BSC 2086 and BSC2086L

Human Anatomy and Physiology 2 and Lab

Course Description

BSC2086	**Human Anatomy and Physiology 2**	**(3) P**
BSC2086L	**Human Anatomy and Physiology 2 Lab**	**(1) P**

This course and its laboratory component use an integrated approach to discuss topics of the main organs systems of the human body. These include: the endocrine, reproductive, cardiovascular, respiratory, urinary and digestive systems along with the topics of metabolism, energy use and fluid and electrolyte balance. This sequence meets the needs of numerous students including all pre-nursing students (bridge/generic ASN and BSN majors) and students who intend to articulate to an upper division health science program (such as Health and Human Performance and Pharmacy majors). The required prerequisite is BSC2085 and BSC2085L.

Prerequisite: BSC2085 and BSC2085L
Co-requisite: BSC2086L must be taken with BSC2086

Rationale

This course is offered to introduce students to crucial concepts in anatomy and physiology and how they apply to contemporary life, health and wellness. The course covers a broad range of basic biological and physiological concepts in the context of the human body. In a society where diabetes, heart disease and obesity are epidemic, understanding the basic structure and function of the human body is critical for healthy lifestyle practices for both the students and their communities. Making appropriate decisions related to human biology requires knowledge of fundamental physiologic interactions. Accordingly, this course and its laboratory component use a unifying theme of homeostatic interrelationships and system connections to present the basic concepts of biology and physiology and their application to everyday life.

This course and its laboratory component support the mission of the College to enrich the lives of our students and the community as a whole and it supports the mission of Sciences for Health Programs, which is to prepare students to succeed in the difficult Nursing and Allied Health Programs and to make reasonable health and wellness decisions for themselves and their families.

Impact Assessment

This course deals with topics that are physiological and biological in nature, but which are vital for our society's overall health and wellness. It has become apparent that limited understanding of human biology is detrimental to the welfare of society. Thus it is important for community colleges to support the acquisition of essential concepts in the structure and functioning of the human body as well as relate these to important contemporary lifestyle and wellness issues. It provides students a background to not only discuss and debate issues but to make reasonable decisions regarding these lifestyle and wellness choices.

Broad Course Objectives

The following fundamental content and process goals, as developed by the HAPS Curriculum and Instruction Committee, form the unifying foundation for all topics in anatomy and physiology and are to be emphasized throughout Anatomy and Physiology I and II. They are directly linked to the learning outcomes written by the HAPS Curriculum & Instruction Committee.

- Develop a vocabulary of appropriate terminology to effectively communicate information related to anatomy and physiology.
- Recognize the anatomical structures and explain the physiological functions of body systems.
- Recognize and explain the principle of homeostasis and the use of feedback loops to control physiological systems in the human body.
- Use anatomical knowledge to predict physiological consequences, and use knowledge of function to predict the features of anatomical structures.
- Recognize and explain the interrelationships within and between anatomical and physiological systems of the human body.
- Synthesize ideas to make a connection between knowledge of anatomy and physiology and real-world situations, including healthy lifestyle decisions and homeostatic imbalances.
- Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system.
- Interpret graphs of anatomical and physiological data.

Course Outline with Specific Objectives

At the end of each unit or topic, the student will be able to:

HEART

1. Describe the size and shape of the heart and indicate its position in the thoracic cavity.
2. On the external heart identify the location of the four chambers as well as the coronary sulcus, anterior interventricular sulcus and posterior interventricular sulcus.
3. Describe the layers of the pericardium and the location of the pericardial cavity.
4. Identify myocardium and describe its histological structure, including the significance of intercalated discs.
5. Discuss the structure and significance of the endocardium.
6. Identify and describe the function of the primary internal structures of the heart, including chambers, septa, valves, papillary muscles, chordae tendineae, and venous and arterial openings.
7. Compare and contrast the structure and function of the atrioventricular and the semilunar valves.
8. Identify the major blood vessels entering and leaving the heart and classify them as either an artery or a vein and as containing either oxygenated or deoxygenated blood.
9. Define systemic and pulmonary circulation.
10. Describe blood flow through the heart naming all chambers and valves passed.
11. Identify the right and left coronary arteries and their branches, the cardiac veins, and the coronary sinus.
12. List the phases of the cardiac muscle action potential and explain the ion movements that occur in each phase.
13. Contrast the way action potentials are generated in cardiac pacemaker cells, in cardiac contractile cells and in skeletal muscle cells.
14. Compare and contrast cardiac muscle contraction and skeletal muscle contraction.
15. List the parts of the conduction system and explain how the system functions (SAN, AVN, AVBundle, AVBundle Branches, Perkinje Fibers).
16. Define automaticity (autorhythmicity) and explain why the SA node normally paces the heart.
17. Explain how the cardiac conduction system produces efficient pumping of blood.
18. Describe the role of the autonomic nervous system in the regulation of cardiac function.
19. Define cardiac cycle, systole, and diastole, explaining the phases of ventricular filling and ventricular ejection.

20. Compare and contrast pressure and volume changes of the left and right ventricles during one cardiac cycle.
21. Relate the heart sounds to the events of the cardiac cycle.
22. Identify the waveforms in a normal EKG. Relate the waveforms to atrial and ventricular depolarization and repolarization and to the activity of the conduction system. Relate the EKG waveforms to the normal mechanical events of the cardiac cycle.
23. Define cardiac output, and state its units of measurement.
24. Calculate cardiac output, given stroke volume and heart rate.
25. Predict how changes in heart rate (HR) and/or stroke volume (SV) will affect cardiac output.
25. Define end diastolic volume (EDV) and end systolic volume (ESV) and calculate stroke volume (SV) given values for EDV & ESV.
26. Define venous return, preload and afterload, and explain the factors that affect them as well as how each of them affects EDV, ESV and SV.
27. Explain the significance of the Frank-Starling Law of the heart.
28. Discuss the influence of positive and negative inotropic agents on SV.
26. Discuss the influence of positive and negative chronotropic agents on HR.

Blood Vessels

1. Compare and contrast the structure of arteries and veins and arterioles and venules.
2. List the types of arteries (elastic/muscular) and their corresponding function. Define vasoconstriction, vasodilation
3. Describe the role of arterioles in regulating tissue blood flow and systemic arterial blood pressure.
4. Correlate the anatomical structure of veins with their function.
5. Discuss how muscular compression and the respiratory pump aid venous return.
6. Describe the location and function of the venous reserve.
7. Define anastomosis and explain the significance of anastomoses, such as the Circle of Willis.
8. Identify the major arteries and veins of the body listed in your lab manual.
9. Describe the structures of the fetal circulation. Compare and contrast prenatal and postnatal circulatory pathways.
10. Define blood flow, blood pressure, and peripheral resistance.
11. State and interpret the equation that relates blood flow to pressure and resistance.
12. List the local, hormonal and neuronal factors that affect peripheral resistance and explain the importance of each. Explain the concept of autoregulation referring to myogenic and chemical influences. List some chemicals that cause vasodilation and those which cause vasoconstriction.
13. Using a graph of pressures within the systemic circuit, interpret the pressure changes that occur in the arteries, capillaries, and veins.
14. Explain how the structure of capillary walls differs from that of other blood vessels.
15. List types of capillaries (continuous, fenestrated, and sinusoids)and state where in the body each type is found.
16. Correlate the anatomical structure of capillaries with their functions.
17. Explain the role of diffusion in capillary exchange of gases, nutrients, and wastes.
18. Explain the roles of filtration and reabsorption in capillary exchange of fluid.
19. Describe how net filtration pressure across the capillary wall determines movement of fluid across the capillary wall.
20. Relate net filtration pressure to potential edema and the need for a functional lymphatic system.
21. Define blood pressure. Given values for systolic and diastolic blood pressure, calculate pulse pressure (PP) and mean arterial pressure (MAP).
22. Explain the baroreceptor reflex, and elaborate on how cardiac output and peripheral resistance are regulated to maintain adequate blood pressure on a moment-to-moment basis.
23. Explain the chemoreceptor reflex, elaborate on how the respiratory and cardiovascular systems are coordinated to provide flow and oxygen to body tissues.

24. Explain the role of the sympathetic nervous system in regulation of blood pressure and volume.
25. Explain the role of hormones(epinephrine and norepinephrine, ANP, ADH, aldosterone) and nitric oxide in regulation of blood pressure, including the mechanism by which specific hormones affect preload, heart rate, inotropic state or vascular resistance. Provide specific examples to demonstrate how the cardiovascular system responds to maintain homeostasis in the body.
26. Explain the role of the RAA mechanism in long-term regulation of blood pressure.

Blood

1. Describe the overall composition of plasma, including the major types of plasma proteins, their functions and where in the body they are produced.
2. Compare and contrast the morphological features of erythrocytes and the five types of leukocytes.
3. State the normal ranges for erythrocyte counts, hematocrit, hemoglobin, total leukocyte count, and platelet count.
4. Describe the location of hematopoiesis and the significance of the pluripotent stem cell (hemocytoblast).
5. Explain the basic process of erythropoiesis, the significance of the reticulocyte, and regulation through erythropoietin.
6. Discuss the structure and function of erythrocytes.
7. Discuss the structure and function of hemoglobin.
8. Discuss the life span and breakdown of erythrocytes.
9. Define anemia and briefly discuss some common causes.
10. Explain the role of surface antigens on RBCs in determining blood groups.
    List the type of antigen and the type of antibodies present in each ABO blood type. State which blood type is considered the universal donor and which blood type is considered the universal recipient, and explain why.

11. Describe how the presence or absence of Rh antigen results in blood being classified as positive or negative.
12. Predict which blood types are compatible and what happens when the incorrect ABO or Rh blood type is transfused.
13. List the five types of leukocytes in order of their relative prevalence in normal blood and classify each type as granulocyte or agranulocyte. Briefly state which formed elements are produced from the myeloid stem cell and which from the lymphoid stem cell.
14. Describe the functions for each of the five major types of leukocytes as well as the two major subtypes of lymphocytes (T and B).
15. Define the terms leukopenia and leukocytosis.
16. Describe the structure and function of thrombocytes with special emphasis on the role of the megakaryocyte in their production.
17. Distinguish between the terms hemostasis and coagulation.
18. Hemostasis:
    a. Describe the vascular phase including the role of endothelial cells.
    b. Describe the role of platelets and the steps involved in the formation of the platelet plug.
    c. Describe the basic steps involved in the formation of the insoluble fibrin clot.
    d. Differentiate between the intrinsic and extrinsic clotting mechanisms.

Lymphatic System

1. Describe the major functions of the lymphatic system
2. Compare and contrast whole blood, plasma, interstitial fluid, and lymph
3. Describe the source of lymph and the mechanism(s) of lymph transport (muscular pump and intrathoracic pressure)

4. Compare and contrast lymphatic vessels and blood vessels in terms of structure and function. Explain the unique characteristics of lacteals regarding location, structure, and function.
5. Describe the path of lymph circulation.
6. For the lymph nodes, thymus, spleen, tonsils, and other aggregations of mucosa-associated lymphatic tissue (MALT):
    a. Identify and describe the gross anatomical features of each organ or tissue.
    b. Identify and describe the microscopic anatomy of each organ or tissue.
    c. Describe the location in the body of each organ or tissue.
    d. Describe the function of each organ or tissue

Immune System

1. Compare and contrast innate (nonspecific) defenses with adaptive (specific) defenses.
2. Innate (Non-specific Immunity):
    a. Name the surface membrane barriers and describe their physical, chemical, and microbiological mechanisms of defense.
    b. Cells and chemicals:
        - Describe the steps involved in phagocytosis and provide examples of important phagocytic cells in the body.
        - Describe natural killer cells and discuss their function
        - Explain how complement and interferon function as antimicrobial chemicals.
    c. Inflammatory response:
        - Describe the mechanisms of inflammation initiation
        - Summarize the cells and chemicals involved in the inflammatory process.
        - List and explain the cause of the four cardinal signs of inflammation
        - Explain why inflammation can be beneficial
    d. Fever:
        - Describe the mechanism of fever and the role of pyrogens
        - Explain why fever can be beneficial
3. Specific Immunity
    a. B cells and T cells:
        - Define immunocompetence and self tolerance and distinguish between naive and activated immune cells.
        - Compare & contrast the sites where the cells originate and achieve their immunocompetence, and the primary location of the immunocompetent cells in the body.
        - Distinguish among the various types of lymphocytes, including helper T cells, cytotoxic T cells, regulatory (or suppressor) T cells, B cells, plasma cells, and memory cells.
    b. Define antigen, antigen receptor, and antigenic determinants
    c. Major histocompatibility complex (MHC):
        - Define MHC
        - Describe where class I and class II MHC and MHC proteins are found.
        - Explain the function of class I and class II MHC in adaptive immunity.
    d. Explain the role of antigen-presenting cells (APCs) and provide examples of cells that function as APCs
    e. Distinguish between humoral and cell-mediated immunity
    f. Humoral immunity:
        - Explain humoral immunity and the role of B cells (B cells, plasma cells, and memory B)

- Describe antibody structure.
- Describe mechanisms of antibody action (in destroying the target antigens (neutralization, Opsonization, agglutination, precipitation, inflammation, and complement activation).
- List the five classes of antibodies and discuss structural and functional features that distinguish each class.
- Interpret a graph of the primary and secondary immune response and describe the immunological memory (anamnestic) response.

g. Cell mediated immunity:
- Explain cell-mediated immunity and the role of T cells (Cytotoxic and helper T)
- Distinguish between active and passive immunity.
- Describe natural and artificial examples of both active and passive immunity.

Respiratory System

1. Describe the major functions of the respiratory system.
2. Describe and distinguish between the upper and lower respiratory tracts.
3. Describe and distinguish between the conducting and respiratory zones of the respiratory tract.
4. List in order, the respiratory structures that air passes through during inspiration.
5. For each of the following: nasal cavities, paranasal sinuses, pharynx, larynx, trachea, bronchi, lungs, pleural membranes, pulmonary blood vessels and nerves, thoracic and pleural cavities, and diaphragm:
    a. Identify each structure.
    b. Describe the gross anatomical features of each structure.
    c. State the function of each structure.
6. Describe the histological changes in epithelial and connective tissue seen in various portions of the air passageways and relate these changes to function.
7. Define pulmonary ventilation, inspiration, and expiration.
8. Identify the muscles used during quiet inspiration, during forced inspiration, and during forced expiration, as well as the nerves responsible for stimulating those muscles.
9. Define and state relative values for atmospheric pressure, intrapulmonary pressure, and intrapleural pressure.
10. State Boyle's Law and relate this law to the specific sequence of events (muscle contractions/relaxations and pressure/volume changes) causing inspiration and expiration.
11. Explain how each of the following factors affect pulmonary ventilation: bronchiolar smooth muscle contractions, lung and thoracic wall compliance and recoil, and pulmonary surfactant and alveolar surface tension.
12. Describe the role of the negative Intrapleural pressure in preventing lung collapse.
13. Define, identify, and determine values for the respiratory volumes (IRV, TV, ERV, and RV) and the respiratory vital capacity, forced vital capacity (FEV_1) and total lung capacity.
14. Define and calculate values for minute ventilation and alveolar ventilation.
15. Define anatomical dead space and explain the effect of anatomical dead space on alveolar ventilation and on the composition of alveolar and expired air.
16. State Dalton's Law and Henry's Law, and relate both laws to the amount of oxygen and carbon dioxide dissolved in plasma.
17. With respect to external respiration:

a. Describe oxygen and carbon dioxide concentration gradients and net gas movements.
b. Analyze how oxygen and carbon dioxide movements are affected by changes in partial pressure gradients (e.g., at high altitude), surface area, diffusion distance, and solubility of the gases.
c. Describe the mechanisms of ventilation-perfusion coupling.

18. With respect to internal respiration:
    a. Describe oxygen and carbon dioxide concentration gradients and net gas movements.
    b. Explain the factors that maintain oxygen and carbon dioxide gradients between blood and tissue cells.
19. With respect to oxygen transport:
    a. Describe the ways in which oxygen is transported in blood and discuss the relative importance of each to total oxygen transport.
    b. State the reversible chemical equation for oxygen binding to hemoglobin.
20. With respect to oxyhemoglobin dissociation curve:
    a. Interpret the curve at low and high partial pressures of oxygen
    b. List factors that shift the curve down and to the right, and explain how this results in increased oxygen delivery to the tissues.
    c. List factors that shift the curve up and to the left, and explain how this facilitates oxygen binding to hemoglobin.
21. With respect to carbon dioxide transport:
    a. Describe the ways in which carbon dioxide is transported in blood and discuss the relative importance of each to total carbon dioxide transport.
    b. State the reversible chemical equation for the reaction of carbon dioxide and water to carbonic acid and then to hydrogen ion and bicarbonate ion.
22. Describe the locations and functions of the brainstem respiratory centers.
23. List and describe the major chemical and neural stimuli to the respiratory centers.
24. Define hyperventilation, hypoventilation, panting, eupnea, hyperpnea, and apnea.

Digestive System

1. Identify the overall function of the digestive system, and differentiate between organs of the alimentary canal and accessory digestive organs.
2. List and define briefly the major processes occurring during digestive system activity: Ingestion, mastication, deglutition, propulsion (peristalsis), absorption, and defecation.
3. Distinguish between mechanical and chemical digestion.
4. Name the major food substrates and the products of the chemical process of digestion.
5. Describe the tissue composition of the four layers of the alimentary canal (the mucosa, submucosa, muscularis externa, and serosa (visceral peritoneum), and discuss the general function of each layer.
6. Briefly discuss the vascular supply and neural control of the gastrointestinal system.
7. Describe the histology of the visceral and parietal peritoneum.
8. Differentiate between intraperitoneal and retroperitoneal location of digestive structures.
9. Identify the mesentery proper and the mesocolon and explain their function.
10. Describe the gross anatomy, histology and physiological functions of each organ in the digestive system.
11. Mouth
    a. Identify the boundaries of the oral cavity

b. Identify the hard and soft palates and discuss their functions.
c. Describe the structures of the tongue, including taste buds and papillae, and discuss their functions
d. Identify the anatomical structures of a tooth
e. Describe the location of the parotid, submandibular, and sublingual glands and their respective ducts.
f. Describe the main components and functions of saliva. Explain how salivation is regulated.
g. Identify the naso-, oro- and laryngopharynx and classify these regions with respect to passage of food and/or air through them.
h. List the structures involved in the process of deglutition and explain how they function, including the changes in position of the glottis and larynx that prevent aspiration.

12. Esophagus: Describe the structure and discuss the function of the upper esophageal and lower esophageal (cardiac) sphincters, including the histological differences compared to the rest of the alimentary canal.
13. Stomach:
    a. Describe the structure and discuss the function of the cardiac and pyloric sphincters.
    b. Identify the structure and discuss the function of the cardiac region, the fundus, the body and the pyloric region of the stomach
    c. Discuss the significance of rugae.
    d. Discuss the function of the oblique muscle layer of the stomach.
    e. Identify the structure of a gastric gland including the location of the chief (zymogenic) cells, parietal (oxynic) cells, enteroendocrine (Gcells) cells, and mucous cells. Discuss the composition of gastric juice and explain the function of each component produced by eachof these different cell types.
    f. Explain the cephalic phase, gastric phase, and intestinal phase gastric juice secretion
14. Liver and Gall Bladder:
    a. Identify the individual lobes of the liver
    b. Identify the coronary ligament, falciform ligament, and round ligament (ligamentum teres).
    c. Identify the hepatic artery, hepatic portal vein, and hepatic vein and discuss the function of each of those blood vessels.
    d. Identify the histological components of a liver lobule (including hepatocytes, hepatic sinusoids, Kupffer cells, bile canaliculi, central vein, and the components of a hepatic triad) and discuss the function of each.
    e. Identify the hepatic duct, cystic duct, gallbladder, common bile duct, sphincter of the hepatopancreatic ampulla (ampulla of Vater and sphincter of Oddi) and discuss the roles of those structures in the flow of bile.
    f. List the major functions of the liver
    g. List the major components and functions of bile
    h. Define emulsification and describe the process. List the organs and structures of the digestive system that function in the process of emulsification.
15. Pancreas:
    a. Identify the head, body and tail of the pancreas
    b. Identify the pancreatic acini and discuss their functions
    c. Identify the pancreatic islets and discuss their functions
    d. Identify the pancreatic duct and the hepatopancreatic sphincter and discuss their roles in the flow of pancreatic enzymes
    e. Identify components of pancreatic juice and their functions in the digestive processes.
16. Small Intestine
    a. Identify the location and discuss the relative length and the functions of the duodenum, jejunum, and ileum.
    b. Identify and discuss the histology and functions of the plicae circulares, villi, and microvilli.

c. Identify Brunner's glands (duodenal glands) in the duodenum and Crypts of Leiberkuhn (intestinal glands) in all portions of the small intestine, and discuss the secretions and functions of these glands.
d. State the organ or structure that produces cholecystokinin, the stimulus for its secretion, its target organ, and action.
e. State the organ or structure that produces secretin, the stimulus for its secretion, its target organ, and action.
f. Define the term segmentation and discuss the role it plays in the various regions of the alimentary canal.
g. Briefly explain the processes involved in absorption of monosaccharides, peptides and amino acids, fatty acids and monoglycerides, fat-soluble and water-soluble vitamins and the absorption of vitamin B_{12}. in the small intestine

17. Large Intestine
    a. Describe the structure and discuss the function of the ileocecal valve and the internal and external anal sphincters
    b. Identify the location and discuss the functions of the cecum and appendix, the ascending, transverse, descending, and sigmoid colon, the rectum, and the anus.
    c. Identify and discuss the functions of teniae coli, haustra, and epiploic appendages
    d. List the major functions of the large intestine.

Metabolism

1. List the six main classes of nutrients
2. For carbohydrates, fats, and proteins – briefly list their dietary sources, and discuss their common uses in the body.
3. Classify vitamins as either fat-soluble or water-soluble and discuss the major uses of each vitamin in the body.
4. Define metabolism, anabolism and catabolism. Provide examples of anabolic and catabolic reactions.
5. Briefly review the processes of oxidation- reduction
6. Explain the roles of coenzyme A, NAD, and FAD in metabolism.
7. With respect to carbohydrate metabolism:
    a. State the overall reaction for glucose catabolism
    b. Describe the processes of glycolysis, formation of acetyl CoA, the Kreb's (TCA) cycle, and the electron transport chain (chemiosmosis), including the substrates and products of each, their locations within the cell and the energy yield of each process.
    c. Describe the processes of glycogenesis, glycogenolysis, and gluconeogenesis, including the substrates and products of each.
    d. Describe the role of hormones (such as cortisol, insulin, glucagon and norepinephrine) in regulation of carbohydrate catabolism and anabolism.
    e. Predict the metabolic conditions that would favor each of the following processes: glycogenesis, glycogenolysis and gluconeogenesis
8. With respect to protein and amino acid metabolism:
    a. With respect to protein and amino acid metabolism:
    b. Describe the process of deamination and its importance in gluconeogenesis and the interconversion
    c. Describe the effect of protein metabolism on ammonia and urea production.
9. With respect to lipid metabolism:
    a. Describe the basic process of lipogenesis and lipolysis
    b. Summarize the overall process of the beta oxidation of fatty acids and explain how it relates to ketogenesis & ketoacidosis.

c. Describe the nutrient interconversion pathways that involve fats.
d. Compare and contrast the structure and function of different types of lipoproteins in the body.
e. Describe the central role of the liver in metabolism

10. Compare and contrast the processes that occur in the absorptive and post-absorptive states
11. Define metabolic rate and basal metabolic rate. Describe factors that affect metabolic rate. Briefly explain thermoregulation in the body.

Urinary System

1. Describe the major functions of the urinary system.
2. With respect to gross anatomy of the urinary tract:
   a. Describe the external structure of the kidney, including its location, support structures and covering.
   b. Identify, and describe the structure and location of, the ureters, urinary bladder and urethra.
   d. Identify the major internal divisions and structures of the renal tissue.
   e. Identify the major blood vessels associated with the kidney. Trace the arterial supply from aorta and renal artery to peritubular capillaries. Trace the venous drainage from the peritubular capillaries to the renal vein and IVC.
3. With respect to the nephron and collecting system:
   a. Identify the major structures and subdivisions of the renal corpuscles, renal tubules and renal capillaries
   b. Compare and contrast cortical and juxtamedullary nephrons.
   c. Identify the location, structures and function of the juxtaglomerular apparatus.
4. Define the role of renin-angiotensin system and aldosterone in filtration and restoration of systemic blood pressure.
5. Trace the path of filtrate/urine from the renal corpuscle to the urethral opening.
6. List the three major processes in urine formation and where each occurs in the nephron and collecting system.
7. With respect to filtration:
   a. Describe the structure of the filtration membrane.
   b. Explain the anatomical features that create high glomerular capillary blood pressure and explain why this blood pressure is significant for urine formation.
   c. Describe the hydrostatic and colloid osmotic forces that favor and oppose filtration.
   d. Describe glomerular filtration rate (GFR), state the average value of GFR
   e. Predict specific factors that will increase or decrease GFR:
      - Intrinsic renal autoregulation
      - Neural regulation (sympathetic)
      - Hormonal (RAA, ANP, and ADH)
8. With respect to reabsorption:
   a. Describe how and where water, organic compounds, and ions are reabsorbed in the nephron.
   b. Explain the role of the loop of Henle, the vasa recta, and the countercurrent multiplication mechanism in the concentration of urine.
9. With respect to tubular secretion:
   a. List the location(s) in the nephron where tubular secretion occurs.
   b. Compare and contrast reabsorption and tubular secretion, with respect to direction of solute movement, due to concentration gradients.
   c. Determine the physical and chemical properties of a urine sample and relate these properties to normal urine composition.
   d. Discuss the factors regulating and altering urine volume and composition.
   e. Predict specific factors involved in creating dilute versus concentrated urine.

10. Compare and contrast blood plasma, glomerular filtrate, and urine and then relate their differences to function of the nephron.
11. Explain the mechanism of action of diuretics.
12. Relate the anatomy and histology of the bladder to its function. Describe the anatomy, histology, and functions of the ureters and urethra. Compare and contrast the male and female urethras.
13. Describe the micturition reflex. Describe voluntary and involuntary neural control of micturition.

Fluid, Electrolytes, Acid-Base Balance

1. Name the fluid compartments (including the subdivisions of the extracellular fluid) and state the relative volumes of each, and explain how water moves from one to another.
2. List the body's sources of water and routes of water loss
3. Describe the mechanisms of regulating water intake and output.
4. Describe some conditions in which the body has a deficiency or excess of water or improper distribution of water among the fluid compartments.
5. Explain how dehydration and overhydration (water intoxication) develop and how fluids shift between the three major body compartments during each.
6. Define electrolyte. Compare and contrast the relative concentrations of major electrolytes in intracellular and extracellular fluids
7. Describe the function(s) of each abundant electrolyte found in body fluids, including sodium, chloride, potassium, phosphate and calcium especially its influence on osmotic pressure.
8. Briefly review the roles of Aldosterone, ANP, and ADH in the regulation of major electrolyte levels in the plasma.

Acid Base Balance

1. Define acid, base, pH and buffer.
2. State the normal pH range for arterial blood.
3. State the chemical equation for the bicarbonate buffer system. Explain how it responds to increases or decreases in pH.
4. Define respiratory acidosis and alkalosis. Define metabolic acidosis and alkalosis.
5. Explain how the respiratory and urinary systems correct acidosis and alkalosis.

Reproductive System

Male Reproductive

1. Describe the major functions of the male reproductive system.
2. Identify and describe the gross anatomy of the male reproductive system, including the gonads, ducts, accessory glands, associated support structures, and external genitalia.
3. Discuss the relationship between the location of the testes and sperm production
4. Describe the pathway of sperm from the seminiferous tubules to the external urethral orifice of the penis
5. Identify and describe the function of the reproductive and supporting cells of the seminiferous tubules of the testis with special reference to interstitial (Leydig) cells and sustentacular (Sertoli) cells.
6. Identify and describe the organs involved in semen production
7. Discuss the composition of semen and its role is sperm function.
8. Contrast the overall processes of mitosis and meiosis.
9. Relate the general stages of meiosis to the specific processes of spermatogenesis
10. State the functions of gonadotropin releasing hormone, follicle stimulating hormone, luteinizing hormone, and testosterone
11. Define the secondary sex characteristics associated with male puberty under the influence of testosterone.

12. Describe the blood and nerve supply of the penis and explain how these govern erection and ejaculation.

Female Reproductive

1. Identify and describe the gross anatomy of the female reproductive system, including the gonads, ducts, accessory glands, associated support structures, and external genitalia.
2. Describe the pathway of the ovum from the ovary to the uterus.
3. Identify and describe the different stages of follicular development in the ovary, including the preovulatory follicles and the corpus luteum.
4. Identify and describe the histology of the uterine wall.
5. Describe the ovarian cycle and relate the events of the ovarian cycle to oogenesis
6. Describe the events of the uterine cycle.
7. State the functions of gonadotropin releasing hormone, follicle stimulating hormone, luteinizing hormone, estrogen and progesterone.
8. Analyze graphs depicting the typical female monthly sexual cycle and correlate ovarian activity, hormonal changes, and uterine events.
9. Describe differences and similarities in the ovarian, hormonal, and uterine events with and without conception.
10. Provide examples of how birth control methods relate to normal reproductive function.
11. Define secondary sex characteristics associated with puberty in females under the influence of estrogen
12. Describe the structure of the nonlactating breast.

Embryonic Development

1. Describe the process of sperm migration and fertilization.
2. Explain how an egg prevents fertilization by more than one sperm.
3. Describe the major events that transform a fertilized egg into an embryo.
4. Describe implantation in the uterine wall.
5. Describe the formation and function of the placenta and extraembryonic membranes
6. Describe the main hormones of pregnancy and their effects, including estrogen, progesterone, and human chorionic gonadotropin

Endocrine System

1. Describe the major functions of the endocrine system
2. Define the terms hormone, endocrine gland, and target cell.
3. Compare and contrast how the nervous and endocrine systems control body function
4. List the major chemical classes of hormones found in the human body. Describe how each class is transported in the blood.
5. Compare and contrast the types of receptors (cell membrane or intracellular) that each class bind*s* to.
6. Compare and contrast the mechanism of response that each class elicits (i.e., change in gene expression or change in an intracellular pathway via phosphorylation mechanism).
7. List and describe several types of stimuli that control production and secretion of hormones (Neural, humoral, and hormonal).
8. Describe the roles of negative and positive feedback in controlling hormone release
9. Describe the locations of and the anatomical relationships between the hypothalamus, anterior pituitary and posterior pituitary glands. Explain the importance of the hypophyseal portal system.
10. Define the terms releasing hormone and inhibiting hormone.
11. Explain the role of the hypothalamus in the release of anterior pituitary hormones.

12. Explain the role of the hypothalamus in the production and release of posterior pituitary hormones
13. For each of the following endocrine glands: describe the stimulus for the release of its hormone, the gland or tissue that produces it, the target organ and effects on the target organ.
    - Pituitary: growth hormone, thyroid-stimulating hormone, luteinizing hormone, follicle stimulating hormone, prolactin, adrenocorticotropic hormone, oxytocin, antidiuretic hormone (or vasopressin)
    - Thyroid gland: thyroxine, triiodothyronine, calcitonin
    - Parathyroid gland: parathyroid hormone
    - Adrenal gland: glucocorticoids (cortisol), mineralocorticoids (aldosterone), epinephrine, norepinephrine
    - Testis: testosterone,
    - Ovary: estrogen, progesterone,
    - Pancreas: insulin, glucagon
    - Pineal gland: melatonin
    - Thymus: thymosin
14. Predict the larger effect that fluctuations in the hormone level will have on conditions (variables) within the body.

Evaluation

BSC2086 student progress will be evaluated using 3-5 unit examinations, quizzes, and a comprehensive final exam. Exam questions will include short answer, multiple choice, and calculations. Successful students will demonstrate the skills necessary to understand and apply scientific concepts and reasoning, including the analysis and interpretation of various types of data using scientific reasoning skills (GELO assessment).

BSC2086L laboratory portion of this course will be evaluated on the basis of laboratory assessments which require deductive or inductive inference, control of variables, application of a model to a new situation, interpretations based on fundamental theories, and interpretation of data in both tabular and graphical form.
Students will take a laboratory midterm and final exam.

If a student earns a grade of C or higher on the comprehensive final exam and an overall grade in the course, that is indicative of the extent to which they understand and are able to apply the broader GELO skills.