ANATOMY AND PHYSIOLOGY (N3)
1st Semester AY 2022-2023
STUDY GUIDE

ORGANIZATION OF THE HUMAN BODY

Introduction

Hello students! Welcome to Anatomy and Physiology. In this course you will appreciate why nurses need to study anatomy and physiology. As nurses, we need to understand how to take good care of themselves and their clients/patients. The body must remain in a balanced condition to operate. When one's body has a problem in balance, health professionals must figure out how to recover the body's stability to help the client/patient.

The first topic is about knowing how the body is organized and the processes that make us alive which are basic foundational knowledge in anatomy and physiology. In this study guide, we will learn about the organization of the human body and the various life processes that ensure growth, development, metabolism, and homeostasis. In the second part of this study guide, we will learn the various anatomical terms and directions which will be important when we want to accurately describe anatomical landmarks and physiological processes.

Hope you enjoy this topic and the rest of Anatomy and Physiology.

Learning outcomes

After going through this topic, you should be able to:

1. Define anatomy and physiology and name several subspecialties in these sciences;
2. Describe the levels of structural organization that make up the human body;
3. Define the important life processes, the concept of homeostasis, and explain its relationship with the interstitial fluid;
4. Explain how homeostatic imbalances are related to disorders
5. Describe the anatomical position
6. Relate the common names to the corresponding anatomical descriptive terms for various regions of the human body
7. Define the anatomical plans, sections, and directional terms used to describe the human body
8. Outline the major body cavities, the organs they contain, and their associated linings.

Resources that you can read

Please read the main references below to better understand the topic.

1. Betts JG, Desaix Peter, Johnson E et al (2017). Chapter 1 An Introduction to the Human Body. *Anatomy and Physiology.* OpenStax Rice University. Pp 7-40.

   Note: You may access this open education resource in this link: https://openstax.org/details/books/anatomy-and-physiology. You have an option to view the book online or download the PDF file.

2. Tortora GJ & Derrickson B. (2014). Chapter 1 An Introduction to the Human Body. *Principles of Anatomy and Physiology.* John Wiley & Sons, Inc. 14 edition. Pp 1-26.

Note: We are still requesting the College of Nursing Library for the purchase of the e-book of this edition.

3. *Organization of the Human Body* pre-recorded lecture video by Asst. Prof. Peter James B. Abad uploaded in Canvas

Topic outline

The specific topics that will be covered in this study guide are as follows:

1. Definition of anatomy and physiology
2. Levels of structural organization
3. Basic life processes
4. Homeostasis and feedback mechanisms
5. Basic anatomical and directional terms
6. Planes and sections
7. Body cavities, regions, and quadrants

1. Definition of Anatomy and Physiology

Simply speaking, **anatomy** is the science of body structures and the relationships among them. Body structures can be big (e.g., a major organ like the liver) or very small (e.g., tissues and cells) which require a microscope for these to be seen.

Physiology, on the other hand, is the science of body functions—how body parts work. For example, in physiology, we would be interested to know how the heart pumps blood and what could be the regulatory mechanisms that maintain the amount of blood ejected every minute (called the cardiac output).

In Nursing 3, we study anatomy and physiology together because the structure of organs provide insight into their functions and vice versa. For example, knowing that the alveoli in the lungs are made up of single layered cells (you will later learn that these are called *simple squamous epithelium)* will give you an idea of their function in gas exchange and how this structure enables diffusion of g gasses to happen.

Activity 1. Anatomy and Physiology Subspecialties

Answer the following question in the discussion forum in VLE.

1. Anatomy as well as physiology have several subspecialties. Can you identify these subspecialties and explain what they specifically study?
2. Can you give your own example on how a structure of a body part is related to its function?

2. Levels of Structural Organization

In studying anatomy and physiology, understanding the six levels of organization will allow us to examine anatomical structures and physiological processes in greater detail. For example, when we study the physiology of digestion, we would need to know what exactly is happening at the cellular, even molecular level, to understand how gastric juices and pancreatic enzymes are produced,

released, and their specific actions. Likewise, any changes in the molecular, cellular, or tissue level may manifest in the organ and/or organism level.

According to Tortora and Derrickson (2014), the six levels of organization are as follows:

1. Chemical level- this is the basic level of organization and includes substances involved in chemical reactions such as enzymes, neurotransmitters, and hormones. This also includes the deoxyribonucleic acid (DNA), the genetic material, which is important to drive body processes and is passed down from one generation to another.

2. Cellular level- this is a basic functional unit in the body. There are many kinds of cells in the body and you will learn more about these in the next topic.

3. Tissue level- certain cells that work together and perform specific functions are call tissues. There are four main types of tissues: epithelium, connective, muscle, and nerve tissues. You will learn more about these in the next topic.

4. Organ level- these are structures that are made up of two or more different tissue types and they have specific functions.

5. System level- this is also called the *organ-system level.* This is composed of several organs with a common function. For example, the respiratory system is involved in ensuring ventilation and this function is carried out by several organs such as the nose, pharynx, trachea, bronchus, and the lungs.

6. Organism level- this pertains to an organism with functioning body parts. This is you.

There are 11 organ-systems in the body. The table below enumerates these organ-systems and their specific functions:

Name of the Organ-System	**Function**
Integumentary system	Protects the body as the first line of defense; helps regulate body temperature; eliminates some wastes in the form of sweat; helps make Vitamin D; and detects sensations such as touch, pain, warmth, and cold.
Skeletal system	Supports and protects the body; provides a surface area for muscle attachments; aids body movements; houses cells that produce blood cells (the bone marrows); stores minerals (e.g., calcium) and lipids.
Muscular system	Produces body movements such as walking; stabilizes body position; and generates heat

Nervous system	Generates action potentials (nerve impulses) to regulate body activities; detects changes in the body's internal and external environments; interprets changes and responds by causing muscular contractions or glandular secretions.
Endocrine system	Regulates body activities by releasing hormones which are chemical messengers transported in blood from an endocrine gland or tissue to a target organ.
Cardiovascular system	The heart pumps blood through blood vessels; blood carries oxygen and CO2 and wastes away from cells and helps regulate acid-base balance, temperature, and water content; blood components (e.g., white blood cells and platelets) help defend against disease and ensures coagulation.
Lymphatic system	Returns proteins and fluid to blood; carries lipids from gastrointestinal tract to blood; it includes structures where lymphocytes that protect against disease-causing microbes mature and proliferate.
Respiratory system	Transfers oxygen from inhaled air to blood and CO2 from blood to exhaled air; helps regulate acid-base balance of body fluids by regulating amount of dissolved CO2 in the blood; air flowing out of lungs through vocal cords produces sounds.
Digestive system	Achieves physical and chemical breakdown of food; absorbs nutrients; eliminate solid wastes
Urinary system	Produces, stores, and eliminates urine; eliminates wastes and regulates volume and chemical composition of the blood; helps maintain the acid-base balance of body fluids; maintains the body's mineral balance; helps regulate production of red blood cells.
Reproductive system	Gonads produce gametes that unite to form a new organism; gonads release hormones that regulate reproduction and other body processes.

Content adapted from: Tortora GJ & Derrickson B. (2014). Chapter 1 An Introduction to the Human Body. *Principles of Anatomy and Physiology.* John Wiley & Sons, Inc. 14 edition. Pp 1-26.

Activity 2. Organ-System Level

Answer the following question in the discussion forum in VLE.

1. What are the organs that constitute each of the organ-systems above?
2. Which organ systems function to regulate acid-base balance in body fluid?

3. Basic life processes

There are six (6) main basic life processes. These life processes distinguish living organisms like us from non-living ones. These six processes are as follows:

1. Metabolism- simply, it refers to the sum of all the chemical processes that occur in the body. *Catabolism* refers to the breakdown of complex chemical substances into simpler components. An example of a catabolic process is digestion of food in which large molecules of sugar are broken down into simpler forms like glucose and fructose. These simpler forms are then absorbed by the body which are needed to generate energy at the cellular level. *Anabolism,* on the other hand, involves building up of complex chemical substances from smaller, simpler components. For example, amino acids produced by protein synthesis in the cells form part of proteins that are responsible for new structures in the body (like your muscle).

2. Responsiveness- this refers to the body's ability to detect and respond to changes or stimulus. The stimulus can be external (i.e., from the environment outside of the body) or internal (i.e., from inside the body). Examples would be when you turn your head toward the sound of a squealing brakes (external stimulus), and when a nerve cell respond by generating electrical signals known as nerve impulses (in response to either an external or internal stimulus).

3. Movement- refers to the motion of the whole body, individual organs, singe cells, and even tiny structures inside cells. Example of gross movement include coordinated movement of your legs when you walk. Another example of a movement of an organ is the contraction of the gallbladder to squirt bile into the gastrointestinal tract. Cells also move and an example of this is the movement of white blood cells to the site of tissue injury.

4. Growth- refers to an increase in body size that results from an increase in the size of existing cells, an increase in the number of cells, or both. An example would be the accumulation of mineral deposits between bone cells causing bones to grow in length and width.

5. Differentiation- refers to the development of a cell from an unspecialized to a specialized state. A few days after fertilization, the resulting zygote is composed of stem cells which can differentiate into various cells as the zygote develops and grow. A stem cell, for example, can differentiate into the muscle cell, blood cells, nerve cells, and all the other cells in the body. Yet another example would be the bone marrow cells which contain stem cells that differentiate to the different blood components (i.e., red blood cell, white blood cell, and platelets).

6. Reproduction- refers either to the formation of new cells for tissue growth, repair, or replacement, or to the production of a new individual. Cellular division is needed for growth and development. There are two types of cellular division—(1) mitosis- which refers to the division of somatic cells (i.e., all cells of the body except the sex cells), and (2) meiosis – which refers to the division of sex cells.

Activity 3. Basic Life Processes Answer the question below in the discussion forum in Canvas.

Discuss the six basic life processes and your own example for each.

4. Homeostasis and feedback mechanisms

Homeostasis is an important concept that we need to study. This refers to the condition of equilibrium in the body's internal environment due to the constant interaction of the body's many regulatory processes. This is related to the responsiveness of the body to internal stimulation and any changes in the body's internal environment will result in a response that will maintain homeostasis. For example, when the blood glucose level is increased (i.e., >120 mg/dL), several mechanisms will happen including the release of insulin from the pancreas to bring down the blood glucose levels to normal. As you will see, there are several organs that come into play to maintain homeostasis.

An important aspect of homeostasis is the maintenance of the volume and composition of body fluids. Briefly, there are two main compartments of body fluids – (1) intracellular fluid – those found inside the cells, and (2) extracellular fluid – those found in the interstitial spaces (between cells) and in the plasma inside the blood vessels. The volume and solute composition of these two fluids needs to be maintained and regulated closely as any changes may result in shifting of fluids from one compartment to another. For example, if there is too much dissolved solute in the extracellular space (i.e., hypertonic solution), the tendency for the fluid inside the intracellular space to shift to the extracellular space is a process called osmosis. The shift of fluid is needed to maintain homeostasis but too much shift of fluid may cause the cells to shrink and be dehydrated.

So, how does the body control or maintain homeostasis?

The *feedback system* is a cycle of events in which the status of a body condition is monitored, evaluated, changed, re-monitored, re-evaluated, and so on. In a feedback system, a *stimulus* is sensed by a *sensor* which sends a signal to a *control center*. The control center will now send signals to *effector* cells to respond to the stimulus. This process is continuous.

There are two types of feedback systems as follows:

1. Negative feedback system- this feedback system reverses a change in a controlled condition. An example would be when the blood glucose level is increased (i.e., >120mg/dL). This increase would be detected by receptors in the pancreas which would then produce insulin. The insulin would do two things: (a) it will act on the liver to increase synthesis of glycogen from glucose for storage and (b) it will act on the cells to increase uptake of glucose. Both actions will return the blood glucose level to normal. The same reversal is true when the blood glucose level is decreased (i.e., <70 mg/dL). In this case, the pancreas will detect the decreased glucose levels which will then produce more glucagon. The glucagon will act on the liver to transform the stored glycogen to glucose hence increasing the blood glucose levels.

2. Positive feedback system- this feedback system strengthens or reinforces a change in one of the body's controlled condition. An example of a positive feedback system is during

childbirth. The pressure that is exerted by the baby's head in the cervix would stimulate the pituitary gland to produce *oxytocin* and this hormone will then stimulate uterine contraction which pushes the baby towards the cervix. And with this pressure in the cervix again stimulates the brain to secrete more oxytocin.

Additional Resource:

To illustrate further physiological feedback mechanisms, you may watch the following video from Khan Academy on *Physiological Concept on Positive and Negative Feedback* with reproductive hormones as example: https://www.youtube.com/watch?v=zv8LHyH7_rI

Activity 4. Feedback Mechanism Answer the question below in the discussion forum in VLE. Give other examples of disturbances in the internal environment that can act as a stimulus to a feedback mechanism.

5. Basic Anatomical Terminology and Directional Terms

Now that you have an overview of the organization of the human body, let us try to examine how we can describe body parts more accurately using anatomical terminologies.

When we describe any region or part of the human body, we describe it in relation to a specific stance called *anatomical position*. In the anatomical position, the person stands erect facing the observer, with the head level and the eyes facing directly forward. The feet are flat on the floor and directed forward, and the upper limbs are at the sides with the palms turned forward. Refer the picture on page 24 of *Anatomy and Physiology* by Betts, Desaix et al (2017). If you are using the book of Tortora and Derrickson (2014), it is on page 13. On this page, you will see the various parts of the body with their corresponding anatomical terminologies. I would suggest that you know these terminologies by heart because we will refer to them more often in this course and in your higher nursing courses.

Now that you know the anatomical terminologies, let us look at the *directional terms*. These terms are used to describe the location of a body part in relation to another body part. Below are the directional terms that we use. You can also visit page 15 of Tortora and Derrickson (2014) or page 25 of Betts, Desaix et al (2017) for the illustration of the directional terms.

Directional Term	Definition and Example
Superior	Toward the head or the upper part of a structure Example: The eyes are superior to the mouth.
Inferior	Away from the head or the lower part of a structure Example: The stomach is inferior to the lungs.

Anterior	Nearer to or at the front of the body Example: The thymus gland is anterior to the heart.
Posterior	Nearer to or at the back of the body. Example: The retina is at the posterior part of the eyes.
Lateral	Farther from the midline. Example: The thumb is lateral to the 5th digit.
Medial	Near to the midline. Example: The ulna is medial to the radius.
Intermediate	Between two structures. Example: The heart is intermediate to the lungs.
Ipsilateral	On the same side of the body as another structure. Example: The pancreas and the descending colon are ipsilateral.
Contralateral	On the opposite side of the body from another structure. Example: The ascending colon and descending colon are contralateral
Proximal	Near to the attachment of a limb to the trunk or nearer to the origination of a structure. Example: The femur is proximal to the tibia and fibula.
Distal	Farther from the attachment of a limb to the trunk or farther from the origination of a structure. Example: The radius is distal to the humerus.
Superficial	Toward or on the surface of the body. Example: The ribs are superficial to the lungs.
Deep	Away from the surface of the body. Example: The ribs are deep to the skin of the chest and back.

Content adapted from: Tortora GJ & Derrickson B. (2014). Chapter 1 An Introduction to the Human Body. *Principles of Anatomy and Physiology.* John Wiley & Sons, Inc. 14 edition. Pp 1-26.

Activity 5. Anatomical Directional Terms

Answer the following in the discussion forum in VLE.

Which directional terms can be used to specific the relationships between:

a. Elbow and shoulder
b. Left and right shoulders
c. Sternum and the humerus
d. Heart and the Diaphragm
e. Knees and tibia
f. Liver and gallbladders
g. Spleen and liver
h. Kidneys and small intestines
i. 3rd and 5th digits
j. Sternum and thymus glands

6. Planes and sections

Aside from using anatomical and directional terms to describe body parts, we will also study body structures through planes and sections. A *plane* is an imaginary flat surface that pass through body parts. We study body parts through the various planes below:

1. Sagittal plane- this is a vertical plane that divides the body or organ into right and left sides. If the plan is midline, we call this *midsagittal plane.* If the plan is dividing the body or organ into unequal sides, we call this *parasagittal plane*.

2. Coronal or frontal plane- divides the body or organ into anterior and posterior portions.

3. Transverse plane or cross-sectional plane- divides the body or organ into superior or inferior portions.

4. Oblique plane- a plane that passes through the body or organ at an angle between a transverse and a sagittal plane, or between a transverse plane and frontal plane.

You can view the illustration of the different planes and sections on page 16 of Tortora and Derrickson (2014) or page 26 of Betts, Desaix et al (2017).

Additional Resource

Here is a short animation on the basic planes that are used to study anatomy:
https://www.youtube.com/watch?v=2J8bDkALBic

Activity 6. Answer the question below in the discussion forum in VLE.

What is the importance of studying organs or the body at different planes and sections?

7. Body Cavities, Regions, and Quadrants

The last topic to be covered in this study guide are the body cavities. Body cavities are spaces within the body that help protect, separate, and support internal organs. There are several body cavities such as the cranial cavity, thoracic cavity, and abdominopelvic cavity.

Activity 7. Cavities

Answer the question below in the discussion forum in VLE.

Can you identify the organs that are in the following cavities?

a. Thoracic cavity
b. Cranial cavity
c. Abdmonial cavity
d. Abdominal Cavity
e. Pelvic cavity
f. Mediastinum

The thoracic and abdominal cavity and the organs within these cavities are lined by *serous membranes.* The serous membranes are epithelial tissues that cover the organs and the cavity walls. It has two parts – (1) parietal layer – which lines the walls of the cavities; and (2) visceral layer – which covers the organs (or the viscera) within the cavity. There is a potential space between the visceral layer and the parietal layer, and this is lubricated by a fluid called *serous fluid*. This lubrication is important to prevent friction and to ease movement of organs.

The serous membrane in the pleural cavity is called *pleura.* The parts of the pleura are:

1. Parietal pleura- lines the walls of the pleural cavity
2. Visceral pleura- covers the lungs

The serous membrane in the pericardial cavity is called *pericardium.* The parts of the pericardium are:

1. Parietal pericardium- lines the pericardial cavity wall
2. Visceral pericardium- covers the heart

The serous membra in the peritoneal cavity is called *peritoneum.* The parts of the peritoneum are:

1. Parietal peritoneum- lines the peritoneal cavity wall
2. Visceral peritoneum- covers the viscera within the abdominal wall

To describe the location of the abdominal and pelvic organs, we use imaginary lines to partition the abdominopelvic cavity into regions and quadrants. See page 20 of Tortora and Derrickson (2014) or page 28 of Betts, Desaix et al (2017) to view the illustration of abdominopelvic regions and quadrants.

Activity 8. Organs

Answer the question below in the discussion forum in VLE.

In which region and quadrant can the following organs be found?

a. Stomach
b. Ascending colon
c. Descending colon
d. Urinary bladder
e. Liver
f. Appendix

Activty 9. Laboratory Activity

To supplement your learning from the resources above, please answer the laboratory worksheets on ORGANIZATION OF THE HUMAN BODY and submit in the designated submission bin.

References:

1. Betts JG, Desaix Peter, Johnson E et al (2017). Chapter 1 An Introduction to the Human Body. *Anatomy and Physiology.* OpenStax Rice University. Pp 7-40.

2. Tortora GJ & Derrickson B. (2014). Chapter 1 An Introduction to the Human Body. *Principles of Anatomy and Physiology.* John Wiley & Sons, Inc. 14 edition. Pp 1-26.