

**Western University: Physiology 2130 – Online  
Course Contents**

**Module 1: Introduction to Physiology Contents**

- Homeostasis
- Negative Feedback Control Systems
- Positive Feedback Control Systems
- Negative and Positive Feedback Control Systems
- The Body's Structural Hierarchy

**Module 2: Body Fluids**

- Body Fluid Compartments
- A Quick Look at Plasma
- Chemical Composition of the Body Fluids

**Module 3: Human Cell Contents**

- Basic Cell Organelles
- The Cell Membrane
- Cell Membrane Structure
- Phospholipids
- Membrane Proteins
- Membrane Transport Mechanisms
  - Diffusion
  - Diffusion of Lipid-Soluble Substances
  - Diffusion of Water-Soluble Substances
  - Diffusion Factors
  - Facilitated Diffusion
  - Active Transport
  - Osmosis
  - Units of Osmosis
- Isotonic, Hypotonic, Hypertonic
- Concentration Gradients and Membrane Permeabilities
- Membrane Potentials
  - The Resting Membrane Potential
  - Equilibrium Potential
- Sodium/Potassium Pump
- Functions of the Sodium/Potassium Pump
- The Significance of the Resting Membrane Potential

#### **Module 4: Nerve Cells**

- Structure of a Nerve Cell
- Voltage-Gated Channels
  - Voltage-Gated Sodium Channels
  - Inactivation of Na<sup>+</sup> Voltage-Gated Channel & the Absolute Refractory Period
  - Voltage-Gated Potassium Channel
- The Action Potential
  - Refractory Periods
  - Threshold for Starting an Action Potential
  - Changes in Na<sup>+</sup> and K<sup>+</sup> Permeability/Conductance during an Action Potential
- Action Potential Propagation
  - Propagation of the Action Potential Down an Unmyelinated Nerve
  - Unidirectional Nature of the Action Potential
  - Propagation of the Action Potential Down a Myelinated Nerve: Saltatory Conduction
- All-or-Nothing Principle of Action Potentials
- Multiple Sclerosis
- Synaptic Transmission
  - The Structure of the Neuromuscular Junction
  - Events at the Neuromuscular Junction

#### **Module 5: Muscles Contents**

- A Whole Look at the Structure of Muscle
- Structure of a Skeletal Muscle
- Structure of a Muscle Cell
  - Thin Myofilament
  - Thick Myofilament
  - Actin / Myosin Relationship
- Muscle Contraction—Sliding Filament Theory
- Excitation-Contraction Coupling and
- Muscle Contraction
- Relaxation of Muscle
- Actin-Myosin and ATP Cycle
- Rigor Mortis
- Altering the Force of Contraction
  - The Motor Unit
  - Recruitment of Motor Units
  - The Muscle Twitch
  - Summation of Twitch Contractions

#### **Module 6: Nervous System Contents**

- Basic Structure of the Brain
- Functional Structure of the Brain
- Neurons and Glial Cells
  - Neurons
  - Glial Cells
- The Language of the Nervous System and Neural Coding

- Ionic Basis of Postsynaptic Potentials—EPSPs and IPSPs
  - Excitatory Postsynaptic Potentials - EPSPs
  - Spatial and Temporal Summation of Synaptic Potentials
  - Spatial Summation
  - Temporal Summation
  - Inhibitory Postsynaptic Potentials—IPSPs
  - EPSPs and IPSPs—Synaptic Integration
- The Somatic-Motor System:
- Basic Structures and Organization
  - The Premotor Cortex
  - The Supplementary Motor Cortex
  - The Primary Motor Cortex
- Corticospinal Tract
- Muscle Receptors
- Muscle Spindles
- Alpha-Gamma Coactivation
- The Reflex Arc
- Stretch Reflex
- Cerebellum
- The Limbic System and the Hypothalamus
- Limbic System
- The Hypothalamus
- The Pituitary Gland
- The Autonomic Nervous System
- Pathways of the ANS
- Neurotransmitters of the ANS
- Functions of the ANS

### **Module 7: Sensory Systems Contents**

- Transduction of Environmental Information
- Environmental Stimuli
- Adequate Stimulus for the Receptor
- Receptor (Generator) Potentials
- Receptor Potentials and Neural Coding
- The Somatosensory System
  - Receptive Field
  - Somatosensory Pathways from the Periphery to the Brain:
- Spinothalamic (Anterolateral) Tract
- Dorsal Column, Medial Lemniscal System
  - Primary Somatosensory Cortex
  - The Somatosensory Homunculus
- The Visual System
  - The Eye
  - The Photoreceptors of the Eye—Rod Cells and Cone Cells
  - Other Cells of the Retina
  - Transduction of Light to Action Potentials
  - How Light Is Transformed into Action Potentials

- Types of Eye Movements
- The Auditory System
  - Structure
  - Structures of the Cochlea
  - What Is Sound?
  - Frequency and Intensity of Sound Waves
  - Transfer and Amplification of Sound Vibrations
  - Transduction of Sound to Action Potentials
  - Basilar (Basement) Membrane
  - Sound
- The Vestibular System
  - Structure of the Vestibular Apparatus
  - Semicircular Canals
  - Otolith Organ
  - The Incredible Hair Cell

### **Module 8: Circulatory System I: The Heart Contents**

- Anatomy—The Heart
- Anatomy—Circulation Through the Heart
- Myocardial Cells
  - Contractile Cells
  - Nodal/Conducting Cells
- Origins of Self-Excitability
  - SA Node Action Potential
- Myocardial Cells—Conducting System of the Heart
- Electrocardiogram (ECG)
- The Cardiac Cycle
  - Contribution of Atrial Contraction to Ventricular Filling
  - Cardiac Cycle—Period of Ejection
  - Cardiac Cycle—Heart Sounds
- Mechanical Performance of the Heart
  - Cardiac Output
  - The Control of Heart Rate
- Parasympathetic Nervous System
- Sympathetic Nervous System
  - Stroke Volume
- Control of Stroke Volume by the Autonomic Nervous System
- Control of Stroke Volume by Changing EDV and Preload
  - Frank-Starling Law of the Heart
  - Changing EDV
  - Changing EDV by Exercising

### **Module 9: Circulatory System Part II: Blood Vessels**

- Anatomy—General Organization
- Blood Volume Distribution

- Blood Velocity and Cross-Sectional Area of Vessels
- Pressure, Flow, and Resistance
  - Resistance to Blood Flow
- Control of Blood Flow in the Body
- Changing Blood Flow in Response to Needs of an Organ
- Blood Pressure and Resistance throughout the Systemic Circulation
- Structure of Blood Vessels
- Exchange of Substances across the Capillary
  - The Capillary—Diffusion
  - Filtration and Reabsorption (Starling Forces)
  - Hydrostatic Pressures
  - Osmotic Forces
  - Net Filtration Pressure
  - Starling Forces and the Lymphatic System
- The Lymphatic System
- Edema
- Control and Regulation of the Cardiovascular System
  - Local Control Mechanisms (Autoregulation)
  - \_ Myogenic Theory
  - \_ Metabolic Theory
    - Humoral Regulation
    - Neural Control Mechanisms
- Regulating Blood Pressure by the Baroreceptor Reflex

## **Module 10: Respiratory System Contents**

- Anatomy
  - Blood Vessels and Blood Flow
  - Histological Structure of an Alveolus
- Pressures of the Lungs
  - Intrapleural Pressure
  - Alveolar and Atmospheric Pressure
  - Transpulmonary Pressure
  - Pneumothorax
- Ventilation
  - Boyle's Law
  - Inspiration and Expiration
  - Mechanisms of Inspiration
  - Mechanisms of Expiration
- Pulmonary Compliance
  - Elastic Tissue Components
  - Surface Tension
  - Pulmonary Surfactant
  - Pulmonary Surfactant and Infant Respiratory Distress Syndrome
- Lung Volumes
  - Spirometer
  - Lung Volumes and Lung Capacities
  - Pulmonary Ventilation—Calculate

- Alveolar Ventilation—Calculate
- Alveolar Ventilation—Example
- Partial Pressure of Gases
  - Partial Pressures of Gases across the Alveoli—Diffusion
  - Partial Pressures—O<sub>2</sub> and CO<sub>2</sub> throughout the Circulatory System
- Oxygen Transport
  - Dissolved in Plasma
  - Hemoglobin
  - Loading and Unloading of Oxygen from Hemoglobin
  - Oxygen-Hemoglobin Dissociation Curve
- Carbon Dioxide Transport
  - Dissolved in Plasma
  - Bicarbonate Ion
  - The Chloride Shift
  - Carbamino Compounds
  - Loading and Unloading of Carbon Dioxide
- Origin of Respiration
  - Inhalation
  - Exhalation
  - Inhalation and Exhalation Combined
  - Apneustic and Pneumotaxic Centers
  - Voluntary Center
- Regulation of Respiration Regulation of Respiration
  - Negative Feedback
  - Chemoreceptors
  - Peripheral Chemoreceptors
  - Central Chemoreceptors

## **Module 11: Renal System, Water & Electrolyte Balance Contents**

- Functions of the Kidneys
- Anatomy of the Kidneys
  - Blood Supply of the Kidneys
  - The Nephron
  - Blood Supply of the Nephron
- The Renal Corpuscle
- Processes along the Nephron
- Glomerular Filtration (GFR)
  - Starling Forces
  - Glomerular Filtration Rate and Filtered Load
- Tubular Transport Mechanisms—Introduction
- Reabsorption
- Reabsorption—Regulated
- Reabsorption—Nonregulated
- Secretion
- Proximal Convolved Tubule
  - Reabsorption of Na<sup>+</sup> and Glucose

- Diabetes Mellitus
- Reabsorption of Water
- Reabsorption of Filtrate Back into the Circulation
- Concentration of Filtrate
- The Loop of Henle
  - Concentration Gradient in the Medulla of the Kidneys
  - Reabsorption of Na<sup>+</sup> and Water in the Descending Limb
  - Reabsorption of Na<sup>+</sup> and Water in the Ascending Limb
- Distal Convoluted Tubule
  - Reabsorption of Na<sup>+</sup> and Water
  - Reabsorption of Na<sup>+</sup>
- Collecting Duct—Reabsorption of Na<sup>+</sup> and Water
- Water Balance
  - Introduction
  - Regulation
  - Osmoreceptors
  - Antidiuretic Hormone (ADH)
  - ADH's Effect on the Cells
- Regulation of Sodium
  - Introduction
  - Aldosterone
  - The Renin-Angiotensin System
- Changes to the Filtrate
- Water Balance
- Hormones Involved with Water Balance

## **Module 12: The Regulation of Acid-Base Balance**

- Why is this Important?
- The Hydrogen Atom and Hydrogen Ion
- What are Acids and Bases?
- The pH Scale
- The Source of Acid in the Body
- Regulation of Hydrogen Ion Concentration
  - Regulation of H<sup>+</sup> Concentration—Buffers
  - Regulation of H<sup>+</sup> Concentration—Respiratory System
  - Regulation of H<sup>+</sup> Concentration—The Kidneys
- Abnormal pH—Alkalosis and Acidosis
  - Respiratory Acidosis and Alkalosis
  - Metabolic Acidosis and Alkalosis

## **Module 13: Endocrine System Contents**

- Endocrine System—Function
- Glands
- Hormones
  - Basic Features
  - Receptors

- Receptors for Hydrophobic Hormones
- Receptors for Hydrophilic Hormones
- The Second Messenger
- Tyrosine Kinase
- Ion Channels
- Control of Secretion
- The Hypothalamus
  - Structure and Function
  - Hormones and Releasing Factors
- The Pituitary Gland
  - Structure
  - Function
  - Anterior Pituitary Hormones
  - Posterior Pituitary Hormones
  - Regulation by Negative Feedback
  - Regulation by Negative Feedback (cont.)
- The Thyroid Gland
  - Structure
  - Function
  - Production of T3 and T4
  - Secretion of T3 and T4
  - Regulation of Secretion
  - Effects of T3 and T4 on the Body
  - Diseases
  - Diseases—Goiter
  - Calcitonin
- The Parathyroid Glands and Parathyroid Hormone
- The Adrenal Glands
  - Structure
  - Function
  - Production of Hormones
  - Cortisol
  - Diseases
- The Pancreas
- Structure and Function
  - Insulin
  - Glucagon
  - Somatostatin
  - Importance of Blood Glucose Regulation
  - Diabetes Mellitus
    - \_ Type I Diabetes Mellitus
    - \_ Type II Diabetes Mellitus

## **Module 14: Reproductive System Contents**

- Introduction
- The Reproductive System—Fetal Development of the Reproductive System
- The Male Reproductive System



- Structure
- Function
- Spermatogenesis
- Control of Testicular Function
- Testosterone
- The Female Reproductive System
  - Structure
  - Functions
  - The Ovaries
  - Oogenesis
  - Ovulation
  - Hormones of the Ovaries
  - The Menstrual Cycle

### **Module 15: Digestive System Contents**

- The Digestive System
  - Anatomy and Basic Function
  - Basic Processes
- The Mouth
- Swallowing
- The Stomach
  - Structure
  - Function
- Function of Gastric Secretions
- The Pancreas
  - Structure
  - Functions
- The Small Intestine
  - Structure
  - Function
  - Carbohydrate Digestion
    - \_ Lactose Intolerance
  - Carbohydrate Absorption
  - Protein Digestion
  - Protein Absorption
  - Fat and Lipids
  - Fat Digestion
    - \_ Bile
    - \_ Colipase
  - Fat Absorption
  - Absorption of Vitamins
  - Absorption of Water
  - Absorption of Ions
- Large Intestine
  - Structure
  - Function
- Digestive System

- Regulation
  - \_ The Enteric Nervous System
  - \_ The Autonomic Nervous System
  - \_ Gastrointestinal Motility
  - \_ Hormones of the Intestine
  - \_ Gastric Hormones
  - \_ Three Phases of Gastric Acid Secretion
- The Cephalic Phase
- The Gastric Phase
- The Intestinal Phase

### **Module 16: Metabolism Contents**

- The Building Blocks
- Energy Production
- Metabolism
  - A General Look
  - The Metabolism of Glucose
    - \_ Glycolysis
    - \_ Lactic Acid
    - \_ The Citric Acid Cycle
  - The Metabolism of Fats and Amino Acids
  - The Fed and Fasted State
  - Regulation
    - \_ Regulation by Insulin
    - \_ Diabetes Mellitus
    - \_ Glucagon
    - \_ Other Hormones