

Chapter 1 - The Human Body: An Orientation

Objectives

An Overview of Anatomy and Physiology

1. Define anatomy and describe the nature of different topics in anatomy.
2. Define physiology and describe the main focus of physiology.
3. Describe the principle of complementarity of structure and function. How does it unite the disciplines of anatomy and physiology?

Levels of Structural Organization

4. Name the different levels of structural organization and describe their relationships with each other.
5. List the organ systems of the body and the major structures within each system.

Maintaining Life

6. Describe the importance of each of the necessary life functions.
7. Describe the survival needs for human life and discuss the importance of each.

Homeostasis

8. Define homeostasis and list the components of a homeostatic control mechanism.
9. Distinguish between negative and positive feedback mechanisms. Describe the mechanics of each and their importance to the maintenance of homeostasis.

The Language of Anatomy

10. Describe the body's position in anatomical position. Why is this position important?
11. Define the directional terms as they relate to the human body.
12. Define the regional terms of the body. Which regions are found within other regions?
13. Identify the body planes and how they relate to sectioning terms and techniques.
14. Describe the body cavities and their relationships to each other. Which cavities are contained within other cavities?
15. Describe the membranes of the ventral cavity and their relationships to each other, the body wall, and the organs they are associated with.
16. Define the abdominopelvic regions and quadrants and describe how they are used by professionals.

Lecture Outline

1. An Overview of Anatomy and Physiology (pp. 2–3)

- A. Anatomy is the study of the structure of body parts and their relationships to each other, and physiology is the study of the function of body parts (p. 2).
- B. Topics of Anatomy (pp. 2–3)

1. Gross (macroscopic) anatomy is the study of structures large enough to be seen with the naked eye.
 - a. Regional anatomy is the study of all body structures in a given body region.
 - b. Systemic anatomy is the study of all structures in a body system.
 - c. Surface anatomy is the study of internal body structures as they relate to the overlying skin.
 2. Microscopic anatomy is the study of structures that are too small to be seen with the naked eye.
 - a. Cytology is the study of individual cells.
 - b. Histology is the study of tissues.
 3. Developmental anatomy is the study of the change in body structures over the course of a lifetime.
 4. Specialized Branches of Anatomy
 - a. Pathological anatomy is the study of structural changes associated with disease.
 - b. Radiographic anatomy is the study of internal structures using specialized visualization techniques.
 - c. Molecular biology is the study of biological molecules.
- C. Topics of Physiology (p. 3)
1. Physiology has several topics, most of which consider the function of specific organ systems.
 2. Physiology often focuses on cellular and molecular events.
- D. Complementarity of Structure and Function (p. 3)
1. The principle of complementarity of structure and function states that function is dependent on structure, and that the form of a structure relates to its function.

II. Levels of Structural Organization (pp. 3–4)

- A. The chemical level is the simplest level of organization (Fig. 1.1).
 1. Atoms, tiny building blocks of matter, combine to form molecules.
 2. Molecules combine in specific ways to form organelles, which are the basic unit of living cells.
- B. The cellular level is the smallest unit of life, and varies widely in size and shape according to the cells' function.
- C. The tissue level is groups of cells having a common function.
- D. The organ level is made up of discrete structures that are composed of at least two groups of tissues that work together to perform a specific function in the body.
- E. The organ system level is a group of organs that work closely together to accomplish a specific purpose (Fig. 1.3).
- F. The organismal level is the total of all structures working together to promote life.

III. Maintaining Life (pp. 4–8)

- A. Necessary Life Functions (pp. 4–8; Fig. 1.2)
 1. Maintaining boundaries allows an organism to maintain separate internal and external environments, or separate internal chemical environments.
 2. Movement allows the organism to travel through the environment, and allows transport of molecules within the organism.

3. Responsiveness, or irritability, is the ability to detect changes in the internal or external environment and respond to them.
 4. Digestion is the process of breaking down food into molecules that are usable by the body.
 5. Metabolism includes all chemical reactions that occur in the body.
 6. Excretion is the process of removing wastes.
 7. Reproduction is the process of producing more cells or organisms.
 8. Growth is an increase in size in body parts or the whole organism.
- B. Survival Needs (p. 8)
1. Nutrients are consumed chemical substances that are used for energy and cell building.
 2. Oxygen is required by the chemical reactions that release energy from foods.
 3. Water, the most abundant chemical substance in the body, provides an environment for chemical reactions and a fluid medium for secretions and excretions.
 4. Normal body temperature is required for the chemical reactions of the body to occur at the proper rate.
 5. Atmospheric pressure must be within an appropriate range so that proper gas exchange occurs in the lungs.

IV. Homeostasis (pp. 8–12)

- A. Homeostasis is the ability of the body to maintain a relatively constant internal environment, regardless of environmental changes (p. 9).
- B. Homeostatic Control Mechanisms (pp. 9–12; Figs. 1.4–1.6)
1. Components
 - a. Variable: the regulated factor or event.
 - b. Receptor: structure that monitors changes in the environment and sends information to the control center.
 - c. Control center: structure that determines the set point for a variable, analyzes input, and coordinates an appropriate response.
 - d. Effector: structure that carries out the response directed by the control center.
 2. Negative Feedback Mechanisms
 - a. Most homeostatic control mechanisms are negative feedback mechanisms.
 - b. A negative feedback mechanism causes the variable to change in a way that opposes the initial change.
 - c. Both the nervous system and the endocrine system are important to the maintenance of homeostasis.
 - d. The goal of negative feedback mechanisms is to prevent sudden, severe changes in the body.
 3. Positive Feedback Mechanisms
 - a. A positive feedback mechanism causes the variable to change in the same direction as the original change, resulting in a greater deviation from the set point.
 - b. Positive feedback mechanisms typically activate events that are self-perpetuating.
 - c. Most positive feedback mechanisms are not related to the maintenance of homeostasis.
 4. Homeostatic imbalance often results in disease.

V. The Language of Anatomy (pp. 12–22)

- A. Anatomical Position and Directional Terms (p. 12; Table 1.1; Fig. 1.7)

1. Anatomical position is a position in which the body is erect, palms face forward, and thumbs point away from the body.
 - a. In anatomical position, right and left refer to the right and left sides of the person viewed.
 - b. In anatomy, anatomical position is always assumed, regardless of the actual position of the body.
 2. Directional terms are used to explain exactly where one body part is in relation to another.
- B. Regional Terms (pp. 12–14)
1. There are two fundamental divisions of the body.
 - a. The axial region includes the head, neck, and trunk.
 - b. The appendicular region consists of the upper and lower limbs.
 2. Regional terms designate specific areas within the axial and appendicular divisions.
- C. Body Planes and Sections (p. 15; Fig. 1.8)
1. Body planes are flat surfaces that lie at right angles to each other.
 - a. Sagittal plane: a vertical plane that separates the body into right and left parts.
 - i. Median, or midsagittal plane: lies exactly along the body's midline.
 - ii. Parasagittal plane: lies offset from the midline.
 - b. Frontal plane: a vertical plane that separates the body into anterior and posterior parts.
 - c. Transverse, or horizontal, plane: a plane that runs horizontally from right to left, and divides the body into superior and inferior parts.
 2. Sections are cuts made along specific planes.
 - a. Transverse section, or cross section, is a cut made along the transverse plane.
 - b. Oblique sections are cuts made at angles between the horizontal and vertical planes.
- D. Body Cavities and Membranes (pp. 15–19; Figs. 1.9–1.13)
1. Body cavities are spaces within the body that are closed to the outside and contain the internal organs.
 2. The dorsal body cavity is the space that houses the central nervous system, and has two subdivisions: the cranial cavity and the vertebral cavity.
 - a. The cranial cavity is within the skull, and houses the brain.
 - b. The vertebral, or spinal, cavity is within the vertebral column, and houses the spinal cord.
 3. The ventral body cavity is anterior to and larger than the dorsal cavity and has two main subdivisions: the thoracic cavity, and the abdominopelvic cavity.
 - a. The thoracic cavity is a superior division of the ventral cavity that is further subdivided into the lateral pleural cavities that surround the lungs.
 - b. The thoracic cavity also contains the medial mediastinum, which includes the pericardial cavity surrounding the heart and the space surrounding the other thoracic structures.
 4. The ventral body cavity houses the body organs, or viscera.
 5. Membranes in the Ventral Body Cavity
 - a. Serous membranes, or serosae, cover the inner walls of the ventral cavity and the outer surfaces of organs.
 - b. The parietal serosa lines the body cavity walls, and is named for the specific cavities it is associated with.
 - c. The visceral serosa covers the outer surfaces of organs, and is named for the specific organs it is associated with.

- d. Serous membranes secrete and are separated by a thin layer of lubrication fluid called serous fluid, which allows organs to slide without friction along cavity walls and between each other.
- 6. Abdominopelvic Regions and Quadrants
 - a. There are nine abdominopelvic regions used primarily by anatomists.
 - b. There are four quadrants used primarily by medical personnel.
- 7. Other Body Cavities
 - a. Oral and digestive cavities are continuous cavities that extend from the mouth through the digestive system to the anus.
 - b. The nasal cavity is within and posterior to the nose.
 - c. The orbital cavities house the eyes.
 - d. The middle ear cavities are within the skull just medial to the eardrums, and house the bones that transmit sound vibrations to the inner ears.
 - e. Synovial cavities are joint cavities lined with a lubricating fluid-secreting membrane associated with all movable joints.

Cross References

Additional information on the topics covered in Chapter 1 can be found in the chapters listed below.

1. Chapter 2: Basic chemical and physical principles
2. Chapter 3: Cellular level of structural organization
3. Chapter 4: Tissue level of structural organization
4. Chapter 16: Hormonal control as an example of feedback regulation
5. Chapter 22: Organs of the mediastinum
6. Chapter 23: Serous membranes of the abdominal cavity
7. Chapter 28: Example of positive feedback (see Fig. 28.16)

Laboratory Correlations

1. Marieb, E. N. *Human Anatomy & Physiology Laboratory Manual: Cat and Fetal Pig Versions*. Eighth Edition Updates. Benjamin Cummings, 2006.
 - Exercise 1: The Language of Anatomy
 - Exercise 2: Organ Systems Overview
2. Marieb, E. N. *Human Anatomy & Physiology Laboratory Manual: Main Version*. Seventh Edition Update. Benjamin Cummings, 2006.
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