Chapter 7
Body Systems: Anatomy and Physiology

Learning Objectives
- Define anatomy, physiology, pathophysiology
- Define homeostasis
- Describe anatomic position
- Describe sagittal, midsagittal, transverse, frontal planes

Learning Objectives (Cont'd)
- List structures that comprise axial, appendicular regions of body
- Name body cavities, membranes, some organs within each cavity
- Describe function of cellular structures
- Describe cytoplasm
Learning Objectives (Cont'd)

- Describe function of cell organelles
- State function of nucleus
- Describe how cells reproduce
- Discuss input, output of aerobic, anaerobic cellular metabolism

Learning Objectives (Cont’d)

- Discuss mechanisms that move substances across cell membranes, including diffusion, facilitated diffusion, osmosis, active transport
- Describe function of epithelial tissue, how classified on basis of shape, arrangement
- Describe functions of connective tissue, relate them to function of body, organ system

Learning Objectives (Cont’d)

- Explain basic differences in skeletal, smooth, cardiac muscle
- Describe nervous tissue
- Define 11 major organ systems of human body
  - Label diagram listing major anatomic features, function, interrelations to other body functions
Learning Objectives (Cont’d)

- State functions of integumentary system
- Name 2 layers of skin
- Describe functions of hair, nails
- Describe functions of sebaceous, sweat glands

Learning Objectives (Cont’d)

- Describe function of skeleton
- List parts of axial, appendicular skeleton
- Describe bones of upper, lower extremities
- Explain how joints are classified
  - Give example of each, describe possible movements

Learning Objectives (Cont’d)

- Describe purpose of muscular system
- List, describe 4 basic properties of muscles
- State 3 primary functions of muscles
- Describe process of muscle movement
Learning Objectives (Cont'd)

- Name 3 main functions of nervous system
- Name divisions of nervous system, state their general functions
- List, describe 3 layers of meninges
- State locations, functions of cerebrospinal fluid

Learning Objectives (Cont’d)

- List, describe 3 divisions of brainstem
- Describe diencephalon of brain
- Describe cerebrum, cerebellum, spinal cord
- Describe peripheral nervous system

Learning Objectives (Cont’d)

- List groups of cranial nerves, describe
- List, describe 2 branches of autonomic nervous system
- Identify primary endocrine glands, list major hormones secreted
- List 2 parts of circulatory system
Learning Objectives (Cont’d)

- List parts of cardiovascular system
- Describe parts of blood
- Describe location of heart
- State Frank-Starling law, explain why increased preload will increase myocardial contractility, cardiac output

Learning Objectives (Cont’d)

- Discuss relations among blood pressure, peripheral vascular resistance, cardiac output, stroke volume, heart rate
- Name great vessels, functions
- Name, describe chambers, valves of heart

Learning Objectives (Cont’d)

- Trace pathway of blood flow through heart, pulmonary circulation
- Describe coronary circulation
- Describe coronary conduction system, cardiac action potential
- Describe systemic circulation
Learning Objectives (Cont’d)

- Describe structure, function of arteries, veins, capillaries
- Describe functions of lymphatic system
- List parts of respiratory system
- Describe pathway of respiratory system, including nasal cavities, pharynx, larynx

Learning Objectives (Cont’d)

- Describe structure, function of larynx
- Describe lower airway structures
- State roles of visceral, parietal pleura in respiration
- Describe general function of digestive system, name major divisions

Learning Objectives (Cont’d)

- Describe structure, function of parts of gastrointestinal tract
- Describe essential function of urinary system
- Describe location, general function of each organ in urinary system
- Name parts of nephron
Learning Objectives (Cont'd)

- List essential, accessory organs of male, female reproductive systems, give general function of each
- Describe sense of smell
- Describe sense of taste
- Name parts of eye, explain function in sight

Learning Objectives (Cont'd)

- Name parts of ear, explain functions in hearing
- Describe isotonic, hypotonic, hypertonic
- Describe mechanisms that affect distribution of body water between intracellular, extracellular spaces

Learning Objectives (Cont'd)

- Define ion, electrolyte, anion, cation
- Define principal intracellular, extracellular anions, cations
- Identify physiologic mechanism used to maintain acid-base balance
Learning Objectives (Cont’d)

- Given values for pH, PaCO₂ determine acid-base imbalance present

Review of Anatomy & Physiology

- Anatomy
  - Study of body’s structure, organization
  - Understanding anatomy
    - Organization of physical exam
    - Description of patient’s body
    - Locate body areas, perform procedures

Review of Anatomy & Physiology (Cont’d)

- Physiology
  - Body functions
  - Understanding physiology
    - Identification of normal, abnormal physiology
    - Understanding of treatments
  - Pathophysiology
    - Functional changes in disease processes
Review of Anatomy & Physiology (Cont'd)

- Homeostasis
  - Stability
  - Body's internal environment
  - Balance

Review of Anatomy & Physiology (Cont'd)

- Terminology
  - Anatomic position
    - Supine
      - Lying on back, face up
    - Prone
      - Lying on stomach, face down
    - Lateral recumbent
      - Lying on left or right side

Review of Anatomy & Physiology (Cont'd)

- Terminology
  - Directional terms
    - Anterior
      - Front/ventral surface
    - Caudal
      - Position toward distal end of body, usually inferior
    - Cephalic
      - Position toward head, usually superior
Review of Anatomy & Physiology (Cont’d)

- Terminology
  - Directional terms
    - Distal
      - Position farther from attachment of limb to trunk
    - Dorsal
      - Back of body, posterior
    - Inferior
      - Toward feet, below point of reference in anatomic region
    - Lateral
      - Position away from midline of body
    - Left
      - Position toward left side of body
    - Medial
      - Position toward midline of body
    - Posterior
      - Back/dorsal surface
    - Proximal
      - Position nearer to attachment of limb to trunk
    - Superior
      - Situated above/higher than point of reference in anatomic position, top
    - Right
      - Position toward right side of body
    - Ventrual
      - Referring to front of body, anterior
Anatomic planes
- Imaginary straight lines of body
- Sagittal
- Transverse/horizontal
- Frontal

Body regions
- Axial skeleton
  - Head, neck, thorax, abdomen
- Appendicular skeleton
  - Extremities including arms, pelvic bones, legs
Body cavities
- Contain organs
- Serous membrane
  - Parietal
  - Visceral

Ventral cavity
- Thoracic
  - Pleural cavities
  - Pericardial cavity
- Abdominopelvic
  - Abdominal cavity
  - Peritoneal cavity

Dorsal
- Structure of CNS
- Cranial cavity
- Spinal cavity
Characteristics of Life

- Characteristics shared by all living things
  - Movement
  - Respiration
  - Digestion
  - Absorption
  - Excretion
  - Responsiveness
  - Circulation
  - Reproduction

Organizational Structure

- Whole organism working together
- Units of organization
  - Cell
  - Tissue
  - Organ
  - Organism

Organizational Structure (Cont'd)

- Chemical organization
  - Atoms, molecules & electrolytes
    - Inorganic substances
    - Organic substances
Cell Structure

- Organelles
  - Cell structures suspended within cytoplasm
  - Most cells contain nucleus

Cell Structure (Cont’d)

- Classes of cells
  - Eukaryotes
  - Prokaryote

Cell Structure (Cont’d)

- General cellular functions
  - Differentiation
  - General functions
    - Movement
    - Conductivity
    - Metabolic absorption
    - Secretion
    - Excretion
    - Respiration
    - Reproduction
Cell Structure (Cont’d)

Basic Cell Structure

- Cytoplasmic membrane
  - Bilayer
  - Intracellular
  - Extracellular
Cell Structure (Cont’d)

- Cytoplasmic membrane
  - Proteins
    - Channel proteins
    - Gated ion channels
    - Enzyme receptors

Cell Structure (Cont’d)

- Cytoplasmic membranes
  - Proteins
    - Protein receptors
    - Identifier proteins identify cell
    - Carrier proteins
    - Membrane proteins shape cell

Cell Structure (Cont’d)

- Cytoplasm
  - Fluid-like material where organelles of cell suspended
    - Lies between cytoplasmic membrane & nucleus
  - Nucleoplasm
    - Fluid contained within nucleus
    - Organelles work as factories
Cell Structure (Cont’d)

- **Organelles**
  - **Ribosomes**
    - New protein synthesized
    - Complex strands of macromolecules of protein, ribonucleic acid
    - Framework for genetic blueprint
    - Free-floating within cytoplasm
    - Attach to endoplasmic reticulum

Cell Structure (Cont’d)

- **Organelles**
  - **Endoplasmic reticulum (ER)**
    - Chain of canals, sacs wind through cytoplasm
    - Connect nuclear membrane to cytoplasmic membrane
    - Circulatory system within cell
    - Detoxification process
    - Smooth or rough
    - Rough ER transport protein to the golgi apparatus

Cell Structure (Cont’d)

- **Organelles**
  - **Golgi apparatus**
    - Series of flattened sacs attached to ER
    - Concentrate & package material
    - Carries material to cytoplasmic membrane
  - **Vesicles**
    - Shipping containers of cell
Cell Structure (Cont’d)

- Organelles
  - Lysosomes
    - Membrane-walled organelles
    - Digest non-functional organelles
    - Peroxisomes

Cell Structure (Cont’d)

- Organelles
  - Mitochondria
    - Power plants of cell
    - Site of aerobic respiration
    - Outer membrane
    - Inner membrane

Cell Structure (Cont’d)

- Organelles
  - Centrioles
    - Paired, rodlike structure
    - Exist in centrosome
    - Important role in cell division
  - Cilia
    - Hairlike projections on epithelial cells
    - Moves fluid over surface of cell
Cell Structure (Cont’d)

- Organelles
  - Flagella
    - Singular, projection from cell
    - Used for propulsion
  - Microvilli
    - Projections from cytoplasmic membrane
    - Increase surface area for absorption

Cell Structure (Cont’d)

- Nucleus
  - Contains nucleoplasm
  - Carries genetic material
  - Nucleolus
    - RNA
  - RNA, DNA considered blueprint of cell

Cell Structure (Cont’d)

- Cell reproduction
  - Most cells reproduce by mitosis
    - One cell divides
    - Process continuous
    - Many cells reproduce throughout life
    - Some divide until birth
Cell Structure (Cont’d)

- Cellular communication
  - Cellular signaling
    - Communication mechanism
    - Alterations in signals cause dysfunction
    - Endocrine signaling
    - Paracrine signaling
    - Autocrine signaling
    - Juxtacrine signaling
    - Synaptic signaling

Cell Structure (Cont’d)

- Cellular metabolism
  - Sum of all physical and chemical changes that occur within the body
  - Metabolic processes
    - Anabolism
    - Catabolism
    - Cellular respiration

Cell Structure (Cont’d)

- Cellular respiration
  - Almost all metabolic functions require energy
  - Major source of energy for cells is 7-carbon sugar, glucose
  - Oxidation
  - ATP
Cell Structure (Cont’d)

- Cellular respiration
  - Glycolysis
    - Anaerobic process
    - Glucose molecule moves into cell
    - Attachment of 2 phosphate molecules to cell
    - Series of complex steps breakdown glucose
    - Final result

Cell Structure (Cont’d)

- Cellular respiration
  - Krebs cycle
    - 2nd step, citric acid/tricarboxylic acid cycle
    - Oxygen presence needed, aerobic respiration
    - Pyruvic acid formed during glycolysis undergoes steps producing several products

Cell Structure (Cont’d)

- Cellular respiration
  - Electron transport system
    - Final step
    - Occurs on the inner cristae of mitochondria
    - ATP production truly occurs
    - Products produced by earlier steps move into inner cristae
    - Transfer electrons
Cell Structure (Cont’d)

- Cellular respiration
  - Total results of cellular respiration
    - 38 molecules produced
    - Not 100% efficient

Cell Structure (Cont’d)

- Aerobic vs. anaerobic respiration
  - Aerobic
    - Oxygen present for oxidation of glucose by cells
  - Anaerobic
    - Lack of oxygen
    - Lactic acidosis
Cell Structure (Cont’d)

- Transport of substances across cell membrane
  - Lipid & water soluble liquids
  - Exchange between intracellular and interstitial fluid
  - Dependent on integrity of cytoplasmic membrane

Cell Structure (Cont’d)

- Transport of substances across cell membrane
  - Diffusion
    - Particles move from higher concentration to lower concentration
    - Requires no energy

Cell Structure (Cont’d)

- Transport of substances across cell membrane
  - Facilitated diffusion
    - Passive transport mechanism
    - Particles from higher to lower concentration
    - Protein carrier transport
    - Substance binds with carrier protein
Cell Structure (Cont’d)

- Transport of substances across cell membrane
  - Osmosis
  - Passive transport mechanism
  - Movement of fluid
  - Tonicity
  - Osmotic gradient

Cell Structure (Cont’d)

- Transport of substances across cell membrane
  - Active transport
    - Particles transported against concentration gradient
    - Particle binds with carrier protein
    - Particle transported through membrane, then released

Tissues

- Group of cells similar in structure, function
- Results from differentiation
  - Early cell development process
  - Cell becomes specialized for specific purpose
  - Stem cells
Tissues (Cont’d)

- Epithelial tissue
  - Covers most surfaces of body, interior of hollow organs
  - Functions
    - Protection
    - Absorption
    - Secretion
    - Excretion

- Squamous, cuboidal, columnar shape
  - Flat, scalelike
  - Cubed
  - Taller than wide
- Arrangement
  - Simple/single layer
  - Stratified/multiple layers
  - Transitional/different layers of variously shaped cells

Tissues (Cont’d)

- Connective tissue
  - Most abundant
  - Cells separated from each by nonliving material
    - Matrix
Tissues (Cont’d)

- Connective tissue
  - Subgroups
    - Areolar
    - Adipose
    - Fibrous
    - Cartilage

Tissues (Cont’d)

- Connective tissue
  - Subgroups
    - Bone
    - Blood
    - Hemopoietic

Tissues (Cont’d)

Connective Tissue: Bones
Muscle tissue
- Contractile, basis of body's movement
- Skeletal muscle
- Smooth muscle
- Cardiac muscle
- Properties

Nervous tissue
- Conduct electrical impulses
- Neurons
  - Conducting cells
Tissues (Cont’d)

- Nervous tissue
  - Neuroglia
    - Supporting cells
    - Do not transmit electrical impulses
  - Functions
    - Nourishment
    - Protection
    - Insulation

Organ Systems

- Organs composed of at least 2 types of tissues
- Systems composed of at least 2 organs

Organ Systems (Cont’d)

- Largest, heaviest system
- Functions
  - Protection
  - Sensation
  - Excretion
  - Fluid regulation
  - Temperature regulation
Integumentary System

- Skin
  - Largest organ
  - Two layers
    - Epidermis
    - Dermis
Integumentary System (Cont’d)

- Hair
  - Small tubular structure
  - Arrector pili
- Nails
  - Cells in epidermis

Integumentary System (Cont’d)

- Glands
  - Two types
    - Sweat glands
      - Mecocrine glands
    - Apocrine glands
    - Sebaceous glands
      - Found in dermis
      - Sebum

Skeletal System

- Functions
  - Support
  - Leverage
  - Protection
  - Storage
  - Maintenance of calcium levels
  - Blood cell production
Skeletal System (Cont'd)

- Structure
  - Long bones
  - Short bones
  - Flat bones
  - Irregular bones
Skeletal System (Cont'd)

Structure of Bone

Skeletal System (Cont'd)

Axial skeleton
  - Skull
  - Hyoid bone
  - Vertebral column
  - Thoracic cage

Skeletal System (Cont'd)

Axial Skeleton: Skull
Skeletal System (Cont'd)

Axial Skeleton: Spine

Skeletal System (Cont'd)

Axial Skeleton: Thoracic Cage

Skeletal System (Cont'd)

- Appendicular skeleton
  - Upper extremities
  - Lower extremities
  - Pectoral girdle
  - Pelvic girdle
Skeletal System (Cont'd)

- Articulations
  - Fibrous joints
    - Two bones united by fibrous tissue
  - Cartilaginous joints
  - Synovial joints

Skeletal System (Cont'd)

Cartilaginous Joint

Skeletal System (Cont'd)

Synovial Joint
Muscular System

- Muscle stimulation
  - Motor unit
    - Muscle fiber group
    - Innervated by 1 motor neuron
  - Resting membrane potential
    - Ions

Muscular System (Cont’d)

- Muscle stimulation
  - Nervous impulse reaches synaptic gap
  - Neurotransmitter released
  - Acetylcholine opens Na+ channels
    - Floods cell with Na+, creates positive charge inside cell
Muscular System (Cont’d)

- Muscle stimulation
  - Repolarization
    - Cell returning to polarized state
    - Opening K+ channels
    - Makes inside of cell more negative than at end of depolarization
    - Initially not completely restored resting membrane potential

Muscular System (Cont’d)

- Muscular movement
  - Proteins
    - Thick filaments of myosin
    - Thin, light filaments of actin
    - Depolarized muscle release Ca2+

Muscular System (Cont’d)

- Muscular movement
  - Contraction
    - Isometric
      - Muscle length remains unchanged
      - Tension along muscle increases, tone, firmness
    - Isotonic
      - Muscle length changes
      - Tension along muscle constant
      - Skeletal movement
Muscular System (Cont'd)

- Maintenance of posture
  - Muscle tone
    - Constant tension in muscles
    - Helps maintain balance, posture

- Heat production
  - Need energy to contract
    - ATP breakdown
  - Body temperature drops below set point
    - Nervous system stimulates muscle shiver
Nervous System

- **Main functions**
  - Monitoring environments
  - Integrating sensory information
  - Coordinating voluntary, involuntary responses

Nervous System (Cont’d)

- **Central Nervous System**

  - **Meninges**
    - Dura mater
    - Arachnois mater
    - Pia mater

Nervous System (Cont’d)
Nervous System (Cont’d)

Meninges

Nervous System (Cont’d)

• Central nervous system
  ➢ Brainstem
    • Connects brain to spinal cord
    • Responsible for vegetative functions
  ➢ Divisions
    ➢ Medulla
    ➢ Pons
    ➢ Midbrain

Nervous System (Cont’d)

• Central nervous system
  ➢ Diencephalon
    ➢ Thalamus
    ➢ Hypothalamus
    ➢ Functions
Nervous System (Cont’d)

Central nervous system
- Cerebrum
  - Largest part of brain
  - Right, left hemispheres
  - Four lobes
    - Frontal
    - Parietal
    - Temporal
    - Occipital

Lobes of Cerebrum
Nervous System (Cont’d)

- Central nervous system
  - Cerebral cortex
    - Gray matter layer on cerebrum surface
    - Follows cerebrum contours
    - Consciousness
    - Distribution of nervous impulses to cerebrum
      - Motor area
      - Sensory area
      - Association area

Nervous System (Cont’d)

- Central nervous system
  - Limbic system
    - Portions of cerebrum, diencephalon
    - Generates emotional response

Nervous System (Cont’d)

- Central nervous system
  - Cerebellum
    - Inferior to occipital lobes
    - Fine, gross motor coordination
Nervous System (Cont’d)

- Central nervous system
  - Spinal cord
    - Connects brain to periphery of body
      - Conus medullaris
      - Cauda equina
      - Main reflex centers of body

Nervous System (Cont’d)

- Central nervous system
  - Spinal cord
    - Impulse from brain reaches spinal cord, transmitted to spinal nerves, to skeletal muscles
    - Spinal cord neurons, upper motor neurons
    - Spinal nerve neurons, lower motor neurons

Nervous System (Cont’d)

- Peripheral nervous system
  - All communication between body, CNS
  - All neural tissue outside of CNS
  - Cranial, spinal nerves
  - Two divisions
    - Afferent
    - Efferent
      - Somatic
      - Autonomic
Nervous System (Cont'd)

- Peripheral nervous system
  - Spinal nerves
    - 31 pairs
    - Spinal plexus

Nervous System (Cont'd)

- Peripheral nervous system
  - Cranial nerves
    - 12 pair
    - Divided into groups
      - Sensory
      - Somatomotor
      - Proprioception (balance)
      - Parasympathetic nerves

Nervous System (Cont'd)

- Peripheral nervous system
  - Parasympathetic nervous system
    - Controls nonstressful situations
  - Sympathetic nervous system
    - Responds to stressful situations
    - "Fight or flight" response
Nervous System (Cont’d)

- Peripheral nervous system
  - Receptors
    - Alpha1
    - Alpha2
    - Beta1
    - Beta2
    - Beta3

Nervous System (Cont’d)

- Transmission of nervous impulses
  - Neurotransmitters
    - Somatic nervous system
      - Acetylcholine
    - Autonomic nervous system
      - Acetylcholine & norepinephrine
      - Dopamine, serotonin, gammaaminobutyric acid
    - Central nervous system
    - Bind with receptor sites on postsynaptic membrane

Endocrine System

- Hormones
  - Manufactured in endocrine glands
  - Released into circulatory system
  - Stimulate or alter cell action
  - Two types
    - Steroid
    - Protein
Endocrine System (Cont'd)

Endocrine Glands

Hypothalamus
- Neuroendocrine system
- Controls anterior pituitary gland
- Hypothalamic releasing hormones

Endocrine System (Cont'd)

Endocrine glands
- Pituitary
  - Base of brain, below optic chiasm
  - Two lobes, anterior, posterior
  - Produces hormones
- Thyroid
  - At thyroid cartilage
  - Two lobes, right, left
  - Controls metabolism
**Endocrine System (Cont’d)**

- **Endocrine glands**
  - Parathyroid
    - Posterior aspects of thyroid gland lobes
    - Increases calcium levels in blood
    - Stimulates bones to release calcium
    - Inhibits excretion by kidneys

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- **Endocrine glands**
  - Adrenal
    - Top of each kidney
    - Two layers, outer cortex, inner medulla
    - Produces corticosteroids

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- **Endocrine glands**
  - Pancreas
    - Midline to retroperitoneal space
    - Islets of langerhans
    - Maintains glucose levels in blood
  - Thymus
    - Mediastinum
    - Creation of T-cells
Circulatory System

- Cardiovascular system
  - Blood components
    - Transports nutrients, waste
  - Components
    - Plasma
    - Formed elements

Circulatory System (Cont'd)

- Cardiovascular system
  - Heart
    - Pumps blood through body
    - Four chambers
      - 2 atria
      - 2 ventricles
    - Enclosed in 2 layer serous membrane
    - Three layers compose walls

Circulatory System (Cont'd)

Heart's Location within Thoracic Cavity
Circulatory System (Cont’d)

- Cardiovascular system
  - Heart
    - Cardiac muscle
    - Contraction
    - Atrial & ventricular syncytiums
    - Frank-Starling mechanism
      - Greater stretch of cardiac muscle, greater contraction

Circulatory System (Cont’d)

- Cardiovascular system
  - Heart
    - Cardiac output
      - Blood amount heart ejects each minute
      - \( CO = SV \times HR \)

Circulatory System (Cont’d)

- Cardiovascular system
  - Heart
    - Factors affecting output
      - ↑ in SV without change in HR ↑ output
      - ↑ in SV without change in HR ↑ output
      - ↑ in HR without change in SV ↑ output
      - ↑ in HR without change in SV ↑ output
      - ↑ in SV & HR ↑ output
      - ↓ in SV & HR ↓ output
Circulatory System (Cont’d)

• Cardiovascular system
  ➢ Heart
    • Blood pressure
      ➢ Mechanical function of heart measures pressures exerted on vascular walls during systole, diastole
      ➢ \[ BP = CO \times PVR \]
Circulatory System (Cont’d)

- Cardiovascular system
  - Heart
    - Heart chambers, valves
      - Septum
        - Divides heart into right, left halves
      - Valves

Circulatory System (Cont’d)

Heart Valves

Circulatory System (Cont’d)

- Cardiovascular system
  - Heart
    - Blood flow through heart, pulmonary circulation
      - Right atrium
      - Right ventricle
      - Lungs
      - Left atrium
      - Left ventricle
Circulatory System (Cont’d)

Blood Flow Through Heart & Pulmonary Circulation

- Cardiovascular system
  - Heart
    - Coronary circulation
    - Coronary arteries

Circulatory System (Cont’d)

Coronary Arteries

- Coronary circulation
- Coronary arteries
Circulatory System (Cont’d)

• Cardiovascular system
  ➢ Heart
    ➢ Cardiac action potential
      ➢ Phase 0: Depolarization
      ➢ Phase 1: Early repolarization
      ➢ Phase 2: Plateau phase
      ➢ Phase 3: Final rapid repolarization
      ➢ Phase 4: Resting membrane potential

Circulatory System (Cont’d)

Cardiac Action Potential

Circulatory System (Cont’d)

• Cardiovascular system
  ➢ Heart
    ➢ Cardiac conduction system
      ➢ Sinoatrial (SA) node
      ➢ Atrioventricular (AV) node
      ➢ Bundle of His
      ➢ Purkinje fibers
Cardiovascular system

- Arteries and veins
  - 3 layered vessels
  - Conducting arteries
  - Distributing arteries
  - Capacitance vessels
  - Venules
Circulatory System (Cont’d)

- Cardiovascular system
  - Capillary network
    - Precapillary sphincters
  - Capillary filtration
    - Exchange of nutrients, waste products between intravascular, intracellular space
    - Dependent factors
      - Capillary membrane permeability
      - Arterial hydrostatic pressure
      - Venous oncotic pressure

Circulatory System (Cont’d)

- Lymphatic system
  - Lymphatic vessels
  - Lymph
  - Function
Respiratory System

- Primary function
  - Bring oxygen into body
  - Eliminate CO₂
- Respiratory tract
  - Passages move air to/from exchange surfaces
- Respiratory membrane
  - Gas exchange occurs
Respiratory System (Cont’d)

Components of Respiratory System

- Lungs
  - Allow mechanical movement of air to/from respiratory membrane

Respiratory System (Cont’d)

- Upper airway structures
  - Nasopharynx
  - Oropharynx
  - Laryngopharynx
  - Larynx
Respiratory System (Cont’d)

Upper Airway Structure

Respiratory System (Cont’d)

Larynx

Respiratory System (Cont’d)

Lower airway structures
- Trachea
  - Air passage
  - Anterior to esophagus
- Bronchial tree
  - Begins at carina
  - Separates into right/left mainstem bronchi
  - Lined with ciliated epithelial and goblet cells
  - Branch into subdivisions
Respiratory System (Cont’d)

- Lower airway structures
  - Alveoli
    - Functional units
    - Compose majority of lung tissue
    - Respiratory gas exchange

Respiratory System (Cont’d)

- Lower airway structures
  - Lungs
    - Located in pleural cavities
    - Expand, contract
    - Attached to heart by pulmonary trunk, veins
    - Hilum

Respiratory System (Cont’d)

- Lower airway structures
  - Lungs
    - Parietal pleura
    - Visceral pleura
    - Total lung capacity
      - Tidal volume (VT)
      - Inspiratory reserve volume (IRV)
Respiratory System (Cont’d)

- Lower airway structures
  - Lungs
    - Total capacity
    - Expiratory reserve volume
    - Residual volume (RV)
  - Pulmonary capacity
    - Inspiratory capacity
    - Functional capacity
    - Vital capacity
    - Total lung capacity

Respiratory System (Cont’d)

- Lower airway structures
  - Lungs
    - Minute volume
    - Anatomic dead space
    - Physiologic dead space

Respiratory System (Cont’d)

- Gas exchange
  - Inspired air
  - Venous blood
  - Factors enhance gas exchange
Respiratory System (Cont’d)

• Transport of carbon dioxide
  ➢ Three methods
    • Dissolved into blood (7%)
    • Attached to hemoglobin (23%)
    • Bicarbonate ions (73%)

Digestive System

• Processes
  ➢ Ingestion
  ➢ Mechanical processing
  ➢ Digestion
  ➢ Secretion
  ➢ Absorption
  ➢ Excretion

Digestive System (Cont’d)
Digestive System (Cont’d)

- Gastrointestinal tract
  - Oral cavity
    - Salivary glands
    - Teeth
    - Tongue
  - Esophagus
    - Peristalsis
  - Stomach
    - Produces acid
    - Breaks food down to chyme
Digestive System (Cont’d)

- Gastrointestinal tract
  - Small intestine
    - Absorption of nutrients
    - Duodenum
    - Jejunum
    - Ileum

Digestive System (Cont’d)

- Gastrointestinal tract
  - Large intestine
    - Water, electrolytes absorbed
    - Cecum
    - Appendix
    - Ascending colon
    - Transverse colon
    - Descending colon
    - Sigmoid colon

Digestive System (Cont’d)
Digestive System (Cont’d)

- Accessory structures
  - Liver
    - Largest internal organ
    - Right upper quadrant
    - Under diaphragm
    - Major detoxifier in body
    - Bile salts
    - Blood proteins

Digestive System (Cont’d)

- Accessory Structures
  - Gallbladder
    - Located beneath liver
    - Stores bile
    - Connected to common bile duct
    - Liver connects to common bile duct
    - Bile emulsifies fat

Digestive System (Cont’d)

- Accessory structures
  - Pancreas
    - Exocrine gland
      - Pancreatic juice
    - Endocrine gland
      - Production of insulin
Urinary System

- Essential functions
  - Regulation of blood volume, blood pressure
  - Regulation of electrolytes
  - Homeostasis of pH
  - Conservation of valuable nutrients, elimination of waste

Urinary System (Cont’d)

Organs of Female & Male Urinary System

Urinary System (Cont’d)

- Kidneys
  - Retroperitoneal space
  - Medulla
  - Renal pyramids
  - Nephron
  - Renal corpuscle
Urinary System (Cont’d)

- Kidneys
  - Bowman’s capsule
  - Glomerulus
  - Proximal tubule
  - Loop of Henle
  - Distal tubule

Urinary System (Cont’d)

- Ureters, urinary bladder, urethra
  - Ureter
  - Urinary bladder
  - Urethra
Urinary System (Cont’d)

Ureters, Urinary Bladder & Urethra

Reproductive System

- Male reproductive system
  - Testes
  - Epididymis
  - Ductus deferens
  - Seminal vesicles
  - Spermatic cord

Reproductive System (Cont’d)

- Male reproductive system
  - Urethra
  - Prostate
  - Bulbourethral glands
  - Sperm
  - Scrotum
  - Penis
Reproductive System (Cont’d)

Male Reproductive System

Female reproductive system
- Ovaries
- Fallopian tubes
- Uterus
- Vagina
- Vulva
- Clitoris
- Mammary glands

Reproductive System (Cont’d)

Female Reproductive System

Reproductive System (Cont’d)
Special Senses

- Olfaction
  - Controlled by first cranial nerve
  - Nerve fibers lie in nasal cavity
  - Molecules in air stimulate olfactory nerves
  - Center in brain interprets impulses as odors
  - Impulses travel through olfactory nerves to brain

Special Senses (Cont’d)

- Gustation
  - Ruled by parts of the 7th & 9th cranial nerves
  - Nerve fibers located in taste buds
  - Impulses relayed to gustation centers in brain
Special Senses (Cont’d)

Gustation

Sight
- Eye
  - Fibrous tunic
  - Vascular tunic
  - Nervous tunic
Special Senses (Cont’d)

- Sight
  - Accessory structures
    - Eyebrows
    - Eyelids
    - Conjunctiva
    - Lacrimal gland

Special Senses (Cont’d)

- Hearing & balance
  - Ear
    - External ear
    - Middle ear
    - Inner ear
Body Environment

- Distribution of body fluids
  - Water, 60% total body weight
  - Essential part of all chemical reactions
  - Distributed through several compartments
    - Intracellular fluid
    - Extracellular fluid

Special Senses (Cont’d)

- Ear

Special Senses (Cont’d)

- Hearing & Balance

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Body Environment (Cont’d)

Distribution of Body Fluids

- Normal hydration
  - Intake equal to output
  - Intake
  - Thirst mechanism
  - Antidiuretic hormone (ADH)
  - Aldosterone

Body Environment (Cont’d)

- Distribution of body fluids
  - Normal hydration
    - Output
    - Mechanism of fluid output
      - Urine
      - Stool
      - Skin
      - Lungs
Body Environment (Cont’d)

- Electrolytes
  - Substances dissociate into charged particles when dissolved in water
  - Cation
    - Sodium
    - Potassium
    - Calcium
    - Magnesium

- Electrolytes
  - Anions
    - Chloride
    - Bicarbonate
    - Phosphate

Body Environment (Cont’d)

- Acid-base balance
  - Required for normal body function
    - 7.35 to 7.45
    - Respiratory/metabolic
      - Bicarbonate buffer system
      - Respiratory system
      - Renal system
Chapter Summary

- Paramedic must understand human anatomy
  - Organization of patient assessment
  - Communicate illness, injury information
- Understanding physiology
  - Prediction of injury, illness patterns
- Anatomic position
  - Patient standing erect, palms facing examiner

Chapter Summary (Cont'd)

- Directional terms used to discuss body
  - Superior, inferior, anterior, posterior
- Appendicular skeleton
  - Extremities including arms, pelvic bones, legs
- Axial skeleton
  - Head, neck, thorax, abdomen

Chapter Summary (Cont'd)

- Abdomen divided into 4 quadrants
  - Upper right, lower right, upper left, lower left
- Major cavities are ventral and dorsal cavities
  - Subcavities
    - Thoracic cavity
    - Abdominopelvic cavity
    - Cranial cavity
    - Spinal cavity
Chapter Summary (Cont’d)

• Thoracic cavity
  ➢ Trachea
  ➢ Esophagus
  ➢ Thymus
  ➢ Heart and great vessels
  ➢ Lungs

• Abdominopelvic cavity
  ➢ Organs
  ➢ Blood vessels

Chapter Summary (Cont’d)

• Cytoplasm
  ➢ Lies between cytoplasmic membrane, nucleus
  ➢ Specialized structure in cell located in cytoplasm
  ➢ Performs jobs key to cell survival
  ➢ Nucleus controls all other organelles in cytoplasm

Chapter Summary (Cont’d)

• Most human cells reproduce by mitosis
  ➢ Cells divide to multiply

• Four types of tissue
  ➢ Epithelial tissue
  ➢ Connective tissue
  ➢ Muscle tissue
  ➢ Nervous tissue

• System is group of organs
  ➢ Perform more complex functions
Chapter Summary (Cont’d)

- Ten major organ systems
  - Integumentary
  - Skeletal
  - Muscular
  - Nervous
  - Endocrine
  - Circulatory (cardiovascular, lymphatic/immune)
  - Respiratory
  - Digestive
  - Urinary
  - Reproductive

Chapter Summary (Cont’d)

- Integumentary system
  - Skin
  - Accessory structures
    - Hair, nails, variety of glands
    - Protects body against injury, dehydration, infection, regulates temperature

Chapter Summary (Cont’d)

- Skeletal system
  - Bone
  - Associated connective tissue
    - Cartilage, tendons, ligaments
  - Provides rigid framework
    - Support and protection
- Three primary functions of muscular system
  - Movement
  - Maintenance of posture
  - Production of heat
Chapter Summary (Cont’d)

- Nervous & endocrine systems
  - Major regulatory, coordinating systems of body
  - Nervous system rapidly sends information by nerve impulses conducted from 1 area of body to another
  - Endocrine system sends information more slowly by chemicals secreted by ductless glands into bloodstream

Chapter Summary (Cont’d)

- Heart & cardiovascular system
  - Responsible for circulating blood throughout body
    - Blood carries carbon dioxide, waste away from tissues
    - Blood carries hormones produced in endocrine glands to target tissues
    - Blood regulates temperature, balances fluid, protects body from bacteria & foreign substances

Chapter Summary (Cont’d)

- Lymphatic system
  - Lymph, lymphocytes and lymph nodes
  - Tonsils
  - Spleen
  - Thymus gland
  - Functions
    - Maintaining fluid balance in tissues
    - Absorb fats from digestive tract
    - Assist immune defense system
Chapter Summary (Cont’d)

- Organs of respiratory system, cardiovascular system
  - Moves oxygen to cells
  - Moves carbon dioxide from cells to air
  - Respiratory System
    - Upper airway begins at nasal cavity
    - Lower airway begins at glottis, leads to lungs

Chapter Summary (Cont’d)

- Digestive system
  - Provides water, electrolytes, nutrients

- Urinary system
  - Helps to maintain homeostasis
  - Removes waste from blood
  - Helps maintain constant body fluid volume, composition
    - Includes kidneys, ureters, urinary bladder, urethra

Chapter Summary (Cont’d)

- Purpose of male reproductive system
  - Makes/transfer spermatozoa to female

- Purpose of female reproductive system
  - Makes oocytes
  - Receives spermatozoa for fertilization, conception, gestation, birth
Chapter Summary (Cont'd)

- Male reproductive system
  - Testes
  - Epididymis
  - Ductus deferens
  - Urethra
  - Seminal vesicles
  - Prostate glands
  - Bulbourethral glands
  - Scrotum and penis

Chapter Summary (Cont'd)

- Female reproductive system
  - Ovaries
  - Uterine/fallopian tubes
  - Uterus
  - Vagina
  - External genital organs
  - Mammary glands

Chapter Summary (Cont'd)

- Senses provide brain with information about outside world
- Four senses recognized as special
  - Smell
  - Taste
  - Sight
  - Hearing & balance
Questions?