Chapter 1

An Introduction to the Human Body

Chapter Overview

• Define Anatomy and Physiology
• Levels of Organization
• Characteristics of Living Things
• Homeostasis
• Anatomical Terminology

Anatomy

• Describes the structures of the body:
  – what they are made of
  – where they are located
  – associated structures

Physiology

• Is the study of:
  – functions of anatomical structures
  – individual and cooperative functions
• All physiological functions are performed by specific anatomical structures
Anatomy Subdisciplines

- Embryology
- Developmental anatomy
- Histology
- Surface anatomy
- Gross anatomy
- Systemic anatomy
- Regional anatomy
- Radiographic anatomy
- Cytology
- Pathological anatomy

Physiology Subdisciplines

- Neurophysiology
- Endocrinology
- Cardiovascular physiology
- Immunology
- Respiratory physiology
- Renal physiology
- Exercise physiology
- Cell physiology
- Pathophysiology
- Reproductive physiology

Levels of Organization

- The chemical level
  - Atoms: the smallest units of matter that participate in chemical reactions
  - Molecules: two or more atoms joined together
- Cells
  - the basic structural and functional units of an organism.
- Tissues
  - groups of similar cells and the substances surrounding them that perform certain special functions.
Levels of Organization

- **Tissues**
  - groups of similar cells and the substances surrounding them that perform certain special functions.
- **Organs**
  - structures of definite form that are composed of two or more different tissues and have specific functions.
- **Systems**
  - related organs that have a common function.
- The human organism
  - any living individual.

Organ Systems

- The body is divided into 11 organ systems:
  - integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, urinary, digestive, and reproductive
- All organ systems work together
- Many organs work in more than one organ system

Clinical Application

Three noninvasive techniques used to assess aspects of body structure and function include:

- palpation
  - The examiner feels body surfaces with the hands; an example would be pulse and heart rate determination.
- auscultation
  - The examiner listens to body sounds to evaluate the functioning of certain organs, as in listening to the lungs or heart.
- percussion
  - The examiner taps on the body surface with the fingertips and listens to the resulting echo.

Characteristics of Living Organisms

- All living things have certain characteristics that distinguish them from nonliving things.

  *Metabolism*
  *Responsiveness*
  *Movement*
  *Growth*
  *Differentiation*
  *Reproduction*
Basic Life Processes

All living things have certain characteristics that distinguish them from nonliving things:

- **Metabolism** is the sum of all chemical processes that occur in the body, including catabolism and anabolism.
- **Responsiveness** is the ability to detect and respond to changes in the external or internal environment.
- **Movement** includes motion of the whole body, individual organs, single cells, or even organelles inside cells.

• **Growth** refers to an increase in size and complexity, due to an increase in the number of cells, size of cells, or both.
• **Differentiation** is the change in a cell from an unspecialized state to a specialized state.
• **Reproduction** refers either to the formation of new cells for growth, repair, or replacement, or the production of a new individual.

Homeostasis

- **Homeostasis**: All body systems working together to maintain a stable internal environment
- Systems respond to external and internal changes to function within a normal range (body temperature, blood pressure, blood glucose)
- Failure to function within a normal range results in disease or death

Control of Homeostasis

- **Autoregulation** (intrinsic):
  – automatic response in a cell, tissue, or organ
- **Extrinsic regulation**:
  – responses controlled by nervous and endocrine systems
Components of Feedback Loop

- **Receptor**
  - monitors a controlled condition
  - receives the stimulus
- **Control center**
  - processes the signal and sends instructions
- **Effector**
  - carries out instructions

Feedback Systems

- If a response reverses the original stimulus, the system is a negative feedback system.
- If a response enhances the original stimulus, the system is a positive feedback system.

Homeostasis of Blood Pressure

- Controlled by negative feedback system
- Pressure receptors in arteries detect an increase in BP
- Brain receives input and then signals heart and blood vessels
- Heart rate slows and arterioles dilate (increase in diameter)
- BP returns to normal

Positive Feedback during Childbirth

- Stretch receptors in walls of the uterus send signals to the brain
- Brain releases a hormone (oxytocin) into bloodstream
- Uterine smooth muscle contracts more forcefully
- More stretch ➔ more hormone ➔ more contraction ➔ etc.
- The cycle ends with birth of the baby & decrease in stretch
KEY CONCEPT

- Homeostasis is a state of equilibrium:
  - opposing forces are in balance
- Physiological systems work to restore balance
- Failure results in disease or death
- Aging is characterized by a progressive decline in the body’s responses to restore homeostasis

KEY CONCEPT

- Anatomical position:
  - hands at sides, palms forward
- Supine:
  - lying down, face up
- Prone:
  - lying down, face down

BASIC ANATOMICAL TERMINOLOGY

- Anatomical position
- Regions of the body
- Anatomical planes, sections and directional terms

Regional Names

- Clinical terminology is based on a Greek or Latin root word
Directional Terms
- Deep vs. superficial
- Lateral:
  - side view
- Frontal:
  - front view
- Superior:
  - top view
- Anatomical direction:
  - refers to the patient’s left or right

Planes and Sections
- Plane:
  - a 3-dimensional axis
- Section:
  - a slice parallel to a plane

Planes and Sections
- Sagittal
  - Midsagittal
  - Parasagittal
- Frontal or coronal
- Transverse (cross-sectional, horizontal)
- Oblique
Planes and Sections of the Brain
(3-D anatomical relationships revealed)

- Horizontal Plane
- Frontal Plane
- Midsagittal Plane

Body Cavities

- Body cavities are spaces within the body that help protect, separate, and support internal organs.

Dorsal Body Cavity

- 2 subdivisions
  - cranial cavity
    - holds the brain
  - vertebral or spinal cavity
    - contains the spinal cord
- Meninges line dorsal body cavity

Ventral Body Cavity

- 2 subdivisions
  - thoracic cavity above diaphragm
  - abdominopelvic cavity below diaphragm
- Diaphragm = large, dome-shaped muscle
- Organs called viscera
- Organs covered with serous membrane
Thoracic Cavity

- The thoracic cavity contains two pleural cavities, and the mediastinum, which includes the pericardial cavity.
  - The pleural cavities enclose the lungs.
  - The pericardial cavity surrounds the heart.
  - The mediastinum is a partition between the lungs that contains all other thoracic organs (heart and great vessels, esophagus, trachea, thymus).

Abdominopelvic Cavity

- The abdominopelvic cavity is divided into a superior abdominal and an inferior pelvic cavity.
  - Viscera of the abdominal cavity include the: stomach, spleen, pancreas, liver, gallbladder, small intestine, and most of the large intestine.
  - Viscera of the pelvic cavity include the: urinary bladder, portions of the large intestine and internal reproductive structures.

Serous Membranes

- Thin slippery membrane lines body cavities not open to the outside
  - parietal layer lines walls of cavities
  - visceral layer covers viscera within the cavities
- Serous fluid reduces friction
Serous Membranes

- The pleural membrane surrounds the lungs
- The pericardium is the serous membrane of the pericardial cavity
- The peritoneum is the serous membrane of the abdominal cavity

Quadrants and Regions (1 of 3)

- 4 abdominopelvic quadrants around umbilicus

Quadrants and Regions (2 of 3)

- 9 abdominopelvic regions

Quadrants and Regions (3 of 3)

- Internal organs associated with abdominopelvic regions
MEDICAL IMAGING

• A specialized branch of anatomy and physiology that is essential for the diagnosis of many disorders.

Conventional Radiography (X ray)

• A single burst of xrays
• Produces 2-D image on film
• Poor resolution of soft tissues
• Major use is osteology

Computed Tomography (CT Scan)

• Moving x-ray beam
• Image produced on a video monitor of a cross-section through body
• Computer generated image reveals more soft tissue detail
• Multiple scans used to build 3D views

Ultrasound (US)

• High-frequency sound waves emitted by hand-held device
• Safe, noninvasive & painless
• Image or sonogram is displayed on video monitor
• Used for fetal ultrasound and examination of pelvic & abdominal organs, heart and blood flow through blood vessels
Magnetic Resonance Imaging (MRI)

- Body exposed to high-energy magnetic field
- Can not use on patient with metal in their body
- Reveals fine detail within soft tissues