The Human Anatomy and Physiology course will help students understand the physical structure and organization of the physical body and relate it to the working function, predictability and harmony of the human body in order to apply this knowledge in all health–related fields. Students will investigate concepts of homeostasis and the essentials of human function at the level of genes, cells, tissues, and organ systems. Through instruction, which will include laboratory activities, students will apply these concepts associated with Human Anatomy and Physiology.

Students enrolled in this course should have a basic understanding of the Principles of Biology including:

* Molecules and Cells
* Developmental and Organismal Biology
* Genetics

Students should know the principles of atomic structure, bonding, molecules, and structural formulas, types of chemical reactions, principles of acids and bases, and molarity.

The course should, with appropriate lab equipment, include ample laboratory experiences that illustrate the application of the standards to the appropriate cells, tissues, organs, and organ systems. Dissection is both appropriate and necessary, but will be affected by the availability of appropriate laboratory equipment. Students should be able to use basic laboratory equipment such as microscopes, balances, and pipettes.

Recommended Grade Level: 11-12

* Required Prerequisite: Biology
* Recommended Prerequisite: Chemistry
* Credits: A two-semester course, one credit per semester
* A Career Academic Sequence, Career-Technical program, or Flex Credit course

The course outline will cover the following areas of the Human Anatomy

Unit 1 – Body Plan and Organization

Unit 2 – Basic Principles of Body Chemistry

Unit 3 – Cells, Histology, and Integumentary System

Unit 4 – Skeletal System

Unit 5 – Muscular System

Unit 6 – Nervous System and Special Senses

Unit 7 – Endocrine System

Unit 8 – Blood, Lymphatic, and Cardiovascular Systems

Unit 9 – Respiratory System

Unit 10 – Digestive System

Unit 11 – Urinary System

Unit 12 – Reproductive System

The specific criteria of the Standards and Objectives to be addressed in each unit are delineated in the following pages.

UNIT 1 – BODY PLAN AND ORGANIZATION

**STANDARD**

01 Students will explore careers in health care and describe the body plan and organization and homeostasis.

**OBJECTIVES**

01.01 Students will explore careers in health care. Students will participate in a minimum of three career exploration experiences to investigate a variety of health care careers related to therapeutic services, diagnostic services, health informatics, support services, and biomedical research and development pathways.

01.02 Students will provide an oral and/or written report for each career exploration utilizing the report outline located in the MAP curriculum. Note: Electronically delivered career exploration experiences are permissible.

01.03 Students will select a topic and defend their position on a current medical ethical dilemma.

01.04 Contrast the sciences of anatomy and physiology.

01.05 Describe the six levels of structural organization of the human body**.** (Chemical, cellular, tissue, organ, system, organism)

01.06 Describe metabolism and its anabolic and catabolic processes.

01.07 Apply directional terms used in human anatomy. (Posterior/anterior, medial/lateral, proximal/distal, superficial/deep, superior/inferior)

01.08 Apply commonly used planes to divide the body. (Sagittal, midsagittal, transverse [horizontal], frontal [coronal])

01.09 Identify the body cavities and locate the following organs within each cavity.

* Dorsal Cavity
  + Vertebral - spinal cord
  + Cranial - brain
* Ventral Cavity
* Thoracic – heart, lungs
* Mediastinum - heart, bronchi, esophagus, thymus
* Pericardial - heart
* Pleural - lungs
* Abdominopelvic Cavity - liver, spleen, intestines, kidneys, stomach
* Pelvic - intestines, urinary bladder, sex organs

01.10 Identify the major organ(s) in each abdominal quadrant.

* RUQ - right upper quadrant - liver, gallbladder, right kidney
* RLQ - right lower quadrant – cecum, appendix, right ovary
* LUQ - left upper quadrant - spleen, stomach, left kidney
* LLQ - left lower quadrant - left ovary

01.11 Examine the relationship between homeostasis and stress.

01.12 Differentiate between negative and positive feedback mechanisms.

UNIT 2 - BASIC PRINCIPLES OF BODY CHEMISTRY

*Students should explain how we control the salt content and volume of the fluid that surrounds the cells of our bodies and why this control is necessary. Students should be able to explain why it is necessary to control the pH of the fluids in our bodies. They should be able to define alkalosis and acidosis. Students should know the various sources of acid and the three ways in which the body defends itself against lethal changes of pH.*

**STANDARD**

02 Students will explain basic principles of body chemistry.

**OBJECTIVES**

02.01 Review the following terms and concepts. (States of matter, elements, basic components of the atom [nucleus, electrons, protons, and neutrons], ion [electrolyte])

02.02 Identify the four major elements in the body. (Carbon, hydrogen, oxygen, nitrogen)

02.03 Differentiate between a compound and a molecule.

02.04 Differentiate between a cation and an anion.

02.05 Describe the characteristics of ionic, covalent, and hydrogen bonds.

02.06 Define pH.

02.07 Categorize acidic, basic, or neutral solutions based on the pH of a solution.

02.08 Distinguish between “neutral” pH and the “average” pH range of the blood. (Neutral pH = 7.0, average pH of blood = 7.35 to 7.45)

02.09 Describe the properties of water and how it is utilized in the human body.

(Universal solvent, transport, lubricant, heat capacity, chemical reactions)

02.10 Distinguish between inorganic and organic compounds. (Inorganic compounds do not contain carbon, are small molecules, and usually form ionic bonds. Organic compounds usually contain carbon, are large molecules, form covalent bonds, and flammable)

02.11 Describe the structures and functions of carbohydrates, proteins, lipids, and nucleic acids.

02.12 Describe how the body produces energy during cellular respiration.

(ATP ↔ ADP + P + ENERGY)

UNIT 3 - CELLS, HISTOLOGY, AND INTEGUMENTARY SYSTEM

*Students should understand that molecules make up the fabric of living cells, which, in turn, make up tissues. Students should know the role of adhesion molecules, the classification of tissues, and the various cell types found in them.*

**STANDARD**

03 Students will describe basic concepts of structures and functions of cells, histology, and the integumentary system.

**OBJECTIVES**

03.01 Identify the four principle parts of a generalized animal cell and their functions. (nucleus, cytosol, organelles & cell membrane)

03.02 Describe the structure and function of the cell membrane.

03.03 Describe a selectively permeable membrane and factors which influence permeability.

03.04 Contrast intracellular and extracellular fluid in terms of location and composition.

03.05 Describe each of the following cellular transport processes and classify them as active or passive. (Passive processes – diffusion, osmosis, facilitated diffusion, dialysis, and filtration. Active processes -- phagocytosis, exocytosis and active transport)

03.06 Review the osmotic effects that occur when a cell is placed in an isotonic, hypotonic, or hypertonic solution.

03.07 Describe the function of the following structures within the cell. (nucleolus, gene, chromatin, chromosome, DNA, ribosomes, endoplasmic reticulum, Golgi complex, mitochondria, lysosomes, vacuole, peroxisomes, microfilaments, microtubules, centrioles, centrosomes, flagella, cilia, microvilli)

03.08 Compare and contrast mitosis and meiosis.

03.09 Identify the general characteristics and functions of each of the four principle types of tissues. (Epithelial - strategies for tissue identification [arrangement & cell shape]; Connective - adipose, cartilage, dense fibrous, blood, bone; Muscular - skeletal, smooth, cardiac; and Nervous)

03.10 Contrast exocrine and endocrine glands.

03.11 Differentiate between the four basic types of membranes. (Mucous, serous, synovial, cutaneous)

03.12 Describe the structures and functions of the integumentary system components. (Skin, glands, hair, nails)

03.13 Describe the major layers of skin. (Epidermis, dermis, subcutaneous [hypodermis])

03.14 Describe the functions of sudoriferous (sweat) and sebaceous (oil) glands.

03.15 Identify the following diseases or disorders of the integumentary system. (Acne, skin cancers [basal cell carcinoma, squamous cell carcinoma, malignant melanoma], decubitus ulcers)

UNIT 4 - SKELETAL SYSTEM

Movement and Support in Humans

*Students know the physiology and structure of bones and skeletal muscle as they interact to provide movement and support of the human body. Students understand the chemical and microscopic structure of bone; its development, repair, turnover and growth; and its ability to heal when damaged. Students know that although the skeleton is made up of rigid bones, many joints allow for movement.*

**STANDARD**

04 Students will describe the structures and functions of the skeletal system and its components.

**OBJECTIVES**

04.01 Identify the general functions of the skeletal system.

04.02 Identify the roles of the osteoblasts, osteocytes, and osteoclasts in bone growth and

ossification.

04.03 Describe the features of a long bone. (Periosteum, diaphysis, epiphysis, medullary cavity, red marrow, yellow marrow, articular cartilage, endosteum, compact bone, spongy bone)

04.04 Identify the four shapes of bones with characteristics and examples of each. (Long, short, flat, rregular)

04.05 Describe and locate the following bone markings. (foramen, meatus, sinus, fossa, condyle, tuberosity, trochanter, tubercle, process)

04.06 Describe the terms “suture” and “fontanel”.

04.07 Contrast the axial and appendicular skeletons.

04.08 Locate the following skull bones. (Mandible, maxilla, zygomatic, frontal, parietal, occipital, sphenoid, ethmoid, hyoid, temporal, mastoid process)

04.09 Contrast the average number, location and function of each of the five groups of vertebrae.

04.10 Explain the structural classifications of articulations. (Fibrous, synovial & cartilaginous)

04.11 Differentiate between ligaments and tendons.

04.12 Identify the following diseases or disorders of the skeletal system. (Herniated disk, osteoarthritis, osteoporosis, scoliosis, spina bifida)

UNIT 5 - MUSCULAR SYSTEM

Movement and Support in Humans

*Students know the physiology and structure of bones and skeletal muscle as they interact to provide movement and support of the human body. Students understand the chemical and microscopic structure of bone; its development, repair, turnover and growth; and its ability to heal when damaged. Students know that although the skeleton is made up of rigid bones, many joints allow for movement.*

**STANDARD**

05 Students will describe the structures and functions of the muscular system and its components.

**OBJECTIVES**

05.01 Identify the general functions of the muscular system.

05.02 Describe the four characteristics of muscle tissue. (Elasticity, excitability [irritability], extensibility, flexibility)

05.03 Contrast the general location, microscopic appearance, control, and functions of the three specific types of muscle tissue. (Skeletal, smooth, cardiac)

05.04 Contrast thick and thin myofilaments.

05.05 Describe the sliding-filament theory of muscle contraction.

05.06 Describe what occurs at the neuromuscular junction.

05.07 Define the terms “origin” and “insertion.”

05.08 Explain the role of prime movers (agonists), antagonists, synergists, and fixators.

05.09 Describe the locations and functions of the following skeletal muscles: (biceps brachii, triceps brachii, sternocleidomastoid, trapezius, deltoid, diaphragm, pectoralis major, latissimus dorsi, gastrocnemius, hamstrings, quadriceps, gluteus maximus)

05.10 Identify the following diseases and disorders of the muscular system. (Fibromyalgia, muscular dystrophy, shin splints)

UNIT 6 - NERVOUS SYSTEM / SPECIAL SENSES

*Students recognize that the nervous system, together with the endocrine system, controls and integrates the workings of the human body. Students recognize that nerve cells are the functional cellular units of the nervous system and that their activity calls for rapid transmission of information along their axons as well as an ability to network by "talking" to other nerve cells. Students should understand that the nervous system is divided into the peripheral nervous system and the central nervous system. Students should be familiar with the structure and functions of the subdivisions of the brain. They should also know that diseases of this part of the brain cause marked impairment of motor function. Students should know the cerebellum may play an important role in the learning of motor skills.*

**STANDARD**

05 Students will describe the structures and functions of the nervous system and special senses.

**OBJECTIVES**

06.01 Restate the three broad functions of the nervous system: (sensory, integration, motor)

06.02 Describe the general organization of the nervous system.

06.03 List the functions and structures of neurons and neuroglial cells: (astrocytes, microglia, oligodenrocytes, ependymal cells, Schwann cells)

06.04 Sequence the major events when the nerve impulse (action potential) is initiated and transmitted through a neuron.

06.05 Contrast white and gray matter of nervous tissue.

06.06 Identify the structures responsible for the maintenance and protection of the central nervous system. (Meninges, dura mater, arachnoid mater and pia mater])

06.07 Explain the role of each of the components of a reflex arc. (Reflex, reflex arc, receptor, sensory neuron, association [interneuron] neuron, motor neuron, effector)

06.08 Identify the four principle parts of the brain. (Cerebrum, cerebellum, brain stem, diencephalon)

06.09 Describe the location and function of CSF. (Ventricles, subarachnoid space)

06.10 Describe the functions of the three structures of the brain stem. (Medulla oblongata, pons, midbrain)

06.11 Describe the structures and functions of the diencephalon. (Thalamus, hypothalamus)

06.12 Describe the locations and functions of the four lobes of the cerebrum. (Frontal, parietal, temporal, occipital)

06.13 Explain the major functions of the cerebellum.

06.14 Identify the following diseases or disorders of the nervous system. (ALS, Alzheimer’s, bacterial meningitis, cerebral palsy, epilepsy, multiple sclerosis, Parkinson’s)

06.15 Describe the principle anatomical structures of the eye. (Accessory structures [eyelid, conjunctiva, lacrimal apparatus, extrinsic muscles] layers of the eyeball (fibrous tunic [sclera, cornea], vascular tunic [choroid, ciliary body, iris, lens, pupil], nervous tunic [retina])

06.16 Describe the principle anatomical structures of the ear. (outer ear [auricle, auditory canal], middle ear [tympanic cavity, tympanic membrane, auditory (Eustachian) tube, auditory ossicles (malleus, incus, stapes)], inner ear [bony labyrinth, membranous labyrinth, semicircular canals, vestibule, cochlea, Organ of Corti])

06.17 Identify the following diseases or disorders associated with special senses. (Presbyopia, myopia, hyperopia, cataracts, conjunctivitis, deafness [conductive, sensorineural], glaucoma, macular degeneration, middle ear infection, strabismus, tinnitus, vertigo)

UNIT 7 - ENDOCRINE SYSTEM

*Students understand the structure and function of the endocrine system in relation to digestion and metabolism, homeostasis, survival, growth, development, and reproduction*

**STANDARD**

06 Students will describe the structures and functions associated with the endocrine system.

**OBJECTIVES**

07.01 Identify the general functions of the endocrine system.

07.02 Describe a “hormone” and how it functions in the body.

07.03 Describe the locations, secretions, and functions of the major endocrine glands. (Pituitary gland [GH, TSH, ACTH], thyroid gland [thyroxine], adrenals [epinephrine, norepinephrine, cortisol, pancreas [glucagon, insulin])

07.04 Identify the following diseases or disorders of the endocrine system. (Acromegaly, cretinism, diabetes mellitus, dwarfism, gigantism, hyperthyroidism, hypothyroidism, myxedema)

UNIT 8 – BLOOD / LYMPHATIC / CARDIOVASCULAR SYSTEMS

*Students understand the functions of blood including its role in essential protection to combat invading microorganisms, acute inflammation, and immune responses. Students should understand the role of the lymphatic system in the body’s defense against marauding pathogens. Students should also understand that many of the cells of the immune system are formed, reside in, are processed in, or travel within and through the structures of the lymphatic system. Students should understand these structures, classify them, and know their location. Students recognize the anatomy and function of the heart and blood vessels. They should also understand that diseases of the cardiovascular system are a major cause of death in this country and, therefore, it is important to understand the normal physiology of the heart and blood vessels.*

**STANDARD**

08 Students will describe the components and functions associated with blood, and the structures and functions of the lymphatic and cardiovascular systems.

**OBJECTIVES**

08.01 Identify the components of blood and their functions. (Erythrocytes, leukocytes, thrombocytes, plasma)

08.02 Describe erythrocytes, including the structure of hemoglobin.

08.03 Define “leukocyte” and list the two major groups with their cell types. (Granulocytes – neutrophils, basophils, eosinophils, and agranulocytes –monocytes, lymphocytes)

08.04 Describe the process of hemostasis. (Vascular spasm, platelet plug formation, coagulation)

08.05 Contrast a thrombus and an embolus.

08.06 Identify the antigens found on the erythrocytes and the antibodies that determine the ABO blood types and the Rh factor.

08.07 Identify the following diseases or disorders associated with the blood. (Anemias, hemolytic disease of the newborn, hemophilia, leukemia, mononucleosis, polycythemia)

08.08 Identify the components of the lymphatic system. (Tonsils, spleen, thymus, lymph nodes, bone marrow, lymph vessels)

08.09 Describe how lymph is moved through the body.

08.10 Contrast antigens and antibodies.

08.11 Describe the general roles of T-cells and B-cells in the immune response.

08.12 Distinguish between active and passive immunity, and natural vs. artificial acquisition of immunity.

08.13 Identify the following diseases or disorders associated with the lymphatic system. (AIDS, measles, mumps, rubella, tetanus)

08.14 List the general functions of the cardiovascular system.

08.15 Describe the layers of the heart. (Epicardium, myocardium, endocardium)

08.16 Identify the chambers of the heart.

08.17 Locate the great blood vessels of the heart. (Superior vena cava, inferior vena cava, pulmonary trunk, pulmonary arteries, pulmonary veins, aorta, branches of the aorta)

08.18 Identify the valves of the heart. (Tricuspid, pulmonary semilunar, bicuspid (mitral), aortic semilunar)

08.19 Trace blood flow through the heart.

08.20 Identify the components of the conduction system of the heart and trace the pathway. (SA node, AV node, AV bundle, bundle branches, Purkinje fibers [conduction], fibers)

08.21 Sequence the principle events of the cardiac cycle in terms of systole and diastole.

08.22 Define cardiac output and identify factors that influence it. (heart rate and stroke volume)

08.23 Contrast the structures and functions of arteries, capillaries, and veins.

08.24 Define pulse and identify the general location of arteries where pulse may be felt.

08.25 Describe blood pressure and how to measure it.

08.26 Contrast pulmonary and systemic circulation.

08.27 Identify the following diseases or disorders of the cardiovascular system. (Aneurysm, arteriosclerosis, atherosclerosis, cerebrovascular accident/stroke, coronary artery disease, hypertension, murmur, myocardial infarction)

UNIT 9 – RESPIRATORY SYSTEM

*Students should understand why it is necessary to breathe. They should understand how breathing is controlled, how the mechanical aspects of the breathing processes occur, and how ventilation of the lungs changes in response to changes in blood oxygen, carbon dioxide, and pH.*

**STANDARD**

09 Students will describe the structures and functions associated with the respiratory system.

**OBJECTIVES**

09.01 Identify the general functions of the respiratory system.

09.02 Sequence the organs of the respiratory system in the order which air will pass through them from the exterior. (nose or mouth, pharynx, larynx, trachea, bronchi, bronchioles, alveolar duct, alveoli).

09.03 Identify the three regions of the pharynx. (Nasopharynx, oropharynx and laryngopharynx)

09.04 Identify the following anatomical features of the larynx. (Epiglottis, glottis, hyoid bone, thyroid cartilage, cricoid cartilage, true and false vocal cords)

09.05 Identify the coverings of the lungs and the gross anatomical features of the lungs. (Apex, base, lobes, visceral pleura, parietal pleura, pleural cavity)

09.06 Identify the site at which gas exchange occurs in the lungs. (Alveoli)

09.07 Identify the volumes and capacities of air exchanged during ventilation. (Tidal volume, vital capacity)

09.08 Differentiate between ventilation, external respiration, and internal respiration.

09.09 Describe the effects of carbon dioxide on ventilation.

09.10 Identify the following diseases or disorders of the respiratory system. (Emphysema, influenza, lung cancer, pneumonia, SIDS, tuberculosis)

UNIT 10 - DIGESTIVE SYSTEM

*Students should be able to define the digestive system and to state the structures, regulators, and functions of its primary and accessory structures and organs. Students should be able to explain why food is essential for life. They should understand the anatomy of the splanchnic circulation and it relationship to the liver.*

**STANDARD**

10 Students will describe the structures and functions associated with the digestive system.

**OBJECTIVES**

10.01 Identify the general functions of the digestive system.

10.02 Contrast chemical and mechanical digestion.

10.03 Differentiate between the alimentary canal structures (mouth, pharynx, esophagus, stomach, small intestines, large intestines, rectum, and anus) and the accessory structures (salivary glands [parotid], pancreas, gallbladder, liver).

10.04 Describe the functions of saliva and salivary amylase in digestion.

10.05 Identify the following parts of a typical tooth. (Crown, neck, root, gingiva, periodontal ligament, enamel, dentin, pulp, root canal)

10.06 Define deglutition, mastication, maceration, segmentation, peristalsis and haustral churning.

10.07 Identify the anatomical features of the stomach. (Fundus, body, pylorus, rugae, cardiac sphincter, and pyloric sphincter).

10.08 Identify the basic components of gastric juice. (Pepsin, hydrochloric acid, and mucus)

10.09 Identify the location and digestive functions of the pancreas.

10.10 Describe the function of bile (emulsification).

10.11 Identify the three sections of the small intestine. (Duodenum, jejunum, ileum)

10.12 Identify the structures and sections of the large intestine. (Cecum, colon [ascending, transverse, descending, sigmoid], rectum, anal canal)

10.13 Identify the following diseases or disorders of the digestive system. (Appendicitis, cirrhosis, colorectal cancer, gallstones, hepatitis, obesity, ulcers)

UNIT 11 - URINARY SYSTEM

*Students should understand the microscopic and macroscopic anatomy of the renal system. Students should understand the function of the kidneys in relation to homeostatic control of bodily fluids, blood pressure, and erythrocyte production. They should understand micturition, the properties of urine and the physiological processes involved in the production of urine. Students should understand the importance of a high blood flow through the kidneys and the kidney’s role in control of sugar, salts, and water.*

**STANDARD**

11 Students will describe the structures and functions associated with the urinary system.

**OBJECTIVES**

11.01 Identify the general functions of the urinary system.

11.02 Identify the four major organs of the urinary system. (Kidneys, ureters, bladder, urethra)

11.03 Identify the gross anatomy of the kidney. (Renal cortex, renal medulla, renal pyramids, renal pelvis)

11.04 Identify the microscopic structures of the nephron: (renal corpuscle, glomerulus, glomerular [Bowman’s] capsule, afferent arteriole, efferent arteriole), renal tubule (proximal convoluted tubule, descending limb, nephron loop, ascending limb, distal convoluted tubule and collecting duct) and peritubular capillaries.

11.05 Describe the three basic physiological processes and the structures involved in urine formation. (Filtration, reabsorption, secretion)

11.06 Identify abnormal constituents of urine. (Glucose, ketones, erythrocytes, leukocytes, bilirubin, microbes)

11.07 Describe the methods of fluid intake (oral [liquid and solid], intravenous, metabolic) and output (micturition, voiding, sweat, feces, exhaled vapor).

11.08 Identify the following diseases or disorders associated with the urinary system. (Cystitis, diabetes insipidus, glomerulonephritis, incontinence, kidney stones, renal failure, urinary tract infections)

UNIT 12 - REPRODUCTIVE SYSTEM

*Students should understand the anatomy of the male and female reproductive systems. They should understand the function of the hormones of male and female gonads, their cell origins and their functions. They should understand the sequence of human development. They should understand the disorders and diseases of the reproductive systems.*

**STANDARD**

12 Students will describe the structures and functions associated with the reproductive system.

**OBJECTIVES**

12.01 Identify the general functions of the reproductive system.

12.02 Describe the anatomy of the male genitalia.

12.03 Identify the function of the testes.

12.04 Identify the functions of testosterone in the male.

12.05 Describe the anatomy of the female reproductive structures.

12.06 Identify the functions of the ovaries.

12.07 Identify the structures and functions of the uterine (Fallopian) tubes, including fimbriae and infundibulum.

12.08 Describe the structures and function of the uterus. (Perimetrium, myometrium, endometrium, fundus, cervix)

12.09 Define the menstrual cycle including the ovarian and uterine cycles and changes that occur during menopause.

12.10 Describe the physiological effects of estrogens, progesterone and relaxin.

12.11 Contrast the general outcomes of spermatogenesis vs. oogenesis.

12.12 Define the following sequence of events that occur during human development. (Fertilization, zygote, implantation, embryo, fetus)

12.13 Identify the principle events associated with the three stages of labor. (Stage 1 - dilation and effacement, Stage 2 - delivery and birth, Stage 3 - placental expulsion)

12.14 Identify the following diseases or disorders of the reproductive system. (Reproductive cancers [breast, testicular, cervical, ovarian, prostate], endometriosis, impotence, Sexually Transmitted Infections – STI’s [gonorrhea, syphilis, genital herpes, chlamydia, trichimoniasis, genital warts, HPV [Human Papilloma Virus])