Outcome: A. Describe and differentiate between the gross and microscopic anatomy of the organs, tissues, and cells of the cardiovascular, lymphatic/immune, respiratory, urinary, digestive and reproductive systems and relate anatomical structures to physiological functions.

Supporting Objectives:

1. Describe the cellular characteristics, biological functions, and life cycle of red blood cells, granulocytes (basophils, eosinophils, and neutrophils), agranulocytes (lymphocytes and monocytes), and platelets.
2. Explain the location of the heart and its major blood vessels.
3. Describe the structures of the pericardium, heart wall, and cardiac valves, and relate these structures to the functions of the heart.
4. Describe the external and internal anatomy of the chambers of the heart, including the attached blood vessels and associated valves, and relate these structures to the functions of the heart.
5. Outline the flow of blood through the heart and systemic and pulmonary circulation naming the correct chambers, valves, and vessels in correct order.
6. Describe the location of coronary arteries and veins and name their functions.
7. Relate the structural characteristics of cardiac muscle cells to their functions.
8. Compare and contrast the structure of muscular arteries, elastic arteries, arterioles, veins, venules, and capillaries and relate their structure to their functions.
9. Compare and contrast continuous, fenestrated, and sinusoidal capillaries and relate their structure to their functions.
10. Identify major arteries and veins of the upper limb, lower limb, thorax, abdomen, and brain and describe their functions.
11. Describe the structure of lymphatic capillaries, vessels, trunks, and ducts and relate their structure to their function.
12. Identify lymphatic vessels, trunks, and ducts and name their functions.
13. Describe the location, structure, and function of primary immune tissues (red bone marrow and thymus).
14. Describe the location, structure, and function of secondary immune tissues and organs including tonsils, lymph nodes, spleen, Peyers Patches, appendix, and mucosal-associated lymphoid tissue (MALT).
15. Describe the location, structure, and function of the components of the respiratory system, beginning at the nose and ending at the alveoli.
16. Describe the gross and microscopic anatomy of the lungs, including their blood and lymphatic supply.
17. Describe the location, structure, and functions of the components of the gastrointestinal tract, beginning at the mouth and ending at the anus.
18. Describe the histology of the gastrointestinal tract and name a function of each layer.
19. Describe the location, structure, and functions of the accessory organs of the digestive system, including salivary glands, liver, gallbladder, and pancreas.
20. Describe the location, structure, and function of the peritoneum.
21. Describe the location, structure, and functions of the components of the urinary system, beginning at the kidney and ending at the urethra.
22. Explain the location, structure, and functions of each region of a nephron.
23. Explain the blood supply to and from the kidney, including the microscopic structure of the glomerulus.
24. Compare and contrast the location, structures, and functions of the components of the male and female reproductive systems.

25. Discuss the structure and development of mammary glands and the endocrine system’s control during lactation.

Outcome: B. Apply fundamental knowledge of the cardiovascular system to explain homeostasis and to predict outcomes of disrupted structure and/or function in order to succeed in preparatory coursework for health professions, biomedical research, and advanced scientific study.

Supporting Objectives:
1. List the functions of blood.
2. Describe the composition of whole blood.
3. Describe the chemical composition and biological functions of plasma.
4. Describe the cellular characteristics, biological functions, and life cycle of red blood cells, granulocytes (basophils, eosinophils, and neutrophils), agranulocytes (lymphocytes and monocytes), and platelets.
5. Define hematopoiesis, describe the origin and production of the different formed elements, and relate factors that influence formed element production.
6. Define hemostasis and describe the mechanisms of actions for vascular spasm, platelet plug formation, and coagulation.
7. Explain hemostatic control mechanisms that limit coagulation.
8. Explain the basis of the ABO and Rh blood grouping systems, transfusion reactions, and hemolytic disease of the newborn.
9. Describe the functions of the heart.
10. Explain the location of the heart and its major blood vessels.
11. Describe the structures of the pericardium, heart wall, and cardiac valves, and relate these structures to the functions of the heart.
12. Describe the external and internal anatomy of the chambers of the heart, including the attached blood vessels and associated valves, and relate these structures to the functions of the heart.
13. Outline the flow of blood through the heart and systemic and pulmonary circulation naming the correct chambers, valves, and vessels in correct order.
14. Describe the location of coronary arteries and veins and name their functions.
15. Explain the structures and functions of the cardiac conducting pathway.
16. Describe the electrical events that occur during the waves and intervals of a normal electrocardiogram (ECG).
17. Describe the pressure and volume changes that occur during a cardiac cycle.
18. Explain common heart sounds and relate their timing to ECG events and changes in pressure during a cardiac cycle.
19. Relate the electrical and mechanical events of cardiac cycle to heart anatomy.
20. Define cardiac output, stroke volume, and heart rate, and describe extrinsic and intrinsic factors that affect these values.
21. Describe the functions of the circulatory system.
22. Compare and contrast the structure of muscular arteries, elastic arteries, arterioles, veins, venules, and capillaries and relate their structure to their functions.
23. Compare and contrast continuous, fenestrated, and sinusoidal capillaries and relate their structure to their functions.
24. Describe the exchange of materials in capillary beds.
25. Identify major arteries and veins of the upper limb, lower limb, thorax, abdomen, and brain and describe their functions.
26. Describe major circulatory routes through the upper limb, lower limb, thorax, abdomen, and brain.
27. Define blood pressure and describe how it is measured.
28. Define pulse and define systolic, diastolic, and pulse pressure.
29. Define mean arterial pressure and peripheral resistance and explain their relationships to the rate of blood flow, blood vessel diameter, blood viscosity, blood volume, and cardiac output.
30. Explain short- and long-term mechanisms that affect arterial blood pressure, including the cardiovascular center of the medulla oblongata; autonomic nervous system; baroreceptors and chemoreceptors; hormones, and autoregulation.

**Outcome: C. Apply fundamental knowledge of the lymphatic/immune system to explain homeostasis and to predict outcomes of disrupted structure and/or function in order to succeed in preparatory coursework for health professions, biomedical research, and advanced scientific study.**

**Supporting Objectives:**

1. Describe the functions of the lymphatic system.
2. Describe the structure of lymphatic capillaries, vessels, trunks, and ducts and relate their structure to their function.
3. Identify lymphatic vessels, trunks, and ducts and name their functions.
4. Describe the location, structure, and function of primary immune tissues (red bone marrow and thymus).
5. Describe the location, structure, and function of secondary immune tissues and organs including tonsils, lymph nodes, spleen, Peyers Patches, appendix, and mucosal-associated lymphoid tissue (MALT).
6. Describe mechanisms of innate immunity including physical barriers, chemical mediators, and cells.
7. Describe the inflammatory response.
8. Describe mechanisms of cell-mediated adaptive immunity, including the cells and molecules necessary.
9. Describe mechanisms of antibody-mediated (humoral) adaptive immunity, including the general structure of antibodies and the functions of the five classes of antibodies.
10. Explain the four ways to acquire adaptive immunity: natural passive, natural active, artificial passive, and artificial active adaptive immunity.

**Outcome: D. Apply fundamental knowledge of the respiratory system to explain homeostasis and to predict outcomes of disrupted structure and/or function in order to succeed in preparatory coursework for health professions, biomedical research, and advanced scientific study.**

**Supporting Objectives:**

1. Describe the functions of the respiratory system.
2. Describe the location, structure, and function of the components of the respiratory system, beginning at the nose and ending at the alveoli.
3. Describe the gross and microscopic anatomy of the lungs, including their blood and lymphatic supply.
4. Discuss the different histological components of the respiratory membrane.
5. Define ventilation, external respiration, and internal respiration and describe events involved in each process.
6. Apply gas laws to inspiration and expiration and movement of gases.
7. Define compliance, minute ventilation, and alveolar ventilation.
8. Distinguish between the different types of pulmonary air volumes and capacities and describe how they are measured.
9. Define partial pressure and explain factors that affect movement of oxygen and carbon dioxide in the body.
10. Describe mechanisms and factors that control ventilation, including the medullary respiratory center, pontine respiratory group, central chemoreceptors, peripheral chemoreceptors, and the Hering-Breuer reflex.

Outcome: E. Apply fundamental knowledge of the urinary system to explain homeostasis and to predict outcomes of disrupted structure and/or function in order to succeed in preparatory coursework for health professions, biomedical research, and advanced scientific study.

Supporting Objectives:
1. Describe functions of the urinary system.
2. Describe the location, structure, and functions of the components of the urinary system, beginning at the kidney and ending at the urethra.
3. Explain the location, structure, and functions of each region of a nephron.
4. Explain the blood supply to and from the kidney, including the microscopic structure of the glomerulus.
5. Discuss the process of urine formation, including glomerular filtration, tubular reabsorption, and tubular secretion, and relate each step to kidney anatomy.
6. Relate the structure of the kidney to its mechanisms to concentrate urine.
7. Compare how different hormones affect urine concentration and volume.
8. Define plasma clearance, glomerular filtration rate, tubular load, and tubular maximum, and relate these values to kidney function.
9. Explain the micturition reflex.
10. List the physical characteristics and normal chemical composition of urine and compare it to the normal chemical composition of plasma and filtrate.
11. Discuss the general principles of fluid and electrolyte balance, acid base balance, and homeostasis of body fluids.

Outcome: F. Apply fundamental knowledge of the digestive system to explain homeostasis and to predict outcomes of disrupted structure and/or function in order to succeed in preparatory coursework for health professions, biomedical research, and advanced scientific study.

Supporting Objectives:
1. Describe the functions of the gastrointestinal tract.
2. Describe the location, structure, and functions of the components of the gastrointestinal tract, beginning at the mouth and ending at the anus.
3. Describe the histology of the gastrointestinal tract and name a function of each layer.
4. Describe the location, structure, and functions of the accessory organs of the digestive system, including salivary glands, liver, gallbladder, and pancreas.

5. Describe the location, structure, and function of the peritoneum.

6. Compare and contrast chemical and mechanical digestion.

7. Define a nutrient, describe the functions of the six classes of nutrients, and state the enzyme(s) necessary to digest it, if applicable.

8. Describe the chemical composition and functions of the major secretions of the gastrointestinal tract and accessory organs, including saliva, bile, gastric acid, and pancreatic juices.

9. Define the various movements of the gastrointestinal tract and describe their regulation. Movements include mastication (chewing), swallowing (deglutition), peristalsis, mass movements, segmental contractions, and defecation.

10. Discuss the neurological and hormonal mechanisms that regulate activity of the gastrointestinal tract and its accessory organs.

Outcome: G. Apply fundamental knowledge of the reproductive system to explain homeostasis and to predict outcomes of disrupted structure and/or function in order to succeed in preparatory coursework for health professions, biomedical research and advanced scientific study.

Supporting Objectives:
1. Describe the functions of the male and female reproductive tracts.
2. Compare and contrast the location, structures, and functions of the components of the male and female reproductive systems.
3. Describe the processes of spermatogenesis and oogenesis.
4. Describe the endocrine system's regulation of the anatomy and physiology of the male reproductive systems, including maturation at puberty, formation of sperm, and sex act.
5. Describe the sex hormones secreted by cells of the male and female reproductive systems, including the source of each hormone, the target cells of each hormone, and their major effects on the body.
6. Describe the events in the ovarian and uterine cycles, including how hormones from the brain control the ovarian cycle and how hormones from the ovaries control the uterine cycle.
7. List the paths of sperm production and release in the male; oocyte production and release in the female; ejaculated sperm in the female; and fertilized oocyte in the female.
8. Discuss the structure and development of mammary glands and the endocrine system's control during lactation.

Outcome: H. Relate the concepts of mitotic and meiotic cell division to cellular repair, gamete formation, and tissue formation.

Supporting Objectives:
1. Describe the processes of spermatogenesis and oogenesis.
2. Discuss the stages, events, and significance of mitosis and meiosis.
3. Describe events that occur during the stages of cell cycle and differentiate between interphase, mitosis, and cytokinesis.
Outcome: I. Describe the stages in the development of the zygote, embryo, and fetus.

Supporting Objectives:
1. Describe major events that occur from fertilization to the blastocyst stage, including the process of implantation.
2. Describe major events in formation of the placenta and three germ layers of the embryo, and describe the fate of each structure.
3. Describe location, structure, functions and fate of the placenta, umbilical cord, and extra-embryonic membranes of early development.
4. Describe major developmental events of fetal and postnatal development and name the time periods during which they occur.

Outcome: J. Describe the events of parturition and the control of lactation.

Supporting Objectives:
1. Discuss the structure and development of mammary glands and the endocrine system's control during lactation.
2. Describe major events that occur during the three stages of parturition.
3. Explain changes in maternal and fetal hormones that occur at birth.
4. Describe respiratory, cardiovascular, and digestive changes that occur in the newborn.
5. Describe the physiological events of lactation and the role of hormones in milk production and release.

Outcome: K. Discuss the principles of classical and contemporary genetics.

Supporting Objectives:
1. Describe the central dogma of biology, the structure of DNA, RNA, and protein molecules, and the transmission of information from DNA to protein.
2. Calculate probabilities of inheritance of dominant/recessive, incomplete dominant, co-dominant, and sex-linked traits and diseases.
3. Create and interpret simple pedigrees illustrating dominant/recessive, incomplete dominant, co-dominant, and sex-linked traits and diseases.
4. Explain basic ideas of biotechnology such as gene "knock-out," genome mapping, gene sequencing, and cloning.