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Biology (BIOL) 2257 Human Physiology with Lab (5 Units) CSU:UC

Prerequisites: None

Advisory: Eligible for ENGL 1500, MATH 1500, and successful completion of BIOL 1500, BIOL 1510, BIOL 2250, or CHEM 1510 strongly recommended

Total Hours: 48 hours lecture; 96 hours lab (144 hours total)

Catalog Description: Study of the physiological principles, function, integration and homeostasis of the human body at the cellular, tissue, organ, organ system and organism level: integumentary system, bone, skeletal, smooth and cardiac muscles, nervous system, sensory organs, cardiovascular system, lymphatic and immune systems, respiratory system, urinary system, digestive system, endocrine system, and reproductive system. This course is primarily intended for Nursing, Allied Health, Kinesiology, and other health related majors. Not open to students who have credit of C or better in Biology 2255 and/or Biology 2256.

Type of Class/Course: Degree Credit

Text: Tortora, Gerard J. and Bryan H. Derrickson *Principles of Anatomy and Physiology*. 14th ed. Hoboken: John Wiley & Sons, Inc., 2014. Print.

Lab Manual, 2013: Developed on site with the inclusion of the PowerLab System.

Additional Instructional Materials: Instructor syllabus and individual handouts for each laboratory exercise.

Course Objectives:

At the conclusion of this course, the student should be able to:

1. Describe and distinguish various roles of major classes of biomolecules in living cells,
2. Describe key functional features of different types of human cells and how they communicate,
3. Identify key functions of major organ systems and the physiological mechanisms underlying their operation,
4. Demonstrate an understanding of how organ systems of the body are integrated and regulated,
5. Demonstrate an understanding of how homeostasis is maintained in the body,
6. Demonstrate knowledge of metabolic and physiological disorders of the major organ systems,
7. Analyze experimental data to demonstrate physiological principles, and
8. Demonstrate an understanding of the scientific method, experimental design, and the philosophy of science. Apply the scientific method and philosophy of science by designing components of and carrying out physiological experiments.

Course Scope and Content: Lecture

- Unit I Introduction to Physiology
- A. Review of elementary tissues: epithelium, connective tissue, muscular, nervous.
 - B. Homeostasis of the bone, body temperatures (thermoregulation), body fluids, etc....
 - C. Review of human body systems.
 - D. Feedback Systems- Positive and Negative feedback loops
 - E. Metabolic processes of the body
- Unit II Cell Structure and Function
- A. Cell Size and Shape
 - B. Movement of materials across cell membranes
 - C. Active cell processes
 - D. Cell structures
 - E. Organization of cells
 - F. Reproduction of cells: normal and abnormal
- Unit III Chemical Organization of the Cell & Chemistry of Life
- A. Basic atomic structure
 - B. Chemical bonds used in living cells
 - C. Chemical elements used in cells
 - D. Water characteristics important to cellular function
 - E. Electrolyte functions in cells
 - F. Structure and function of major macromolecules in cells: carbohydrates, lipids, proteins, and nucleic acids
 - G. Control of cellular processes by nucleic acids
 - H. Uses of recombinant deoxyribonucleic acid (DNA) in human physiology
- Unit IV Muscular System
- A. Structure and function of muscle
 - B. Types of muscle tissue
 - C. Microscopic functional anatomy of skeletal muscle during relaxation and contraction
 - D. Excitation of skeletal muscle, membrane potentials, and action potentials.
 - E. Muscular disorders
 - F. Sliding filament theory of muscle contraction
 - G. Physiologic properties of muscles
 - H. Types of muscle contractions
 - I. Structural and functional characteristics of skeletal muscle types
 - J. Smooth muscle basic structure and function
 - K. Clinical application: Abnormal contractions of muscle tissue
- Unit V Nervous System
- A. Functions of the nervous system
 - B. Anatomical and function classification of the nervous system
 - C. Electrical properties of cells: membrane permeability, active transport, and Na/K pumps, resting potential
 - D. Nerve impulse, membrane potential and the action potential
 - E. Effects of chemicals and drugs on the synapse
 - F. Cells of the nervous system
 - G. Characteristic structure of neurons
 - H. Types of neurons
 - I. Physiologic properties of neurons
 - J. The nervous message: synapse function and types of neurotransmitters

- K. Components of a reflex arc
- L. Development of the brain
- M. Component structures of the brain
- N. Cerebral fluid formation and function
- O. Spinal cord structure and function
- P. Components of the peripheral nervous system (PNS)
- Q. Spinal and cranial nerve distribution and function
- R. Clinical application

- Unit VI The Autonomic Nervous System (ANS)
- A. Autonomic nervous system functional and structural anatomy
 - B. Parasympathetic division structure and function
 - C. Sympathetic division structure and function
 - D. Effects of sympathetic and parasympathetic stimulation
 - E. Effects of drugs on the ANS
 - F. Clinical application

- Unit VII Sensory Receptors And The Special Senses
- A. Structure and function of sensory receptors
 - B. Anatomy of the eye
 - C. Physiology of the eye: lens accommodation, retinal stimulation, nervous message transmission to central nervous system visual centers
 - D. Common disorders of the eye
 - E. Innervation of the ear for hearing and equilibrium
 - F. Anatomy of the ear: middle ear, internal ear, otolithic organs
 - G. Physiology of hearing: steps in sound perception for volume and pitch
 - H. Physiology of equilibrium: static and dynamic
 - I. Motion sickness related to equilibrium sense
 - J. Clinical application

- Unit VIII Endocrine System
- A. Comparison of the endocrine and nervous system function and regulation
 - B. Cell to cell communication
 - C. Control of the secretion of hormones
 - D. Pituitary gland hormones and their function
 - E. Thyroid and parathyroid glands hormones and their function
 - F. Adrenal gland hormones and their function
 - G. Pituitary gland hormones and their function
 - H. Pancreas gland hormones and their function
 - I. Gonad (ovary and teste) glands hormones and their function
 - J. Thymus gland hormones and their function
 - K. Other hormones and their function (erythropoietin and human chorionic gonadotropin)
 - L. Clinical application

- Unit IX Blood and Lymph
- A. Primary functions of blood the lymphatic system
 - B. Components of blood: plasma and formed elements
 - C. Life cycle of the erythrocyte
 - D. Hemostasis: vasoconstriction, platelet plug, and blood coagulation
 - E. Anticoagulant and thrombolytic agent use in hemostasis
 - F. Common disorders of the clotting mechanism

- G. Functions, formation and flow of lymph
- H. Clinical application

Unit X Immune System: Body Defenses Against Disease

- A. Nonspecific resistance to disease: physical, chemical, antimicrobial
- B. Role of integumentary system in non-specific defense
- C. Specific defense mechanisms: lymphatic system immune functions
- D. Antibody mediated immunity
- E. Cellular mediated immunity
- F. Allergy
- G. ABO and Rh blood groups: immunology and transfusion
- H. Transfusion reactions and hemolytic disease of the newborn
- I. Clinical application

Unit XI The Cardiovascular System

- A. Functions and regulation of the cardiovascular system
- B. Components of the cardiovascular system
- C. Heart anatomy
- D. The heart beat and nodal tissue
- E. Characteristics of cardiac muscle
- F. The heart as a pump
- G. Factors that control cardiac output
- H. Alterations of heart rate and rhythm
- I. Common heart pathology
- J. The cardiac cycle and the electrocardiogram
- K. Heart sounds
- L. Categories and functions of blood vessels
- M. Factors that affect blood pressure
- N. Factors that control pressure, flow, and velocity of fluid in a vessel
- O. Location of blood at a given time
- P. Blood return to the heart
- Q. Common disorders that affect the cardiovascular system: hypertension, hypotension, and shock
- R. Clinical application

Unit XII The Respiratory System

- A. Function, regulation and components of the respiratory system
- B. Exchange of air: volumes and capacities
- C. The gas composition of the atmosphere and the body tissues
- D. Transport of gasses by the blood
- E. Acid base balance in the body
- F. Common pulmonary disorders
- G. Clinical application

Unit XIII The Digestive System

- A. Function and components of the digestive system
- B. Nutrition and hypotheses of the control of feeding
- C. Functions and control of specific digestive organs: mouth, pharynx, esophagus, stomach, small intestine, large intestine, and liver
- D. Digestion in the small intestine
- E. Intermediary metabolism overview

- F. Common disorders of the digestive system
- G. Clinical application

Unit XIV

The Urinary System

- A. Function, regulation and components of the urinary system
- B. Microscopic structure of the nephron
- C. Basic processes of the nephron: nonselective filtration, selective reabsorption, and secretion
- D. Regulation of electrolyte and water balance in the body; production of hypertonic and hypertonic urine
- E. Clinical application

Unit XV

The Reproductive System

- A. Function, regulation and components of the female and male reproductive system
- B. Male reproductive components
- C. Formation of sperm and the determination of offspring sex
- D. Physiology of erection and ejaculation
- E. Semen constituents
- F. Female reproductive components
- G. The formation of ova and the pathway of the oocyte
- H. The role of male hormones in reproduction
- I. The role female hormones in reproduction
- J. The role of prostaglandins on reproduction
- K. Clinical application

Course Scope and Content: Laboratory

Unit I

Basic Laboratory Calculations, Concepts of Concentration, Cellular Metabolism and Biomolecules

- A. Laboratory calculation including the metric system and conversions, atomic number, atomic mass, serial dilution math problems, and molar and percent solution calculations.
- B. Performing osmosis experiments to demonstrate effects of concentration, molecular weight, and temperature on rates of diffusion.
- C. Perform kidney dialysis-urinary output experiment to understand the nature of osmosis and diffusion in the human body.
- D. Preparation of serial dilutions.
- E. Safety issues in handling blood specimens.
- F. Demonstration of the major groups of biomolecules through basic chemical and physical reactions.

Unit II

Using the Powerlab System to Study Human Muscle Physiology

- A. Explanation and demonstration of the Powerlab System with typical electrodes and transducers.
- B. Conduct an exercise to determine the motor points in human muscle.
- C. Determination of the major characteristics of human muscle.
- D. Determination of factors that affect fatigue in human muscle groups.
- E. Making electromyograms of human muscle activity in antagonistic muscles.

Unit III Sensory Modalities: Somatic and Special Senses

- A. Experimentation of visual sense.
- B. Experimentation of auditory sense.
- C. Experimentation of gustatory sense.
- D. Experimentation of proprioceptive sense.
- E. Experimentation of tactile sense.
- F. Experimentation of thermal sense.

Unit IV Cardiovascular System, Blood, Hemodynamics and Homeostasis

- A. Evaluation of formed element morphology: RBC, WBC and platelets.
- B. Determination of hemoglobin and hematocrit.
- C. Evaluation of hemostasis: bleeding time, clot formation and triple response.
- D. Determination of blood types: ABO and Rh.
- E. Determination of blood compatibility: transfusions.
- F. Evaluation of a normal ECG, heart sounds, and pulse wave.
- G. Determination of arterial blood pressure.
- H. Determination of venous pressure.
- I. Evaluation of one-way venous valves.
- J. Determination of capillary flow: white reaction, red reaction, hyperemia and microcirculation.
- K. Determination of vascular fitness with physical exercise.

Unit V Respiratory System

- A. Determination of respiratory volumes and capacities using a spirometer.
- B. Evaluation of the regulation of acid-base balance through the process of respiration.

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 6 hours per week outside of the regular class time doing the following:

- 1. Studying course lectures notes, handouts, and textbook reading,
- 2. Answering questions on study assignments,
- 3. Completing required reading as assigned, and
- 4. Completing written work as assigned.

Methods of Instruction:

- 1. Lectures,
- 2. Pre and Post Class discussions,
- 3. Multimedia presentations,
- 4. Performance of laboratory exercises under direct supervision of the instructor, and
- 5. Observation by students of demonstration exercises performed by the instructor.

Methods of Evaluation:

- 1. Proctored, closed book/closed note examinations,

2. Written laboratory reports, and
3. Study assignments.

Laboratory Category: Extensive Laboratory

Pre delivery criteria: All of the following criteria are met by this lab.

1. Curriculum development for each lab.
2. Published schedule of individual laboratory activities.
3. Published laboratory activity objectives.
4. Published methods of evaluation.
5. Supervision of equipment maintenance, laboratory setup, and acquisition of lab materials and supplies.

During laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is physically present in lab when students are performing lab activities.
2. Instructor is responsible for active facilitation of laboratory learning.
3. Instructor is responsible for active delivery of curriculum.
4. Instructor is required for safety and mentoring of lab activities.
5. Instructor is responsible for presentation of significant evaluation.

Post laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is responsible for personal evaluation of significant student outcomes (lab exercises, exams, practicals, notebooks, portfolios, etc.) that become a component of the student grade that cover the majority of lab exercises performed during the course.
2. Instructor is responsible for supervision of laboratory clean up of equipment and materials.