Chapter 4
The Human Body

Learning Objectives
● Define:
  ▶ Torso
  ▶ Anterior
  ▶ Posterior
  ▶ Medial
  ▶ Lateral
  ▶ Bilateral
  ▶ Proximal
  ▶ Plantar
  ▶ Palmar
  ▶ Distal
  ▶ Midline
  ▶ Midaxillary
  ▶ Midclavicular

Learning Objectives
● Describe the anatomy and function of the following major body systems:
  ▶ Respiratory
  ▶ Circulatory
  ▶ Musculoskeletal
  ▶ Nervous
  ▶ Endocrine
Introduction

- **Anatomy**
  - Study of body structure, function
  - Body parts

- **Physiology**
  - Study of processes
  - Activities of living organism

Anatomic Terms

- Normal anatomic position
  - Body position
  - Superior
  - Inferior
  - Midline
  - Midaxillary

Anatomic Terms

- Normal anatomic position
  - Anterior/ventral
  - Posterior/dorsal
  - Lateral
  - Bilateral
  - Medial
Anatomic Terms

- Normal anatomic position
  - Midclavicular
  - Proximal
  - Distal
  - Palmar surface
  - Plantar surface

- Normal anatomic position
  - Central
  - Peripheral
  - Arm
  - Leg
Anatomic Terms

Terms relating to position, movement
- Erect
- Prone
- Lateral recumbent
- Left lateral recumbent

Terms relating to position & movement
- Abduction
- Adduction
Anatomic Terms

- Terms relating to position & movement
  - Flexion
  - Extension
  - Hyperextension
Anatomic Terms

- Terms relating to position & movement
  - Medial rotation
  - Lateral rotation

Body Systems

- **Cell**
  - Fundamental unit of all living things

- **Tissue**
  - Specialized cells grouped together
    - Muscle
    - Nerve
    - Epithelial
    - Connective

Body Systems

- **Organ**
  - Several tissue types

- **Organ system (body system)**
  - Group of organs
Body Systems

- **Skeletal system**
  - Provides structure, support
  - Protects organs
  - Allows movement
  - Connective tissue
    - Bones
    - Cartilage
    - Ligaments
    - Tendons
Body Systems

- Skeletal system
  - Skull
    - Cranium, face bones
    - Protects brain tissue, central nervous system (CNS)
  - Facial bones
    - Front
    - Zygomas
    - Mandible

Body Systems

Body Systems

Body Systems
Body Systems

- Skeletal system
  - Spinal column
    - Vertebrae
      - Cervical
      - Thoracic
      - Lumbar
      - Sacral
      - Coccygeal
      - Spinal canal

Body Systems

- Thoracic cavity
  - Rib cage
    - Surrounds, provides ventilation structure, protects organs
  - Sternum
    - Upper manubrium, middle body, lower xiphoid process
  - Clavicles
    - Lie over anterior upper ribs, extend from sternum to shoulders
Body Systems

- Skeletal system
  - Thoracic cavity
    - Scapulae
      - Lie over upper posterior ribs, attach to clavicles, humerus
      - Form shoulder
    - Acromion
      - Tip of shoulder
    - Diaphragm
      - Dome-shaped muscle, forms base of cavity
      - Inspiration - contracts
      - Expiration - rises

Body Systems

- Skeletal system
  - Thoracic cavity
    - Heart
    - Lungs
    - Great vessels
    - Esophagus

Body Systems

- Skeletal system
  - Thoracic cavity
    - Subdivided into:
      - Mediastinum
      - Pleural space
Body Systems

- Skeletal system
  - Abdominopelvic cavity
    - From diaphragm to pelvic cavity
    - Protected by:
      - Spine (posteriorly)
      - Muscles (anteriorly and laterally)
      - Lower ribs (superiorly)

Body Systems

- Skeletal system
  - Abdominopelvic cavity
    - Abdominal cavity
      - Stomach
      - Small & large intestines
      - Liver
      - Gallbladder
      - Pancreas
      - Kidneys
      - Ureters
      - Spleen

Body Systems

- Skeletal system
  - Abdominopelvic cavity
    - Pelvic cavity
      - Pelvic girdle formed by sacral section of spinal column, ilium, ischium, pubis
      - Pelvic girdle protects lower intestine, rectum, urinary bladder, female reproductive organs
      - Iliac crest
      - Symphysis pubis
Body Systems

- Skeletal system
  - Abdominopelvic cavity
    - Abdominal quadrants
      - Division to describe location of pain, tenderness, physical findings
      - Right upper, left upper, right lower, left lower
Body Systems

- Skeletal system
  - Upper extremities
    - Shoulder
    - Arm
    - Forearm
    - Elbow
    - Wrist
    - Hand

- Lower extremities
  - Thigh
  - Hips
  - Lower leg
  - Knee
  - Ankle
  - Foot
Body Systems

- Skeletal system
  - Joints
    - Ball and socket
    - Hinge
    - Pivot
    - Gliding
    - Saddle
    - Condyloid
Body Systems

- Muscular system
  - Tissue can contract
  - Gives the body shape
  - Protects internal organs
  - Voluntary
  - Involuntary
  - Cardiac

Body Systems

- Respiratory system
  - Upper airway
    - Mouth
    - Nose
    - Pharynx
    - Larynx
    - Epiglottis
    - Trachea
Body Systems

- Respiratory system
  - Lower airway
    - Bronchi
    - Bronchioles
    - Alveoli
    - Lungs
Body Systems

- Respiratory system
  - Muscles of respiration
    - Chest movement allows air exchange
    - Diaphragm
    - Inhalation
    - Exhalation
Body Systems

- Respiratory system
  - Accessory muscles of respiration
    - Strenuous exercise
    - Inspiration
    - Expiration
    - Respiratory distress

Body Systems

- Physiology of respiration
  - Tidal volume
  - Respiratory rate
Body Systems

- Respiratory system
  - Nervous system regulation
    - "Thermostat" that monitors respiratory function
    - Brain, peripheral nerves
  - Automatic control
  - Voluntary control
  - As breathing increases, more O₂ enters & CO₂ expelled
  - As breathing decreases, CO₂ levels increase
  - Metabolism

- Alveolocapillary cellular exchange
  - Diffusion
    - Molecules move from area of higher concentration to area of lower concentration
    - Movement of O₂ & CO₂
Body Systems

- Respiratory system
  - Adequate vs. inadequate breathing
    - Assess rate, rhythm, quality, depth
    - Rate varies with age
    - Rhythm should be regular
    - Quality (breath sounds, chest rise, effort)
    - Additional signs:
      - Skin color
      - Retractions, nasal flaring
      - Increased muscular effort
      - Irregular, inadequate, agonal effort

- Circulatory system
  - Body transport system
  - Examination priority
  - Proper functioning depends on:
    - Heart
    - Blood vessels
    - Blood
Body Systems

- Circulatory system
  - Heart
    - Muscular pump
    - Positioned in mediastinum
    - Pericardium
    - Layers of heart
Body Systems

- **Circulatory system**
  - Heart chambers
    - Right/left atria receive blood from lungs/body
    - Right/left ventricles pump oxygenated blood to body
    - Septum
  - **Pulmonary circulation - Right ventricle**
    - Pumps blood through lungs, receives O₂, releases CO₂ for exhalation and then delivers O₂ to left atrium
  - **Systemic circulation - Left ventricle**
    - Delivers oxygen-rich blood to body, picks up CO₂, metabolism waste products and delivers to right atrium
Body Systems

- Circulatory system
  - Valves, one-way flow, closure
    - Systole - ventricles contract
    - Diastole - ventricles relax
Body Systems

- Circulatory system
  - Blood vessels
    - Arteries
    - Arterioles
    - Capillaries
    - Veins
    - Major veins

- Arteries
  - Direct blood flow away from heart
  - 3 layers
    - Smooth inner lining (endothelium)
    - Elastic middle layer
    - Thick outer layer
Body Systems

- Circulatory system
  - Blood vessels
    - Major arteries
      - Pulmonary artery
      - Aorta
      - Coronary arteries
      - Arteries to head, upper extremity
      - Arteries to thorax, abdomen, lower extremities

- Arterioles
  - Terminal branches of arteries
  - Muscle tone regulates amount of blood available
  - Vasoconstriction decreases inner diameter
  - Vasodilation increases inner diameter
Body Systems

- Circulatory system
  - Blood vessels
    - Capillaries
      - Walls one-cell thick
      - Diffuse oxygen, waste

Body Systems

- Veins
- Venous reservoir

Body Systems

- Circulatory system
  - Blood vessels
  - Veins
  - Venous reservoir
Body Systems

- Circulatory system
  - Blood vessels
    - Major veins
      - Pulmonary
      - Superior vena cava
      - Inferior vena cava

Body Systems

- Circulatory system
  - Blood
    - Average adult: 5 to 6 L
    - Plasma
    - Red blood cells
    - White blood cells
    - Platelets
Body Systems

- Circulatory system
  - Blood
    - Red blood cells (RBC)
    - Hemoglobin (large protein) binds with O₂
  - Hemoglobin
    - 98% O₂ bound to hemoglobin; 2% in plasma

Body Systems

- Circulatory system
  - Blood
    - White blood cells
      - Combat infecting organisms, foreign materials
    - Platelets
      - Circulating cell fragments responsible for clotting
      - Combine with proteins to form thrombus
    - Clotting process (thrombosis) takes 5 to 6 minutes

Body Systems

- Circulatory system
  - Blood pressure
    - Force exerted by blood volume on vessel walls
    - Systole
    - Diastole
Body Systems

- Circulatory system
  - Perfusion
    - Flow matched to energy requirements organ by organ, $O_2$ needs

- Shock
  - Inadequate perfusion and tissue oxygenation
  - Signs/symptoms:
    - Weak, poor muscular activity
    - Cyanosis
    - Rapid, weak pulse
    - Clammy, cool skin
    - Rapid, shallow breathing
    - Restless, anxious
    - Altered mental state
    - Decreasing blood pressure

Body Systems

- Nervous system
  - Brain viability
    - Brain dysfunction = cardiopulmonary failure, death
  - Controlling body organ
Body Systems

- Nervous system
  - Central nervous system
    - Receives information about external environment and internal body function
    - Organizes, analyzes, formulates response to direct activities of organs, muscles, tissues
    - Composed of brain, brainstem, spinal cord

- Brain
  - Processes sensory input
  - Receptors in ear, special nerve pathways relay input for balance, equilibrium
  - Receives input about O₂ and CO₂ content, circulatory, nutritional status
Body Systems

- Nervous system
  - Central nervous system
    - Cerebrum
      - Largest, most superior portion
      - Divided into right/left hemispheres
    - Brainstem
      - Lower part of brain
      - Monitors and directs respiratory, circulatory functions
    - Cerebellum
      - Posterior to brainstem
      - Coordinates movement, balance

Body Systems

- Nervous system
  - Central nervous system
    - Spinal cord
      - Emerges from brainstem
      - Has its own processing centers
      - Reflex arcs

Body Systems

- Nervous system
  - Central nervous system
    - Cerebrum
      - Largest, most superior portion
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      - Lower part of brain
      - Monitors and directs respiratory, circulatory functions
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      - Posterior to brainstem
      - Coordinates movement, balance
Body Systems

- Nervous system
  - Central nervous system
    - Voluntary
      - Connects CNS with sensory nerves that receive information from the skin and senses (sight, hearing, smell, taste, pain)
    - Motor nerves carry information to body, direct conscious actions
  - Involuntary/autonomic
    - Parasympathetic
    - Sympathetic
      - "Fight or flight" response

- Body Systems
  - Nervous system
    - Central nervous system
      - Involuntary/autonomic
        - Controls vital body functions

- Body Systems
  - Nervous system
    - Central nervous system
    - Parasympathetic
    - Sympathetic
      - "Fight or flight" response

- Body Systems
  - Nervous system
    - Central nervous system
    - Parasympathetic
    - Sympathetic
      - "Fight or flight" response
Body Systems

- Nervous System
  - Peripheral nervous system
    - Nerves outside central nervous system
    - Extends from brainstem, spinal cord
    - Carries messages to spinal cord, brain
    - Carries messages back to muscles, various organs via motor nerves

Body Systems

- Integumentary system
  - Epidermis
    - Outermost layer
    - Nonvascular
    - Impermeable
    - Prevents fluid loss from cells beneath
    - Superficial layer - dead tissue
    - Keratin
    - Melanin

Body Systems

- Integumentary system
  - Dermis
    - Dense connective tissue that contains nerves, blood vessels, sweat glands, hair follicles
    - Skin strength
    - Sweat glands
    - Excessive loss of structure requires grafting
Body Systems

- Integumentary system
  - Mucous membranes
    - Skin within body orifice changes character
  - Subcutaneous tissues
    - Fat layer and connective tissue beneath skin

Body Systems

- Endocrine system/glands
  - Endocrine system
    - Regulatory system
    - Secretes hormones
    - Major hormones
      - Epinephrine
      - Insulin
      - Growth hormone
      - Thyroxine
      - Testosterone
      - Estrogen
Digestive system
- All nutritional intake, except oxygen
- Food processed mechanically and chemically
- Water, nutrients absorbed
- Saliva begins chemical process
- Food moves from oropharynx to esophagus
- Chyme
- Liver excretes bile
- Gallbladder stores bile

Digestive system
- Small intestine
  - Duodenum, jejunum, ileum
  - Liver, filters blood and assists with storage, breakdown, synthesis of protein, fat, carbohydrates
- Large intestine
  - Cecum, ascending colon, transverse colon, descending colon, sigmoid colon
Body Systems

- Urinary system
  - Kidneys, ureters, urinary bladder, urethra
  - Filters blood and excretes excess water, waste
Body Systems

● Lymphatic system
  ➢ Lymph nodes
  ➢ Tonsils
  ➢ Spleen
  ➢ Thymus gland
  ➢ Lymph vessels transport fluid from tissues
  ➢ Blood vessels transport fluid out

Body Systems

● Reproductive system
  ➢ Female
    • Ovaries
    • Uterus
    • Vagina
  ➢ Male
    • Testes
    • Vas deferens
    • Prostate
    • Penis
Body Systems

Understanding Relevance of Anatomy & Physiology

- Vital organ systems
  - Nervous
  - Respiratory
  - Circulatory
    - Intimately interrelated
    - Failure leads to death

Understanding Relevance of Anatomy & Physiology

- Oxygen deprivation
  - Breathing stops
  - Brain function stops
    - Clinical death
    - Biological death
  - Death slowed
Sudden & Unexpected Death

- Most common causes
  - Cardiovascular disease
  - Cerebrovascular disease
  - Accidental injuries

- Understand conditions leading to death
  - Priorities
  - Rapid delivery

Summary

- Define:
  - Torso
    - Anterior
    - Posterior
    - Medial
    - Lateral
    - Bilateral
  - Proximal
  - Plantar
  - Palmar
  - Distal
  - Midline
  - Midaxillary
  - Midclavicular

- Define:
  - Supine
  - Prone
  - Lateral recumbent

- Define:
  - Abduction
  - Adduction
  - Flexion
  - Extension
  - Medial rotation
  - Lateral rotation
Summary

- Skeletal system gives body structure, support, protects vital organs, allows body movement
- Bones, cartilage, ligaments are connective tissue

Summary

- 206 bones in body
- Major bones:
  - Skull
  - Spinal column
  - Thorax
  - Pelvis
  - Upper extremities
  - Lower extremities

Summary

- Joints:
  - Ball-and-socket
  - Hinge
- Muscles:
  - Voluntary/skeletal
  - Involuntary/smooth
  - Cardiac
Summary

- Respiration brings oxygen in, waste product CO₂ out
- Respiratory system comprised of:
  - Nose
  - Mouth
  - Nasopharynx
  - Oropharynx
  - Larynx
  - Epiglottis
  - Trachea
  - Bronchi
  - Bronchioles
  - Alveoli
  - Lungs

Summary

- Diaphragm, chest, & intercostal muscles expand thoracic cavity for inhalation
- Relaxation of diaphragm, intercostals for exhalation
- The exchange of O₂ and CO₂ occurring at level of alveoli and capillaries is diffusion

Summary

- Accessory muscles increase respiratory volumes to accommodate strenuous disease, trauma
- Adequate breathing characteristics:
  - Breath sounds equal
  - Regular rhythm
  - Chest expansion
  - Normal respiratory rates
Summary

- Inadequate breathing characteristics:
  - Breath sounds diminished/absent
  - Irregular rhythm
  - Chest expansion shallow/nonexistent
  - Respiratory rates outside normal range
  - Skin cool/cyanotic
  - Retractions, nasal flaring
  - Agonal respirations

Summary

- Circulatory system transports:
  - Oxygen
  - Nutrients
  - Waste products
  - Specialized cells that repair injured tissues, combat foreign bacteria, and control bleeding

Summary

- Circulatory system
  - Heart
  - Blood
    - Plasma
    - Red blood cells
    - White blood cells
    - Platelets
  - Blood vessels
Summary

- Major arteries include:
  - Aorta
  - Pulmonary
  - Carotid
  - Coronary
  - Femoral
  - Radial
  - Brachial
  - Posterior tibia
  - Dorsalis pedis

Summary

- Major veins: Pulmonary and vena cavae

- Voluntary functions
  - Muscular movement

- Involuntary functions
  - Heart rate
  - Controlled by nervous system

Summary

- Nervous system: Central, peripheral nervous systems controlling brain/spinal cord & sensory/motor nerves

- Reflex arch in spinal cord mediates reflexes, automatic muscular movements

- Skin layers: Dermis, epidermis, subcutaneous tissue
Questions?