**CHAPTER 1**

**INTRODUCTION TO HUMAN ANATOMY AND PHYSIOLOGY**

**Learning Outcomes**

**1.1 Origins of Medical Science**

**1: 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**

**2: 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**

**3: 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 Common Themes in Anatomy and Physiology**

**4. Key concepts in anatomy and physiology**

**and**

**5. 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 Life and the Maintenance of Life**

**6: 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.

**7: 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.

**8: 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.

**9: 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.

**10: 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**

**11: Identify the locations of the major body cavities.**

**and**

**12: List the organs located in each major body cavity.**

**and**

**13: 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.

**14: Name the major organ systems, and list the organs associated with each.**

**and**

**15: 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**

**16: 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**

**17: 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 Common Themes in Anatomy and Physiology

1.5 Life 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 Abdominal 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