Hole's Essentials of Human Anatomy & Physiology 15th edition Welsh Solutions Manual

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ANSWERS TO PRACTICE QUESTIONS

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 kinds 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.

Practice 1.2

1. **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).

2. **List examples that illustrate how the structure of a body part makes possible its function.**

   The front teeth (incisors) are pointed for grasping and tearing food, while the back teeth (molars) are flattened for grinding food. The jointed structure of the bones of the fingers allow us to grasp objects. The cone-shaped, chambered heart pumps blood through the blood vessels. The tubular blood vessels transport blood to the cells of the body.

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, which consist of layers of cells. Cells are composed of organelles, which consist of molecules, and finally, atoms.

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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 two 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. **What are the characteristics of life?**

   The characteristics of life are properties that all living organisms exhibit. They include movement, reproduction, responsiveness, growth, and metabolism, which in turn consists of the processes of respiration, digestion, circulation, and excretion.

2. **How are the characteristics of life dependent on metabolism?**

   Metabolism is the sum of all the chemical reactions that occur in the cells. Metabolism supports life processes. For example, digestion of food is accomplished by metabolic reactions that break down the food into smaller particles that can be absorbed across the membrane of the small intestine. Once absorbed, food particles are circulated, and used for growth, movement, and reproduction. Wastes from food are excreted.

Practice 1.5

1. **Which requirements of organisms does the external environment provide?**

   The environment provides water, food, oxygen, heat, and pressure.

2. **Why is homeostasis important to survival?**

   Homeostasis is the maintenance of a stable internal environment, which consists of the fluid around our body cells. Changes in the external environment affect the internal environment, and therefore, the health of our cells. Cells, tissues, organs, and systems function properly only in the presence of certain concentrations of water, oxygen, hydrogen ions (pH), and nutrients, and specific conditions of heat and pressure. Having enough water in our cells prevents dehydration, shrinkage of cell nuclei, and cell death. Homeostatic pH prevents

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irreversible alteration of enzyme structure (denaturation) and function.

3. **Describe two 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. 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 change. During blood clotting, certain chemicals stimulate further blood clotting, to stop the bleeding.

Practice 1.6

1. **Which organ occupies the cranial cavity? The vertebral canal?**

The brain occupies the cranial cavity, and the spinal cord occupies the vertebral canal.

2. **What does *viscera* mean?**

"Viscera" refers to the organs within the thoracic and abdominopelvic cavities.

3. **Name the cavities of the head.**

The small cavities of the head include the oral cavity, nasal cavity, orbital cavities, and middle ear cavities. The cranial cavity is the large cavity of the head; it is occupied by the brain.

4. **Describe the membranes associated with the thoracic and abdominopelvic cavities.**

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.

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5. Name and list the organs of the major organ systems.

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

Skeletal system: bones

Muscular system: muscles

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

Endocrine system: endocrine glands

Cardiovascular system: heart, arteries, veins, capillaries, and blood

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

6. Describe the general functions of each organ system.

Integumentary system: Protects internal structures, 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; communicates via nerve impulses to help detect changes in the environment, integrate information, and respond 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,

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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. Describe the anatomical position.

A person in the 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.

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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 the 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. Name the nine regions of the abdomen.

Epigastric, left and right hypochondriac, umbilical, left and right lateral (lumbar), pubic (hypogastric), and left and right inguinal (iliac) regions

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CHAPTER 1:
INTRODUCTION TO HUMAN ANATOMY AND PHYSIOLOGY

1.1 Introduction

Learning Outcome 1: Identify some of the early discoveries that led to our understanding of the body.

1) Lecture Suggestions and Guidelines
   a) Give an overview of the roles of primitive doctors.
   b) Compare various beliefs regarding the connection between natural forces and the human body.
   c) Identify the origins of basic terms used in the study of anatomy and physiology.
2) Application Question(s)
   a) 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.

3) Critical Thinking Issue(s)
   a) Compare and contrast several ancient uses of herbs and potions.

   Answer: Students may be required to research this topic via the library, used bookstores, or Internet.

1.2 Anatomy and Physiology

Learning Outcome 1: Explain how anatomy and physiology are related.

1) Lecture Suggestions and Guidelines
   a) Describe anatomy as the study of the structure of the human body.
   b) Describe physiology as the study of the function of the human body.
   c) Discuss ways in which the function of a body part depends upon the way it is constructed.
2) Application Question(s)
   a) Ask students to choose a body part and explain how its unique structure is related to its function.

   Answer: Some excellent examples would include the hand, (adapted for grasping), the heart, (adapted for receiving and pumping blood), the mouth, (adapted for speaking and receiving food), and the urinary bladder (adapted for storing urine).
3) Critical Thinking Issue(s)
   a) Ask students to consider the implications of changes in function of a body part that has been altered in structure.

   Answer: Examples may include loss of pumping ability of the heart due to scar tissue formation, loss of the ability to grasp when the thumb, (opposable digit), is injured, inability to plantar flex and evert the foot due to injury to the peroneus muscles.

1.3 Levels of Organization

Learning Outcome 1: List the levels of organization in the human body and the characteristics of each.

1) Lecture Suggestions and Guidelines
   a) Emphasize the fact that the body is composed of parts with different levels of organization.
   b) Introduce the levels of complexity from simplest to most complex, including atoms, molecules, macromolecules, cells, tissues, organs, organ systems, organism.
   c) Discuss how organs within a system are grouped together to accomplish a unified purpose.
2) Application Question(s)

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a) Ask students to apply their knowledge of levels of organization to an example outside the human body.

Answer: For example, begin with a single book. Combining several books together will form a bookshelf. Several bookshelves combine to form a bookcase. Many bookcases are joined together to form a section of a library. Many sections of the library can combine to form one whole library. Many libraries are linked together to form a library system, etc.

3) Critical Thinking Issue(s)

a. Ask students to describe a system from the simplest to most complex level.

Answer: The skeletal system serves as an excellent example. Discussion should begin with a brief overview of atoms, molecules, and macromolecules, followed by a description of bone cells (osteocytes), which combine to form osseous tissue, which form more complex structures called bones (organs). The 206 bones of the human body, when taken together, form the skeletal system (organ system). This system combines with other organ systems to become an organism.

1.4 Characteristics of Life

Learning Outcome 1: List and describe the major characteristics of life.

1) Lecture Suggestions and Guidelines
   a) Define the characteristics of life as traits that all organisms share.
   b) List the major characteristics of life and give an example of each. Include a discussion of growth, reproduction, responsiveness, movement, and metabolism.
   c) Explain to students that metabolism includes respiration, digestion, circulation, and excretion.
2) Application Question(s)
   a) Ask students to list the major characteristics of life and briefly describe why each characteristic is important in maintaining human life. Relate each characteristic to a specific body system.

   Answer: Responses should include a discussion of growth (all body systems), reproduction (reproductive system), responsiveness (nervous, endocrine, integumentary systems), movement (muscular and skeletal systems), metabolism (respiratory system (respiration), digestive system (digestion, excretion), cardiovascular system (circulation), lymphatic system (circulation), urinary system (excretion)).
3) Critical Thinking Issue(s)
   a) Ask students to describe the importance of monitoring vital signs and their relationships to the major characteristics of life.

   Answer: Vital signs include the measurement of various organ system functions that are necessary to maintain life. They include measurements of breathing, pulse, responsiveness, blood pressure, temperature, movement, reflexes, and brain activity.

Learning Outcome 2: Give examples of metabolism.

1) Lecture Suggestions and Guidelines
   a) Define metabolism as the sum total of all the chemical reactions in the body.
   b) Describe respiration as an example of a metabolic process.
   c) Describe digestion as an example of a metabolic process.
2) Application Question(s)
   a) Ask students to compare human metabolic processes with processes of other animals.

   Answer: Comparisons may include mammals, fish, invertebrates, insects, etc.
3) Critical Thinking Issue(s)
   a) Ask students to predict the dire effects on the human body when one of the major metabolic processes malfunctions.

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Answer: Responses should include a discussion of the effects on homeostasis. For example, the effects of an asthma attack that restricts airflow into and out of the lungs and the resulting effect on gas exchange.

1.5 Maintenance of Life

Learning Outcome 1: List and describe the major requirements of organisms.

1) Lecture Suggestions and Guidelines
   a) Describe how the structures and functions of body parts maintain the life of the organism.
   b) Discuss the major requirements of organisms, including water, heat, and pressure.
   c) Describe the implications of excesses and deficiencies of the major requirements of organisms.
2) Application Question(s)
   a) Apply the requirements of organisms to the structure and function of body parts. Ask students to explain how each requirement helps to maintain life.

   Answer: Responses should include a discussion of water, heat, and pressure. For example, blood pressure is necessary to filter the blood in the kidneys, and water is necessary for certain membranes to adhere to one another (such as the pleura of the lungs), and for certain chemical reactions to occur (such as the breakdown of starch to glucose molecules).
3) Critical Thinking Issue(s)
   a) Ask students to describe an example of the effects upon a body system when it is subjected to a less than optimal quantity and quality of its basic environmental requirements.

   Answer: Examples may include a dysfunctional cardiovascular system when blood pressure falls above or below normal limits, dehydration of tissues when water levels are too low, or edema when fluids accumulate in the tissues, or malnutrition when food does not supply the body with the correct nutrients in optimal amounts. It should be noted that malnutrition might result from overeating the “wrong” things as well as not eating enough of the “right” things.

Learning Outcome 2: Explain the importance of homeostasis to survival.

1) Lecture Suggestions and Guidelines
   a) Define homeostasis in terms of maintaining an internal stable environment.
   b) Ask students to describe their major field of study and give examples of patient conditions that would upset a level of homeostasis.
   c) Introduce the concept of a negative feedback mechanism.
2) Application Question(s)
   a) Ask students to apply their knowledge of a homeostatic mechanism to a situation outside of the human body.

   Answer: Responses may include the analogy of a homeostatic mechanism used by a furnace or air conditioning system. In any case, the discussion should include a self-regulating mechanism that receives signals about changes within the system that have deviated from the norm. The self-regulating mechanism provides feedback to the system to allow it to initiate the changes necessary to return to normal conditions.
3) Critical Thinking Issue(s)
   a) Ask students to trace the steps of a homeostatic mechanism within the human body.

   Answer: One example is the maintenance of optimal body temperature. When body temperature rises, the brain detects the change and causes increased sweating and the dilation of skin blood vessels. These reactions initiate the loss of heat, thus stimulating the body temperature to return to normal. Another example is the maintenance of normal blood sugar levels. When blood sugar (glucose) levels increase, the pancreas secretes the hormone insulin into the blood, and insulin acts

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on certain body cells to allow glucose transport into the cells, which helps lower blood sugar back toward normal.

Learning Outcome 3: Describe the parts of a homeostatic mechanism and explain how they function together.

1) Lecture Suggestions and Guidelines
   a) Apply the concept of homeostasis to the maintenance of blood pressure.
   b) Apply the concept of homeostasis to the maintenance of body temperature.
   c) Give examples of situations or processes that would not be considered homeostatic mechanisms.
   d) Define receptors, effectors, and control centers.
2) Application Question(s)
   a) Ask students to apply the concept of homeostasis to the maintenance of blood pressure.

   Answer: The maintenance of blood pressure is based upon sensors in the walls of the blood vessels that send feedback to a control center in the brain. This initiates messages from the brain to the heart, telling it to contract more slowly or more rapidly depending upon the situation.
3) Critical Thinking Issue(s)
   a) Ask students to describe the effects of environmental pollution, i.e., water, air, or soil upon maintaining homeostasis in the human body.

   Answer: The possible responses are limitless but should include a discussion of the body's attempts to maintain a stable internal environment.

1.6 Organization of the Human Body

Learning Outcome 1: Identify the locations of the major body cavities.

1) Lecture Suggestions and Guidelines
   a) Identify the cavities of the axial portion of the human organism, which include the cranial cavity, vertebral cavity, thoracic cavity, and abdominopelvic cavity.
   b) Identify the diaphragm that separates the thoracic and abdominopelvic cavities, and the mediastinum between the right and left sides of the thoracic cavity.
   c) Distinguish between the abdominal cavity and pelvic cavity.
   d) Identify the smaller body cavities of the head.
2) Application Question(s)
   a) Ask students to identify the major cavity that is: directly above the pelvic cavity; behind the thoracic and abdominopelvic cavities; body cavity on the head; body cavity below the abdominal cavity

   Answer: Directly above the pelvic cavity = abdominal cavity; behind the thoracic and abdominopelvic cavities = vertebral cavity; body cavity on the head = cranial cavity; body cavity below the abdominal cavity = pelvic cavity.

Learning Outcome 2: List the organs located in each major body cavity.

1) Lecture Suggestions and Guidelines
   a) Identify the body organs located within each cavity of the axial portion of the human organism, including the brain, spinal cord, heart, spleen, gallbladder, lungs, liver, stomach, intestines, and urinary bladder.
   b) Identify the major body organs located in the mediastinum.
   c) Identify the organs associated with the smaller body cavities.
2) Application Question(s)
   a) Ask students to identify the body cavity that would be the focus of an image, such as a CT scan,

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MRI, angiogram, or X-ray, given the following: gallstones obstructing the bile duct, herniated ("slipped") disc, collapsed lung; coronary artery blockage, colorectal cancer, ovarian cyst.

Answer: Gallstones obstructing the bile duct = abdominal cavity, herniated ("slipped") disc = vertebral cavity, collapsed lung = thoracic cavity, coronary artery blockage = thoracic cavity/mediastinum, colorectal cancer = abdominal cavity, ovarian cyst = pelvic cavity.

b) Ask students to identify the smaller body cavity that would be the focus of a physician's examination given the following: a baseball pitch hitting a batter's eye, a root canal, a deviated septum, an ear infection.

Answer: A baseball pitch hitting a batter's eye = orbital cavity, a root canal = oral cavity, a deviated septum = nasal cavity, an ear infection = middle ear cavities.

Learning Outcome 3: Name and identify the locations of the membranes associated with the thoracic and abdominopelvic cavities.

1) Lecture Suggestions and Guidelines
   a) Distinguish between the parietal and visceral membranes.
2) Application Question(s)
   a) Ask students to imagine gently punching their fist into a partially inflated balloon, and then ask the students to discuss the similarities between this and the arrangement of the membranes and their associated cavity.

   Answer: The part of the balloon that is against the skin of the fist is the visceral membrane. The outer surface of the balloon is the parietal membrane. The cavity between these two membranes is represented by the air within the balloon.
3) Critical Thinking Issue(s)
   a) How would an infection that causes excess fluid within the pericardial cavity affect function of the heart?

   Answer: The heart's movement would be restricted, and therefore, it would not be able to pump blood as effectively.

Learning Outcome 4: Name the major organ systems, and list the organs associated with each.

1) Lecture Suggestions and Guidelines
   a) Identify the eleven body organ systems.
   b) Distinguish the body organ system that contain the following organs
2) Application Question(s)
   a) Provide the students with an illustration of the human body. Ask them to label each organ system and to identify as many organs as possible within each of those systems.

   Answer: Illustrations should include identification of the organs in the integumentary system, skeletal system, muscular system, nervous system, endocrine system, cardiovascular system, lymphatic system, respiratory system, digestive system, urinary system, and reproductive system.

Learning Outcome 5: Describe the general functions of each organ system.

1) Lecture Suggestions and Guidelines
   a) Discuss how each system includes a set of interrelated organs that work together.
   b) Describe the organ system involved with each of the following functions: body covering, support and movement, transport, absorption, excretion, and reproduction.
2) Application Question(s)
   a) Pick a body system and explain how malnourishment could affect its function.

   Answer: Answers will vary. An example would be not getting the required nutrients in the diet could result in muscle weakness because there would be less proteins to enable the muscle to contract.

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Another example would be that malnourishment would result in less hemoglobin in red blood cells, so less oxygen being carried to the body's cells.

3) Critical Thinking Issue(s)
   a) Which major body functions are served by more than one organ system? Name the functions that they serve.

   Answer: Support and movement - skeletal and muscular systems; integration and coordination - nervous and endocrine systems; transport - cardiovascular and lymphatic systems; absorption and excretion - digestive, respiratory, and urinary systems.

1.7 Anatomical Terminology

Learning Outcome 1: Properly use the terms that describe relative positions, body sections, and body regions.

1) Lecture Suggestions and Guidelines
   a) Introduce students to the correct anatomical position.
   b) Discuss terms of relative position to describe the location of one body part with respect to another.
   c) Describe the three major body sections or planes.
   d) Describe the anterior and posterior body regions, and give examples using an anatomical term as well as a common term. For example, arm = brachial region; carpal = wrist region, etc.
2) Application Question(s)
   a) Apply the student's knowledge of directional terms learned in this chapter to situations outside the human body.

   Answer: Responses will vary, but attempt to describe relative positions of items in a cupboard, relative positions of student seating in the classroom, relative positions of the working parts found inside a clock, etc.

   b) Ask students to apply their knowledge of the major body cavities by drawing and identifying, on an illustration of the human body, the nine abdominal regions.

   Answer: Responses should include drawings and identification of the right hypochondriac region, epigastric region, left hypochondriac region, right lumbar region, umbilical region, left lumbar region, right iliac region, hypogastric region, and left iliac region.
3) Critical Thinking Issue(s)
   a) By utilizing the directional terms learned in this chapter, ask students to choose a body part and to describe its relative position.

   Answer: Students may use relative directional terms, body planes, abdominal regions, and terms used to describe body regions. Remind them of the importance of maintaining the correct anatomical position before they begin to use directional terms.

   b) If a patient enters the emergency room with a gunshot wound to the epigastric region, which visceral organs may have been traumatized?

   Answer: Damage to the liver, stomach, transverse colon, gall bladder, pancreas, kidneys, and associated blood vessels would be of major concern.

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