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+ 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+ and K+ 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
  o Excitatory Postsynaptic Potentials - EPSPs
  o Spatial and Temporal Summation of Synaptic Potentials
  o Spatial Summation
  o Temporal Summation
  o Inhibitory Postsynaptic Potentials—IPSPs
  o EPSPs and IPSPs—Synaptic Integration

The Somatic-Motor System:
  • Basic Structures and Organization
    o The Premotor Cortex
    o The Supplementary Motor Cortex
    o 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
    o Receptive Field
    o Somatosensory Pathways from the Periphery to the Brain:
      • Spinothalamic (Anterolateral) Tract
      • Dorsal Column, Medial Lemniscal System
        o Primary Somatosensory Cortex
        o The Somatosensory Homunculus
  • The Visual System
    o The Eye
    o The Photoreceptors of the Eye—Rod Cells and Cone Cells
    o Other Cells of the Retina
    o Transduction of Light to Action Potentials
    o How Light Is Transformed into Action Potentials
• Types of Eye Movements

• The Auditory System
  o Structure
  o Structures of the Cochlea
  o What Is Sound?
  o Frequency and Intensity of Sound Waves
  o Transfer and Amplification of Sound Vibrations
  o Transduction of Sound to Action Potentials
  o Basilar (Basement) Membrane
  o Sound

• The Vestibular System
  o Structure of the Vestibular Apparatus
  o Semicircular Canals
  o Otolith Organ
  o The Incredible Hair Cell

Module 8: Circulatory System I: The Heart Contents
• Anatomy—The Heart
• Anatomy—Circulation Through the Heart
• Myocardial Cells
  o Contractile Cells
  o Nodal/Conducting Cells
• Origins of Self-Excitability
  o SA Node Action Potential
• Myocardial Cells—Conducting System of the Heart
• Electrocardiogram (ECG)
• The Cardiac Cycle
  o Contribution of Atrial Contraction to Ventricular Filling
  o Cardiac Cycle—Period of Ejection
  o Cardiac Cycle—Heart Sounds
• Mechanical Performance of the Heart
  o Cardiac Output
  o The Control of Heart Rate
• Parasympathetic Nervous System
• Sympathetic Nervous System
  o Stroke Volume
• Control of Stroke Volume by the Autonomic Nervous System
• Control of Stroke Volume by Changing EDV and Preload
  o Frank-Starling Law of the Heart
  o Changing EDV
  o 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
o Alveolar Ventilation—Calculate
o Alveolar Ventilation—Example

• Partial Pressure of Gases
  o Partial Pressures of Gases across the Alveoli—Diffusion
  o Partial Pressures—O2 and CO2 throughout the Circulatory System

• Oxygen Transport
  o Dissolved in Plasma
  o Hemoglobin
  o Loading and Unloading of Oxygen from Hemoglobin
  o Oxygen-Hemoglobin Dissociation Curve

• Carbon Dioxide Transport
  o Dissolved in Plasma
  o Bicarbonate Ion
  o The Chloride Shift
  o Carbamino Compounds
  o Loading and Unloading of Carbon Dioxide

• Origin of Respiration
  o Inhalation
  o Exhalation
  o Inhalation and Exhalation Combined
  o Apneustic and Pneumotaxic Centers
  o Voluntary Center

• Regulation of Respiration
  o Negative Feedback
  o Chemoreceptors
  o Peripheral Chemoreceptors
  o Central Chemoreceptors

Module 11: Renal System, Water & Electrolyte Balance Contents

• Functions of the Kidneys
• Anatomy of the Kidneys
  o Blood Supply of the Kidneys
  o The Nephron
  o Blood Supply of the Nephron
• The Renal Corpuscle
• Processes along the Nephron
• Glomerular Filtration (GFR)
  o Starling Forces
  o Glomerular Filtration Rate and Filtered Load
• Tubular Transport Mechanisms—Introduction
• Reabsorption
• Reabsorption—Regulated
• Reabsorption—Nonregulated
• Secretion
• Proximal Convoluted Tubule
  o Reabsorption of Na+ and Glucose
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+ Concentration—Buffers
  - Regulation of H+ Concentration—Respiratory System
  - Regulation of H+ 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
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
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