Chapter 7

Anatomy and Physiology
7:1 Basic Structure of the Human Body

• The normal function of the human body is compared to an organized machine
• The machine malfunctions, disease occurs
• Anatomy: study of form and structure
• Physiology: study of processes
• Pathophysiology: study of how disease occurs and body’s response
Protoplasmin

• Basic substance of life
• Made of ordinary elements (e.g., carbon, oxygen, hydrogen)
• Scientists can combine these elements, but not create life
Cells

• Made of protoplasm
• Microscopic organisms
• Carry on all functions of life
• Body contains trillions of cells
• Vary in shape and size
• Perform different functions
Basic Parts of Cells

• Cell membrane
• Cytoplasm
• Organelles
• Nucleus
• Nucleolus
• Chromatin
• Genome

(continues)
Basic Parts of Cells
(continued)

- Centrosome
- Mitochondria
- Golgi apparatus
- Endoplasmic reticulum
- Vacuoles
- Lysosomes
- Pinocytic vesicles
Mitosis

• Asexual reproduction process used by most cells
• Different types of cells reproduce at different rates
• Process of mitosis—see Figure 7-2 in text (p. 144)
Meiosis

• Process by which sex cells reproduce
• Uses two separate cell divisions
• Female cells (ova) and male cells (spermatozoa or sperm) divide to produce 23 chromosomes each
• When ova and sperm combine, 46 chromosomes result to form zygote
Tissues

• Cells of same type joined together
• 60%–99% water
• Groups of tissues
  – Epithelial
  – Connective
  – Nerve
  – Muscle

(create a chart including 4 types of tissues and their function)
Organs and Systems

- Organs: two or more tissues joined together for a specific purpose
- Systems: organs and other body parts joined together for a particular function
Summary

- Protoplasms is basic substance of life
- Protoplasms forms structural units called cells
- Cells combine to form tissue
- Tissues combine to form organs
- Organs and other parts combine to form systems
- Systems work together to create miracle of human body
7:2 Body Planes/Directions/Cavities

- Body planes: imaginary lines drawn through body at various levels to separate body into sections
- Directional terms are created by planes
- Transverse plane
- Midsagittal or median plane
- Frontal or coronal plane
- Proximal and distal
Cavities

• Spaces within the body that contain vital organs
• Dorsal or posterior cavity
  - cranial
  - spinal (vertebral canal)
• Ventral or anterior cavities
  – Thoracic cavity
  – Abdominal cavity
  – Pelvic cavity
• Three small cavities
Cranial cavity (contains brain)

Dorsal body cavity

Vertebral cavity (contains spinal cord)

Thoracic cavity (contains heart and lungs)

Diaphragm

Abdominal cavity (contains digestive viscera)

Pelvic cavity (contains bladder, reproductive organs, and rectum)

Key:
- Yellow: Dorsal body cavity
- Red: Ventral body cavity

(a) Lateral view
Abdominal Regions

- Abdominal cavity is separated into regions or sections because it is so large
- Quadrants
  - RUQ
  - LUQ
  - RLQ
  - LLQ
Abdominal Regions

(continued)

• Regions
  – Epigastric
  – Umbilical
  – Hypogastric
  – Hypochondriac
  – Lumbar
  – Iliac or inguinal
7:3 Integumentary System

• Name for the skin and its structures
• Called a membrane because it covers the body
• Called an organ because it contains several kinds of tissues
• Called a system because it has organs and other parts that work together for a particular function
Layers of the Skin

• Epidermis—outermost layer
• Dermis—“true skin”
• Subcutaneous fascia or hypodermis—the innermost layer
Glands and Other Parts of the Skin

- Sudoriferous glands (sweat glands)
- Sebaceous glands (oil glands)
- Hair
- Nails
Functions

- Protection
- Sensory perception
- Regulation of body temperature
- Storage
- Absorption
- Excretion
- Production
Skin Color—Pigmentation

- Skin color is inherited and is determined by pigments in the epidermis
  - Melanin
  - Carotene
Skin Color—Albino

- Absence of skin pigments
- Skin has pinkish tint
- Hair is pale yellow or white
- Eyes are red in color and sensitive to light
Skin Color—Abnormal

- Erythema
- Jaundice
- Cyanosis
Skin Eruptions

- Macules (macular rash)
- Papules (papular rash)
- Vesicles
- Pustules
- Crusts
- Wheals
- Ulcer
Diseases and Abnormal Conditions

- Acne vulgaris
- Athlete’s foot
- Skin cancer
  - Basal cell carcinoma
  - Squamous cell carcinoma
  - Melanoma

(continues)
Diseases and Abnormal Conditions
(continued)

• Dermatitis
• Eczema
• Impetigo
• Psoriasis
• Ringworm
• Verrucae/warts/plantar warts
7:4 Skeletal System

- Made of organs called bones
- Adult has 206 bones
- Serves as framework for muscles, fat, and skin
- Protects internal structures
- Produces blood cells
- Stores calcium, phosphorus, and fats
Long Bones

- Bones of the extremities
- Diaphysis
- Epiphysis
- Medullary canal
- Yellow marrow
Long Bones

(continued)

- Endosteum
- Red marrow
- Periosteum
- Articular cartilage
Skeleton

• Axial
  – Main trunk of body
  – Skull, spinal column, ribs, and sternum

• Appendicular
  – Extremities
  – Shoulder girdle, arm bones, pelvic girdle, and leg bones
Skull

- Cranial and facial bones
- Sutures
- Sinuses
- Foramina
Cranial Bones

• Eight bones of skull that surround and protect the brain
• Frontal
• Parietal (2)
• Temporal (2)
• Occipital
• Ethmoid
• Sphenoid
Facial Bones

• 14 bones of skull that form facial features
• Mandible—lower jaw
• Maxilla (2)—upper jaw
• Zygomatic (2)—cheek
• Nasal (5)—upper part of nose
• Lacrimal (2)—inner aspect of eye
• Palatine (2)—hard palate (roof of mouth)
Vertebrae

- Spinal column—26 bones
- Protects the spinal cord
- Supports head and trunk
- Cervical (7)—neck
- Thoracic (12)—chest, attach to ribs
- Lumbar (5)—waist
- Sacrum (1)—back of pelvic girdle
- Coccyx (1)—tailbone
Intervertebral Disks

• Pads of cartilage separating vertebrae
• Act as shock absorbers
• Permit bending and twisting movements
Ribs (costae)

• 12 pairs of long slender bones
• Attach to thoracic vertebrae
• True ribs—first 7 pairs; attach to sternum
• False ribs—last 5 pairs
Sternum

• Breastbone
• Consists of 3 parts
• Two clavicles attach
• Ribs attach with cartilage
Shoulder or Pectoral Girdle

- 2 clavicles (collarbones)
- 2 scapula (shoulder bones)
- Upper arm bones attach to scapula
Bones of the Arm

- Humerus
- Radius
- Ulna
- Carpals
- Metacarpals
- Phalanges
Bones of Pelvic Girdle

• Consists of 2 os coxae (coxal or hip bones)
• Symphysis pubis
• Ilium
• Ischium
• Pubis
• Acetabula
• Obturator foramen
Bones of the Legs

• Femur
• Patella
• Tibia
• Fibula
• Tarsals
• Metatarsals
• Phalanges
Joints

• Where two or more bones join
• Ligaments
• Three types of joints
  – Diarthrosis or synovial
  – Amphiarthrosis
  – Synarthrosis
Diseases and Abnormal Conditions

- Arthritis
- Bursitis
- Fractures
- Dislocation
- Sprain
- Osteomyelitis

(continues)
Diseases and Abnormal Conditions
(continued)

• Osteoporosis
• Ruptured disk
• Abnormal curvature of spine
  – Kyphosis
  – Scoliosis
  – Lordosis
7:5 Muscular System

• 600+ muscles in the body
• Bundles of muscle fibers held together with connective tissue
• Properties of muscles
  – Excitability/irritability
  – Contractibility
  – Extensibility
  – Elasticity
Kinds of Muscles

- Cardiac—involuntary
- Visceral or smooth—involuntary
- Skeletal—voluntary
Functions of Muscles

- Attach to bones to provide movement
- Produce heat and energy
- Help maintain posture
- Protect internal organs
Attachments to Bone

• Tendon
• Fascia
• Origin and insertion
Actions or Movements of Muscles

- Adduction
- Abduction
- Flexion
- Extension
- Rotation
- Circumduction
Muscle Tone

- Partially contracted at all times
- Muscle tone allows for state of readiness
- Loss of muscle tone
Diseases and Abnormal Conditions

• Fibromyalgia
• Muscular dystrophy
• Duchenne’s dystrophy
• Myasthenia gravis
• Muscle spasms or cramps
• Strain
7:6 Nervous System

• Complex and highly organized
• Coordinates all of the many activities of the body
• Allows the body to respond and adapt to changes that occur both inside and outside the body
Neuron

- Neuron is also called a nerve cell
- Basic structural unit of the nervous system
- Parts of neuron
  - Cell body
  - Nucleus
  - Nerve fibers (dendrites, axon)
Nerves

- Combination of nerve fibers
- Located outside the brain and spinal cord
- Afferent—sensory nerves
- Efferent—motor nerves
- Associative—internuncial nerves
Central Nervous System

• Consists of two main divisions
  – Central nervous system (CNS)
  – Brain and spinal cord
  – Peripheral nervous system
  – Somatic nervous system
  – Autonomic nervous system
Central Nervous System
The Brain

- Cerebrum
- Cerebellum
- Diencephalon
- Midbrain
- Pons
- Medulla oblongata
Central Nervous System
The Spinal Cord

• Continues down from medulla oblongata
• Surrounded and protected by the vertebrae
• Responsible for many reflex actions
• Carries sensory (afferent) messages to the brain
• Carries motor (efferent) message from the brain
Central Nervous System

- Meninges
- Dura mater
- Arachnoid membrane
- Pia mater
- Ventricles
Peripheral Nervous System

• Cranial nerves
• Spinal nerves
• Autonomic nervous system
  – Sympathetic
  – Parasympathetic
Diseases and Abnormal Conditions

- Amyotrophic lateral sclerosis (ALS)
- Carpal tunnel syndrome
- Cerebral palsy
- Cerebrovascular accident (CVA)
- Encephalitis
- Epilepsy or seizure syndrome

(continues)
Diseases and Abnormal Conditions (continued)

• Hydrocephalus
• Meningitis
• Multiple sclerosis (MS)
• Neuralgia
• Paralysis
• Parkinson’s disease
• Shingles or herpes zoster
7:7 Special Senses

- Senses allow body to react to the environment
- See, hear, taste, smell, and to maintain balance
- Body structures receive sensation, nerves carry to brain, brain interprets and responds to message
Eye

• Sense of sight
• Light rays transmitted to the optic nerve
• Optic nerve relays information to brain
• Eye is well protected
  – Bony socket
  – Eyelids and eyelashes
  – Lacrimal glands
  – Conjunctiva
Layers of the Eye

- Sclera—outer
- Choroid coat—middle
- Retina—innermost
Other Special Structures

- Iris
- Pupil
- Lens
- Aqueous humor
- Vitreous humor
- Muscles
Diseases and Abnormal Conditions

- Amblyopia—lazy eye
- Astigmatism
- Cataract
- Conjunctivitis—pink eye
- Glaucoma

(continues)
Diseases and Abnormal Conditions

(continued)

- Hyperopia—farsightedness
- Myopia—nearsightedness
- Macular degeneration
- Presbyopia
- Strabismus
Ear

- Controls hearing and balance
- Sound waves transmitted to the auditory nerve
- Auditory nerve relays information to the brain for interpretation
- Consists of the outer ear, middle ear, and inner ear
Outer Ear

• Pinna or auricle
• Auditory canal
• Tympanic membrane
Middle Ear

- Malleus
- Incus
- Stapes
- Eustachian tube
Inner Ear

- Oval window
- Vestibule
- Cochlea
- Organ of Corti
- Semicircular canals
Diseases and Abnormal Conditions

• Hearing loss
• Meniere’s disease
• Otitis externa
• Otitis media
• Otosclerosis
Sense of Taste

• Taste receptors located on the tongue
• Four main tastes
  – Sweet
  – Salty
  – Sour
  – Bitter
Sense of Smell

- Nose is the organ of smell
- Olfactory receptors in nasal cavity
- Impulses carried from the olfactory nerve to the brain for interpretation
- Humans can detect over 6,000 smells
- Sense of taste and smell related
Skin and General Senses

• Sense receptors for pressure, heat, cold, touch, and pain located in the skin and connective tissue
• Allows the human body to respond to its environment
• Help body react to conditions that could cause injury
7:8 Circulatory System

• Also known as the cardiovascular system
• Consists of heart, blood vessels, blood
• Transports oxygen and nutrients to all body cells
• Transports carbon dioxide and metabolic materials away from the body cells
Heart

- Muscular, hollow organ functions as pump
- Weight is less than one pound
- Location
- Three layers of tissue
  - Endocardium
  - Myocardium
  - Pericardium
Heart
(continued)

- Septum
- Heart chambers
- Valves
  - Tricuspid
  - Pulmonary
  - Mitral
  - Aortic

(continues)
Heart (continued)

- Cardiac cycle
- Conductive pathways
- Arrhythmias
Blood Vessels

• Blood is carried throughout the body in blood vessels
• Arteries
• Capillaries
• Veins
Blood

• Average adult: 4–6 quarts
• Transports many substances
• Plasma
• Blood cells
  – Erythrocytes or red blood cells
  – Leukocytes or white blood cells
  – Thrombocytes
Diseases and Abnormal Conditions

- Anemia
- Aneurysm
- Arteriosclerosis
- Atherosclerosis
- Congestive heart failure (CHF)
- Embolus
• Hemophilia
• Hypertension
• Leukemia
• Myocardial infarction—heart attack
• Phlebitis
• Varicose veins
7:9 Lymphatic System

• Works with the circulatory system
• Removes waste and excess fluids from the body tissues
• Lymph
• Lymphatic vessels
• Lymph nodes (glands)
Lymphatic System

(continued)

• Lymphatic ducts
• Lymph tissue
• Spleen
• Thymus
Diseases and Abnormal Conditions

• Adenitis
• Hodgkin’s disease
• Lymphangitis
• Splenomegaly
• Tonsillitis
7:10 Respiratory System

• Lungs and air passages
• Takes oxygen in and removes carbon dioxide
• Works continuously or death occurs in 4–6 minutes
Respiratory System
(continued)

• Nose
• Sinuses
• Pharynx—throat
• Larynx—voice box
• Trachea—windpipe
• Bronchi
• Alveoli
• Lungs
Ventilation

• Process of breathing
• Inspiration—inhalation
•Expiration—exhalation
• External respiration
• Internal respiration
Diseases and Abnormal Conditions

• Asthma
• Bronchitis
• Chronic obstructive pulmonary disease
• Emphysema
• Epistaxis—nosebleed

(continues)
• Influenza—flu
• Laryngitis
• Lung cancer
• Pleurisy
• Pneumonia
Diseases and Abnormal Conditions (continued)

• Rhinitis
• Sinusitis
• Sleep apnea
• Tuberculosis (TB)
• Upper respiratory infection (URI)
7:11 Digestive System

• Physical and chemical breakdown of food for use by the body
• System consists of the alimentary canal and the accessory organs
Alimentary Canal

- Long muscular tube
- Begins at the mouth and ends at the anus
- Accessory organs: salivary glands, tongue, teeth, liver, gallbladder, pancreas
Mouth, Buccal, or Oral Cavity

- Receives food as it enters the body
- Actions in the mouth
- Teeth
- Tongue
- Hard palate
- Soft palate
- Salivary glands
Pharynx or Throat

- Carrier for both air and food
- Carries food bolus to the esophagus
- When bolus swallowed, epiglottis closes to prevent food from entering respiratory tract
Esophagus

- Muscular tube dorsal to the trachea
- Carries bolus to stomach
- Peristalsis moves food toward stomach
Stomach

• Receives food from esophagus
• Mucous membrane lining contains rugae
• Cardiac sphincter
• Pyloric sphincter
• Food remains in stomach about 1–4 hours
• Gastric juices
Small Intestine

• About 20 feet long; 1 inch in diameter
• Receives food from the stomach in the form of chyme
• Small intestine
  – Duodenum
  – Jejunum
  – Ileum

(continues)
Small Intestine (continued)

- Intestinal juices
- Bile
- Pancreatic juice
- Villi
- When food has finished its journey through the small intestine, only wastes, indigestible materials, and excess water remain
Large Intestine

• About 5 feet long; 2 inches in diameter
• Functions
• Cecum
• Colon
• Rectum
Liver

• Largest gland in the body
• Accessory organ for digestive system
• Location
• Functions
Gallbladder

- Small muscular sac
- Location
- Stores and concentrates bile
- Bile needed to emulsify fats
Pancreas

- Fish-shaped organ located behind the stomach
- Produces pancreatic juices to digest food
- Produces insulin which is secreted into the blood stream; regulates burning of carbohydrates to convert glucose to energy
Diseases and Abnormal Conditions

• Appendicitis
• Cholecystitis
• Cirrhosis
• Constipation
• Diarrhea
• Diverticulitis
• Gastroenteritis

(continues)
• Hemorrhoids
• Hepatitis
• Hernia or rupture
• Pancreatitis
• Peritonitis
• Ulcer
• Ulcerative colitis
7:12 Urinary System

- Excretory system
- Removes certain wastes and excess water from the body
- Maintains homeostasis
- Maintains acid-base balance
- 2 kidneys, 2 ureters, bladder, and urethra
Kidneys

- Bean-shaped organs
- Location
- Protection
- Cortex
- Medulla
- Hilum
- Nephrons
Ureters

• Muscular tubes about 10–12 inches long
• Extend from renal pelvis of each kidney to bladder
• Peristalsis moves urine through tube to bladder
Bladder

• Muscular sac
• Lined with mucous membranes
• Three layers of visceral muscle form walls
• Function
• Urge to void
• Circular sphincter muscles
Urethra

• Carries urine from bladder to the outside
• Urinary meatus
• Female and male systems
• Urine
• Conditions affecting urination
Diseases and Abnormal Conditions

- Cystitis
- Glomerulonephritis or nephritis
- Pyelonephritis
- Renal calculus or urinary calculus
- Renal failure
- Chronic renal failure
- Uremia
- Urethritis
7:13 Endocrine System

- Group of ductless (without tubes) glands
- Secrete substances called hormones
- Hormones that are secreted directly into bloodstream
Pituitary Gland

• Master gland of the body
• Located at the base of the brain
• Anterior and posterior lobes
• Acromegaly
• Giantism
• Diabetes insipidus
• Dwarfism
Thyroid Gland

• Regulates body’s metabolism
• Located in neck
• Requires iodine from food intake
• Goiter
• Hyperthyroidism
• Graves’ disease
• Hypothyroidism
Parathyroid Glands

- Attached to thyroid glands
- Regulate amount of calcium in the blood
- Hyperparathyroidism
- Hypoparathyroidism
Adrenal Glands

- Located above the kidneys
- Cortex
- Medulla
- Addison’s disease
- Cushing’s syndrome
Pancreas

- Located behind the stomach
- Both an exocrine and endocrine gland
- Diabetes mellitus
Other Endocrine Glands

• Ovaries: female sex glands, located in the pelvis, secrete hormones that regulate menstruation and secondary sexual characteristics

• Testes: male sex glands, located in the scrotal sac, produce hormones that regulate secondary sexual characteristics
Thymus

- Located in the upper part of chest
- Active in early life
- Atrophies (wastes away) during puberty
- Produces thymosin
Pineal Body

• Located in the brain
• Exact function unknown
Placenta

• Temporary endocrine gland produced during pregnancy
• Functions
• Expelled after the birth of the child
7:14 Reproductive System

• Function is to produce life
• Consists of gonads (sex glands) and accessory organs
Male Reproductive System

- Testes
- Scrotum
- Epididymis
- Vas deferens
- Seminal vesicles
- Ejaculatory ducts

(continues)
Male Reproductive System (continued)

- Prostate gland
- Cowper’s glands
- Urethra
- Penis
Diseases and Abnormal Conditions
Male

- Epididymitis
- Orchitis
- Prostatic hypertrophy or hyperplasia
- Testicular cancer
Female Reproductive System

- Ovaries
- Fallopian tubes
- Uterus
- Vagina
- Bartholin’s glands
- Vulva
- Breasts or mammary glands
Diseases and Abnormal Conditions Female

- Breast tumors
- Cancer of the cervix and/or uterus
- Endometriosis
- Ovarian cancer
- Pelvic inflammatory disease (PID)
- Premenstrual syndrome (PMS)
Sexually Transmitted Diseases (STDs)

- AIDS
- Chlamydia
- Gonorrhea
- Herpes
- Pubic lice
- Syphilis
- Trichomonas vaginalis