COURSE OUTLINE
Anatomy and Physiology

Course Description
BI 240. Anatomy and Physiology. 5 hours credit. This course will enable the student to develop an understanding of the principles in structure and function of the human body systems. The student will study basic chemistry, cells, tissues, and these body systems: integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, urinary, digestive, and reproductive. The student will participate in three hours of lecture and four hours of laboratory per week. This course is an intermediate study designed primarily for pre-professional students in health-related fields. The department highly recommends BI 050 and AH 201 with a C or better. The learning outcomes and competencies detailed in this outline meet, or exceed the learning outcomes and competencies specified by the Kansas Core Outcomes Project for this course, as approved by the Kansas Board of Regents (Transfers as BIO2020).

Required Materials

McGraw-Hill Connect or ConnectPlus. A 120-day subscription is required and may be included with a new textbook.

* - For complete textbook information, refer to https://bookstore.butlercc.edu

Butler-assessed Outcomes
The intention is for the student to be able to:
1. Apply the concept that form dictates function within the human body to different situations
2. Discuss how different body systems are interrelated
3. Apply the concept of homeostasis to body systems
4. Identify macroscopic and microscopic structures on slides, models, dissected/preserved specimens, and/or human cadaver.

Learning PACT Skills that will be developed and documented in this course
Through involvement in this course, the student will develop ability in the following PACT skill area(s):

Analytical Thinking Skills
Critical thinking - Through the application of the scientific process to human anatomy and physiology, the student will develop not only the general concepts, but also skills that can be applied and transferred to real life analytical types of situations in health related fields.

Communication Skills
Reception and interpretation of messages - Through application of the scientific process to human anatomy and physiology, the student will be able to interpret and evaluate application questions related to human anatomy and physiology.

**Technology Skills**
- Discipline-specific technology - Through the use of proper microscope technique, the student will be able to identify tissues found in the human body.

**Major Summative Assessment Task(s)**
These Butler-assessed Learning Outcome(s) and the Learning PACT skill(s) will be demonstrated by:
1. Completing the departmental final exam (A-skill) which involves real-world questions that the student must interpret (C-Skill) and applying knowledge in order to demonstrate a comprehensive understanding of anatomy and physiology of the human body.
2. Demonstrating the ability to use the microscope (T-skill) to identify tissues found in the human body.

**Skills or Competencies**
Actions that are essential to achieve the course outcomes:
1. Discuss homeostasis
2. Use microscopes to inspect slides of human tissues
3. Understand the chemical and metabolic basis of life
4. Describe the structure and function(s) of a eukaryotic human cells and tissues
5. Describe the structure and function(s) of these organ systems: integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, urinary, digestive, and reproductive.

**Learning Units**
I. Introduction to study of anatomy and physiology
   A. Define anatomy and physiology
   B. Describe processes or functions that are associated with living things:
      C. metabolism, excretion, movement, growth, differentiation/maturation, responsiveness, irritability, excitability, reproduction, evolution/adaptation, secretion, absorption, and circulation
   D. Define homeostasis or dynamic equilibrium and stress
   E. Describe how nervous, endocrine and cardiovascular systems regulate homeostasis
   F. Define negative feedback mechanisms
   G. Describe these specific examples of negative feedback: blood pressure and blood glucose levels
   H. Define positive feedback mechanisms
   I. Describe these specific examples of positive feedback: uterine contractions during labor and coagulation of blood
   J. Describe each level of the structural hierarchy from largest to smallest: organ system (and major functions), organ, tissue, cell, organelle, molecule, and atom
II. Directional terms and body cavities, cell, and microscope lab exercises
A. Define the following terms: mid-sagittal plane, frontal/coronal plane, and transverse/horizontal, ventral/anterior, dorsal/posterior, superficial, deep, proximal, distal, inferior, superior, lateral, medial, parietal, and visceral
B. Name one specific organ per line found in the dorsal cavity - cranial cavity and vertebral canal, and four specific organs in the ventral cavity - thoracic cavity, abdominal cavity, and pelvic cavity
C. Identify on a diagram, write a description and functions for the following organelles: cell membrane, nucleus, nucleolus, cytoplasm, mitochondrion, Golgi complex, lysosome, ribosome, rough endoplasmic reticulum, smooth endoplasmic reticulum, vesicle, centrioles, microfilament, microtubules, cilia, and flagellum
D. Define these terms: field of view or field, parfocal, and resolving power or resolution
E. Identify and state the and functions of these parts of the microscope: base, arm, ocular or eyepiece, body tube, rotating nosepiece, objective or lens, mechanical stage, mechanical stage knobs, coarse adjustment knob, fine adjustment knob, iris diaphragm/condenser, light source, and light switch
F. Describe proper handling of the microscope and calculate total magnification

III. Chemistry
A. Define atom and element
B. Distinguish between protons, neutrons, and electrons
C. Define atomic number, atomic mass, and isotopes
D. Describe how to use the Periodic Table of Elements
E. Draw and label two atoms
F. Describe stability in an atom and the octet rule
G. Show the bonding potentials for hydrogen, oxygen, nitrogen, and carbon
H. Distinguish between molecular and structural formula
I. Describe the ionic bond
J. Diagram the atomic structure of two ionic compounds
K. Define covalent bond
L. Diagram the atomic structure of the covalent molecules carbon dioxide (CO₂) and nitrogen (N₂)
M. Distinguish between nonpolar covalent bond and polar covalent bond
N. Describe these properties of water: polarity, hydrogen bonding, and solvency
O. Distinguish between solute, solvent, and solution
P. Draw the atomic structure of a water molecule and label the slight electrical charges
Q. Write the chemical reaction of the ionization of a water molecule
R. Describe pH, acid, base, and buffer
S. Distinguish between inorganic and organic compounds
T. Identify the molecular and structural formulas for the following functional groups: hydroxyl (alcohol), methyl, amino, carboxyl (organic acid), and phosphate
U. Identify the monomers and polymers listed: carbohydrates-monosaccharides (glucose and fructose), disaccharides (sucrose), and polysaccharides (starch and glycogen); lipids- saturated fatty acid, unsaturated fatty acid, triglyceride, phospholipid (solubility differences), and cholesterol (steroid); proteins- amino acid, peptide bond, describe the four levels of structure in proteins: level of structure, number of amino acid chains, types of bonds present, shape, and ability to function, and denaturation; nucleic acid- list the components of a nucleotide, ATP or adenosine triphosphate, and compare the nucleic acids: DNA and RNA

IV. Metabolism
B. Define cellular respiration
C. Understand the general chemical equation for cellular respiration
D. Compare and contrast energy input, efficiency of energy production, oxygen use, by-products, and cellular location with respect to glycolysis, the Krebs’ (citric acid or TCA) cycle, and the electron transport chain
E. Distinguish between anaerobic and aerobic respiration

V. The cellular level of organization
A. Define eukaryote cell
B. Describe the functions of these organelles and know if there is a membrane present: nucleus, nucleolus, cytoplasm, mitochondrion, Golgi complex/apparatus, lysosome, rough endoplasmic reticulum, ribosome, smooth endoplasmic reticulum, centrioles, vesicle, microfilament, and microtubule
C. List the compounds found in the membranes of the cell
D. Describe the functions of the following membrane proteins: receptor protein (site/active site), enzyme, ion channel, gated ion channel or carrier protein, cell-identity markers, and cell-adhesion molecules
E. Know the difference between these surface extensions: microvilli, cilia and flagella
F. Compare passive to active forms of transportation of ions through the plasma membrane
G. Define these passive forms of transport: simple diffusion, facilitated diffusion, osmosis, and describe filtration and hydrostatic pressure
H. Describe the types of solutions: hypotonic, hypertonic, and isotonic
I. Describe the direction water flows across a selectively permeable membrane in hypotonic, hypertonic, and isotonic solutions
J. Define active transport and list examples
K. Define these types of bulk transport: phagocytosis, pinocytosis, and exocytosis
L. Define the process of protein synthesis: unraveling the DNA molecule, transcription, and translation
M. Explain how RNA is synthesized
N. Explain the roles of mRNA, rRNA, and tRNA in protein synthesis
O. Define these terms: cell division, mitosis and cytokinesis
P. Distinguish between normal cell division and cancerous cell division: rate of growth, maturation of cells, and contact inhibition

VI. Tissues
A. Define tissue and histology
B. Name the four major types of tissues and their generalized functions
C. Distinguish between the types of arrangement of cells: simple, stratified, and pseudostratified
D. Describe the three shapes of epithelial cells: squamous, cuboidal, columnar, and goblet cells
E. Describe three characteristics, not functions, of epithelial tissue
F. Define these terms: muscle fiber, striations, and intercalated disc
G. Distinguish between the muscle tissues: striations present, number of nuclei per cell/fiber, shape of fibers, and type of neural control
H. Define these terms; neuron, nerve fiber, and neuroglia
I. Describe matrix
J. List the chemical composition of ground substance in connective tissue
K. Describe three kinds of protein fibers found in matrix of connective tissues
L. Identify and state function(s) of the specific cells found in these connective tissues: areolar tissue, adipose tissue, dense tissue, cartilages, and bone tissues
M. List the locations of elastic cartilage and fibrocartilage
N. Know why is blood a type of connective tissue
O. Identify, state locations, and functions of these tissues: simple cuboidal epithelium, simple columnar epithelium, pseudostratified columnar epithelium, stratified squamous epithelium, smooth muscle tissue, skeletal muscle tissue, cardiac muscle tissue, areolar tissue, adipose tissue, dense tissue, hyaline cartilage, compact bone tissue, and nervous tissue

VII. Integumentary system
A. Describe the five functions of the integumentary system including homeostasis and temperature regulation
B. Name the primary organ of the Integumentary system
C. List the accessory organs/structures of the integumentary system
D. Identify and describe tissue types in the epidermis, dermis and hypodermis
E. Name the specialized cells and their functions found in the epidermis
F. Name and describe the layers of the epidermis
G. List the three protein pigments that contribute to skin color
H. Name the type of tissues present in the following structures: hair follicles and nails, piloerector muscle, merocrine/apocrine glands, and sebaceous gland
I. Recognize these structures and state the type of tissue present on slides and models: hair follicle, piloerector muscle, merocrine gland, apocrine gland, sebaceous gland, epidermis, dermis, and hypodermis

VIII. Skeletal system
A. Describe at least five major functions of skeletal system
B. Describe the four types of bone cells
C. Describe the components of bone matrix
D. Describe the arrangement of spongy bone tissue as trabeculae
E. Label these structures of an osteon (functional unit of compact bone):
   osteonic/central canal, lamellae, osteocyte, canaliculi, and perforating canal
F. Define epiphysis, epiphyseal plate/line, and diaphysis
G. List the tissues found in bones and describe their arrangement: cartilages, dense tissues, compact and spongy bone tissues
H. Define ossification
I. Distinguish between intramembranous ossification and endochondral ossification
J. List the chemical agents that affect bone tissue development and how (building or reabsorption)
K. Describe how the hormone calcitriol (vitamin D3) affects bone growth and development
L. Describe how calcitonin affects bone growth and development
M. Describe how parathyroid hormone affects bone growth and development
N. Describe the negative feedback mechanism for controlling blood calcium levels
O. Define the physiological classes of joints: diarthrosis, amphiarthrosis, and synarthrosis
P. Define the anatomical classes of joints: fibrous, cartilaginous, and synovial joint
Q. Distinguish these joints by the physiological and anatomical classes: suture, gomphosis, syndesmosis, synchondrosis, and symphysis
R. Describe these structures found in synovial joints: synovial membrane, articular cartilage, ligament, and accessory structures (meniscus, bursae, pad of adipose tissue)
S. List examples of these synovial joints: ball-and-socket, hinge, pivot, plane, saddle, and condyloid
T. Define the two major divisions of the skeletal system, axial and appendicular and list subdivisions within each
U. Define the following terms: alveolus, canal, condyle, crest, facet, fissure, foramen, fossa, head, meatus, process, sinus, spine, sulcus, trochanter, tubercle, and tuberosity
V. Identify the structures on the articulated skeleton, individual skulls, and individual in the axial skeleton:
   frontal bone: supraorbital foramen/notch, sinuses; nasal bone; lacrimal bone, lacrimal fossa/canal; sphenoid: optic foramen/canal, greater wing, lesser wing, sella turcica; ethmoid: perpendicular plate, cribriform plate with olfactory formina, crista galli; vomer; zygomatic bone; maxilla, alveolar process, palatine process, infraorbital foramen; mandible: mental foramen, ramus, condyle, coronoid process; parietal bone: squamosal suture, sagittal suture; occipital: condyle, foramen magnum, lambdoid suture; temporal bone: external auditory meatus, mastoid process, carotid canal, jugular foramen, mandibular fossa, styloid process; palatine bone; hyoid bone; atlas: transverse foramen, superior articular facet; axis:
dens, spinous process, superior articular facet; for all vertebrae: body, spinous process, vertebral foramen, transverse process, vertebral arch (lamina and pedicle); cervical vertebrae, transverse foramen; thoracic vertebrae, costal facet; lumbar vertebrae, superior articular facet; sacrum: posterior (dorsal) foramina, hiatus, canal median crest, anterior (ventral) foramina; coccyx; sternum: body, xiphoid process, manubrium; rib: body, head, neck, tubercle Identify left and right structures on the skeleton, individual skulls, and individual in the appendicular skeleton: clavicle, acromial end, sternal end; scapula, acromion, coracoid process, glenoid cavity, spine, infraspinatus fossa, supraspinatus fossa; humerus: coronoid fossa, deltoid tuberosity, greater tubercle, head, olecranon fossa, trochlea; ulna: coronoid process, olecranon, styloid process, trochlear notch, radial notch; radius: head, styloid process, tuberosity, ulnar notch; carpals; metacarpals; phalanges; ilium: acetabulum, crest, greater sciatic notch; ischium: obturator foramen, spine, tuberosity; pubis: acetabulum, obturator foramen, symphysis; femur: greater trochanter, head, neck, lateral condyle, lesser trochanter, medial condyle; patella; fibula: head, lateral malleolus; tibia: anterior crest, lateral condyle, medial malleolus, tuberosity; tarsals; metatarsals; and phalanges

IX. Muscular System
A. List the five functions of the skeletal muscular system
B. List the characteristics of muscle cells: excitability, contractility, extensibility, and elasticity
C. Describe the general structure of a skeletal muscle organ (endomysium, perimysium, fascicle, epimysium, fasciae, tendons, and aponeurosis)
D. Describe the comprehensive microanatomy of the muscle cell to the level of sarcomere bands (sarcoplasm, glycogen, myoglobin, sarcolemma with transverse tubules, sarcoplasmic reticulum with terminal cisternae, thick filaments, myosin, thin filaments, actin, tropomyosin, troponin, A band, H band, I band, Z disc/line, and cross-bridge)
E. Define motor unit, its components, neuromuscular junction (synaptic knob, synaptic vesicles, synaptic cleft, junctional folds, receptor proteins, acetylcholine and acetylcholinesterase)
F. Describe the sequence of events for excitation, contraction, and relaxation
G. Define threshold stimulus, latent period and refractory period
H. Define muscle twitch, treppe, incomplete tetany and complete tetany
I. Describe the energy sources for muscle excitation, contraction and relaxation, initial (myokinase and creatine kinase), short-term or secondary, and long-term energy sources
J. Describe muscle fatigue and oxygen debt
K. Define the following terms: flexion, extension, abduction, adduction, elevation, depression, supination, pronation, plantar flexion, dorsiflexion, retraction, protraction, inversion, and eversion
L. Describe the origins and insertions for these muscles: sternocleidomastoid,
pectoralis major, biceps brachii, triceps brachii, rectus abdominis, rectus femoris, and gastrocnemius

M. Identify locations and functions for these muscles: frontalis, orbicularis oculi, orbicularis oris, zygomatici, buccinator, temporalis, masseter, sternocleidomastoid, abdominal obliques, transversus abdominis, rectus abdominis, pectoralis major, pectoralis minor, serratus anterior, trapezius, teres major, rhomboids, rotator cuff: supraspinatus, infraspinatus, subscapularis and teres minor; latissimus dorsi, deltoid, triceps brachii, brachialis, biceps brachii, brachioradialis, pronator teres, flexor carpi radialis, flexor carpi ulnaris, extensor carpi radialis longus, extensor carpi ulnaris, gluteus maximus, gluteus medius, tensor fascia latae, quadriceps femoris: rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius; sartorius, gracilis, adductor magnus, adductor longus, hamstrings: biceps femoris, semimembranosus, and semitendinosus; tibialis anterior, extensor digitorum longus, fibularis longus, gastrocnemius, and soleus

X. Nervous System I-Nerve cells
A. List and describe the anatomical and physiological divisions as well as the organs within them
B. Describe the following components of a neuron: cell body (soma), axon, dendrite, nucleolus, neurofibrils, axon hillock, and Nissl bodies
C. Distinguish these structural groups of neurons: multipolar neuron, bipolar neuron, and unipolar neuron
D. Distinguish between the three physiological types of neurons: sensory/aferent neurons, interneuron/association neurons, and motor/efferent neurons
E. Describe the components and functions of the neuroglia: oligodendrites, ependymal cells, microglia, astrocytes, satellite cells, and Schwann’s cells.
F. Define myelin and describe myelin sheath, neurilemma, internodes, and nodes of Ranvier
G. Distinguish between white matter and gray matter in the spinal cord with respect to myelination
H. Describe the sodium potassium-pump, events of depolarization, action/local/resting membrane potential, repolarization, and refractory period with respect to electrical potential
I. Distinguish between impulse conduction along myelinated and unmyelinated fibers
J. Define and describe the components of the synapse between two neurons.
K. Define neurotransmitter and name the four chemical types of neurotransmitters
L. Describe synaptic transmission
M. Give an example of an excitatory and inhibitory neurotransmitter (ie. ACh and GABA)
N. List the functions of the spinal cord
O. Describe the anatomy of the spinal cord
P. Distinguish between the ascending tracts and descending neural tracts
Q. Define meninges and list the three meningeal layers and spaces
R. Define nerve and describe the anatomic arrangement
S. Define spinal roots and distinguish between the anterior/ventral and posterior/dorsal roots
T. List the number of pairs in each section of spinal nerves
U. Define neural plexus and list the nerves in each
V. Define somatic/spinal reflex and describe the reflex arc
W. Distinguish between monosynaptic and polysynaptic reflexes
X. Describe decussation or crossing-over
Y. Distinguish between these pathways: posterior/dorsal columns, spinothalamic tracts, and the corticospinal tracts (number of nerves, where they cross/decussate, which roots, thalamus vs. internal capsule)

XI. Nervous System II: Brain, cranial nerves, and autonomic nervous system
A. Define the following: longitudinal fissure, lateral sulcus, central sulcus, and gyrus (gyri)
B. List the structures located in these regions of the brain: forebrain, diencephalon, hindbrain, and brainstem
C. Describe the meninges covering the brain
D. Describe the arrangement of white matter and gray matter in the brain
E. Define ventricle
F. Define choroid plexus
G. List in sequence the structures involved in circulating cerebrospinal fluid
H. Describe the production of cerebrospinal fluid
I. List the functions of cerebrospinal fluid
J. Describe the functions and location of the insula
K. Describe the functions and location of the reticular formation
L. Describe the function of basal nuclei/ganglia and dopamine
M. Describe the functions and the components of the limbic system
N. Discuss the twelve pairs of cranial nerves
O. Describe visceral or autonomic reflexes
P. List the structures of the visceral (autonomic) reflex arc
Q. Define preganglionic and postganglionic neuron
R. Distinguish between the sympathetic and parasympathetic divisions of the autonomic nervous system: anatomical names, nerves, location of autonomic ganglia, postganglionic fiber secretion(s), general function(s), and specific actions
S. Describe cholinergic and adrenergic fibers and name their types of receptors
T. Define sensation
U. List the four requirements to experience a sensation
V. Describe the stimulus associated with these types of receptors: chemoreceptor, thermoreceptor, nociceptors, mechanoreceptors (baroreceptors), photoreceptors, and proprioceptors
W. Define these terms: afferent or sensory neuron, efferent or motor neuron, association or interneuron, soma, dendrite, axon, meninges, decussation or crossing-over, autonomic nervous system, somatic nervous system, receptor organ, myelin, Schwann cell, astrocyte, and nerve plexus
X. Identify and state the tissues present in these structures: dura mater, arachnoid mater, pia mater, and central canal

Y. Identify the structure and state the functions of these structures: dorsal column, ventral column, lateral column, dorsal horn, lateral horn, ventral horn, gray commissure, dorsal root, dorsal root ganglion, ventral root, spinal nerve, cortex of cerebellum, arbor vitae of cerebellum, medulla oblongata, pons, cerebral peduncles, red nucleus, corpora quadrigemina, cerebrum aqueduct, thalamus, hypothalamus, pituitary gland, pineal gland, lateral ventricles, third ventricle, fourth ventricle, corpus callosum, primary olfactory area of frontal lobe, Broca’s area of frontal lobe, primary motor area of frontal lobe, primary somesthetic area of parietal lobe, primary gustatory area of parietal lobe, primary auditory area of temporal lobe, Wernicke’s area, and primary visual cortex of occipital lobe

Z. Identify and state the specific functions for the twelve pairs of cranial nerves

AA. Identify the following peripheral nerves: medial cutaneous nerve, axillary nerve, median nerve, musculocutaneous nerve, ulnar nerve, radial nerve, femoral nerve, saphenous nerve, obturator nerve, sciatic nerve, tibial nerve, common fibularis nerve, deep fibularis nerve, and superficial fibularis nerve

XII. Endocrine system
A. Identify and state hormones secreted by these glands: hypothalamus, anterior pituitary gland, posterior pituitary gland, pineal gland, thyroid gland, parathyroid glands, adrenal cortex, adrenal medulla, pancreas, ovaries, and testes
B. Distinguish between exocrine gland and endocrine glands (hypothalamus, anterior pituitary gland, posterior pituitary gland, pineal gland, thyroid gland, parathyroid glands, adrenal cortex, adrenal medulla, pancreas, ovaries, and testes)
C. Describe the general hormonal pathway: hormone, transport protein, target cell/tissue, receptor protein, hormone-receptor complex, and second messenger
D. Describe the steroid mode of action and non-steroid (monoamines, oligopeptides, polypeptides, and glycoproteins)
E. Describe the hormones, target organs and actions of these glands: hypothalamus, anterior pituitary gland, posterior pituitary gland, thyroid gland, parathyroid glands, adrenal gland, and pancreas
F. Describe types of hormone interactions and processes: permissive, antagonistic, and synergistic effects; negative feedback; and positive feedback
G. List chemical messengers secreted by tissues embedded within various organs: heart, liver, and kidneys

XIII. Lymphatic system
A. Describe the general functions of lymph system
B. Describe the tissue layers and functions of these vessels: lymph capillaries, collecting vessels, lymph trunks, cisternae chili, right lymphatic duct, and thoracic duct
C. Describe the composition and formation of lymph
D. Describe the composition, location, and functions of the lacteals, Peyer’s patches, tonsils, thymus, spleen, and lymph nodes
E. Describe these cells: T cells (cytotoxic, helper 1, helper 2, and memory), natural killer cells, B lymphocytes (plasma cells), and macrophages

XIV. Blood
A. Describe vascular tissue or blood and list the functions of blood
B. Define antigen and antibody
C. List the formed elements
D. Describe the term hematocrit
E. Know the normal values of blood: average volume in adults, pH, hematocrit, hemoglobin, erythrocytes, leukocytes, and platelets
F. List the components or solutes found in plasma, including nitrogenous wastes and plasma proteins: (albumin, globulin, and fibrinogen)
G. Define hemopoiesis and hemocytoblast (stem cell)
H. List the tissues that produce blood cells
I. Describe the erythrocytes
J. Define hemoglobin, heme with Fe (iron), and globin
K. Describe agglutination, blood typing, the ABO and Rh typing systems, and erythroblastosis fetalis
L. Describe leukocyte: granular vs. agranular, percentage, and specific functions
M. Describe the structure and functions of megakaryocyte and platelets
N. Describe hemostasis, vascular spasm, platelet-plug, and coagulation
O. Define clotting factor, list four examples of clotting factors, and describe use of calcium ion and vitamin K in coagulation
P. Distinguish between intrinsic and extrinsic coagulation including the cascade of common pathway of coagulation (clotting)

XV. Heart and blood vessels
A. List the organs (blood and capillaries) of the cardiovascular system
B. List the functions of the cardiovascular system
C. Describe these circulation pathways: pulmonary circuit, systemic circuit, and hepatic portal system
D. Describe the location of the heart, apex, and base
E. Define pericardium, describe components (parietal pericardium, pericardial cavity, and visceral pericardium), and list its functions
F. Describe and name the three layers of the heart wall (epicardium, myocardium, and endocardium)
G. Describe the function and components of the atroventricular valves: cusps, tendinous cords, and papillary muscles
H. Describe the composition and function of the semilunar valves
I. Describe the coronary circuit
J. Describe characteristics of cardiac muscle tissue and fibers
K. Define and describe cardiac conduction system: sinoatrial node, atrioventricular node, atrioventricular bundle, right and left bundle branches, and Purkinje fibers
L. Define systole and diastole
M. Describe the nervous system structures that control heart rate: cardiac center of medulla oblongata, cardiac accelerator nerve, and vagus nerve
N. Distinguish between depolarization and repolarization
O. List the events measured by the P-wave, QRS - complex and T-wave
P. Define these arrhythmias: flutter, fibrillation, tachycardia, and bradycardia
Q. List the events of the cardiac cycle (complete heartbeat)
R. Describe causes of the heart sounds (lub + dub)
S. State normal heart rate or beats per minute for adults
T. Define stroke volume, end-diastolic volume, end-systolic volume, ejection fraction, and cardiac output, and conditions that increase or decrease it
U. Describe the effects on heart rate: blood pressure, body temperature, respiratory rate, and very little K+
V. Define blood vessel, layers of the vessel wall including endothelium
W. List the traits of the aorta, arteries and arterioles
X. Describe and state functions of capillaries and fenestrations
Y. List the traits of venules, veins, and vena cavae
Z. State the effects of sympathetic and parasympathetic stimulation on arteries: skeletal muscle arteries, skin arteries, and visceral organ arteries
AA. Define and give examples of blood reservoirs
BB. List the areas and percentages of blood volume distribution at rest
CC. Define systemic blood pressure and clinical blood pressure measures
DD. Describe how cardiac output, total blood volume and resistance affect blood pressure
EE. Define resistance and describe how blood's viscosity, vessel length, and vessel diameter influence resistance
FF. Describe how blood pressure is regulated including hormones for vasoconstriction/vasodilation

XVI. Lab of cardiovascular system
A. Identify the formed elements: erythrocytes, neutrophil, monocyte, lymphocyte, basophil, and eosinophil
B. Discuss the normal adult ranges for blood glucose, hematocrit, and hemoglobin
C. Name three conditions associated with anemia
D. Determine blood type hematocrit, hemoglobin and glucose of an actual specimen
E. Identify the following structures on the human heart model and on the *pig heart: inferior vena cava, superior vena cava, coronary sinus, *right atrium, *tricuspid valve, *right ventricle, pulmonary valve, *pulmonary trunk, pulmonary artery, pulmonary vein, *left atrium, *bicuspid valve or mitral valve, *left ventricle, *aortic valve, aorta/segments, left and right coronary arteries, left anterior descending artery, circumflex branch, great cardiac vein,
posterior interventricular vein or middle cardiac vein, *interventricular septum,*papillary muscle, and *tendinous cords
F. Distinguish between an artery and a vein as well and identify the layers in a cross section
G. Identify these arteries and veins, on the full muscle models and flat plaques:
   superior vena cava, left/right brachiocephalic veins, thoracic aorta, brachiocephalic trunk, internal jugular vein, left/right common carotid arteries, left/right subclavian veins/arteries, axillary veins/arteries, brachial veins/arteries, radial veins/arteries, ulnar veins/arteries, inferior vena cava, hepatic portal vein, hepatic vein, renal veins/arteries, common iliac veins/arteries, external iliac veins/arteries, internal iliac vein/arteries, femoral veins/arteries, great saphenous vein, abdominal aorta, celiac artery or celiac trunk, common hepatic artery, superior mesenteric artery, and inferior mesenteric artery
H. Trace the blood flow through the heart

XVII. Respiratory system
A. Distinguish between the upper and lower respiratory tracts
B. Describe the functions of the respiratory system
C. Describe the components and functions of the nose (nasal cavity and vestibule, nasal septum, conchae/turbinates, hard/soft palates), pharynx, larynx (epiglottis, cricoid and thyroid cartilages, vocal cords), trachea, bronchial tree, lungs (alveoli, squamous alveolar cells, greater alveolar cells, alveolar macrophages) and pleura
D. Discuss the gas laws
E. Describe the mechanisms of the three gas exchanges: pulmonary ventilation, alveolar gas exchange (external respiration), and systemic gas exchange (internal respiration)
F. Define the following respiratory volumes and capacities: tidal volume, inspiratory reserve volume, expiratory reserve volume, residual volume, vital capacity, total lung capacity, and dead spaces
G. Describe role of the medulla oblongata and pons: dorsal respiratory group (inspiratory center), ventral respiratory group (expiratory center), and the pontine center in the pons
H. Describe the stimuli detected and locations of chemoreceptors, baroreceptors, and irritant receptors needed to regulate the respiratory system
I. List the components of atmospheric air
J. Describe all the ways O\textsubscript{2} and CO\textsubscript{2} gas is transported in the blood
K. Describe how O\textsubscript{2} saturation of hemoglobin, temperature and pH affects O\textsubscript{2} diffusion rates
XVIII. Lab for respiratory system
   A. Know location and functions of these respiratory structures on rats, models,
      and plaques, external nares, nasal vestibule, superior conchae, medial
      conchae, inferior conchae, hard palate, soft palate, nasopharynx, oropharynx,
      laryngopharynx, epiglottis, thyroid cartilage, cricoid cartilage, vocal cords,
      trachea, main (primary) bronchi, lobar (secondary) bronchi, bronchioles, right
      lung: superior lobe, medial lobe, inferior lobe, left lung: superior lobe and
      inferior lobe, diaphragm, external intercostal muscles, internal intercostal
      muscles, and other accessory muscles
   B. Compare height with inspiratory and expiratory reserve volumes

XIX. Urinary system
   A. Describe the functions of the urinary system
   B. List the nitrogenous wastes and its source(s)
   C. Describe these structures of the kidney: renal capsule, renal cortex, renal
      medulla, renal pyramids, renal columns, renal papilla, minor calyx, major
      calyx, renal pelvis, nephron, renal corpuscle (glomerulus and glomerular
      capsule), and renal tubules (proximal convoluted tubule, descending limb of
      nephron loop, ascending limb of nephron loop, distal convoluted tubule, and
      collecting ducts)
   D. List the blood vessel pathway from the renal artery to the renal vein.
   E. Describe the urine-producing processes: glomerular filtration, tubular
      reabsorption, tubular secretion, and water conservation
   F. Define juxtaglomerular apparatus
   G. Describe how the filtration rate is regulated: autoregulation, sympathetic
      control, and the renin-angiotensin mechanism
   H. Describe how aldosterone, natriuretic peptide, and antidiuretic hormone
      influence water/electrolyte balance
   I. Describe these normal attributes of urine: color, clarity, odor, osmolarity,
      pH, substances present, and average daily volume
   J. Define the term diabetes and name the hormone deficient in diabetes mellitus
      and diabetes insipidus
   K. Describe the components and functions of the ureters, urinary bladder,
      detrusor muscle, internal/external sphincters, and urethra
   L. Describe the differences between male and female urethra
   M. Distinguish between the involuntary and voluntary reflexes for micturition
   N. Describe the compartments/places where water is distributed from largest to
      smallest quantities
   O. Describe how fluids move through the body compartments
   P. Describe the sources of water (input) and the routes of water loss (output)
      and list the excretory organs
   Q. Describe how the antidiuretic hormone regulates fluid intake
   R. Describe how the thirst response is triggered by the hypothalamus
   S. Describe electrolyte vs. non-electrolyte, (milliequivalents per liter, mEq/L),
      cations and anions with respect to urinary processes
T. Describe the most common electrolytes by major locations and functions within the body: Ca$^{2+}$, Na$^+$, K$^+$, Cl$^-$, HPO$_4^{2-}$, and HCO$_3^-$

U. Describe how aldosterone, calcitonin, and parathyroid hormone regulate Na$^+$, K$^+$ and Ca$^{2+}$

V. Define pH, the pH scale, acids, and bases

W. Describe buffer, chemical buffer systems, and physiological buffer systems

X. Describe how bicarbonate-carbonic acid, phosphate and protein chemical buffering systems work

Y. Describe how the respiratory and urinary systems work as physiological buffer systems

Z. Describe symptoms, metabolic causes, and respiratory causes of acidosis and alkalosis

XX. Lab for urinary system

A. Know location and functions of these urinary structures on the rats, human models, plaques, etc.: kidney, renal capsule, renal cortex, renal medulla, renal pyramids, renal papilla, renal columns, minor calyx, major calyx, renal pelvis, ureter, urinary bladder, urethra, and adrenal gland

B. Label components of a nephron: glomerulus, glomerular capsule, proximal convoluted tubule, descending limb of nephron loop, ascending limb of nephron loop, distal convoluted tubule, and collecting ducts

XXI. Digestive system

A. Define these functions and terms associated with digestive functions: gustation, enzyme, substrate, ingestion, mastication, chemical digestion, mechanical digestion, deglutition, peristalsis, mixing action, absorption, and defecation

B. List the organs of the gastrointestinal or digestive tract and the accessory structures of the digestive system

C. Describe these basic tissue layers of the gastrointestinal tract organs and their functions: mucosa, submucosa, muscularis, serosa, and adventia

D. Describe these extensions of the parietal peritoneum: mesentery, lesser omentum, and greater omentum

E. Describe the components and functions of the mouth: oral cavity, cheeks, lips, tongue, hard palate, soft palate, and teeth (incisors, canines, premolars and molars)

F. Describe the extrinsic salivary glands

G. Define bolus and chyme

H. Describe the functions of these components of saliva: salivary amylase, lingual lipase, mucus, lysozyme, and immunoglobulin A

I. Compare and contrast the tissues of the esophagus and the functions of the esophagus and gastroesophageal sphincter

J. Compare and contrast the tissue specifications of the stomach and its functions
K. Describe the functions of these components of gastric juice: mucus, hydrochloric acid, intrinsic factor, pepsinogen, gastric lipase, gastrin, serotonin, histamine and somatostatin
L. Describe the structures and major digestive functions of the liver
M. Describe the components and pathway of bile (bile ductules to duodenum).
N. Describe the functions of the gallbladder and the pancreas
O. Describe the functions of these components of pancreatic juice: trypsinogen, chymotrypsinsogen, procarboxypeptidase, pancreatic amylase, pancreatic lipase, ribonuclease, and deoxyribonuclease
P. Compare and contrast the tissues of the small and large intestine and their functions
Q. List the contents of feces
R. Know location/function(s) of these digestive structures on rats, models, and plaques: parotid salivary gland, submandibular salivary gland, sublingual salivary gland, tongue, hard palate, soft palate, mesentery, esophagus, gastroesophageal sphincter, forestomach (cardiac region of stomach), fundus of stomach, body of stomach, pyloric stomach, pyloric sphincter, duodenum, jejunum, ileum, ileocecal valve, cecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum, anus, lobes of liver (right, left, quadrate, caudate), hepatic duct, common hepatic duct, gallbladder, cystic duct, pancreas, pancreatic, and spleen

XXII. Reproductive system
A. Describe sexual reproduction, gametes, and zygote
B. List the primary, secondary internal (spermatic ducts and accessory glands), and secondary external male reproductive organs
C. Describe the primary and secondary functions of the male reproductive system
D. Describe gubernaculum and cryptorchidism
E. Describe the structures and functions of the scrotum, including the dartos and cremaster muscles
F. Describe these structures found in the testis: tunica albuginea, seminiferous tubule, spermatogenic cell, nurse cell (sustenacular cells), interstitial cell, lobules, and rete testes
G. Describe the arrangement of tissues in the spermatic ducts
H. List the secretions and actions of these exocrine glands: seminal vesicles, prostate gland, and bulbourethral (Cowper’s) glands
I. Describe the structures of the penis including: body, corpus spongiosum, corpora cavernosa, glans penis, and prepuce
J. Describe the primary and secondary functions of the female reproductive system
K. Name the primary, secondary internal, and secondary external (vulva) female reproductive organs
L. Name the ligaments that hold the ovaries in place
M. Describe the structures and functions of the fallopian tubes/oviducts/uterine tubes (fimbriae, infundibulum), uterus, vagina, and mammary glands
N. Distinguish between menarche and menopause
O. Define meiosis, chromatid, chromatin, and chromosome
P. Describe terms associated with the amount (number) of chromosomes present: diploid, haploid, and replicated chromosome
Q. Describe the stages of spermatogenesis (spermatogonium, primary spermatocyte, secondary spermatocyte, spermatid, and spermatozoa) and hormones that stimulate them
R. Describe these components and function of a sperm: head (nucleus), acrosome (hyaluronidase), body (mitochondria), and tail (flagellum)
S. Describe the action of the components of semen: fructose, serine protease, sperminolysin, and prostaglandins
T. Describe the parasympathetic response of erection and the sympathetic responses of emission and ejaculation
U. Describe unequal cytokinesis and oogenesis
V. Describe these developmental stages of the follicle: primordial follicle, primary follicle (granulosa cells), and Graafian (mature) follicle
W. Define ovulation, corpus luteum, and corona radiata
X. Describe these cells produced during oogenesis: oogonium, primary oocyte, secondary oocyte, and ootid/ovum
Y. Describe the phases and hormones associated with the menstrual cycles

XXIII. Lab for reproductive system
A. Know location and functions of these male reproductive structures on rats, models, and plaques: testis, epididymis, vas deferens, ejaculatory duct, urethra, seminal vesicles, prostate gland, bulbourethral (Cowper’s) glands, corpus spongiosum, corpus cavernosum, glans penis, prepuce, and scrotum.
B. Know location and functions of these female reproductive structures on rats, models, and plaques: ovary, oviduct/Fallopian tube/uterine tube, uterus: fundus, body and cervix, uterine horns (rat), vagina, labium minor, labium major, Bartholin’s (vestibular) glands, clitoris, and mons pubis

Learning Activities
Independent and collaborative learning activities will be assigned to assist the student to achieve the intended learning outcomes. The following teaching/learning activities will assist the student to achieve course outcomes: lecture, lab, class discussion, group activities, written assignment, computer activities/simulations, textbook reading assignments, and other activities at the discretion of the instructor.

Grade Determination
The student will be evaluated on the basis of performance on the following: quizzes, hand-written assignments, on-line (via Connect) assignments, written assignments, oral presentations, lecture exams, and lab practicals.