

Chapter 1

An Introduction to Anatomy and Physiology

An Introduction to Studying the Human Body

- Classification of Living Things
 - Humans and many other animals are *vertebrates*
 - Characterized by a segmented vertebral column
 - Common characteristics suggest the same path in evolution
- Homeostasis
 - The goal of physiological regulation and the key to survival in a changing environment

1-1 Anatomy and Physiology Directly Affect Your Life

- Anatomy
 - Is the study of body structures
 - Oldest medical science: 1600 BCE
- Physiology
 - Is the study of function
 - Biochemistry
 - Biology
 - Chemistry
 - Genetics

1-2 Anatomy and Physiology

- 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

1-3 Relationships between Anatomy and Physiology

- Anatomy
 - **Gross anatomy**, or macroscopic anatomy, examines large, visible structures
 - *Surface anatomy*: exterior features
 - *Regional anatomy*: body areas
 - *Systemic anatomy*: **organ systems**
 - *Clinical anatomy*: medical specialties

- *Developmental anatomy*: from conception to death

1-3 Relationships between Anatomy and Physiology

- Anatomy
 - **Microscopic anatomy** examines cells and molecules
 - **Cytology**: study of **cells** and their structures
 - *cyt-* = cell
 - **Histology**: study of **tissues** and their structures

1-3 Relationships between Anatomy and Physiology

- Physiology
 - *Cell physiology*: processes within and between cells
 - *Organ physiology*: functions of specific organs
 - *Systemic physiology*: functions of an organ system
 - *Pathological physiology*: effects of diseases

1-4 Levels of Organization

- *The Chemical (or Molecular) Level*
 - Atoms are the smallest chemical units
 - Molecules are a group of atoms working together
- *The Cellular Level*
 - Cells are a group of atoms, molecules, and organelles working together
- *The Tissue Level*
 - A **tissue** is a group of similar cells working together
- *The Organ Level*
 - An **organ** is a group of different tissues working together

1-4 Levels of Organization

- *The Organ System Level*
 - An **organ system** is a group of organs working together
 - Humans have 11 organ systems
- *The Organism Level*
 - A human is an **organism**

1-4 Levels of Organization

- The Organ Systems
 - Integumentary
 - **Major Organs**
 - Skin
 - Hair
 - Sweat glands

- Nails
- **Functions**
 - Protects against environmental hazards
 - Helps regulate body temperature
 - Provides sensory information

1-4 Levels of Organization

- The Organ Systems
 - Skeletal
 - **Major Organs**
 - Bones
 - Cartilages
 - Associated ligaments
 - Bone marrow
 - **Functions**
 - Provides support and protection for other tissues
 - Stores calcium and other minerals
 - Forms blood cells

1-4 Levels of Organization

- The Organ Systems
 - Muscular
 - **Major Organs**
 - Skeletal muscles and associated tendons
 - **Functions**
 - Provides movement
 - Provides protection and support for other tissues
 - Generates heat that maintains body temperature

1-4 Levels of Organization

- The Organ Systems
 - Nervous
 - **Major Organs**
 - Brain
 - Spinal cord
 - Peripheral nerves
 - Sense organs
 - **Functions**
 - Directs immediate responses to stimuli
 - Coordinates or moderates activities of other organ systems
 - Provides and interprets sensory information about external conditions

1-4 Levels of Organization

- The Organ Systems
 - Endocrine
 - **Major Organs**
 - Pituitary gland
 - Thyroid gland
 - Adrenal glands
 - Pancreas
 - Gonads
 - Endocrine tissues in other systems
 - **Functions**
 - Directs long-term changes in the activities of other organ systems
 - Adjusts metabolic activity and energy use by the body
 - Controls many structural and functional changes during development

1-4 Levels of Organization

- The Organ Systems
 - Cardiovascular
 - **Major Organs**
 - Heart
 - Blood
 - Blood vessels
 - **Functions**
 - Distributes blood cells, water, and dissolved materials including nutrients, waste products, oxygen, and carbon dioxide
 - Distributes heat and assists in control of body temperature

1-4 Levels of Organization

- The Organ Systems
 - Lymphatic
 - **Major Organs**
 - Spleen
 - Thymus
 - Lymphatic vessels
 - Lymph nodes
 - Tonsils
 - **Functions**
 - Defends against infection and disease
 - Returns tissue fluids to the bloodstream

1-4 Levels of Organization

- The Organ Systems
 - Respiratory
 - **Major Organs**
 - Nasal cavities
 - Sinuses
 - Larynx
 - Trachea
 - Bronchi
 - Lungs
 - Alveoli

1-4 Levels of Organization

- The Organ Systems
 - Respiratory
 - **Functions**
 - Delivers air to alveoli (sites in lungs where gas exchange occurs)
 - Provides oxygen to bloodstream
 - Removes carbon dioxide from bloodstream
 - Produces sounds for communication

1-4 Levels of Organization

- The Organ Systems
 - Digestive
 - **Major Organs**
 - Teeth
 - Tongue
 - Pharynx
 - Esophagus
 - Stomach
 - Small intestine
 - Large intestine
 - Liver
 - Gallbladder
 - Pancreas

1-4 Levels of Organization

- The Organ Systems
 - Digestive
 - **Functions**
 - Processes and digests food
 - Absorbs and conserves water
 - Absorbs nutrients
 - Stores energy reserves

1-4 Levels of Organization

- The Organ Systems
 - Urinary
 - **Major Organs**
 - Kidneys
 - Ureters
 - Urinary bladder
 - Urethra
 - **Functions**
 - Excretes waste products from the blood
 - Controls water balance by regulating volume of urine produced
 - Stores urine prior to voluntary elimination
 - Regulates blood ion concentrations and pH

1-4 Levels of Organization

- The Organ Systems
 - Male Reproductive
 - **Major Organs**
 - Testes
 - Epididymides
 - Ductus deferentia
 - Seminal vesicles
 - Prostate gland
 - Penis
 - Scrotum

1-4 Levels of Organization

- The Organ Systems
 - Male Reproductive
 - **Functions**
 - Produces male sex cells (sperm), seminal fluids, and hormones
 - Sexual intercourse

1-4 Levels of Organization

- The Organ Systems
 - Female Reproductive
 - **Major Organs**
 - Ovaries
 - Uterine tubes
 - Uterus
 - Vagina
 - Labia
 - Clitoris

- Mammary glands

1-4 Levels of Organization

- The Organ Systems
 - Female Reproductive
 - **Functions**
 - Produces female sex cells (oocytes) and hormones
 - Supports developing embryo from conception to delivery
 - Provides milk to nourish newborn infant
 - Sexual intercourse

1-5 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, fluid balance)

1-5 Homeostasis

- Mechanisms of Regulation
 - **Autoregulation (intrinsic)**
 - Automatic response in a cell, tissue, or organ to some environmental change
 - **Extrinsic regulation**
 - Responses controlled by nervous and endocrine systems

1-5 Homeostasis

- **Receptor**
 - Receives the stimulus
- **Control Center**
 - Processes the signal and sends instructions
- **Effector**
 - Carries out instructions

1-6 Negative and Positive Feedback

- The Role of **Negative Feedback**
 - The response of the effector negates the stimulus
 - Body is brought back into homeostasis
 - Normal *range* is achieved

1-6 Negative and Positive Feedback

- The Role of **Positive Feedback**

- The response of the effector increases change of the stimulus
- Body is moved away from homeostasis
 - Normal range is lost
- Used to speed up processes

1-6 Negative and Positive Feedback

- Systems Integration
 - Systems work together to maintain homeostasis
- Homeostasis is a **state of equilibrium**
 - Opposing forces are in balance
 - **Dynamic equilibrium** — continual adaptation
- Physiological systems work to restore balance
 - Failure results in **disease** or death

1-7 Anatomical Terminology

- **Superficial Anatomy**
 - Locating structures on or near the body surface
- Anatomical Landmarks
 - **Anatomical position:** hands at sides, palms forward
 - **Supine:** lying down, face up
 - **Prone:** lying down, face down

1-7 Anatomical Terminology

- Superficial Anatomy
 - Anatomical landmarks
 - References to palpable structures
 - Anatomical regions
 - **Abdominopelvic quadrants**
 - **Abdominopelvic regions**
 - Anatomical directions
 - Reference terms based on subject

1-7 Anatomical Terminology

- Sectional Anatomy
 - Planes and sections
 - *Plane:* a three-dimensional axis
 - *Section:* a slice parallel to a plane
 - Used to visualize internal organization and structure
 - Important in radiological techniques
 - MRI
 - PET
 - CT

1-8 Body Cavities

- Essential Functions of **Body Cavities**
 1. Protect organs from accidental shocks
 2. Permit changes in size and shape of internal organs
- *Ventral Body Cavity (Coelom)*
 - Divided by the **diaphragm**
 - **Thoracic cavity**
 - **Abdominopelvic cavity**

1-8 Body Cavities

- *Serous Membranes*
 - Line body cavities and cover organs
 - Consist of *parietal layer* and *visceral layer*
 - Parietal layer — lines cavity
 - Visceral layer — covers organ

1-8 Body Cavities

- The Thoracic Cavity
 - Right and left **pleural cavities**
 - Contain right and left lungs
 - **Mediastinum**
 - Upper portion filled with blood vessels, trachea, esophagus, and thymus
 - Lower portion contains **pericardial cavity**
 - The heart is located within the pericardial cavity

1-8 Body Cavities

- The Abdominopelvic Cavity
 - *Peritoneal cavity*: chamber within abdominopelvic cavity
 - *Parietal peritoneum*: lines the internal body wall
 - *Visceral peritoneum*: covers the organs

1-8 Body Cavities

- The Abdominopelvic Cavity
 - **Abdominal cavity** — superior portion
 - Diaphragm to top of pelvic bones
 - Contains digestive organs
 - *Retroperitoneal space*
 - Area posterior to *peritoneum* and anterior to muscular body wall
 - Contains pancreas, kidneys, ureters, and parts of the digestive tract

1-8 Body Cavities

- The Abdominopelvic Cavity
 - **Pelvic cavity** — inferior portion
 - Within pelvic bones
 - Contains reproductive organs, rectum, and bladder