The Human Body Structure and Function
Learning Outcomes

• Identify major structures of each body system
• Describe major functions of each of body system
• Describe common diseases & disorders
• Recognize role of drug therapy
Key Terms

• Antigen
• Autoimmunity
• Diastole
• Digestion
• Endocrine
• Endocrine glands
• Gonads
• Hormone
• Pathophysiology
Key terms

• pH
• Peristalsis
• Physiology
• Receptors
• Secrete
• Sphygmomanometer
• Systole
• Tolerance
Overview of Human Body

- **Anatomy:** body structure
- **Physiology:** collective functions & processes of the body systems
- **Pathophysiology:** abnormal physiological functions of body systems
Nervous System
Nervous System

• Overview of Structure & Function
  – Brain
  – Spinal cord
  – System of nerve cells (neurons)

• 2 major parts
  – central nervous system
    • brain & spinal cord
  – peripheral nervous system
    • network of nerves
      – exit from spinal cord
      – extend throughout entire body.
Peripheral System

• Afferent division
  – brings information
    • temperature
    • information on status of internal organs

• Efferent division
  – delivers signals from brain to organs & tissues
Divisions of Efferent System

• Somatic nervous system
  – transmits signals to skeletal muscles
  – voluntary control

• Autonomic nervous system
  – communicates with many different organs
  – controlled automatically by brain
  – further subdivided into sympathetic & parasympathetic
Sympathetic & Parasympathetic

• Opposing actions in body
• Sympathetic nervous system
  – when body is under stress
  – best described as flight-or-fight response
• Parasympathetic system
  – functions when body is at rest
Chemical Messengers

• Neurotransmitters
  – bind to special proteins (receptors) in organs & tissues

• Parasympathetic uses acetylcholine
  – parasympathetic-cholinergic system

• Sympathetic uses norepinephrine
  – sympathetic-adrenergic system
Nervous system

• Communication is rapid

• Autonomic (involuntary) nervous system (ANS)
  – Regulates internal organs of body
    • sweat glands, smooth muscle, heart, lungs, eyes, kidneys, sexual organs

• Somatic nervous system
  – solely responsible skeletal muscle

• Communication via release of neurotransmitters
Common Diseases & Disorders

• Seizure Disorders:
  – strong surge of electrical activity affects part of brain

• Multiple symptoms

• Many different types of seizures

• Many causes
  – imbalance between neurotransmitters GABA & acetylcholine

• Antiepileptic activity
Parkinson’s Disease

• Nerve cells in brain lose ability to release neurotransmitter dopamine
• Imbalance between dopamine & acetylcholine
• Symptoms
  – difficulty with initiating & controlling movement
  – stooped, slow, stiff, shuffling gait
  – muscle tremors at rest are common
• Drug therapy restores balance between dopamine and acetylcholine
Alzheimer’s Disease

- Progressive degenerative neurological disorder
- Brain tissue shrinks & nerve cells are lost
  - primary nerve cells lost are those that produce neurotransmitter acetylcholine
- Impairments in
  - memory, thinking, reasoning, ability to communicate
  - accompanying conditions
    - depression and paranoia

Drug treatment includes use of cholinesterase inhibitors, which prevent the breakdown of acetylcholine.
Multiple Sclerosis

• Myelin sheath (covers somatic neurons) is broken down

• Lesions appear on nerves

• Multiple symptoms develop
  – speech & swallowing difficulty
  – muscle weakness, balance & gait
  – eye muscles become paralyzed
  – numbness & tingling in extremities

• Drug treatment is focused on preventing exacerbations & on treating symptoms
Pain

- Many forms of pain
- Neuropathic pain—involves nerves
- Acute pain=6 six months or less
- Chronic pain=months to years
- Pain perceived by specialized receptors
  - transmit signals via neurotransmitters
  - specialized pain pathways- spinal cord to brain
- Brain releases natural opioids that decrease perception of pain
- Analgesics are used to treat pain
Mood Disorders

• Type of mental illness involving disturbance of mood
• Depression & bipolar disorder (manic-depressive disorder)
• Loss of interest in pleasurable activities
  – depressed mood
  – lack of energy
  – problems with sleeping
  – changes in diet (loss of appetite or overeating)
  – difficulty concentrating
Mood Disorders

• Imbalance of specific neurotransmitters
  – serotonin & norepinephrine
• Drugs work by increasing levels of neurotransmitters
• Bipolar disorder - extreme mood swings
  – cycle between overexcited (manic) state & depression
• Treatment focused on
  – treating manic & depressed states
  – preventing mood swings
Anxiety Disorders

- Feeling of being powerless & unable to cope with stressful events
- Interferes with daily functioning
  - generalized anxiety disorder
  - panic disorder
  - social anxiety disorder
  - obsessive-compulsive disorder (OCD)
Anxiety Disorders

• Number of factors contribute
  – environmental
  – genetic
  – chemical

• Treatment
  – correct imbalance of neurotransmitters in brain
Psychotic Disorders

• Capacity to recognize reality is distorted

• Schizophrenia—one type of psychosis
  – chronic, disabling disorder
  – alters how an individual thinks, behaves, expresses emotions, perceives reality, interacts with people

  – Common symptoms
    • hallucinations (hearing or seeing things that are not real)
    • delusions (fixed beliefs that are false)

– Cause unclear
ADHD

• Attention Deficit Hyperactivity Disorder
• Difficulty staying focused
• Hyperactivity
• Most commonly seen in childhood
• May continue into adolescence, adulthood
• Cause unknown

• Treatment
  – behavioral modification
  – drugs such as stimulants
Myasthenia Gravis

- Chronic neuromuscular disease
- Communication between somatic nervous system & muscles disrupted
- Receptors in skeletal muscle destroyed
- Acetylcholine no longer functions to contract muscle
- Symptoms are
  - muscle weakness, difficulty speaking, swallowing, breathing, extreme fatigue, drooping eyelids
- Drug treatment: acetylcholinesterase inhibitors
Cardiovascular System
Cardiovascular System

• Structure & Function
  – heart
  – blood vessels called arteries
  – capillaries and veins
  – blood
Blood

• Mixture of plasma, platelets, red & white blood cells
• Red blood cells (erythrocytes)
  – transporting oxygen in and carbon dioxide out
• White blood cells (leukocytes)
  – fight against invading microorganisms
• Blood carries nutrients to cells
  – takes away break down products
Heart

- Strong muscular organ that pumps blood
- Fist sized, hollow
- Located in center of chest (thoracic) cavity
- Pericardium surrounds heart
- Coronary arteries
- Myocardium
- Endocardium
Heart

• 4 chambers
  – 2 upper chambers-atria
  – 2 bottom chambers-ventricles

• Veins
  – Superior & inferior vena cava
  – Pulmonary veins
Heart Valves

• 4 valves
  – prevent backflow
• 2 valves between atria & ventricles on each side of heart
• 2 valves are between ventricles & arteries
Conduction System

• Specialized cells—pacemaker cells
• Generate electrical signals
  – trigger contraction of heart
  – set heart rhythm
• Electrocardiogram (ECG or EKG)
  – arrhythmia
  – drugs used to return abnormal electrical activity back to normal
Rate & Force of Heart

• Regulated by
  – nervous system
  – sympathetic & parasympathetic divisions
• Sympathetic-increases heart rate & force
• Parasympathetic-slow heart rate
Diseases and Disorders

• Coronary Artery Disease
  – blood vessels that supply heart with oxygen become narrowed
  – atherosclerosis- caused by fatty deposits (plaque) inside blood vessels
  – myocardial infarction (heart attack)
  – abnormal heart rhythm (arrhythmia)
Stroke (CVA)

• Acute decrease or stoppage of blood to brain

• Causes
  – blood clot (ischemic stroke)
  – blood vessel rupture (hemorrhagic stroke)

• Conditions can lead to stroke
  – atrial fibrillation
  – atherosclerosis
  – aneurysm
  – high blood pressure

• Important to recognize & treat stroke right away
Heart Failure (CHF)

• Inadequate blood ejected from ventricles to body

• Symptoms
  – tiredness
  – shortness of breath
  – lower extremity swelling
  – increased heart rate (pulse)
  – shortness of breath
CHF Continued

• Causes:
  – heart attack
  – high blood pressure
  – coronary artery disease
  – abnormal heart valves
  – heart defects

• Treatment
  – lifestyle changes
  – medications
  – surgery
Hypertension

• Pressure changes measured by sphygmomanometer
• Regulation of blood pressure is disrupted
• Diastolic pressure remains elevated >90 mmHg
• Systolic pressure >140 mmHg
• Uncontrolled blood pressure increases risks
  – stroke, heart attack, heart failure, kidney & retinal damage
• Treatment: chronic
  – anti-hypertensive medications
Venous Thromboembolism

- Clot forms in veins
- Small portions of clot
  - can break away
  - travel to the lungs
- Cause pulmonary (lung) embolism
- Requires urgent treatment with anti-clotting drugs (anticoagulants)
Arrhythmias/Dysrhythmias

• Abnormal rhythms of heart
  – bradycardia
  – tachycardia

• Common arrhythmias
  – originating in atria
  – atrial fibrillation
  – atrial flutter

• Premature ventricular contractions (PVCs)
  – ventricular tachycardia
  – ventricular fibrillation
The Respiratory System
Structure & Function

- Upper airways
- Respiratory tract
- Lungs
- Nasal and oral cavities
- Pharynx
- Larynx
- Vocal cords
- Epiglottis
- Trachea
- Bronchi
- Bronchioles
- Alveoli
Breathing

• Gas exchange at two levels
  – Between alveoli & blood
  – between blood & tissues

• Erythrocytes hemoglobin carries oxygen

• Deoxygenated blood
  – travels from the right side of heart to lungs

• Oxygenated blood
  – travels to left side of heart where it is pumped to cells
Acidity & Alkalinity (pH)

• Blood slightly alkaline – pH 7.4
• Respiratory system regulates blood pH
• If breathing rate abnormally low
  – respiratory acidosis
• If breathing rate too fast
  – respiratory alkalosis
• Acidosis-affects nervous system
• Alkalosis -results in seizures & convulsions
Common Diseases & Disorders

• Asthma
  – inflammation of bronchioles
  – increased mucus secretion
  – abnormal contractions of smooth muscles in bronchioles
  – narrowing of airway passages

• Chronic Obstructive Pulmonary Disease (COPD)
  – emphysema
  – chronic obstructive bronchitis
Respiratory Infections

– Upper respiratory tract infections
  – Viruses
    • nose, oropharynx, larynx

• Lower respiratory tract infections
  – Viruses or bacteria
  – Influenza virus
  – Pneumonia

• Supportive treatment for viral infection

• Antibiotics treatment for bacterial infections
The Musculoskeletal System
Structure & Function

• Skeleton is made up of 206 bones
  – connected by ligaments at joints

• Skeleton gender differences
  – density of arms & legs heavier in males
  – hip bones of females wider

• Muscles connected to bones by tendons
Skeletal Muscles

• Facial muscles attached to skin
• More than 600 muscles in body
• Muscle fibers contain actin & myosin
  – make muscle contract & relax
  – gives skeletal muscle striped appearance
• Skeletal muscle-voluntary control
Smooth Muscle

• Under involuntary control
  – autonomic nervous system
  – primary muscle found in internal organs

• Actin & myosin arranged in layers

• Cardiac muscle
  – found exclusively in heart
  – has characteristic striped appearance

• Red bone marrow
  – essential for production of all blood cells
Common Diseases & Disorders

• Osteoporosis
  – bone loss occurs faster than bone replacement
  – bones become fragile, lighter, prone to fractures
  – symptoms of disease are “silent”

• Risk factors
  – female, menopause, older age, family history, low calcium & vitamin D intake

• Treatment:
  – calcium & vitamin D supplements
  – medications prevent bone loss & rebuild bone
Rheumatoid Arthritis

• Autoimmune inflammatory disease of joints

• Symptoms:
  – low-grade fever, lack of energy, loss of appetite, general feeling of malaise
  – swollen, red, painful, stiff joints

• Treatment:
  – drugs decrease inflammation
  – prevent further destruction of joint tissue
Osteoarthritis

• Cartilage of joint deteriorates
• Affects bone underneath
• Affects weight-bearing joints
• Occurs as result of aging
• Drug treatment
  – relieving pain
  – decrease joint swelling
Muscle Sprain & Strain

- Tendon injured-strain injury
- Ligament injured-sprain injury
- Sprains & strains
  - back, wrist, ankle, knee, hamstring muscles
- Over-the-counter drugs prescribed
  - reduce pain & swelling
  - ibuprofen
The Endocrine System
Structure & Function

• Endocrine glands
  – release chemical messengers (hormones) into blood
  – dispersed throughout body
  – not structurally related to each other

• Hormones & target tissue or cells
  – relay information/instructions throughout body
  – bring specific response in other cells of body
Endocrine System Works To:

• Maintain body’s normal internal balance—homeostasis
• Help body deal with stressful situations
• Regulate growth & development
• Control reproduction
• Produce, use, & store energy
Common Diseases & Disorders

• Diabetes Mellitus-high levels of glucose (sugar)
  – Type 1 diabetes
    • lack of insulin production
    • treated with insulin
  – Type 2 diabetes
    • decreased production of insulin
    • abnormal sensitivity of tissues to insulin
    • treated with:
      – diet alone, oral hypoglycemic agents, insulin, or combination of remedies
Diabetes Insipidus

• Pituitary gland doesn’t produce vasopressin (ADH)
• Kidneys do not respond to hormone ADH
• Kidneys are unable to reabsorb water
  – high volumes of urine excreted
  – extreme thirst
• Treated with replacement hormone vasopressin
Thyroid Disease

• Too little thyroid hormone (hypothyroidism)
  – weakness, fatigue, muscle cramps, intolerance to cold, dry skin, lethargy
  – thyroid hormone replacement

• Too much thyroid hormone (hyperthyroidism)
  – weakness, sweating, weight loss, nervousness, moist skin, intolerance to heat
  – thyroid hormone blocker
  – radioactivity to destroy part of gland
The Immune System
Structure & Function

• Cells in
  – bone marrow
  – thymus gland
  – lymphatic system of ducts & nodes
  – spleen
  – blood

• Work together to protect body from invasion
Cells in Immune System

• White blood cells (leukocytes)
  
• Phagocytes
  – monocytes
  – macrophages
  – neutrophils)

• Granulocytes
  – eosinophils & basophils

• Lymphocytes
  – B cells & T cells
Lymphoid Organs

• Concerned with lymphocyte
• Lymphatic vessels
  – similar to blood vessels
• Major lymphoid organs
  – lymph nodes, tonsils, adenoids, appendix, spleen, thymus
• Lymph nodes
  – remove cellular debris
Immune Response

• Innate immune response
  – nonspecific response
  – inflammation (neutrophils and macrophages)

• Acquired immune responses
  – specific responses target specific invaders
  – body has been exposed to invader before
Common Diseases & Disorders

- **Allergy**
  - offending agent-allergen
  - B cells make IgE antibody-mast cells release histamine
  - treated with antihistamines

- **Autoimmune Disease**
  - immune responses directed against its own cells
  - rheumatoid arthritis

- **Acquired Immune Deficiency Syndrome (AIDS)**
  - weakens immune system
THE GASTROINTESTINAL SYSTEM
Structure & Function

- Mouth
- Pharynx
- Esophagus
- Stomach
- Small Intestine
- Large Intestine
- Liver
- Gallbladder
- Pancreas
Digestion

- Ingested food energy source
  - salivary glands, liver, pancreas
  - secretions into the tube

- Chewing → swallowing → peristalsis → substantial chemical & enzymatic digestion → stomach muscles → small intestine → nutritional & drug absorption → pancreas & liver send secretions → large intestine → bacteria aid digestion → feces → rectum → anal sphincter
Common Diseases & Disorders

- Ulcers
- Esophageal Disorders
- Gastrointestinal Infections
- Inflammatory Bowel Disease
- Diarrhea
- Constipation
The Urinary System
Overview of Structure and Function

• Urinary system
  – kidneys, ureters, bladder, urethra
• Kidneys
  – filter blood
• Ureter
  – transports urine to bladder
• Bladder
  – stores urine
• Urethra – excretion of urine
Kidney

- Cortex
- Medulla
- Renal pelvis
- Nephrons
- Regulates
  - volume of plasma
  - certain electrolytes
- Maintains pH
- Production of erythropoietin
Common Diseases & Disorders

• Kidney Stones – nephrolithiasis
• Kidney Failure
• Overactive Bladder
Other Body Systems
Homeostasis

• Sensory organs
• Thermoreceptors
• Photoreceptors
• Mechanoreceptors
• Chemoreceptors
• Proprioceptors
• Nociceptors
Eyes

- Structure and Function
- Sclera/cornea
- Choroid/ciliary body/iris
- Retina
- Photoreceptors
- Nerve cell carries information collected from eye to brain where information processed
Common Diseases & Disorders

• Dry Eyes-dry eye syndrome
• Conjunctivitis
• Glaucoma
Ears

• Structure and Function

• External ear
  – pinna
  – auditory canal
  – ear drum (tympanic membrane)

• Middle ear

• Inner ear
  – three small bones, vestibular apparatus & Organ of Corti
Common Diseases & Disorders

• Otitis Externa
• Otitis Media
Dermatologic System

- Structure & Function
- Skin largest organ in body
- Regulation of temperature
- Prevention of damage from ultra-violet (UV) radiation
- Synthesis of Vitamin D
- Protection against excess fluid loss
- Prevention of penetration by invading microorganisms
Common Diseases & Disorders

• Dry Skin
• Sunburn
• Contact Dermatitis
• Eczema
• Acne
Women’s Health

• Overview of Female Reproductive System

• Gonads

(1) production of reproductive cells (gametes-eggs)

(2) production of estrogen & progesterone

• female organs
  – vulva
  – vagina
  – uterus (or womb)
  – fallopian tubes
Common Diseases & Disorders

• Infertility
• Hormone Deficiencies
• Endometriosis
• Sexually Transmitted Diseases (STDs)
• Viruses
  – HIV-AIDS, genital herpes, hepatitis C, human papillomavirus [HPV], genital warts
• Bacteria
  – chlamydia, gonorrhea, syphilis, trichomoniasis, pelvic inflammatory disease
Men’s Health

• Overview of Male Reproductive System
• Pair of testes
  (1) production of reproductive cells, called gametes
  (2) production of sex hormone testosterone
• Sperm & male sex hormones produced in testes
• Scrotum
• Penis
Common Diseases & Disorders

• Benign Prostatic Hyperplasia (BPH)
• Erectile Dysfunction
• Sexually Transmitted Diseases