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
  o Diffusion
  o Diffusion of Lipid-Soluble Substances
  o Diffusion of Water-Soluble Substances
  o Diffusion Factors
  o Facilitated Diffusion
  o Active Transport
  o Osmosis
  o Units of Osmosis
• Isotonic, Hypotonic, Hypertonic
• Concentration Gradients and Membrane Permeabilities
• Membrane Potentials
  o The Resting Membrane Potential
  o 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
  o 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
  o The Capillary—Diffusion
  o Filtration and Reabsorption (Starling Forces)
  o Hydrostatic Pressures
  o Osmotic Forces
  o Net Filtration Pressure
  o Starling Forces and the Lymphatic System
• The Lymphatic System
• Edema
• Control and Regulation of the Cardiovascular System
  o Local Control Mechanisms (Autoregulation)
    _ Myogenic Theory
    _ Metabolic Theory
  o Humoral Regulation
  o Neural Control Mechanisms
• Regulating Blood Pressure by the Baroreceptor Reflex

Module 10: Respiratory System Contents
• Anatomy
  o Blood Vessels and Blood Flow
  o Histological Structure of an Alveolus
• Pressures of the Lungs
  o Intrapleural Pressure
  o Alveolar and Atmospheric Pressure
  o Transpulmonary Pressure
  o Pneumothorax
• Ventilation
  o Boyle’s Law
  o Inspiration and Expiration
  o Mechanisms of Inspiration
  o Mechanisms of Expiration
• Pulmonary Compliance
  o Elastic Tissue Components
  o Surface Tension
  o Pulmonary Surfactant
  o Pulmonary Surfactant and Infant Respiratory Distress Syndrome
• Lung Volumes
  o Spirometer
  o Lung Volumes and Lung Capacities
  o Pulmonary Ventilation—Calculate
  o Alveolar Ventilation—Calculate
  o Alveolar Ventilation—Example
• Partial Pressure of Gases
• Partial Pressures of Gases across the Alveoli—Diffusion
• 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

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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
  o Diabetes Mellitus
  o Reabsorption of Water
  o Reabsorption of Filtrate Back into the Circulation
  o Concentration of Filtrate
• The Loop of Henle
  o Concentration Gradient in the Medulla of the Kidneys
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
  o Structure
  o Function
  o Anterior Pituitary Hormones
  o Posterior Pituitary Hormones
  o Regulation by Negative Feedback
  o Regulation by Negative Feedback (cont.)

• The Thyroid Gland
  o Structure
  o Function
  o Production of T3 and T4
  o Secretion of T3 and T4
  o Regulation of Secretion
  o Effects of T3 and T4 on the Body
  o Diseases
  o Diseases—Goiter
  o Calcitonin

• The Parathyroid Glands and Parathyroid Hormone

• The Adrenal Glands
  o Structure
  o Function
  o Production of Hormones
  o Cortisol
  o Diseases

• The Pancreas
• Structure and Function
  o Insulin
  o Glucagon
  o Somatostatin
  o Importance of Blood Glucose Regulation
  o 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
  o Structure
  o Function
  o Spermatogenesis
  o Control of Testicular Function
  o Testosterone

• The Female Reproductive System
  o Structure
  o Functions
  o The Ovaries
  o Oogenesis
Module 15: Digestive System Contents
• The Digestive System
  o Anatomy and Basic Function
  o Basic Processes
• The Mouth
• Swallowing
• The Stomach
  o Structure
  o Function
• Function of Gastric Secretions
• The Pancreas
  o Structure
  o Functions
• The Small Intestine
  o Structure
  o Function
  o Carbohydrate Digestion
    _ Lactose Intolerance
  o Carbohydrate Absorption
  o Protein Digestion
  o Protein Absorption
  o Fat and Lipids
  o Fat Digestion
    _ Bile
    _ Colipase
  o Fat Absorption
  o Absorption of Vitamins
  o Absorption of Water
  o Absorption of Ions
• Large Intestine
  o Structure
  o Function
• Digestive System
  o 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