

Integrative Physiology Knowledge-Based Competencies.

Homeostasis

1. Explain the concept of homeostasis and the role of feedback loops to this process.
2. Describe how different physiological systems work in concert to maintain homeostasis.

Neuroscience

1. Describe the mechanisms that create and maintain resting membrane potential in excitable cells.
2. Identify the mechanisms that mediate changes in membrane permeability that create receptor potentials and action potentials.
3. Demonstrate how action potential generation leads to neurotransmitter release in neuroeffector junctions and synapses.
4. Describe the different functions of classes of putative neurotransmitters in the nervous system.
5. Describe the structure and function of the major components of the autonomic nervous system.

Muscle

1. Explain the structure and function of skeletal muscle and the neuromuscular junction.
2. Describe the cellular mechanisms responsible for the contraction of skeletal muscle and compare the different fiber types.
3. Describe the organization and function of the skeletal motor system.
4. Describe the action potentials of the different types of muscles.

CARDIOVASCULAR

Cardiac Muscle

1. Explain the structure and function of cardiac muscle.
2. Describe the cellular mechanisms responsible for contraction of cardiac muscle, including mechanisms that increase and decrease the force of contraction.
3. Explain the relationship between fiber length and contractile force in cardiac muscle and how it is affected by inotropic agents.

Cardiovascular System Structure & Function

1. Describe the structure and function of the cardiovascular system
2. Explain the relationships between pressure, flow, and resistance, and factors that modify these relationships

Cardiac Electrophysiology

1. Explain the mechanisms of the cardiac action potential and cardiac conduction

2. Describe and interpret basic normal and abnormal electrocardiograms

Cardiac Pump and Cardiac Cycle

1. Diagram left ventricular pressure-volume relationships
2. Explain how preload, afterload, and contractility can affect cardiac function

Regulation of the Heart

1. Describe the physiological and physical factors that determine heart rate

Control of Cardiac Output

1. Show the physical and physiological factors that determine cardiac output and venous return

Peripheral Circulation

1. Describe the effect of aortic compliance on capillary blood flow
2. Explain the techniques for measuring arterial pressure and describe factors that determine these pressures

Microcirculation & Lymphatics

1. Describe the structure and function of the microcirculation, and the lymphatic system
2. Explain the different mechanisms of transcapillary exchange, and identify factors that influence these mechanisms
3. Describe the factors that determine filtration and absorption, and net filtration pressure
4. Describe the factors that promote and prevent edema

Regulation and Control of Blood Flow

1. Explain baroreflex control of blood flow
2. Describe regulatory mechanisms for local adjustments to blood flow
3. Describe the role of hormones in the regulation of blood flow

Special Circulations

1. Discuss the special characteristics and control mechanisms of the pulmonary, coronary, cerebral, splanchnic, renal, cutaneous, and skeletal muscle circulations

Integrated Cardiovascular Response to Stress

1. Show how the cardiovascular system responds to physical stress including aerobic exercise and hemorrhage

RESPIRATORY

Pulmonary Structure and Function

1. Explain the structure and function of the respiratory system
2. Describe the respiratory and non-respiratory functions of the respiratory system

Mechanics of Ventilation

1. Explain the anatomical and physiological basis of inspiration and expiration
2. Define lung volumes and capacities derived from spirometry and the determinants of these volumes
3. Describe the factors that can modify ventilation

Ventilation-Perfusion Relationships

1. Show alveolar ventilation and related gas equations
2. Explain the role of ventilation-perfusion matching in the lung, including the consequences of mismatch
3. Compare the major mechanisms of hypoxemia and hypercapnia

Transport of Oxygen and Carbon Dioxide

1. Describe the fundamental principles of gas exchange in the lung and tissues, including O₂ utilization and CO₂ production
2. Explain the mechanisms of O₂ and CO₂ transport, including the role of hemoglobin

Regulation & Control of Breathing

1. Explain the central organization of breathing, and identify the role of chemoreceptors (central and peripheral) and mechanoreceptors in the regulation of respiration
2. Describe how the respiratory system responds to physical stress including exercise and high altitude

GI

1. Describe the organization and function of the gastrointestinal tract.
2. Explain the neural and humoral modulation of GI function.
3. Describe the function of each phase of digestion.
4. Describe the digestion and absorption of major nutrients.

Endo

1. Describe the synthesis, regulation or release, and actions of different hormones.
2. Explain how changes in regulatory controls for different hormones lead to pathophysiology.

Renal Physiology

1. Describe the mechanisms of glomerular filtration, tubular reabsorption and tubular secretion.
2. Demonstrate how water and solutes are handled at different sites of kidney and identify the major factors responsible for the production of urine.
3. Identify hormones that regulate glomerular filtration and tubular transport and describe the cellular mechanisms of the hormones

Body fluid and Electrolyte Balance

1. Explain the importance of body fluid and electrolyte balance.
2. Describe how kidney integrates with other systems to maintain the homeostasis of body fluid and electrolytes.

Acid-Base Balance

1. Describe how the kidneys regulate acid-base balance.
2. Explain the mechanisms of renal compensation for respiratory acid-base imbalance.