Hole's Human Anatomy and Physiology 2024 Release 1st edition Welsh Solutions Manual

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ANSWERS TO CHAPTER ASSESSMENTS

Chapter 1
Introduction to Human Anatomy and Physiology

1.1 Origins of Medical Science

1. Describe how an early interest in the human body eventually led to the development of modern medical science.

Our earliest ancestors probably became curious about the body during illnesses and injuries. At these times, they visited shamans who relied on superstition and magic. Throughout early time, this curiosity lead to discoveries of the healing powers of certain herbs and potions, especially to treat coughs, headaches, and other common problems. Not until about 2,500 years ago did these superstitious attitudes change and the body was looked at in the new light of modern science. Experiments, accurate observations, and tried techniques rapidly expanded knowledge of the human body. Greek and Latin words were used as a basis to describe body part locations and to explain their functions. This formed the basis for anatomy and physiology.

1.2 Anatomy and Physiology

2. Distinguish between anatomy and physiology.

Anatomy deals with the structure (morphology) of the body parts. This includes the shapes, forms, and placement of body organs and appendages. **Physiology** deals with the functions of body parts, what the body parts do, and how this is accomplished.

3. Explain the relationship between the form and function of body parts and give three examples.

The functional role will depend upon the manner in which the part is constructed. The human hand with its long, jointed fingers makes it possible for human beings to grasp things, etc.

1.3 Levels of Organization

4. Describe the relationship between each of the following pairs: molecules and cells, tissues and organs, organs and organ systems.

The basic unit of structure and function in the human body is the microscopic **cell**. These cells organize into layers that have common functions. These layers are called **tissues**. These tissues then group together to form **organs**. Groups of organs make up **organ systems**. Groups of organ systems make up the **organism**, which in this case is the human.

1.4 Core Themes in Anatomy and Physiology

5. Explain the relationship between homeostasis and the internal environment.

Homeostasis refers to the stable internal environment of an organism. In human beings, if the requirements listed above are compromised, the body will react in certain ways to regain its stable internal environment. An example would be sweating to help decrease body temperature.

6. Describe each of the underlying mechanisms common to anatomy and physiology.
Gradients and Permeabilities – A gradient is a difference in concentration of a substance between two points. Permeability pertains to membranes. If a membrane, such the cell membrane or other membrane is permeable to a substance, that substance will be able to pass through the membrane.
Cellular Differentiation – Different cells become specialized by accessing the information in different genes and thereby making different proteins.
Cell Membrane Mechanisms – The cell membrane determines which substances can enter or leave a cell. The cell membrane also allows cells to respond to certain signals.
Cell-to-Cell Communication – Cells communicate with each other through a variety of mechanisms, many of which involve membrane receptors.
Feedback Loops – The various systems that maintain homeostasis work through a form of cell-to-cell communication called a feedback loop.
Balance – Constancy of the internal environment requires that input or production be balanced by losses or elimination.
Energy Processes – Useable energy is needed for all cells to survive. A number of processes provide useable energy -- chief among them is cellular respiration.

1.5 The Characteristics and Maintenance of Life

7. Identify those characteristics of living organisms that relate to metabolism.
Metabolism refers to the totality of chemical changes that occur within body parts. Conversion of food into energy is an example.

8. Compare your own needs for survival with the requirements of organisms described in the chapter.
Water, the most abundant substance in the body, is required for many metabolic processes. It provides the environment for the metabolic processes to take place and then transports substances within the body. It is also important in the process of regulating body temperature.
Food is the substances that provide the body with the necessary chemical to sustain life, in addition to water. These chemicals are used in a variety of ways by the body.
Oxygen, which makes up about one-fifth of air, is used in the process of releasing energy from food substances.
Heat, a form of energy, is a product of metabolic reactions. The rate at which these reactions occur is partly governed by the amount of heat present.
Pressure is a state in which a force is applied to something. Atmospheric pressure is an important role in breathing. Hydrostatic pressure, the pressure of fluid, plays an important role in the circulatory system.

9. Describe a general physiological control system, including the role of negative feedback.
Homeostatic mechanisms detect changes away from the normal state by means of receptors that compare measured values against a set point value. If conditions deviate from the set point, this stimulates responses in the opposite directions until the deviation is corrected and the responses are turned off. This process is called **negative feedback**.

10. Explain the control of body temperature.
Control of body temperature is maintained by a self-regulating control mechanism that can receive signals about changes away from the normal set points and cause reactions that return conditions to normal. Receptors sense changes in body temperature in either direction, too warm or too cold; the set point is in a part of the brain called the hypothalamus; effectors include skin blood vessels (which either dilate to increase heat loss or constrict to conserve heat), sweat glands, and skeletal muscle, which may contract involuntarily to generate heat (shivering).

11. Describe the homeostatic mechanisms that help regulate blood pressure and blood glucose – what do they have in common and how are they different?
Homeostasis is maintained in each of these situations by a self-regulating control mechanism that can receive signals about changes away from the normal set points and cause reactions that return conditions to normal. Blood pressure control depends on receptors that respond to blood pressure changes, a set point for the normal blood pressure range, and effectors that include the heart and various blood vessels. Blood glucose control depends on cells in the pancreas that respond to changes in blood glucose, and the hormones insulin and glucagon that act on various effector cells, such as fat cells and cells that store glucose in the form of glycogen. The major difference between these two systems is that blood pressure control communicates with effector organs primarily through the nervous system (although some hormones are involved), whereas control of blood glucose communicates with effector cells primarily via hormones (although the nervous system may become involved).

1.6 Organization of the Human Body

12. Explain the difference between the axial and appendicular portions of the body.
Axial portion—This consists of the head, neck, and trunk.
Appendicular portion—This consists of the arms and the legs.

13. Identify the cavities within the axial portion of the body.
The **ventral cavity** is the front part of the organism. It is subdivided into two parts—a **thoracic cavity**, which houses the lungs and heart; and an **abdominopelvic cavity**, which houses the stomach, liver, spleen, gallbladder, small and large intestines, urinary bladder, and the internal reproductive organs.

14. Define *viscera*.
The **viscera** are the organs found deep within a body cavity.

15. Describe the mediastinum and its contents.
The **mediastinum** is the region that forms a boundary between the right and left sides of the thoracic cavity. The mediastinum contains the heart, esophagus, trachea, and thymus. The right and left lungs are on either side of the mediastinum.

16. Name the body cavity that houses each of the following organs:
a. Stomach—abdominal
b. Heart—thoracic

c. Brain—cranial
d. Liver—abdominal
e. Trachea—thoracic
f. Rectum—pelvic
g. Spinal cord—vertebral
h. Esophagus—thoracic
i. Spleen—abdominal
j. Urinary bladder—pelvic

17. List the cavities of the head and the contents of each cavity.
Oral cavity is the mouth area and contains the teeth and the tongue.
Nasal cavity is located within the nose and is divided into right and left portions by a nasal septum. Air-filled sinuses are connected to the nasal cavity, including the sphenoidal and frontal sinuses.
Orbital cavities contain the eyes and associated skeletal muscles and nerves.
Middle ear cavities are found inside the ear and contain the middle ear bones.

18. Distinguish between a parietal and a visceral membrane.
A **parietal membrane** refers to a membrane that is attached to the wall and forms the lining of a cavity whereas a **visceral membrane** refers to a membrane that is deeper toward the interior and covers the internal organs contained within a cavity.

19. Describe the general contribution of each of the organ systems to maintaining homeostasis.
Integumentary system—It protects underlying tissues, helps regulate body temperature, houses a variety of sensory receptors, and synthesizes certain products.
Skeletal system—It provides frameworks and protective shields for softer tissues; serves as attachments for muscles when body parts move. It also has a role in blood cell production and storage of inorganic salts.
Muscular system—It provides the forces that cause body movements. They also maintain posture and are the main source of body heat.
Nervous system—It provides the ability to detect changes that occur inside and outside the body. It interprets the sensory impulses and what to do in response to these impulses. It also plays a role in muscle contraction and gland secretions.
Endocrine system—It secretes hormones that alter metabolism of a target tissue.
Cardiovascular system—It pumps blood throughout the body. The blood serves as a fluid for transporting gases, nutrients, hormones, and wastes.
Lymphatic system—It transports tissue fluid back to the bloodstream and carries certain fatty substances away from the digestive organs. It also plays a role in immunity.
Digestive system—It receives various food molecules from the outside and converts them into simpler ones that can be absorbed.
Respiratory system—It provides for the intake and output of air and for the exchange of gases between blood and air.
Urinary system—It removes various wastes from the blood and assists in maintaining the body's water, electrolyte, and acid-base balances.

Reproductive system—It is responsible for the production of whole new organisms like itself.

20. List the major organs that compose each organ system and identify their functions.
Integumentary system—It consists of the skin and various accessory organs such as the hair, nails, sweat glands, and sebaceous glands.
Skeletal system—It consists of the bones, ligaments, and cartilages.
Muscular system—It consists of the muscles.
Nervous system—It consists of the brain, spinal cord, nerves, and sense organs.
Endocrine system—It consists of glands that secrete hormones.
Cardiovascular system—It consists of the heart, arteries, veins, capillaries, and blood.
Lymphatic system—It consists of the lymphatic vessels, lymph fluid, lymph nodes, thymus gland, and spleen.
Digestive system—It consists of the mouth, tongue, teeth, salivary glands, pharynx, esophagus, stomach, liver, gallbladder, pancreas, small intestine, and large intestine.
Respiratory system—It consists of the nasal cavity, pharynx, larynx, trachea, bronchi, and lungs.
Urinary system—It consists of the kidneys, ureters, urinary bladder, and urethra.
Reproductive system—The male reproductive system consists of the scrotum, testes, epididymides, vasa deferentia, seminal vesicles, prostate gland, bulbourethral glands, penis, and urethra. The female reproductive system consists of the ovaries, uterine tubes, uterus, vagina, clitoris, and vulva.

1.7 Life-Span Changes

21. Describe physical changes associated with aging that occur during each decade past the age of thirty.
By the fourth or fifth decade our hair color fades, skin etches become wrinkles, elevated blood pressure, and slightly elevated blood glucose levels. The sixth decade sees grayer/whiter hair, deeper skin wrinkles, and waning immunity.

22. List age-associated changes that occur at the molecular, cellular, tissue and/or organ levels.
Some cells may not be able to divide, which slows wound healing. DNA repair slows and transport of substances into and out of cells, lose efficiency. Overall, we have a metabolic slowdown resulting from decreased thyroid function.

1.8 Anatomical Terminology

23. Write complete sentences using each of the following terms to correctly describe the relative locations of specific body parts:
a. superior—The head is superior to the abdomen.
b. inferior—The legs are inferior to the chest.
c. anterior—The eyes are anterior to the ears.
d. posterior—The ears are posterior to the eyes.
e. medial—The nose is medial to the eyes.
f. lateral—The ears are lateral to the eyes.

g. bilateral--The lungs are bilateral.
h. ipsilateral—The spleen and descending colon are ipsilateral to each other.
i. contralateral—The spleen and gallbladder are contralateral to each other.
j. proximal—The elbow is proximal to the wrist.
k. distal—The fingers are distal to the wrist.
l. superficial—The epidermis is the superficial layer of the skin.
m. peripheral—The nerves that branch from the brain and spinal cord are peripheral nerves.
n. deep—The dermis is the deep layer of the skin.

24. Sketch the outline of a human body, and use lines to indicate each of the following sections:
a. Sagittal
b. Transverse
c. Frontal
See Figure 1.22 in the textbook.

25. Sketch the abdominal area, and indicate the location of each of the following regions:
a. Epigastric
c. Umbilical
b. Hypchondriac
d. Lateral
e. Pubic
f. Inguinal
See Figure 1.25(a) in the textbook.

26. Sketch the abdominal area, and indicate the location of each of the following regions:
a. right upper quadrant
b. right lower quadrant
c. left upper quadrant
d. left lower quadrant
See Figure 1.25(b) in the textbook.

27. Provide the common name for the region to which each of the following terms refers:
a. acromial—point of shoulder
b. antebrachial—the forearm
c. axillary—the armpit
d. buccal—the cheek
e. celiac—the abdomen
f. coxal—the hip
g. crural—the leg
h. femoral—the thigh
i. genital—the reproductive organs

j. gluteal—the buttocks
k. inguinal—the depressed area of the abdominal wall near the thigh (groin)
l. mental—the chin
m. occipital—the lower back region of the head
n. orbital—the eye cavity
o. otic—the ear
p. palmar—the palm of the hand
q. pectoral—the chest
r. pedal—the foot
s. perineal—the region between the anus and external reproductive organs (perineum)
t. plantar—the sole of the foot
u. popliteal—the area behind the knee
v. sacral—the posterior region between the hipbones
w. sternal—the middle of the thorax, anteriorly
x. tarsal—the instep of the foot
y. umbilical—the navel
z. vertebral—spinal column

ANSWERS TO INTEGRATIVE ASSESSMENTS/CRITICAL THINKING QUESTIONS

Chapter 1

1. Which characteristics of life does a computer have? Why is a computer not alive?
Responsiveness to stimuli and circulation of energy are characteristics of life seen in a computer. A computer is not alive because it does not experience growth, reproduction, digestion, absorption, assimilation, respiration, movement, or excretion. (1.2, 1.3, 1.5)

2. Put the following in order, from smallest and simplest, to largest and most complex, and describe their individual roles in homeostasis: organ, molecule, organelle, atom, organ system, tissue, organism, cell, macromolecule.
atom – the building block of all elements
molecule – formed by combining atoms, the many possible combinations give us the substances in the world around us, including those forming and needed by living things
macromolecule – the larger molecules, including proteins, starches, and nucleic acids
organelle – a part within a cell necessary for cell function
cell – working together, cells maintain the environment inside a human that keeps the cells alive
tissue – provides specialized function by combining cells with the same properties
organ – specialized structure in a multicellular organism formed of two or more tissue types, each contributing to the organ's function
organ system – group of organs working together to support a special function, such as maintaining homeostasis, in an organism
organism – the combination of organ systems that forms a living thing, such as a human
(Outcomes 1.2, 1.3, 1.5, 1.6)

3. What environmental conditions would be necessary for a human to survive on another planet?
Human needs include water, food, oxygen, heat and pressure. In order to survive on another planet, a human would have to fill these needs from the new environment. (Outcomes 1.4, 1.5)

4. In health, body parts interact to maintain homeostasis. Illness can threaten the maintenance of homeostasis, requiring treatment. What treatments might be used to help control a patient's *(a)* body temperature, *(b)* blood oxygen level, and *(c)* blood glucose level?
Possible treatments under the guidance of a physician or other qualified clinician might include:
a) Treatment of body temperature—If temperature is too low: hypothermia blanket and maintaining nutritional intake. If temperature is too high: hyperthermia blanket, increased fluid intake; if due to a fever, antipyretic medications; if fever is due to a bacterial infection, antibiotics, rest, and maintaining nutritional intake.

b) Blood oxygen level—If airway is blocked, oral tracheal suction to keep airway open, administering oxygen, tracheostomy if airway is completely blocked.
c) Blood glucose—Dietary changes, administration of insulin, monitor exercise.
(Outcomes 1.4, 1.5, 1.6, 1.7)

5. How might health-care professionals provide the basic requirements of life to an unconscious patient? Describe the body parts involved in the treatment, using correct directional and regional terms.
Possible treatments an unconscious person might need under the guidance of a physician or other qualified clinician might include: oral tracheal suctioning if airway is blocked (to keep the airway open, provide resuscitation, and administer oxygen); nasogastric, gastric, or intravenous feedings; urinary catheter (for urine collection); turning in bed (to prevent decubitus ulcers, or bedsores); elastic stockings (to prevent blood clots and thrombophlebitis); stool softeners or suppositories; passive range-of-motion exercises to the extremities; and possibly a hypothermia or hyperthermia blanket to maintain body temperature. (Outcomes 1.4, 1.5, 1.6, 1.7)

6. Suppose two individuals develop benign (noncancerous) tumors that produce symptoms because they occupy space and crowd adjacent organs. If one of these persons has the tumor in the thoracic cavity and the other has the tumor in the abdominopelvic cavity, which person would be likely to develop symptoms first? Why? Which might be more immediately serious? Why?
The individual with the tumor in the thoracic cavity might develop symptoms first. Since the thoracic cavity is smaller and more rigid than the abdominal cavity, the tumor might exert pressure against the heart or lungs, causing potentially serious symptoms.
(Outcome 1.6)

7. If a patient complained of a "stomachache" and pointed to the umbilical region as the site of discomfort, which organs located in this region might be the source of the pain?
Organs in the umbilical region that could be the source of pain include the small intestine (obstruction or ulcers), abdominal aorta (aneurysm), transverse colon (diverticulitis). The appendix borders on the umbilical region (appendicitis).
(Outcome 1.6)

ANSWERS TO PRACTICE QUESTIONS

Hole's Human Anatomy & Physiology, 2024R

Chapter 1

Practice 1.1

1. What factors probably stimulated an early interest in the human body?
Factors include attempting to understand the causes of various injuries, illnesses, and the loss of function of body parts, and trying to treat these conditions.

2. What types of activities helped promote the development of modern medical science?
Activities include dissection of cadavers, the production of prosthetic body parts, experimentation to improve medical knowledge and techniques, and the discovery of certain chemicals in nature as treatments for specific conditions.

3. What is the role of a hypothesis in the scientific method?
The hypothesis is the idea or proposition being evaluated, or tested. It is formulated based on observations, and tested through experiments.

Practice 1.2

1. What are the differences between anatomy and physiology?
Anatomy is the study of body structures and relies on examination of those structures. Physiology is the study of the functions of body parts, and relies more on experimentation.

2. Why is it difficult to separate the topics of anatomy and physiology?
Structure is closely related to function; body parts are shaped and arranged (anatomy) in such a way that they are able to perform their functions (physiology)

3. List several examples that illustrate how the structure of a body part makes possible its function.
The arrangement of bones and muscles in the hand allow grasping; the heart's muscular walls pump blood, and heart valves keep blood flowing in the proper direction; the mouth is shaped to receive food and the shapes of the teeth allow them to break down food into pieces; the tongue mixes food with saliva and prepares food particles for swallowing.

4. How are anatomy and physiology both old and new fields?

The fields of anatomy and physiology are ancient, but new discoveries continue in both, especially at the molecular level.

5. Give a few examples of variation in the human body.
Answers may include (but are not limited to) variations in height, hair texture, skin color, resting heart rate, branching of blood vessels, size and shape of muscles, absence of a muscle, presence of an extra bone.

Practice 1.3

1. How does the human body illustrate levels of organization?
Larger structures are composed of smaller and smaller components. For example, the body consists of several systems, such as the cardiovascular system. The cardiovascular system consists of organs, such as the heart and blood vessels. The heart is composed of tissues, such as muscle tissue and connective tissue. Tissues consist of layers of cells, such as muscle cells and nerve cells. Cells are composed of organelles, which consist of molecules, and finally atoms.

2. What is an organism?
An organism is a complete unit of life. Organisms range in size from a single cell to a complex living thing like a human, which is composed of trillions of cells. Humans, as complex organisms, are composed of organ systems, organs, tissues, cells, molecules and atoms.

3. How do body parts at different levels of organization vary in complexity?
Typically, the higher the level of organization a structure is part of, the more complex it is. For example, a molecule is composed of 2 or more atoms; therefore, a molecule is more complex than an atom. An organ system, such as the cardiovascular system, is composed of organs, such as the heart and blood vessels. Therefore, an organ system is more complex than any of its organs.

Practice 1.4

1. How are cells interdependent on each other?
Cells are specialized to make unique contributions to maintaining homeostasis. They work together as tissues, which form organs, which in turn form organ systems. Some cells detect changes in the internal environment and communicate with other cells, which then initiate responses to correct the changes. Cells that defend an organism against infection or disease, for example, contribute to the health of other cells in the organism, and of the entire organism.

2. How is balance related to the internal environment?
For the internal environment to be maintained constant, input must be balanced by output. Substances or conditions that are in excess (such as extra heat production)

must be matched by increased elimination (such as increased heat loss). Shortages must be matched by increased intake or production.

Practice 1.5

1. What is the function of metabolism in the body?
Metabolism includes all of the physiological events that obtain, release, and use energy. It includes all of the chemical reactions that occur in cells to support life. Metabolism consists of the processes of respiration, digestion, circulation, and excretion. Respiration, for example, supplies oxygen to break down nutrients, and gets rid of carbon dioxide, a byproduct of nutrient breakdown.

2. Which requirements of organisms does the external environment provide?
The external environment provides water, nutrients, some heat (some is produced during metabolic reactions too), oxygen, and pressure. Atmospheric pressure is provided for humans. External hydrostatic pressure is mainly provided to water-dwelling organisms.

3. Why is homeostasis so important to survival?
Survival of the human organism depends on the survival of its cells. Homeostasis maintains the internal environment, in which those cells live.

4. Describe three homeostatic mechanisms.
Negative feedback is a common homeostatic mechanism. When a variable deviates from its set point, this mechanism activates effectors that return the variable toward its normal range. Body temperature and the level of blood glucose are body regulated by negative feedback. For example, if a person is too hot, sweating and increased blood flow to the skin return the body temperature to its normal range. A less common mechanism is positive feedback, in which a change in a variable leads to further deviation from the set point. During blood clotting, certain chemicals stimulate further blood clotting, to stop the bleeding.

Practice 1.6

1. What are the viscera?
Viscera are the organs within the thoracic and abdominopelvic cavities.

2. Which organs occupy the thoracic cavity?
Heart, lungs, trachea, esophagus, thymus
The abdominal cavity?
Stomach, liver, spleen, gallbladder, kidneys, small intestine, most of the large intestine
The pelvic cavity?
Terminal end of the large intestine, urinary bladder, internal reproductive organs

3. Name the cavities of the head.
Cranial cavity, oral cavity, nasal cavity, orbital cavities, middle ear cavities

4. Describe the membranes associated with the thoracic cavity.
Double-layered serous membranes line the walls of the thoracic and abdominopelvic cavities and surround each organ. The parietal layer lines the wall of the cavity, and the visceral layer surrounds an organ. Between the layers is a potential space, or cavity, filled with lubricating fluid. The pleural membranes surround the lungs, the pericardial membrane surrounds the heart, and the peritoneal membrane surrounds the abdominopelvic organs.

5. Distinguish between the parietal and visceral peritoneum.
The parietal peritoneum lines the inner surface of the wall of the abdominopelvic cavity, and the visceral peritoneum covers the surfaces of most abdominopelvic organs.

6. Name the major organ systems and list the organs of each system.

Integumentary system: skin, hair, nails, sweat and sebaceous glands

Skeletal system: bones, ligaments, cartilages

Muscular system: muscles

Nervous system: brain, spinal cord, nerves, and sense organs

Endocrine system: endocrine glands: pituitary gland, thyroid gland, parathyroid glands, adrenal glands, pancreas, ovaries, testes, pineal gland and thymus

Cardiovascular system: heart, arteries, veins, capillaries

Lymphatic system: lymph nodes, thymus, and spleen

Digestive system: mouth, teeth, tongue, pharynx, esophagus, stomach, small intestine, large intestine, salivary glands, liver, pancreas, and gallbladder

Respiratory system: nasal cavity, pharynx, larynx, trachea, bronchi, and lungs
Urinary system: kidneys, ureters, urinary bladder, and urethra

Reproductive system of male: scrotum, testes, epididymides, ductus deferentia, seminal vesicles, prostate gland, bulbourethral glands, penis, and urethra

Reproductive system of female: ovaries, uterine tubes, uterus, vagina, clitoris, and vulva

7. Describe the general functions of each organ system.

Integumentary system: Protects tissues, regulates body temperature, detects changes in environment via sensory receptors, and synthesizes specific chemicals, such as vitamin D

Skeletal system: Provides a framework for the body, supports and protects internal organs and soft tissues, helps with body movements, produces blood cells, and stores inorganic salts, such as calcium salts

Muscular system: Provides force to move body parts, maintains posture, and produces most of the body heat

Nervous system: Regulates and adjusts organ function for homeostasis; detects changes in the environment, receives and interprets sensory information, and responds to this information by stimulating muscles and glands

Endocrine system: Regulates and adjusts organ function for homeostasis, and communicates via hormone secretion into body fluids; each hormone alters metabolism of specific target cells

Cardiovascular system: Transports red and white blood cells, platelets, respiratory gases, nutrients, hormones, and wastes throughout the body

Lymphatic system: Defends the body against infection and disease, transports some tissue fluid back to the bloodstream, and carries large fats from the digestive system to the general circulation

Digestive system: Receives nutrients from the environment, breaks down food particles into smaller molecules that can be absorbed across cell membranes and enter body fluids, eliminates wastes, and produces hormones to regulate digestive processes

Respiratory system: Moves air into and out of the lungs, and exchanges oxygen and carbon dioxide between the lungs and the blood

Urinary system: Removes blood wastes, helps maintain water, electrolyte, and acid-base balance, produces urine, and transports urine to the outside of the body

Reproductive system of male: Produces and maintains sperm, produces hormones that develop male body type, and transfers sperm to the female reproductive tract

Reproductive system of female: Produces and maintains oocytes (eggs), produces hormones that develop female body type, receives sperm for fertilization, supports development of the embryo and fetus, functions in birth process, and nourishes infant

Practice 1.7

1. Define *aging.*
Aging refers to the changes in the body that occur with the passage of time.

2. List some aging-related changes at the microscopic and whole-body levels.
Changes at the microscopic level include decreased production of elastin and collagen proteins, diminished subcutaneous fat, which leads to skin wrinkling, increased percentage of body fat, which alters the rate of drug metabolism, decreased efficiency of DNA repair mechanisms, and decreased efficiency of energy extraction from nutrients. Whole-body changes include fading hair color, wrinkling skin, loss of effectiveness of the immune system, increased blood pressure, and slightly elevated blood glucose, which may become clinically significant.

Practice 1.8

1. Describe the anatomical position.
A person in anatomical position is standing up straight, facing forward, has upper limbs at the sides, and the palms are facing forward.

2. Using the appropriate terms, describe the relative positions of several body parts.

The head is superior to the neck.

The foot is inferior to the knee.

The toes are anterior to the heel.

The brain is posterior to the nose.

The great toe is medial to the smallest toe.

The thumb is lateral to the smallest finger.

The kidneys are bilateral.

The left kidney and the spleen are ipsilateral.

The left kidney and the right kidney are contralateral.

The knee is proximal to the foot.

The knee is distal to the thigh.

The skin is superficial to the subcutaneous layer.

The lens of the eye is deep to the cornea.

3. Describe three types of body sections.
A sagittal section divides the body into left and right portions. If the portions are equal, it is called a median or midsagittal plane. If the portions are unequal, it is called a parasagittal plane. A transverse or horizontal plane divides the body into top and bottom portions. A frontal or coronal section divides the body into front and back portions.

4. Describe the nine regions of the abdomen.
The epigastric region is the upper middle part of the abdominal area. The left and right hypochondriac regions lie on both sides of the epigastric region. The umbilical region is in the central part of the abdominal area. The left and right lateral (lumbar) regions lies on both sides of the umbilical region. The pubic (hypogastric) region occupies the lower middle part of the abdominal region. The left and right inguinal (iliac) regions lie along both sides of the pubic region.

5. Explain how the names of the abdominal quadrants describe their locations.
The umbilicus is the reference point for the abdominal quadrants. Above the umbilicus is termed “upper,” and below is termed “lower.” The sides are named anatomically as left or right.

CHAPTER 1
INTRODUCTION TO HUMAN ANATOMY AND PHYSIOLOGY

Learning Outcomes

1.1 Origins of Medical Science

- **Identify some of the early discoveries that lead to our current understanding of the human body.**

Lecture Suggestions and Guidelines

1. Give an overview of the roles of primitive doctors.
2. Compare various beliefs regarding the connection between natural forces and the human body.
3. Identify the origins of basic terms used in the study of anatomy and physiology.

Application Question(s)

1. Ask students to develop a chart of basic terms found in the language of anatomy and physiology.
   Answer: Responses should include a minimum of 50 modern terms accompanied by their Greek/Latin derivatives.

Critical Thinking Issue(s)

1. Compare and contrast several ancient uses of herbs and potions.
   Answer: Students may be required to research this topic via the library, used book stores, or the Internet.

1.2 Anatomy and Physiology

- **Explain how anatomy and physiology are related.**

Lecture Suggestions and Guidelines

1. Give an overview of the study of anatomy and physiology.
2. Describe the relationship between the structures of body parts and the functions of these body parts.
3. Compare the scientific research efforts of an anatomist with the concerns of a physiologist.

Application Question(s)

1. The function of a body part (physiology) is determined by the way it is constructed (anatomy). How does this relationship apply to the human heart? Ask students to give other examples, which illustrate this concept.
   Answer: The human heart is constructed such that two superior atria serve to receive blood and two inferior, thick-walled ventricles serve to pump blood. The heart is muscular, has three major tissue layers, and contains a series of valves, which insure one-way blood flow.

2. Ask students to demonstrate ways in which structure determines function by providing examples outside the human body.
   Answer: Examples will vary. Some possibilities include small appliances, such as a toaster, a mixer, or a potato peeler. Clocks, automobile parts, and tools would be other examples.

Critical Thinking Issue(s)

1. How does the arrangement of parts in the human hand compare in functional effectiveness to analogous parts in other animals?
   Answer: The human hand is composed of long, jointed fingers, an opposable digit, and dermal papillae, all of which enhance gripping ability.

1.3 Levels of Organization

- **List the levels of organization in the human body and the characteristics of each.**

Lecture Suggestions and Guidelines

1. Introduce the major levels of structural complexity.
2. Discuss how the human body illustrates levels of organization to include atoms, molecules, macromolecules, organelles, cells, tissues, organs, organ systems, and organism.

Application Question(s)

1. Ask students to apply the concept of structural complexity by preparing a flow chart, which illustrates the levels of organization for one of the major organ systems of the human body.
   Answer: Differences will become evident for each organ system once the student reaches the cell, tissue, and organ levels.

Critical Thinking Issue(s)

1. Ask students to apply the concept of levels of structural complexity to an example other than the human body.
   Answer: For example, a single letter combines with other letters to form a word. A group of words forms a sentence. A group of related sentences forms a paragraph. Paragraphs combine to form pages. Pages combine to form chapters, which then combine to form a book, etc.

1.4 Core Themes in Anatomy and Physiology

- **List and describe the key concepts in anatomy and physiology.**
- **List and describe the underlying mechanisms in anatomy and physiology.**

Lecture Suggestions and Guidelines

1. Introduce the key concepts to understand anatomy and physiology.
2. Briefly discuss each key concept.
3. Describe the underlying mechanisms and how they work.

Application Question(s)

1. Choose a mechanism and explain how it contributes to homeostasis.
   Answer: Responses will vary.

Critical Thinking Issue(s)

1. Cells provide a wide variety of functions throughout the body even though they all arise from a single fertilized egg. Explain how this is possible.
   Answer: Students should discuss the process of cell differentiation.

1.5 The Characteristics and Maintenance of Life

- **List and describe the major characteristics of life.**

Lecture Suggestions and Guidelines

1. Introduce the concept of maintaining life through necessary life functions.
2. Briefly discuss the ten major characteristics of life shared by all organisms.
3. Describe the physical and chemical events, which constitute metabolism.

Application Question(s)

1. Ask students to compare and contrast a newborn baby, a teenager, and a senior citizen in terms of the ten characteristics of life, including movement, responsiveness, growth, reproduction, respiration, digestion, absorption, circulation, assimilation, and excretion.
   Answer: Responses will vary.

Critical Thinking Issue(s)

1. The sum of all chemical and physical events and reactions in the human body constitutes metabolism. How might diabetes mellitus be defined as a metabolic disease in terms of the ten major characteristics of life?
   Answer: Students should express their responses by illustrating diabetes' effects on movement, responsiveness, growth, reproduction, respiration, digestion, absorption, circulation, assimilation, and excretion.

- **Give examples of *metabolism.***

Lecture Suggestions and Guidelines

1. Define metabolism as the sum total of all of the chemical reactions in the body.
2. Describe respiration as an example of a metabolic process.
3. Describe digestion as an example of a metabolic process.

Application Question(s)

1. Ask students to compare human metabolic processes with processes of other animals.
   Answer: Comparisons may include mammals, fish, invertebrates, insects, etc.

Critical Thinking Issue(s)

1. Ask students to predict the dire effects on the human body when one of the major

metabolic processes malfunctions.
Answer: Responses should include a discussion of the effects on homeostasis.

- **List and describe the major requirements of organisms.**

Lecture Suggestions and Guidelines

1. Describe environmental factors required of organisms to maintain life, including water, food, oxygen, heat, and pressure.
2. Discuss which requirements of organisms are provided from the external environment.

Application Question(s)

1. Ask students to provide examples of ways in which the human body requires pressure to maintain life.
   Answer: Examples might include: a) hydrostatic pressure, which is necessary for kidney filtration; b) blood pressure due to heart action, which keeps blood flowing through the blood vessels; c) pressure on both surfaces of the eardrum, in order for the eardrum to vibrate freely; or d) atmospheric and pulmonary pressure, which is vital to the mechanisms of breathing.

Critical Thinking Issue(s)

1. Water is the most abundant substance in the body. Which properties make water vital to the maintenance of human life in the event of:
   a. vigorous exercise;
   b. transport of nutrients, gases, and wastes;
   c. food digestion;
   d. movement of bone within a joint cavity?

   Answer: a) Water prevents sudden changes in body temperature due to its high heat capacity. b) Nutrients, gases, and wastes can dissolve in water since water is an excellent solvent. Water also acts as a transport and exchange medium as well. c) Water molecules are added to the bonds of larger biological molecules to break them down during digestion. d) Synovial fluids, which contain a water base, lubricate the movement of bones within joint cavities. Water is present in all body lubricants.

- **Explain the importance of homeostasis to survival.**

Lecture Suggestions and Guidelines

1. Describe homeostasis as a dynamic state of equilibrium.
2. Discuss the body's role in maintaining a relatively stable internal environment.

Application Question(s)

1. How can the concept of homeostatic imbalance be applied to the following situations? Can homeostasis be restored? How?
   a. dental caries
   b. a kidney stone
   c. a bulging intervertebral disc

   Answer: a) filling or extracting; b) "passing" it through the urinary tract, lithotripsy,

surgical excision; c) physical therapy, medication, surgery

Critical Thinking Issue(s)

1. How would environmental pollution (air, water, soil) threaten homeostasis and the survival of organisms?
   Answer: Answers will vary.

- **Describe the parts of a homeostatic mechanism and explain how they function together.**

Lecture Suggestions and Guidelines

1. Describe the process by which homeostatic mechanisms regulate body temperature, blood pressure, and blood sugar concentration.
2. Define and discuss positive and negative feedback mechanisms.

Application Question(s)

1. Apply the concept of negative feedback mechanisms by comparing a home heating system to the regulation of body temperature in the human body.
   Answer: a) Set the thermostat to 70 degrees F. b) Room temperature drops below 70 degrees; furnace comes on. c) Room temperature rises until it reaches approximately 70 degrees. 4) Thermostat transmits signal to shut off furnace. The human body operates in an analogous way through the use of a receptor and control center (thermostat located in the hypothalamus) and an effector (the heating system) to regulate body temperature.

Critical Thinking Issue(s)

1. How does a homeostatic control mechanism regulate blood glucose levels when the level is too high? Too low?
   Answer: When blood glucose levels are too high, the pancreas releases insulin into the blood, uptake of glucose in most body cells is enhanced, the liver captures glucose and stores it as glycogen, and the blood glucose levels begin to decline. When blood glucose levels are too low, the pancreas releases glucagon into the blood, the liver breaks down glycogen and releases glucose, and the blood glucose levels begin to rise.

1.6 Organization of the Human Body

- **Identify the locations of the major body cavities.**
- **List the organs located in each major body cavity.**
- **Name and identify the locations of the membranes associated with the thoracic and abdominopelvic cavities.**

Lecture Suggestions and Guidelines

1. Define the terms axial portion and appendicular portion.
2. Introduce the two sets of internal cavities that provide protection to the organs within them.
3. Describe the location of the dorsal body cavity, including the cranial and spinal cavities.

4. Describe the location of the ventral body cavity, including the thoracic cavity, diaphragm, and abdominopelvic cavities.
5. Briefly describe the oral, nasal, orbital, and middle ear cavities.
6. Describe the cranial cavity, which houses the brain, and the spinal cavity, which contains the spinal cord and is surrounded by vertebrae.
7. Locate the thoracic cavity viscera, including the heart, lungs, esophagus, trachea, and the thymus gland.
8. Describe the location of the mediastinum.
9. Locate the viscera of the abdominopelvic cavity, including the stomach, liver, spleen, gall bladder, small and large intestines, urinary bladder, and the internal reproductive organs.
10. Introduce the terms visceral and parietal.
11. Describe the pleural membranes, which line the thoracic cavity and cover the lungs.
12. Describe the pericardial membranes, which surround the heart and cover its surface.
13. Describe the peritoneal membranes, which line the abdominopelvic cavity and cover the organs inside.
14. Define the pleural, pericardial, and peritoneal cavities.

Application Question(s)

1. Ask the students to use a dissectible manikin to illustrate the major body cavities, the membranes associated with those cavities, the organs found in each cavity, and the nine separate regions which comprise the abdominopelvic cavity.
   Answer: N/A.

Critical Thinking Issue(s)

1. A boxer received multiple blows to the thoracic, abdominal, and pelvic regions. Why are the organs contained in the abdominal region the most vulnerable?
   Answer: The pelvic organs receive some additional protection from the bony pelvis. The thoracic organs are shielded somewhat by the sternum and rib cage. However, the abdominal organs lie in a cavity, which is not reinforced by bone, but rather are protected only by abdominal muscles.

- **Name the major organ systems, and list the organs associated with each.**
- **Describe the general function of each organ system.**

Lecture Suggestions and Guidelines

1. Introduce the major organ systems of the human body, including integumentary, skeletal, muscular, nervous, endocrine, digestive, respiratory, cardiovascular, lymphatic, urinary, and reproductive systems.
   Describe and locate the major organs of each system, using wall charts, models, and overhead transparencies.

Application Question(s)

1. Ask the students to develop a chart which illustrates the major organ systems to include the name of the system, the major organs associated with each system, and

the major functions of each system.
Answer: N/A.

Critical Thinking Issue(s)

1. How might a physiologist place the organ systems into categories according to their main functions? Use the terms body covering, support and movement, integration and coordination, transport, absorption and excretion, and reproduction.
   Answer: Body covering-integumentary; support and movement-skeletal and muscular; integration and coordination-nervous and endocrine; transport- cardiovascular and lymphatic; absorption and excretion digestive, respiratory, and urinary; reproduction-reproductive

1.7 Life-Span Changes

- **Identify changes related to aging, from the microscopic to the whole-body level.**

Lecture Suggestions and Guidelines

1. Describe aging as a part of life.
2. Give examples of the evidence of aging at the tissue, cell, and molecular levels.
3. Describe the effects of lifestyle choices upon aging.

Application Question(s)

1. Have students make a comparison of a baby, a 40-year old adult, and a senior citizen in terms of the evidence of aging at the tissue, cell, molecular, and whole-body levels.
   Answer: Responses will vary.

Critical Thinking Issue(s)

1. Ask students to compare and contrast various products on the market that claim to impede the aging process. Which of these claims are difficult to believe? Why?
   Answer: Responses will vary.

1.8 Anatomical Terminology

- **Properly use the terms that describe relative positions, body sections, and body regions.**

Structure Suggestions and Guidelines

1. Use anatomical terminology to describe relative positions of the body parts. Name each term, define each term, provide an illustration to depict each term, and give practical examples of each.
2. Demonstrate the three major planes: sagittal, frontal, and transverse, by using anatomical models and textbook photographs.
3. Introduce terms which designate body regions. Define the four-quadrant and nine-region systems for describing the subdivisions of the abdominal area.

Application Question(s)

1. Have each student develop twenty flash cards, each of which contains the name of a

body part on one side, and a description of its relative position using appropriate anatomical terms on the reverse. Collect the cards and quiz the students with them.
Answer: Responses will vary.

Critical Thinking Issue(s)

1. Ask students to choose one disease or set of symptoms, and describe the patient's condition as explicitly as possible using appropriate directional terms, body planes, sections, and regions. The instructor may wish to analyze real-life medical record reports with the class. (Remember to insure patient confidentiality).
Answer: N/A.

Topical Chapter Outline

1.1 Origins of Medical Science
1.2 Anatomy and Physiology
1.3 Levels of Organization
1.4 Core Themes in Anatomy and Physiology
1.5 The Characteristics and Maintenance of Life
  a. Characteristics of Life
  b. Requirements of Organisms
  c. Homeostasis
1.6 Organization of the Human Body
  a. Body Cavities
  b. Thoracic and Abdominopelvic Membranes
  c. Organ Systems (Body Covering, Support and Movement, Integration and Coordination, Transport, Absorption and Excretion, Reproduction)
1.7 Life-Span Changes
1.8 Anatomical Terminology
  a. Relative Position
  b. Body Sections
  c. Body Regions