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## Course Outline for BIO 7B

### HUMAN PHYSIOLOGY

Effective: Fall 2019

#### I. CATALOG DESCRIPTION:

BIO 7B — HUMAN PHYSIOLOGY — 5.00 units

Function and regulation of the human body. This course examines general, cellular, and molecular interactions that integrate the organ systems to maintain homeostasis. Human responses and computer simulations are used to collect and analyze data. Designed for nursing, physical and occupational therapy, and other health sciences majors.

3.00 Units Lecture 2.00 Units Lab

#### Prerequisite

CHEM 30A - Intro and Applied Chemistry I  
with a minimum grade of C  
or

CHEM 31 - Intro to College Chemistry  
with a minimum grade of C  
or

CHEM 1A - General College Chemistry I  
with a minimum grade of C

BIO 7A - Human Anatomy  
with a minimum grade of C

#### Strongly Recommended

CHEM 30B - Intro and Applied Chemistry II  
with a minimum grade of C

- Eligibility for ENG 1A -

#### Grading Methods:

Letter Grade

#### Discipline:

- Biological Sciences

	<b>MIN</b>
<b>Lecture Hours:</b>	54.00
<b>Lab Hours:</b>	108.00
<b>Total Hours:</b>	162.00

#### II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

#### III. PREREQUISITE AND/OR ADVISORY SKILLS:

**Before entering the course a student should be able to:**

##### A. CHEM30A

1. Make unit conversions in the metric system using the prefixes mega, kilo, deci, centi, milli, and micro;
2. Describe the structure of the atom in terms of proton, neutrons, and electrons;
3. Identify and describe effects of intermolecular forces;
4. Use standard nomenclature;
5. Describe ideal gas laws qualitatively and quantitatively;
6. Define concentration units of solutions and use these definitions in problem solving—molarity, osmolarity, and percent;
7. Describe properties of solutions, including osmotic pressure and processes such as osmosis and dialysis and their application to biological systems;
8. Interpret reactions according to acid-base theory;
9. Use the pH scale to compare acidity;
10. Describe buffer solutions in terms of their composition and function, especially ones in biological systems;

11. Use Le Châtelier's principle to predict the qualitative effects of changes in concentration, temperature and pH on an equilibrium;
  12. Describe factors affecting the rates of reactions;
  13. Describe types of nuclear radiation, isotopes and their half-life, nuclear reactions, units of radiation, and medical/industrial uses;
  14. Collect and analyze scientific data;
  15. Use an electronic balance and various pieces of volumetric glassware;
  16. Record laboratory observations in a useful, detailed manner;
- B. CHEM31
1. Define matter and energy;
  2. Classify states of matter and describe phase changes using the kinetic molecular theory;
  3. Solve conversion problems, including metric system and metric to English, and density problems, using dimensional analysis;
  4. Describe basic atomic structure using simple quantum theory;
  5. Write electron configurations for main group elements and state their relationship to placement of the elements on the periodic table;
  6. Perform calculations using the gas laws;
  7. Define ionic and covalent bonds and give properties of each;
  8. Perform calculations involving molarity and percent concentration for solutions;
  9. Classify solutes and write net ionic equations to determine if reaction has occurred;
  10. Define acids and bases by Arrhenius and Bronsted-Lowry theories;
  11. Perform calculations involving pH, pOH,  $[H^+]$ , and  $[OH^-]$ ;
  12. Quantitatively transfer solid and liquid chemicals from one container to another;
  13. Accurately measure liquids using analytical volumetric glassware such as graduated cylinders, pipettes, and burettes;
  14. Measure temperature and barometric pressure;
  15. Accurately and comprehensively observe chemical and physical changes, and record such information in a scientifically correct form;
  16. Correctly plot data and determine the slope of any resulting straight line, using both conventional and computer methods;
  17. Determine the conductivity of a variety of chemicals in solution;
  18. Maintain laboratory records in proper form and detail.
  19. Health and Safety
  20. describe and follow self-protection procedures
  21. describe and follow basic laboratory safety rules
  22. describe and follow procedures for safe handling of chemicals and glassware
- C. CHEM1A
1. Solve complex problems involving the concepts listed under course content;
  2. Write short explanations describing various chemical phenomena studied;
  3. Write balanced chemical equations including net ionic equations;
  4. Describe the different models of the atom;
  5. Use standard nomenclature and notation;
  6. Describe hybridization, geometry and polarity for molecules and polyatomic ions;
  7. Draw Lewis dot structures for molecules and polyatomic ions;
  8. Describe bonding in compounds and ions;
  9. Define concentrations of solutions in terms of molarity, molality, normality, percent composition, and ppm;
  10. Determine the extent of molecular reactions through the study of equilibrium;
  11. Apply Le Châtelier's principle to equilibria;
  12. Utilize library and Internet resources in Chemistry;
  13. Collect and analyze scientific data, using statistical and graphical methods;
  14. Acquire and analyze data with a computer and appropriate software.
- D. BIO7A
1. Speak and write using anatomical terminology
  2. Identify organizational levels of the body and explain how they are related
  3. Use anatomical terminology for regions, positions, planes and cavities
  4. Identify cellular organelles and relate the cellular organelles to the function of a variety of cell types
  5. Identify histological tissues and describe the structures, and functions of specific types of epithelial, connective, muscle and nervous tissues
  6. Give the structure, function, and location of body membranes
  7. Identify the structures and describe the function of the integumentary system
  8. Describe the microscopic structure of skeletal muscles
  9. Identify selected human muscles and describe the action of selected human muscles
  10. List the structural and functional divisions of the nervous system and describe the microscopic structure of a typical neuron
  11. Describe the anatomy of peripheral nerves including spinal and cranial nerves and the anatomy of the autonomic nervous system
  12. Identify and describe the anatomy of the brain and spinal cord
  13. Describe the structure of sensory receptors and selected special senses, and the neural pathways to the central nervous system
  14. Describe the location and structure of the major endocrine glands
  15. Identify components of blood and list their functions
  16. Identify the organs of the cardiovascular system, and describe the anatomy of the heart and blood vessels
  17. Trace the arterial and venous paths of circulation
  18. Describe the structure and function of the lymphatic system
  19. Describe the structures and functions of the respiratory system
  20. Describe the structures and functions of the organs and accessory organs of the digestive system
  21. Describe the gross anatomy and functions of urinary organs and the microscopic structure of the nephron
  22. Describe the structures and functions of the male and female reproductive systems
  23. Compare normal versus diseased structures, injured or age-related structural changes in any or all of the above organ systems

**Before entering this course, it is strongly recommended that the student should be able to:**

- A. CHEM30B
1. Distinguish between properties of organic compounds and inorganic compounds;
  2. Describe the structure, properties, and functions of carbohydrates, lipids, amino acids and proteins, and nucleic acids
  3. Interpret the reactions involved in the metabolism of carbohydrates, lipids, proteins, and nucleic acids
  4. Describe the factors affecting fluids and electrolytes, including pH, in physiological systems
  5. Perform laboratory experiments in an efficient, safe, and purposeful manner;
- B. -Eligibility for ENG 1A
1. Use strategies to assess a text's difficulty, purpose, and main idea prior to the act of reading
  2. Annotate a text during the act of reading
  3. Employ strategies that enable a critical evaluation of a text
  4. Respond critically to a text through class discussions and writing

5. Write effective summaries of texts that avoid wording and sentence structure of the original
6. Organize coherent essays around a central idea or a position
7. Apply structural elements in writing that are appropriate to the audience and purpose
8. Provide appropriate and accurate evidence to support positions and conclusions
9. Produce written work that reflects academic integrity and responsibility, particularly when integrating the exact language and ideas of an outside text into one's own writing
10. Utilize effective grammar recall to check sentences for correct grammar and mechanics
11. Proofread his/her own and others' prose

#### IV. MEASURABLE OBJECTIVES:

**Upon completion of this course, the student should be able to:**

- A. Explain fundamental laws of physics, chemistry and physiology as they relate to body organization and function;
- B. Review the chemistry of life, with emphasis on nucleic acid and protein function, including anabolic and catabolic metabolism, such as transcription, translation, replication, enzymatic reactions, aerobic and anaerobic respiration;
- C. Discuss water, electrolyte and acid base balance;
- D. Review all the organelles and their functions;
- E. Define homeostasis and outline how negative and positive feedback loops are used in physiology and medicine;
- F. Review structure and function of the cell membrane and describe the various active and passive transport systems and cell to cell communication modes;
- G. Explain the functions of the integumentary system;
- H. Distinguish between the major body control systems;
- I. Explain the Role of bone tissue in homeostasis;
- J. Explain membrane potentials and action potentials, define and explain excitation contraction coupling, and review various mechanisms of synaptic junctions;
- K. Review the nervous system and its subdivisions with emphasis on molecular neuron function and integration;
- L. Review general sensation and explain how mechanical, chemical, and light energy is converted into nerve impulses in the special sensory organs;
- M. Describe how visual accommodation is achieved and describe the defects associated with myopia, hyperopia, presbyopia and astigmatism;
- N. Discuss skeletal muscle structure and function, including regulation of contraction and excitation-contraction coupling, and skeletal muscle metabolism during exercise;
- O. Explain the functioning of the endocrine system, its regulation, and its integration with the nervous system;
- P. Outline thermoregulation;
- Q. Discuss the overall, cellular, and molecular function of the cardiovascular system and its regulation;
- R. Explain the function of the heart and cardiac cycle and obtain and analyze an ECG tracing;
- S. Distinguish between the various functions of the lymphatic system and describe mechanisms of nonspecific and specific immunity;
- T. Explain respiratory system function and regulation and apply a spirometer to conduct pulmonary function tests;
- U. Explain urinary system function and regulation and distinguish between the composition of glomerular filtrate and urine;
- V. Discuss the functions of the different parts of the digestive system and evaluate the role of proper nutrition;
- W. Reproductive functions and regulation;
- X. Review clinical applications by collecting clinical data such as pulse, blood pressure, urinalysis, blood indices and spirometric indices;

#### V. CONTENT:

- A. Review of fundamentally related chemical and physical principles
  1. Periodic table
  2. Reactivity
  3. Molecules and bonds
  4. Ions and isotopes
  5. Law of mass action
  6. Diffraction and its function as a lab tool
  7. Solutions and solutes
  8. Biomolecules
- B. Cell Biology and Cellular Metabolism
  1. Tissue Remodeling
  2. Apoptosis
  3. Stem cells
  4. Enzymes
  5. Anabolic and Catabolic metabolisms
  6. Cellular respiration
- C. Membrane Dynamics
  1. Diffusion and its variables
  2. Active transport systems
  3. Establishment of a resting membrane potential
- D. Cell Communication and Integration
  1. Gap junctions
  2. Autocrines and paracrines
  3. Hormones and Neurohormones
  4. Cytokines
  5. Signal transduction
  6. Homeostasis
  7. Response and feedback loops
- E. Endocrine Physiology
  1. Hormone classes and mechanisms of action
  2. Control of hormone release
  3. Hormone interactions
  4. Endocrine pathologies
- F. Physiology of the Excitable Cell
  1. Depolarization, repolarization
  2. Hyperpolarization
  3. Threshold
  4. Action potential
  5. Graded potential
  6. Temporal and spatial summation
  7. Refractory period, absolute and relative
- G. Synaptic Physiology
  1. Chemical synapse vs. electrical synapse
  2. Role of calcium in neurotransmitter release
  3. Classes of neurotransmitters

4. Postsynaptic responses: EPSP vs. IPSP
5. Inactivation of neurotransmitters
6. Integration of neural information
- H. Central Nervous System Physiology
  1. Neural networks
  2. Blood-brain barrier
  3. Gray vs. white matter
  4. Functional areas of the cerebral cortex
  5. Sensory homunculus
- I. Sensory Reception
  1. Sensory transduction
  2. Receptive fields
  3. Somatic senses
  4. Chemoreception: gustation and olfaction
  5. Vision – Photo transduction
  6. Hearing – Sound transduction
  7. Equilibrium
- J. Muscle Physiology
  1. Sliding filament theory
  2. Excitation-contraction-coupling
  3. ATP supply and phosphocreatine
  4. Muscle contraction studies: muscle twitch, tension development, summation, Treppe, tetanus
  5. isometric and isotonic contractions
- K. Cardiovascular Physiology
  1. Autorhythmic cells and electrical conduction of the heart
  2. Action potentials in myocardial cells
  3. Cardiac excitation-contraction coupling
  4. Cardiac cycle and pumping action of heart
  5. Cardiac output
  6. Autonomic modulation of heart rate
  7. EKG - normal/abnormal
  8. Intracardial and intravascular hemodynamics
  9. Blood pressure and its measurements
  10. Regulation of blood pressure
  11. Peripheral resistance
  12. Exchange at capillaries
  13. Role of lymphatic system
  14. Neural and endocrine considerations
  15. Thrombus and embolus formation
  16. Ischemia and infarction
- L. Blood Physiology
  1. Blood plasma and formed elements
  2. Blood cell production
  3. Blood typing
  4. Coagulation
  5. Blood chemistry and blood pathology
- M. Pulmonary Physiology
  1. Gas laws
  2. Pulmonary ventilation
  3. Gas exchange in lungs and tissue
  4. Gas transport in blood
  5. Hemoglobin vs. myoglobin vs. fetal hemoglobin
  6. Oxygen dissociation curves
  7. Lung compliance and elastance
  8. Surfactant
  9. Indices of spirometry
  10. Respiration and the acid-base balance of the body
  11. Regulation of ventilation
  12. Breathing under special conditions: high altitude climbing and deep sea diving
- N. Kidney Physiology – Fluid and Electrolyte Balance
  1. Sources of loss and gain of water
  2. Filtration, Reabsorption, Secretion
  3. Excretion
  4. Micturition
  5. Water balance and urine concentration
  6. Sodium balance
  7. Potassium balance
  8. Acid-Base balance
  9. Renal failure and its consequences
- O. Digestive System Physiology
  1. Motility
  2. Secretion
  3. Digestion: mechanical and chemical
  4. Roles of salivary glands, pancreas and gall bladder
  5. Absorption
  6. Regulation of GI function
  7. Foods, minerals and vitamins
  8. Carbohydrate, protein and fat metabolism
  9. Energy balance and heat production
  10. Metabolic disorders
- P. Immune System
  1. Innate immunity
  2. Physical and chemical barriers, inflammation, NK cells
  3. Acquired immunity
  4. Clonal selection and deletion of B and T cells
  5. Antigen presenting cells and MHC molecules
  6. Antibody classes and functions
  7. Allergies and autoimmune disorders
- Q. Reproductive Physiology
  1. Mitosis vs. meiosis

2. Gamete production and fertilization
3. Menstrual cycle
4. Human cytogenetics and birth defects
5. Survey of birth control techniques
6. Survey of infertility treatments
7. Hormonal changes during pregnancy
8. Puberty
9. Menopause and Andropause

#### VI. LAB CONTENT:

- A. Medical Math review
- B. Concentration and dilution review
- C. Cell transport mechanisms and permeability
- D. Biochemical measurements – spectrophotometry and graphing
- E. Enzyme activity and kinetics of salivary amylase
- F. VNTR polymorphism – Polymerase chain reaction and DNA analysis
- G. Neurophysiology of nerve impulses
- H. Human reflex physiology
  - I. General sensation – Receptor physiology
  - J. Clinical examination of the eye – Conducting visual tests and experiments
  - K. Clinical examination of the ear – Conducting laboratory tests of hearing and equilibrium
  - L. Clinical examination of olfaction and taste
- M. Skeletal muscle physiology – Electrical stimulation, isometric and isotonic contractions
- N. Human cardiovascular physiology – Conduction system of the heart and EKG studies
- O. Human cardiovascular physiology – Blood pressure and pulse determination
- P. Cardiovascular dynamics – Mechanics of circulation, vessel resistance, and pump mechanics (computer simulations)
- Q. Frog cardiovascular physiology – Assessing physical and chemical modifiers of the heart rate (computer simulations)
- R. Blood – Hematologic tests
- S. The immune response – Antibodies and tests for their presence
- T. Respiratory sounds – Clinical assessment of lung function
- U. Spirometry – Respiratory volumes and capacities (wet lab and computer simulations)
- V. Role of respiratory system in acid-base balance of blood
- W. Chemical and physical processes of digestion
- X. Urinalysis – clinical evaluation of urine
- Y. Renal Physiology – The function of the nephron (computer simulations)
- A@. Acid-base balance – Respiratory vs. metabolic acidosis and alkalosis, renal system compensation (computer simulations)
- AA. Experiments on hormonal action – Hormones and metabolism, hormone replacement therapy, insulin and diabetes (computer simulations)
- AB. Physiology of reproduction – Gametogenesis and the female cycles
- AC. Enzyme-Linked Immunosorbent Assay (ELISA) – Immunological pregnancy testing
- AD. Principles of Heredity

#### VII. METHODS OF INSTRUCTION:

- A. **Directed Study** - Readings from the text and the laboratory manual
- B. **Student Presentations** - Student-led presentations
- C. Derivation of conclusions and clinical implications
- D. **Lab** - Laboratory observations, collection and analysis of data. Lab reports
- E. **Simulations** - Computer interactive laboratory exercises
- F. **Guest Lecturers** - Experts from fields related to human Physiology will share their knowledge during (maximum of) 1 hour talks.
- G. **Projects** - Research project, culminating in paper and/or oral PowerPoint presentation. Other written assignments .
- H. **Audio-visual Activity** - Utilization of video, CD-ROM and other audio visual aids
- I. **Lecture** - Multimedia lecture presentations and discussions on major themes and concepts

#### VIII. TYPICAL ASSIGNMENTS:

- A. Reading and Discussion
  1. Read Chapter 14, "Cardiovascular Physiology," by D. U. Silverthorn, pp. 449-484. Be prepared to list the events of the cardiac cycle in sequence, beginning with atrial and ventricular diastole. Note where valves open and close. Be prepared to list and briefly explain four types of information that the EKG provides about the heart.
  2. Read Chapter 19, "The Kidneys," by D. U. Silverthorn, pp. 599-619. Be prepared to define, compare and contrast filtration, secretion and excretion. What are the advantages of a kidney that filters a large volume of fluid and then reabsorbs 99% of it?
- B. Collaborative learning
  1. With your lab partner work through exercise 31: Electrocardiography. Record ECGs for your lab partner first under baseline (resting) conditions and then under conditions of fairly strenuous exercise. Finally, take a recording while your lab partner holds his or her breath. Then have your lab partner do the same with you. Compare the baseline recordings with the other recordings and determine the reasons for the observed differences in the recordings.
  2. National Center for Case Study Teaching in Science: In a small group, cooperate while delving into neurophysiology and analyzing the case of "Escape from Planet Soma". Read the background information then discuss and answer the integrated questions, such as: "How will the non-functional sodium channels affect the signaling capabilities of a neuron?" and "What effect will the destruction of myelin have on the signaling capability of a neuron?" During a whole class discussion share your findings with the rest of your colleagues.
- C. Writing
  1. Complete the review sheets for exercise 31 in your laboratory manual.
  2. Research and write a report on your chosen topic. Turn in the written report to your instructor and be prepared to present your report to the rest of the class in no more than ten minutes. Pretend that you are addressing your report to a group of patients just diagnosed with this disease. Examples of topics: Diagnosis and classification of Diabetes mellitus – A clinical education; Causes and consequences of clinical hypertension – A clinical education.

#### IX. EVALUATION:

##### Methods/Frequency

- A. Exams/Tests
  - 4 per semester
- B. Quizzes
  - Weekly
- C. Papers
  - Written research paper
- D. Oral Presentation
  - Presentation of research report
- E. Class Participation

- Participation in class discussions
- F. Lab Activities
  - Laboratory reports and practicals

X. TYPICAL TEXTS:

1. Silverthorn, Dee. *Human Physiology an Integrated Approach*. 8th ed., Pearson, 2018.
2. Fox, Stuart , and Krista Rompolski. *Human Physiology*. 15th ed., McGraw Hill, 2018.
3. Derrickson, Bryan. *Human Physiology*. 2nd ed., Wiley, 2019.
4. Robert Amitrano. Anatomy & Physiology Laboratory Manual. Cengage Learning , 2013.
5. Martin, T., & Prentice-Craver, C.. Laboratory Manual for Human Anatomy & Physiology Main Version. McGraw Hill , 2018.
6. Marieb, E., & Smith, L.. Human Anatomy & Physiology Laboratory Manual. Pearson , 2019.
7. Mastering A&P. Pearson Publishing, (current ).
8. PhysioEx. Pearson Publishing, (current).

XI. OTHER MATERIALS REQUIRED OF STUDENTS:

- A. One black fine point sharpie.