **median**, or **midsagittal**, **plane**.

![](_page_33_Figure_1.jpeg)

# Figure 1.3 Planes of the body.

**Frontal** (coronal) plane: A longitudinal plane that divides the body (or an organ) into anterior and posterior parts.

**Transverse plane:** A plane that runs horizontally, dividing the body into superior and inferior parts. These sections are also commonly called **cross sections**.

As shown in Figure 1.4, a sagittal or frontal section of any nonspherical object, be it a banana or a body organ, provides quite a different view than a transverse section.

# Activity: Observing Sectioned Specimens

Go to the Demonstration area and observe the entire (uncut) and transversely and longitudinally cut kidneys at Station 1, and the bananas at Station 2. Pay close attention to the different structural details you can see in the samples.

![](_page_33_Figure_8.jpeg)

Figure 1.4 Comparison of longitudinal and transverse sections. Sections of (a) a banana and (b) the small intestine.

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![](_page_34_Figure_0.jpeg)

**Figure 1.5 Body cavities.** Arrows indicate the angular relationship between the abdominal and pelvic cavities.

Thoracic

Diaphragm

Abdom-

inal

cavity

Pelvic cavity

Ventral body cavity

Abdomino pelvic

cavity

cavity

# **Body Cavities**

**Objective 3:** Name the body cavities and indicate important organs in each cavity.

The axial portion of the body has two main cavities (Figure 1.5).

# **Dorsal Body Cavity**

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The dorsal body cavity consists of the cranial and spinal cavities. The **cranial cavity**, within the rigid skull, contains the brain. The **spinal cavity**, which runs within the bony vertebral column, protects the spinal cord. The spinal cord is a continuation of the brain, and the cavities containing them are continuous with each other. 5

# **Ventral Body Cavity**

Like the dorsal cavity, the ventral body cavity is subdivided. The superior **thoracic cavity** is separated from the rest of the ventral cavity by the muscular diaphragm. The heart and lungs, located in the thoracic cavity, are protected by the bony rib cage. The cavity inferior to the diaphragm is the **abdominopelvic cavity**. Although there is no further physical separation of this part of the ventral cavity, some describe the abdominopelvic cavity in terms of a superior **abdominal cavity**, the area that houses the stomach, intestines, liver, and other organs, and an inferior **pelvic cavity**, which is partially enclosed by the bony pelvis and contains the reproductive organs, bladder, and rectum. Notice in Figure 1.5 that the pelvic cavity tips away from the abdominal cavity in a posterior direction.

**Abdominopelvic Quadrants and Regions** The abdominopelvic cavity is quite large and contains many organs, so it is helpful to divide it up into smaller areas for study. The medical scheme divides the abdominal surface (and the abdominopelvic cavity deep to it) into four approximately equal regions called quadrants, named according to their relative position—that is, *right upper quadrant, right lower quadrant, left upper quadrant, and left lower quadrant* (see Figure 1.6a).

![](_page_34_Picture_11.jpeg)

**Figure 1.6** Abdominopelvic surface and cavity. (a) The four quadrants. (*Figure continues on page 6.*)

![](_page_35_Figure_1.jpeg)

**Figure 1.6 (continued)** (b) Nine regions delineated by four planes. The superior horizontal plane is just inferior to the ribs; the inferior horizontal plane is at the superior aspect of the hip bones. The vertical planes are just medial to the nipples. (c) Anterior view of the ventral body cavity showing superficial organs.

Another scheme, commonly used by anatomists, divides the abdominal surface and abdominopelvic cavity into nine separate regions by four planes, as shown in Figure 1.6b. Read through the descriptions of these nine regions below and locate them in the figure. Notice the organs they contain by referring to Figure 1.6c.

Umbilical region: The centermost region, which includes the umbilicus.

**Epigastric region:** Immediately superior to the umbilical region; overlies most of the stomach.

Hypogastric (pubic) region: Immediately inferior to the umbilical region; encompasses the pubic area.

**Iliac regions:** Lateral to the hypogastric region and overlying the superior parts of the hip bones.

Lumbar regions: Between the ribs and the flaring portions of the hip bones; lateral to the umbilical region.

**Hypochondriac regions:** Flanking the epigastric region laterally and overlying the lower ribs.

# Activity: Locating Abdominal Surface Regions

Locate the regions of the abdominal surface on a torso model and on yourself before continuing. ■

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## REVIEW SHEET exercise

# The Language of Anatomy

# Surface Anatomy

Match each of the following descriptions with a key term, and record the term in front of the description.

Key:	brachial buccal	carpal cervical	deltoid digital	patellar scapular
. <u> </u>	1,	cheek		5. anterior aspect of knee
	2.	referring to the fingers		6. referring to the arm
	3.	shoulder blade region		7. curve of shoulder
	4.	. wrist area		8. referring to the neck

# Body Orientation, Direction, Planes, and Sections

1. Several incomplete statements are listed below. Correctly complete each statement by choosing the appropriate anatomical term from the key. Record the key terms on the correspondingly numbered blanks below.

Key:	anterior	inferior	posterior	superior
	distal	lateral	proximal	transverse
	frontal	medial	sagittal	

In the anatomical position, the umbilicus and knees are on the <u>1</u> body surface; the calves and shoulder blades are on the <u>2</u> body surface; and the soles of the feet are the most <u>3</u> part of the body. The ears are <u>4</u> and <u>4</u> to the shoulders and <u>5</u> to the nose. The breastbone is <u>6</u> to the vertebral column (spine) and <u>7</u> to the shoulders. The elbow is <u>8</u> to the shoulder but <u>9</u> to the fingers. The thoracic cavity is <u>10</u> to the abdominopelvic cavity and <u>11</u> to the spinal cavity. In humans, the ventral surface can also be called the <u>12</u> surface; however, in quadruped animals, the ventral surface is the <u>13</u> surface.

If an incision cuts the brain into superior and inferior parts, the section is a <u>14</u> section; but if the brain is cut so that anterior and posterior portions result, the section is a <u>15</u> section. You are told to cut a dissection animal along two planes so that the lungs are observable in both sections. The two sections that meet this requirement are the <u>16</u> and <u>17</u> sections.

![](_page_36_Figure_12.jpeg)

2. A nurse informs you that she is about to give you a shot in the lateral femoral region. What portion of your body should you uncover?

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3. Correctly identify each of the body planes by inserting the appropriate term for each on the answer line below the drawing.

![](_page_37_Picture_3.jpeg)

# **Body Cavities**

1. Which body cavity would have to be opened for the following types of surgery? (Insert the key term(s) in the samenumbered blank. More than one choice may apply.)

Key:	abdominopelvic cranial	dorsal spinal	thoracic ventral	
1. surgery	to remove a cancerous l	ung lobe	1	
2. remova	l of an ovary		2	-
3. surgery	rgery to remove a ruptured disk		3	-
4. append	ectomy		4	-
5. remova	al of the gallbladder		5	-

2. Correctly identify each of the described areas of the abdominal surface by inserting the appropriate term in the answer blank preceding the description.

1. overlies the lateral aspects of the lower ribs

- 2. surrounds the "belly button"
  - \_\_\_\_\_\_ 3. encompasses the pubic area
    - 4. medial region overlying the stomach

3. What are the bony landmarks of the abdominopelvic cavity?

4. Which body cavity affords the least protection to its internal structures?