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The Human Body: An Orientation: Part A

Overview of Anatomy and Physiology
• Anatomy: The study of structure
• Subdivisions:
  • Gross or macroscopic (e.g., regional, surface, and systemic anatomy)
  • Microscopic (e.g., cytology and histology)
  • Developmental (e.g., embryology)

Overview of Anatomy and Physiology
• Essential tools for the study of anatomy:
  • Mastery of anatomical terminology
  • Observation
  • Manipulation
  • Palpation
  • Auscultation

Overview of Anatomy and Physiology
• Physiology: The study of function at many levels
  • Subdivisions are based on organ systems (e.g., renal or cardiovascular physiology)

Overview of Anatomy and Physiology
• Essential tools for the study of physiology:
  • Ability to focus at many levels (from systemic to cellular and molecular)
  • Basic physical principles (e.g., electrical currents, pressure, and movement)
  • Basic chemical principles

Principle of Complementarity
• Anatomy and physiology are inseparable.
  • Function always reflects structure
  • What a structure can do depends on its specific form

Levels of Structural Organization
• Chemical: atoms and molecules (Chapter 2)
• Cellular: cells and their organelles (Chapter 3)
• Tissue: groups of similar cells (Chapter 4)
• Organ: contains two or more types of tissues
• Organ system: organs that work closely together
• Organismal: all organ systems

Overview of Organ Systems
• Note major organs and functions of the 11 organ systems (Fig. 1.3)

Organ Systems Interrelationships
• All cells depend on organ systems to meet their survival needs
• Organ systems work cooperatively to perform necessary life functions

Necessary Life Functions
1. Maintaining boundaries between internal and external environments
   • Plasma membranes
   • Skin
2. Movement (contractility)
   • Of body parts (skeletal muscle)
   • Of substances (cardiac and smooth muscle)

Necessary Life Functions
3. Responsiveness: The ability to sense and respond to stimuli
   • Withdrawal reflex
   • Control of breathing rate
4. Digestion
   • Breakdown of ingested foodstuffs
   • Absorption of simple molecules into blood

Necessary Life Functions
5. Metabolism: All chemical reactions that occur in body cells
   • Catabolism and anabolism
6. Excretion: The removal of wastes from metabolism and digestion
   • Urea, carbon dioxide, feces
Necessary Life Functions
7. Reproduction
   • Cellular division for growth or repair
   • Production of offspring
8. Growth: Increase in size of a body part or of organism

Survival Needs
1. Nutrients
   • Chemicals for energy and cell building
   • Carbohydrates, fats, proteins, minerals, vitamins
2. Oxygen
   • Essential for energy release (ATP production)

Survival Needs
3. Water
   • Most abundant chemical in the body
   • Site of chemical reactions
4. Normal body temperature
   • Affects rate of chemical reactions
5. Appropriate atmospheric pressure
   • For adequate breathing and gas exchange in the lungs

Homeostasis
• Maintenance of a relatively stable internal environment despite continuous outside changes
• A dynamic state of equilibrium

Homeostatic Control Mechanisms
• Involve continuous monitoring and regulation of many factors (variables)
• Nervous and endocrine systems accomplish the communication via nerve impulses and hormones

Components of a Control Mechanism
1. Receptor (sensor)
   • Monitors the environment
   • Responds to stimuli (changes in controlled variables)
2. Control center
   • Determines the set point at which the variable is maintained
   • Receives input from receptor
• Determines appropriate response

**Components of a Control Mechanism**

3. Effector
   • Receives output from control center
   • Provides the means to respond
   • Response acts to reduce or enhance the stimulus (feedback)

**Negative Feedback**
   • The response reduces or shuts off the original stimulus
   • Examples:
     • Regulation of body temperature (a nervous mechanism)
     • Regulation of blood volume by ADH (an endocrine mechanism)

**Negative Feedback: Regulation of Blood Volume by ADH**
   • Receptors sense decreased blood volume
   • Control center in hypothalamus stimulates pituitary gland to release antidiuretic hormone (ADH)
   • ADH causes the kidneys (effectors) to return more water to the blood

**Positive Feedback**
   • The response enhances or exaggerates the original stimulus
   • May exhibit a cascade or amplifying effect
   • Usually controls infrequent events e.g.:
     • Enhancement of labor contractions by oxytocin (Chapter 28)
     • Platelet plug formation and blood clotting

**Homeostatic Imbalance**
   • Disturbance of homeostasis
     • Increases risk of disease
     • Contributes to changes associated with aging
     • May allow destructive positive feedback mechanisms to take over (e.g., heart failure)