Medical Anatomy and Physiology, Advanced

Exam Information

Exam number
703

Items
100

Points
100

Prerequisites
Medical Anatomy and Physiology

Recommended course length
One year

National Career Cluster
Human Science

Performance standards
Included (Optional)

Certificate available
Yes

Description

The Advanced Medical Anatomy and Physiology industry certification exam is a college-level assessment that evaluates in-depth knowledge of body structures and functions. This exam is preparatory for further healthcare training programs or careers.

Exam Blueprint

Standard	Percentage of exam
1. Body Plan and Organization	3%
2. Inorganic Chemistry	4%
3. Organic Chemistry	2%
4. Cells	2%
5. Tissues	2%
6. Integumentary System	3%
7. Skeletal System	8%
8. Muscular System	3%
9. Nervous System I	17%
10. Nervous System II	5%
11. Endocrine System	7%
12. Cardiovascular System I	12%
13. Cardiovascular System II	10%
14. Respiratory System	8%
15. Digestive System	5%
16. Urinary System	7%
17. Reproductive System	2%

Standard 1

Body Plan and Organization- Students will explore and describe the body plan, organization, and homeostasis.

Objective 1 Contrast the sciences of anatomy and physiology.

Objective 2 Describe the six levels of structural organization of the human body and their interrelationship.

1. Chemical
2. Cellular
3. Tissue
4. Organ
5. System
6. Organism

Objective 3 Define anatomical position and identify commonly used planes in gross anatomy and/or imaging.

1. Sagittal
2. Midsagittal
3. Parasagittal
4. Transverse (horizontal)
5. Frontal (coronal)
6. Oblique

Objective 4 Apply directional terms used in human anatomy.

1. Posterior/Anterior
2. Medial/Lateral
3. Proximal/Distal
4. Superficial/Deep
5. Superior/Inferior
6. Cranial/Caudal
7. Ventral/Dorsal
8. Ipsilateral/Contralateral
9. Parietal/Visceral

Objective 5 Apply regional terms used in human anatomy.

1. Head (cephalic)
    a. Skull (cranial)
    b. Base of skull (occipital)
2. Face (facial)
    a. Forehead (frontal)
    b. Temple (temporal)
    c. Eye (orbital, ocular)
    d. Ear (otic)
    e. Cheek (bucca
    f. Nose (nasal)
    g. Mouth (oral)
    h. Chin (mental)

3. Neck (cervical)
4. Spinal column (vertebral)
5. Trunk
6. Chest (thoracic)
    a. Breastbone (sternal)
    b. Breast (mammary)
    c. Shoulder blade (scapular)
    d. Back (dorsal)
7. Abdomen (abdominal)
    a. Navel (umbilical)
8. Hip (coxal)
    a. Loin (lumbar)
    b. Between hips (sacral)
9. Pelvis (pelvic)
    a. Groin (inguinal)
    b. Pubis (pubic)
    c. Buttock (gluteal)
    d. Perineal
10. Upper Extremity
    a. Armpit (axillary)
    b. Arm (brachial)
    c. Front of elbow (antecubital)
    d. Back of elbow (olecranal, cubital)
    e. Forearm (antebrachial)
    f. Wrist (carpal)
    g. Hand (manual)
    h. Thumb (pollux)
    i. Palm (palmar, volar)
    j. Back of hand (dorsum)
    k. Fingers (digital, phalangeal)
11. Lower Extremity
    a. Thigh (femoral
    b. Knee
    c. Anterior surface (patellar)
    d. Posterior surface (popliteal)
    e. Leg (crural)
    f. Calf (sural)
    g. Foot (pedal)
    h. Ankle (tarsal)
    i. Sole (plantar)
    j. Top of foot (dorsum)
    k. Heel (calcaneal)
    l. Toes (digital, phalangeal)
    m. Great toe (hallux)

Objective 6 Identify the body cavities and locate the following organs within each cavity.

1. Dorsal Cavity
    a. Vertebral (spinal) -spinal cord
    b. Cranial-brain
2. Ventral Cavity
    a. Thoracic
        i. Mediastinum-heart, bronchi, esophagus, thymus.

ii. Pericardial-heart
iii. Pleural-lungs

3. Abdominopelvic Cavity
    a. Abdominal-liver, spleen, intestines, kidneys, stomach
    b. Pelvic-intestines, urinary bladder, sex organs

Objective 7 Identify the four abdominopelvic quadrants and the nine abdominopelvic regions and locate the major organ(s) in each.

1. Quadrants
    a. RUQ-right upper quadrant-liver, gallbladder, right kidney
    b. RLQ-right lower quadrant-cecum, appendix, right ovary
    c. LUQ-left upper quadrant-spleen, stomach, left kidney.
    d. LLQ-lower left quadrant-left ovary
2. Regions
    a. Right/Left hypochondriac
    b. Right/Left lumbar
    c. Right/Left inguinal (iliac)
    d. Epigastric
    e. Umbilical
    f. Hypogastric (pubic)

Objective 8 Define and describe the mechanism of homeostasis.

1. Receptors
2. Control
3. Effectors

Objective 9 Compare and contrast negative and positive feedback mechanisms to maintain homeostasis. Give examples of each.

1. Positive feedback (induce or stimulates)
    a. childbirth
    b. breast feeding
    c. blood clotting
    d. severe bleeding
2. Negative feedback (inhibits or reverses)
    a. blood pressure
    b. blood glucose
    c. thermoregulation
    d. water balance (thirst)

Standard 2

Basic Principles of Body Chemistry-Students will explain basic principles of inorganic chemistry.

Objective 1 Review the following terms and concepts.

1. States of Matter
2. Elements
3. Basic components of the atom
    a. Nucleus
    b. Electrons

c. Protons
d. Neutrons

4. Metabolism
    a. Anabolic
    b. Catabolic

Objective 2 Identify the major, lesser, and trace elements in the body and their chemical symbols.

1. Major
    a. Carbon (C)
    b. Hydrogen (H)
    c. Oxygen (O)
    d. Nitrogen (N)
2. Lesser
    a. Sodium (Na)
    b. Chlorine (Cl)
    c. Potassium (K)
    d. Calcium (Ca)
3. Trace
    a. Helium (He)
    b. Lithium (Li)
    c. Beryllium (Be)
    d. Boron (B)
    e. Fluorine (Fl)
    f. Neon (Ne)
    g. Magnesium (Mg)
    h. Aluminum (Al)
    i. Silicon (Si)
    j. Phosphorus (P)
    k. Sulfur (S)
    l. Argon (Ar)
    m. Iron (Fe)
    n. Selenium (Se)
    o. Bromine (Br)
    p. Krypton (Kr)
    q. Iodine (I)
    r. Xenon (Xe)

Objective 3 Differentiate between atomic number, mass number, and atomic mass using the periodic table.

Objective 4 Define isotopes and distinguish between stable isotopes and radioisotopes.

Objective 5 Define valence and electronegativity, and describe how they relate to the position of an element on the periodic table.

Objective 6 Describe the characteristics and strength of different chemical bonds.

1. Ionic (cation, anion)
2. Covalent

a. Non-polar
    i. Single
    ii. Double
    iii. Triple
b. Polar

3. Hydrogen

Objective 7 Describe the properties of water and how it is utilized in the human body.

1. Universal solvent
2. Transport
3. Lubricant
4. Heat capacity
5. Chemical reactions

Objective 8 Define acid, and base, and describe the pH scale.

1. Acidic
    a. Hydrogen (proton) donor
2. Basic (alkaline)
    a. Hydrogen (proton) acceptor
3. Neutral
4. Blood ph= 7.35 to 7.45

Objective 9 Define a pH buffer and describe the carbonic acid/bicarbonate buffer system.

Standard 3

Basic Principles of Body Chemistry-Students will explain basic principles of organic chemistry.

Objective 1 Distinguish between:

1. Inorganic compounds-do not contain carbon, small molecules, usually form ionic bonds
2. Organic compounds-usually contain carbon, large molecules, form covalent bonds, flammable

Objective 2 Compare and contrast how anabolic and catabolic processes play a role in monomers, dimers, and polymers.

1. Dehydration synthesis
2. Hydrolysis

Objective 3 Describe the naming, structure, and functions of carbohydrates and give an example of each:

1. Monosaccharides
    a. Hexose
        i. Glucose
        ii. Fructose
        iii. Galactose
    b. Pentose
        i. Deoxyribose
        ii. Ribose
2. Disaccharides

    a. Sucrose (glucose + fructose)
    b. Lactose (glucose + galactose)
    c. Maltose (glucose + glucose)
3. Polysaccharides
    a. Glycogen
    b. Starch
    c. Cellulose

Objective 4 Describe the naming, structures, and functions of proteins and give an example of each:

1. Amino Acids
    a. Carboxyl
    b. R-Group (20 unique groups)
    c. Amino Group
2. Bonds
    a. Peptide
    b. Dipeptide
    c. Polypeptide
3. Levels of protein structure
    a. Primary
    b. Secondary
    c. Tertiary
    d. Quaternary
    e. Enzymes

Objective 5 Describe the structures and functions of lipids and give an example of each:

1. Fatty acids (monomer)
    a. Saturated
    b. Unsaturated
    c. Monounsaturated
    d. Polyunsaturated
2. Triglycerides
3. Steroids

Objective 6 Describe the structures and functions of nucleic acids and give an example of each:

1. Nitrogenous Bases
    a. Adenine
    b. Guanine
    c. Thymine
    d. Cytosine
    e. Uracil
2. Nucleotide = base + sugar + phosphate (monomer)
3. RNA and DNA (polymer)

Objective 7 Describe the structure and function of phospholipids.

Objective 8 Describe the structure and function of glycolipids and glycoproteins as cell surfaces.

Standard 4

Cells- Students will describe basic structures and functions of cells.

Objective 1 Identify the principal parts of a generalized animal cell and their functions.

1. Nucleus
    a. Nucleolus
    b. Chromosome
        i. Chromatin
        ii. Gene (DNA, RNA)
2. Cytoplasm
    a. Cytosol
    b. Organelles
        i. Ribosome
        ii. Endoplasmic Reticulum (smooth, rough)
        iii. Golgi complex (body)
        iv. Lysosome
        v. Mitochondria
        vi. Centrosome (centrioles)
        vii. Cytoskeleton
        viii. Cilia
        ix. Flagella
        x. Peroxisome
3. Cell membrane
    a. Phospholipids
    b. Cholesterol
    c. Glycoproteins
    d. Glycolipids
    e. Protein channels

Objective 2 Describe a selectively permeable membrane and factors which influence permeability.

Objective 3 Contrast intracellular and extracellular fluid in terms of location and composition.

Objective 4 Describe each of the following cellular transport processes and classify them as active or passive.

1. Passive processes
    a. Simple diffusion
    b. Facilitated diffusion
    c. Filtration (dialysis)
    d. Osmosis
2. Active processes
    a. Endocytosis
        i. Phagocytosis
        ii. Pinocytosis
        iii. Receptor mediated
    b. Exocytosis
    c. Secondary Active Transport
        i. Antiport

ii. Symport
d. Sodium/Potassium pump

Objective 5 Compare and contrast the osmotic effects that occur when a cell is placed in the following solutions:

1. Isotonic
2. Hypotonic
3. Hypertonic

Objective 6 Describe how and where the body produces energy during cellular respiration.

1. ATP ↔ ADP + P + ENERGY
    a. Glycolysis (anaerobic)
    b. Formation of acetyl coenzyme A/lactic acid (aerobic vs anaerobic pathways)
    c. Citric Acid Cycle (Krebs)
    d. Electron Transport Chain

Objective 7 Sequence the steps of the cell cycle. Compare and contrast mitosis and meiosis.

1. Interphase
    a. G0
    b. G1
    c. S
    d. G2
2. Mitosis
    a. Prophase
    b. Metaphase
    c. Anaphase
    d. Telophase
    e. Cytokinesis
3. Meiosis
    a. Prophase I & II
    b. Metaphase I & II
    c. Anaphase I & II
    d. Telophase I & II
    e. Cytokinesis

Objective 8 Describe the process of transcription and translation in relationship to protein synthesis.

Objective 9 Describe the process of DNA replication.

Standard 5

Students will describe basic structures and functions of tissues.

Objective 1 Identify and describe the general characteristics and functions of each of the four principle types of tissues.

1. Epithelial

2. Connective
3. Muscular
4. Nervous

Objective 2 Describe the naming, structural features, and locations of epithelial tissue.

1. Structural features
    a. Apical surface
    b. Basal surface
    c. Basement membrane
    d. Avascular
2. Naming conventions
    a. Arrangement of cells
        i. Simple
        ii. Stratified
        iii. Pseudostratified
    b. Cell Shape
        i. Squamous
        ii. Cuboidal
        iii. Columnar
        iv. Transitional
3. Glandular epithelium
    a. Exocrine glands
    b. Endocrine glands

Objective 3 Describe the structural features, types, and locations of connective tissue.

1. Cells
    a. Extracellular matrix
        i. Fibers
        ii. Ground substance
    b. Types of connective tissue
    c. Loose
        i. Areolar
        ii. Adipose
        iii. Reticular
    d. Dense
        i. Regular
        ii. Irregular
        iii. Elastic
    e. Cartilage
        i. Hyaline
        ii. Fibrocartilage
        iii. Elastic
    f. Blood
    g. Bone
    h. Lymph

Objective 4 Describe the five main types of cellular junctions.

1. Tight
2. Gap
3. Adherens
4. Desmosomes
5. Hemidesmosomes

Objective 5 Compare and contrast epithelial and connective tissue membranes.

1. Cutaneous
2. Serous
3. Mucous
4. Synovial

Objective 6 Compare and contrast skeletal, cardiac, and smooth muscle tissue.

1. Voluntary vs. involuntary
2. Striated vs. non-striated
3. Location and number of nuclei

Objective 7 Describe the identify the key features of nervous tissue.

1. Neuron
2. Glial cells

Standard 6

Integumentary System

Objective 1 Describe the general structures and functions of the integumentary system.

Objective 2 Identify and describe the tissue type making up the epidermis. Identify and describe layers of the epidermis. Differentiate between thick and thin skin. Describe renewal of the epidermis.

Objective 3 Explain how each cell type (stem cells, keratinocytes, melanocytes, Langerhans cells, Merkel cells and discs) and substances (keratin, extracellular lipids) contribute to the function of the epidermis.

Objective 4 Identify and describe the dermis and its layers. Know the tissue types that make up each layer.

Objective 5 Identify and describe the hypodermis/subcutaneous layer. Know the tissue types that make up the hypodermis.

Objective 6 Identify exocrine glands of the integumentary system and describe their function.

1. Sudoriferous
    a. Eccrine
    b. Apocrine
2. Sebaceous
3. Ceruminous

Objective 7 Identify nerve endings of the integumentary system and describe their functions.

1. Meissner's corpuscles
2. Merkel disk
3. Free nerve endings
4. Pacinian corpuscles
5. Ruffini ending

Objective 8 Describe the structures and functions of accessory structures of the integumentary system.

1. Hair
2. Nails

Objective 9 Explain the role of skin in the maintenance of body temperature (thermoregulation).

Standard 7

Skeletal System

Objective 1 Describe the general functions of the skeletal system.

Objective 2 List the cellular components of bone tissue. List the extracellular components of bone tissue.

1. Osteoblasts
2. Osteocytes
3. Osteoclasts
    a. Organic
    b. Inorganic

Objective 3 Compare and contrast compact and spongy bones.

Objective 4 Describe the roles and location of dense regular, dense irregular, and cartilage in the skeletal system.

1. Ligaments
2. Tendons
3. Periosteum
4. Articular cartilage

Objective 5 Identify the features of a long bone.

1. Periosteum
2. Diaphysis
3. Metaphysis
4. Epiphysis
5. Medullary cavity
6. Red marrow
7. Yellow marrow
8. Articular cartilage
9. Endosteum
10. Compact bone
11. Spongy bone

Objective 6 Compare and contrast endochondral and intramembranous ossification.

Objective 7 Explain how hormones are involved in bone growth and maintenance. Explain the roles of calcitonin, parathyroid hormone and calcitriol in bone remodeling and blood calcium regulation.

Objective 8 Define and locate bone markings including:

1. Condyle
2. Epicondyle
3. Facet
4. Fissure
5. Foramen
6. Fossa
7. Head
8. Meatus
9. Process
10. Spine
11. Sulcus
12. Trochanter
13. Trochlear
14. Tubercule
15. Tuberosity

Objective 9 Locate the following bones of the axial and appendicular skeletons.

1. Axial Skeleton
    a. Mandible
    b. Maxilla
    c. Zygomatic
    d. Frontal
    e. Parietal
    f. Occipital
    g. Sphenoid
    h. Ethmoid
    i. Hyoid
    j. Temporal
    k. Vertebrae (lamina, body, pedicle, spinous process, transverse process)
        i. Cervical
        ii. Thoracic
        iii. Lumbar
        iv. Sacral
        v. Coccygeal
    l. Ribs
    m. Sternum
2. Appendicular Skeleton
    a. Clavicle
    b. Scapula
    c. Pubic bone
        i. Ilium
        ii. Ischium
        iii. Pubis
    d. Femur
    e. Patella
    f. Tibia
    g. Fibula
    h. Tarsals

i. Metatarsals
j. Phalanges
k. Humerus
l. Ulna
m. Radius
n. Carpals
o. Metacarpals
p. Phalanges

Objective 10 Compare and contrast functional and anatomical (structural) classification of joints.

1. Structural:
    a. Fibrous
    b. Synovial
    c. Cartilaginous
2. Functional:
    a. Amphiarthrotic
    b. Diarthrotic
    c. Synarthrotic

Objective 11 Describe the different movements of a joint.

1. Flexion/extension/hyperextension
2. Abduction/adduction/circumduction
3. Pronation/supination
4. Internal (medial) and external (lateral) rotation
5. Plantarflexion/dorsiflexion

Standard 8

Muscular System

Objective 1 Describe the general functions of the muscular system.

Objective 2 Contrast the general location, microscopic appearance, control, and functions of the three specific types of muscle tissue.

1. Skeletal
2. Smooth
3. Cardiac

Objective 3 Describe muscle organization and structure.

1. Sarcomere
2. Myofibril
3. Muscle cell (muscle fiber)
4. Sarcolemma
5. Sarcoplasm
6. Transverse tubules (T-tubules)
7. Sarcoplasmic reticulum
8. Triad
9. Fascicle
10. Endomysium
11. Perimysium
12. Epimysium

Objective 4 Describe the structures of the sarcomere.

1. Myofilaments
    a. Actin (thin)
    b. Myosin (thick)
2. Bands and zones
    a. A-band
    b. I-band
    c. Z-disc
    d. H-zone
    e. M-line

Objective 5 Label the components of the neuromuscular junction on a diagram and explain the role in triggering a muscle contraction.

Objective 6 Describe the sliding filament model of muscle contraction.

Objective 7 List the sequence of events from muscle cell action potential to the contraction of muscle.

Objective 8 Explain the role of other molecules like creatine and myoglobin in energy metabolism.

Objective 9 Define and describe the terms origin, insertion, action, prime mover, agonist, antagonist, synergist, and fixator.

Objective 10 Define and compare the types of muscle contraction: concentric, eccentric, and isometric.

Objective 11 Relate the different terms used to name muscles:

1. Location
2. Shape
3. Size
4. Number of origins
5. Direction of fibers
6. Origin and insertion
7. Action

Objective 12 Identify the following muscles including their location, origin/insertion, and action.

1. Upper Extremity
    a. Rotator cuff
    b. Deltoid
    c. Serratus Anterior

    d. Pectoralis Major
    e. Latissimus Dorsi
    f. Triceps Brachii
    g. Biceps Brachii
    h. Brachialis
    i. Brachioradialis
    j. Wrist flexors
    k. Wrist extensors
2. Lower Extremity
    a. Iliopsoas
    b. Gluteus Maximus
    c. Gluteus Medius
    d. Sartorius
    e. Hip adductors
    f. Quadriceps
    g. g. Hamstrings
    h. h. Gastrocnemius
    i. i. Soleus
    j. j. Tibialis Anterior
    k. k. Tibialis Posterior
    l. l. Peroneal (fibular) group
3. Head/neck/Trunk
4. Masseter
    a. Sternocleidomastoid
    b. Trapezius
    c. Diaphragm
    d. Intercostals
    e. Rectus Abdominis
    f. Internal/External Oblique
    g. Transverse Abdominis
    h. Erector Spinae

Standard 9

Nervous System I

Objective 1 Distinguish between sensory and motor (somatic and autonomic) divisions of the nervous system and the terminology associated.

1. Ganglia vs nuclei
2. Tracts vs nerves
3. Gyrus vs sulcus vs fissure

Objective 2 Compare and contrast characteristics of the two cell types of the nervous system: neurons and glial cells.

1. Neurons
    a. Cell body
    b. Axon
    c. Dendrite
2. Glial Cells
    a. Astrocytes
    b. Microglia

c. Oligodendrocytes
d. Ependymal cells
e. Schwann cells
f. Satellite cells

Objective 3 Compare and contrast concentration and electrical forces. Apply these principles to the movement of ions across the cell membrane.

Objective 4 List and describe the sequence of events in the action potential. Label a diagram of the action potential including: threshold, depolarization, repolarization, hyperpolarization, and absolute and relative refractory periods.

Objective 5 List and describe in order the sequence of events at the synapse. Begin with the arrival of the action potential and end with the effect of neurotransmission on the postsynaptic cell (postsynaptic potential and/or biochemical change).

Objective 6 List and describe the following neurotransmitters:

1. Acetylcholine (AcH)
2. Dopamine
3. Serotonin
4. Epinephrine
5. Norepinephrine

Objective 7 Compare and contrast the action potential with graded potentials (EPSPs and IPSPs).

Objective 8 Describe the gross anatomy of the spinal cord and spinal nerves. Differentiate between gray and white matter. Understand the relationship of the spinal cord and spinal nerves to the bony vertebrae surrounding them. Label on a diagram the structures associated with the spinal cord including lateral corticospinal tract, posterior column, spinothalamic tract, dorsal root ganglia, dorsal and ventral roots, and spinal nerves.

Objective 9 Identify and describe the structures and functions of the brain.

1. Cerebrum
    a. Frontal
        i. Precentral gyrus (motor homunculus)
    b. Parietal
        i. Postcentral gyrus (sensory homunculus)
    c. Temporal
    d. Occipital
2. Cerebellum
3. Brain stem
    a. Medulla oblongata
    b. Pons

    c. Midbrain
4. Diencephalon
    a. Thalamus
    b. Hypothalamus
5. Gray/white matter organization
6. Brain Landmarks
    a. Fissures
    b. Medial Longitudinal
    c. Lateral
    d. Transverse
7. Sulci
    a. Central
    b. Parieto-occipital
8. Other
    a. Corpus Callosum
    b. Limbic System

Objective 10 Describe the anatomy and physiology of the sympathetic nervous system. In the description of the anatomy, include the location of preganglionic and postganglionic neurons and synapses. In the description of the physiology, include the activity of various organs innervated by the autonomic nervous system.

Objective 11 Describe the anatomy and physiology of the parasympathetic nervous system. In the description of the anatomy, include the location of preganglionic and postganglionic neurons and synapses. In the description of the physiology, include the activity of various organs innervated by the autonomic nervous system.

Objective 12 Identify the effectors of the autonomic nervous system. Identify the effectors of the somatic nervous system. Compare and contrast these.

Objective 13 Identify the three meninges. For each meninx, be able to describe its anatomical relationship to the skull, to the brain, and to the other meninges.

1. Dura Mater
2. Arachnoide
3. Pia Mater

Objective 14 Describe cerebrospinal fluid. Identify locations where it is made; where it circulates; and where it is reabsorbed into the bloodstream.

1. Lateral Ventricles (2)
2. Third Ventricle
3. Aqueduct
4. Fourth Ventricle
5. Subarachnoid space
6. Arachnoid villi

Objective 15 Describe the structure and function of the blood-brain barrier.

Objective 16 List the twelve cranial nerves. Be able to correctly associate their names and numbers. State a function for each, and whether it is sensory, motor, or mixed.

Objective 17 Define upper motor neuron. Define lower motor neuron. Compare and contrast

these. Describe the motor systems and pathways.

1. Precentral gyrus
2. Pyramids
3. Lateral corticospinal tract
4. Effector

Objective 18 Identify the general features of a sensory system. Define transduction. Describe the sensory pathways for pain and temperature vs touch.

1. Pain and temperature
    a. Receptor
    b. Sensory nerve
    c. Dorsal root ganglion
    d. Lateral spinothalamic tract (crosses in spinal cord)
    e. Thalamus
    f. Postcentral gyrus
2. Touch
    a. Receptor
    b. Sensory nerve
    c. Dorsal root ganglion
    d. Posterior column
    e. Crosses in the medulla
    f. Thalamus
    g. Postcentral gyrus

Objective 19 Define each of the following three categories of sensory receptors: exteroceptor, interoceptor, proprioceptor.

Objective 20 For the following six sensory receptor types, list the relevant stimulus and state in which sensory system it might be found: mechanoreceptors, thermoreceptors, nociceptors, photoreceptors, chemoreceptors, and osmoreceptors.

Objective 21 State the concept of dermatomes and their importance to human disease. Be able to identify the skin surface features associated with the C6, T4, T10, and L2-L-5 dermatomes.

Standard 10

Nervous System II – Reflexes; Special Senses

Objective 1 Explain the role of each of the components of a reflex arc.

1. Reflex
2. Reflex arc
3. Receptor
4. Sensory neuron
5. Association (interneuron) neuron
6. Motor neuron
7. Effector

Objective 2 Describe examples of common reflexes

1. Stretch reflex
2. Flexor (withdrawal reflex)
3. Cross extensor reflex

Objective 3 Label the components of the eye and describe the neural pathway to the brain.

1. Accessory structures
    a. Eyelid
    b. Conjunctiva
    c. Lacrimal apparatus
    d. Extrinsic muscles
2. Layers of the eyeball
    a. Fibrous tunic
        i. Sclera
        ii. Cornea
    b. Vascular tunic
        i. Choroid
        ii. Ciliary body
        iii. Iris
        iv. Lens
        v. Pupil
    c. Nervous tunic
        i. Retina
        ii. Rods
        iii. Cones
    d. Neural pathway
        i. Photoreceptor
        ii. Optic nerve
        iii. Optic chiasm
        iv. Thalamus
        v. Occipital lobe

Objective 4 Explain the location and function of olfactory receptors. Describe the neural pathway to the brain.

1. Olfactory receptors
    a. Olfactory nerve
    b. Olfactory bulb
    c. Olfactory tract

d. Olfactory cortex of the temporal lobe

Objective 5 Explain the location and function of gustatory receptors. Describe the neural pathway to the brain.

1. Gustatory receptors
    a. Fungiform papillae
    b. Foliate papillae
    c. Vallate papillae
2. Cranial nerve VII, IX, X
3. Medulla
4. Thalamus
5. Postcentral gyrus

Objective 6 Identify the principal anatomical structures of the ear.

1. Outer ear
    a. Auricle
    b. Auditory Canal
2. Middle ear
    a. Tympanic cavity
    b. Tympanic membrane
    c. Auditory (Eustachian) tube
    d. Auditory ossicles
    e. Malleus
    f. Incus
    g. Stapes
3. Inner ear
    a. Oval window
    b. Round window
    c. Bony labyrinth
    d. Utricle
    e. Saccule
    f. Semicircular canals
    g. Vestibule
    h. Cochlea & Organ of Corti
    i. Vestibular duct (scala vestibuli)
    j. Tympanic duct (scala tympani)

Objective 7 Follow the sound conduction pathway from the auricle to the fluids of the inner ear. Describe the neural path to the brain.

1. Neural Pathway Receptors (hair cells)
2. Cranial nerve VIII
3. Medulla
4. Thalamus
5. Temporal lobe

Objective 8 Explain the coding of pitch and loudness in the auditory system.

Objective 9 For the vestibular system, compare and contrast static vs. dynamic equilibrium. Describe the neural pathway to the brain.

1. Receptors (hair cells)
2. Cranial nerve VIII
3. Medulla

4. Thalamus
5. Somatosensory cortex

Standard 11

Endocrine System

Objective 1 Describe the functions of the endocrine system.

Objective 2 Describe and analyze the following endocrine terminology and concepts.

1. Hormone
2. Target cells
3. Circulating, paracrine, autocrine
4. Permissive, synergistic, and antagonistic effects
5. Water soluble vs lipid soluble
6. Target cell response
    a. Up regulation
    b. Down regulation
7. Primary vs secondary endocrine glands

Objective 3 Describe the location, secretion, and functions of the hypothalamus.

1. Growth Hormone Releasing Hormone (GHRH)-targets anterior pituitary
2. Thyrotropin Releasing Hormone (TRH)-targets anterior pituitary
3. Corticotropin Releasing Hormone (CRH)-targets anterior pituitary
4. Gonadotropin Releasing Hormone (GnRH) – targets anterior pituitary
5. Prolactin Releasing Hormone (PRL) – targets anterior pituitary
6. Antidiuretic Hormone (ADH)
    a. Produced in hypothalamus
    b. Stored in posterior pituitary
7. Oxytocin Hormone (Oxt)
    a. Produced in hypothalamus
    b. Stored in posterior pituitary

Objective 4 Describe the location, secretion, and functions of the pituitary gland.

1. Anterior Pituitary (adenohypophysis)
    a. Human Growth Hormone (GH)
        i. Targets cells stimulating growth
2. Thyroid Stimulating Hormone (TSH)
    a. Targets thyroid gland
3. Adrenocorticotropic Hormone (ACTH)
    a. Targets adrenal cortex
4. Follicle Stimulating Hormone (FSH)
    a. Targets gonads for gamete production
5. Luteinizing Hormone (LH)
    a. Targets gonads
6. Prolactin (PRL)
    a. Targets mammary glands
7. Melanocyte Stimulating Hormone (MSH)
    a. Targets melanocytes
8. Posterior Pituitary (neurohypophysis)

    a. Antidiuretic Hormone (ADH)
        i. Targets kidneys, sudoriferous glands, smooth muscle of blood vessels.
9. Oxytocin (Oxt)
    a. Targets uterus and breasts

Objective 5 Describe the anatomical and physiological relationships between the pituitary (which includes the adenohypophysis and the neurohypophysis) and the hypothalamus.

Objective 6 Describe the location and structures of the thyroid gland. List the hormones produced and target cells. Detail the synthesis, secretion, and transport of thyroid hormones.

1. Structures
    a. Follicle cells
    b. Parafollicular cells
    c. Thyroid follicle
    d. Isthmus
2. Hormones
    a. Thyroxine (T4)
    b. Follicular cells
    c. Targets cells increasing metabolism
3. Triiodothyronine (T3)
    a. Follicular cells
    b. Targets cells increasing metabolism
4. Calcitonin
    a. Parafollicular cells
    b. Lowers blood calcium

Objective 7 Describe the location, secretion, and functions of the parathyroid gland.

1. Parathyroid hormone
    a. Chief cells
    b. Increases blood calcium

Objective 8 Describe the antagonistic relationship between calcitonin and parathyroid hormone in regulating blood calcium.

Objective 9 Describe the location and structures of the adrenal gland. List the hormones produced and target cells.

1. Adrenal cortex
    a. Zona glomerulosa – mineralocorticoids – aldosterone
    b. Zona fasciculata – glucocorticoids – cortisol
    c. Zona reticularis- gonadocorticoids - androgens
2. Adrenal medulla
    a. Catecholamines
        i. Epinephrine
        ii. Norepinephrine

Objective 10 Describe the renin-angiotensin-aldosterone system (RAAS) and its role in regulating blood pressure.

Objective 11 Describe the location and structures of the pancreas. List the hormones produced and their functions. Describe the antagonistic relationship between glucagon and insulin in regulating blood glucose.

1. Structures
    a. Head
    b. Body
    c. Tail
    d. Pancreatic Acini – exocrine – digestive function
    e. Pancreatic Islets
        i. Alpha – glucagon – increases glucose levels
        ii. Beta – insulin – decreases glucose levels

Objective 12 Describe the location, secretion, and functions of the pineal gland.

1. Melatonin – regulates sleep/wake cycle

Objective 13 Describe the location, secretion, and functions of the thymus gland.

1. Thymosin: T-lymphocyte maturation

Objective 14 Describe the location, secretion, and functions of the gonads.

1. Ovaries: estrogen, progesterone
2. Testes: testosterone

Standard 12

Cardiovascular System I – Blood, Lymphatic System, & Immunity

Objective 1 Identify and describe the components of whole blood.

1. Erythrocytes
    a. Leukocytes
    b. Thrombocytes (platelets)
    c. Plasma
        i. Water
        ii. Proteins
        iii. Nutrients
        iv. Hormones

Objective 2 Describe hematopoiesis including erythropoiesis.

Objective 3 Describe the structure and function of the red blood cells (RBCs).

1. Physical characteristics
2. Hemoglobin
3. Hematocrit
4. Antigens
    a. ABO
    b. Rh

Objective 4 Define leukocytes and identify the various types of white blood cells normally present in the blood.

1. Leukocytes
    a. Granulocytes
        i. Neutrophils
        ii. Basophils
        iii. Eosinophils
2. Agranulocytes
    a. Monocytes
    b. Lymphocytes
        i. B-cells
        ii. T-cells

Objective 5 Identify the production and functions of thrombocytes.

Objective 6 Define hemostasis and describe the three mechanisms that contribute to hemostasis. Describe fibrinolysis.

1. Vascular spasm
2. Platelet plug formation
3. Coagulation
    a. Intrinsic
    b. Extrinsic
    c. Common final pathway
4. Anti-coagulation (fibrinolysis)

Objective 7 Describe the structures and functions of the lymphatic system. Explain how lymphatic is formed and how it circulates.

1. Structures
    a. Primary lymph organs
        i. Thymus
        ii. Bone marrow
    b. Secondary lymph organs
        i. Lymph nodes
            1. Cervical
            2. Submandibular
            3. Axillary
            4. Inguinal
        ii. Spleen
        iii. Appendix
        iv. Tonsils
    c. Lymph capillaries
    d. Lymph vessels
    e. Lymphatic ducts
2. Functions
    a. Lipid transport
    b. Interstitial fluid drainage
    c. Immunity

Objective 8 Define the following terms as they apply to immunity.

1. Antigen

2. Antibody
3. Epitope

Objective 9 Describe innate immunity and give examples of common mechanisms.

1. Barriers
    a. Physical
    b. Chemical
2. Fever and Inflammation
3. Compliment
4. Phagocytosis

Objective 10 Describe adaptive immunity and give examples of common mechanisms. Describe the roles of T-cells and B-cells in the immune response.

1. Cell-mediated
    a. T- cytotoxic
    b. T- helper
    c. Memory cells
2. Antibody mediated (humoral)
    a. B-cells
    b. Plasma cells
    c. T-helper
    d. Memory cells

Objective 11 Distinguish between active and passive immunity and natural vs. artificial acquisition of immunity.

Objective 12 Describe the basic structure and functions of an antibody. Identify and describe the five classes of antibodies. Identify and describe the five classes of antibodies.

1. IgG
2. gM
3. IgE
4. IgD
5. IgA

Objective 13 Contrast the primary and secondary immune responses.

Standard 13

Cardiovascular System II

Objective 1 List the general functions of the cardiovascular system.

Objective 2 Describe the general shape and location of the heart.

Objective 3 Describe the major structures of the heart.

1. Layers/membranes
    a. Endocardium
    b. Myocardium
    c. Epicardium (visceral pericardium)

    d. Parietal Pericardium
    e. Pericardial fluid
2. Chambers
    a. Atria
    b. Ventricles
3. Great blood vessels
    a. Superior vena cava
    b. Inferior vena cava
    c. Pulmonary trunk
    d. Pulmonary arteries
    e. Pulmonary veins
    f. Aorta
4. Valves
    a. Right atrioventricular (AV), tricuspid
    b. Pulmonary semilunar
    c. Left atrioventricular (AV), bicuspid (mitral)
    d. Aortic semilunar

Objective 4 Describe the pattern of blood flow in relation to the great vessels, valves, and chambers of the heart. State when each valve is open or closed during blood flow.

Objective 5 Identify and describe the conduction system of the heart and trace the pathway.

1. Sinoatrial (SA) node
2. Atrioventricular (AV) node
3. AV bundle (Bundle of His)
4. Bundle branches
5. Purkinje fibers

Objective 6 Given a diagram of an electrocardiogram, state the name of each waveform. Explain what is happening at each stage of the electrocardiogram.

Objective 7 Compare and contrast the action potential of an autorhythmic cell and a myocardial cell.

Objective 8 Describe the parasympathetic and sympathetic innervation of the heart.

Objective 9 Sequence the principal events of the cardiac cycle in terms of systole and diastole.

Objective 10 Define the following cardiac function measurements:

1. Heart rate
2. End-diastolic volume
3. End-systolic volume
4. Ejection Fraction
5. Cardiac output

Objective 11 Describe the histology of arteries and veins. Compare and contrast the microscopic structure of arteries and veins.

1. Tunica Externa
2. Tunica Media
3. Tunica Interna

Objective 12 Describe the histology and anatomy of capillaries. Name three types of capillaries, location, and distinguishing characteristics.

1. Continuous
2. Fenestrated
3. Sinusoid

Objective 13 Explain the process of capillary exchange of nutrients, gasses, and wastes. Describe Starling's Law of the Capillary.

Objective 14 Identify the major arteries of the human body. Define: anastomosis.

1. Carotids
2. Subclavian
3. Brachiocephalic
4. Brachial
5. Radial
6. Aorta
    a. Ascending
    b. Arch
    c. Descending
    d. Thoracic
    e. Abdominal
7. Renal
8. Iliac (common, internal, external)
9. Femoral
10. Popliteal

Objective 15 Identify the major veins of the human body.

1. Jugular
2. Subclavian
3. Brachiocephalic
4. Brachial
5. Radial
6. Vena Cava (superior, inferior)
7. Renal
8. Iliac (common, internal, external)
9. Femoral
10. Popliteal

Objective 16 Name the parts of the coronary circulation.

1. Coronary arteries
    a. Right coronary artery
    b. Marginal artery
    c. Posterior interventricular
    d. Left coronary artery
    e. Anterior interventricular (LAD)
    f. Circumflex
2. Coronary veins
    a. Great cardiac vein
    b. Anterior cardiac vein
    c. Middle cardiac vein
    d. Small cardiac vein
3. Coronary sinus

Objective 17 Contrast pulmonary and systemic circulation.

Objective 18 Compare and contrast fetal circulation to adult blood flow.

Standard 14

Respiratory System

Objective 1 List the functions of the respiratory system.

Objective 2 List each of the structures through which air passes during inspiration. Differentiate them into upper and lower respiratory tracts and conducting and respiratory zones.

1. Nose/mouth
2. Pharynx
    a. Nasopharynx
    b. Oropharynx
    c. Laryngopharynx
3. Larynx
4. Trachea
5. Bronchi
6. Bronchioles
7. Terminal bronchioles
8. Respiratory bronchioles
9. Alveolar duct
10. Alveolar sacs
11. Alveoli

Objective 3 Identify the following structures associated with the larynx.

1. Epiglottis
2. Glottis
3. Hyoid bone
4. Vocal cords

Objective 4 Identify the trachea and its anatomic features.

1. Carina
2. Cartilage rings

Objective 5 Identify the coverings of the lungs and the gross anatomical features of the lungs.

1. Apex
2. Base
3. Lobes
4. Fissures
5. Cardiac notch
6. Hilum
7. Visceral pleura
8. Parietal pleura
9. Pleural cavity
10. Pleural fluid

Objective 6 Describe the muscles of respiration and their innervation.

1. Diaphragm
2. External and Internal Intercostals

Objective 7 Describe the histology of the respiratory system.

1. Pseudostratified columnar ciliated epithelium
    a. Goblet cells
2. C-shaped hyaline cartilage of the trachea
3. Smooth muscle of the bronchi and bronchioles
4. Type 1 alveolar cells
5. Type 2 alveolar cells
6. Alveolar macrophages
7. Alveolar-capillary membrane
    a. Simple squamous endothelium

Objective 8 Define pulmonary ventilation, inspiration, and expiration.

Objective 9 Define: Boyle's Law. Explain the application of Boyle's Law to inspiration and expiration.

Objective 10 State the four respiratory volumes and four respiratory capacities. Identify each of these on a spirogram.

1. Tidal volume
2. Inspiratory reserve volume
3. Expiratory reserve volume
4. Residual volume
5. Vital capacity
6. Inspiratory capacity
7. Functional residual capacity
8. Total lung capacity

Objective 11 State Henry's Law and Dalton's Law. Explain how each is relevant to external and internal respiration.

Objective 12 State the ways oxygen and carbon dioxide are carried in the blood.

Objective 13 State the chemical equation which describes the relationship between carbon dioxide, bicarbonate ion, and carbonic acid in blood. Predict how raising and lowering pH or carbon dioxide concentration will affect respiration rate.

Objective 14 State the location and function of the respiratory control centers.

1. Medullary rhythmicity area - medulla
    a. Inspiratory center
    b. Expiratory center
2. Pneumotaxic – pons
3. Apneustic - pons

Objective 15 Summarize the embryonic development of the respiratory system. Explain the role of surfactant.

Standard 15

Digestive System

Objective 1 Describe the functions of the digestive system.

Objective 2 Identify the major and accessory structures of the digestive system.

1. Alimentary Canal Structures
    a. Mouth
    b. Pharynx
    c. Esophagus
    d. Stomach
    e. Small intestines
    f. Large intestines
    g. Rectum
    h. Anus
2. Accessory Structures
    a. Salivary glands (parotid)
    b. Teeth
    c. Pancreas
    d. Gallbladder
    e. Liver

Objective 3 Describe and be able to recognize the histology of the alimentary canal (gastrointestinal system). Identify and describe the function of the following layers: mucosa, submucosa, muscularis, serosa.

Objective 4 Describe the anatomy and functions of oral cavity structures.

1. Tongue
2. Taste buds
3. Teeth
    a. Deciduous
    b. Permanent
4. Salivary Glands
    a. Parotid
    b. Submandibular
    c. Sublingual
5. Enzymes
    a. Salivary amylase

Objective 5 Describe the anatomy and functions of the pharynx.

1. Nasopharynx
2. Oropharynx
3. Laryngopharynx

Objective 6 Describe the anatomy and functions of the esophagus.

1. Sphincters
    a. Upper
    b. Lower
2. Smooth vs voluntary muscle

3. Swallowing (deglutition) stages
    a. Voluntary
    b. Pharyngeal
    c. Esophageal

Objective 7 Describe anatomy, histology and function of the stomach. Explain the function, production, and regulation of hydrochloric acid (HCl) secretion.

1. Anatomy
    a. Fundus
    b. Cardia
    c. Body
    d. Pyloric antrum
    e. Pyloris
    f. Pyloric canal
    g. Rugae
    h. Cardiac sphincter
    i. Pyloric sphincter
2. Histology
    a. Gastric pits
        i. Parietal cells – secretes hydrochloric acid (HCl), and intrinsic factor
        ii. ii. Chief cells – secretes pepsinogen and lipase
        iii. iii. Mucous neck cells – secretes mucous
        iv. iv. G cells – secretes gastrin
    b. Oblique muscle layer

Objective 8 Describe anatomy, histology and function of the small intestine.

1. Anatomy:
    a. Duodenum
    b. Jejunum
    c. Ileum
2. Histology:
    a. Plicae circulares
    b. Villi
    c. Microvilli
    d. Cells
        i. Enterocytes – absorb nutrients
            1. Carbohydrate
            2. Protein
            3. Lipids
                a. lacteals
    e. Goblet cells – secretes mucous
    f. Paneth cells – enzymes, phagocytes
    g. Enteroendocrine – secretes hormones

Objective 9 Describe anatomy, histology and function of the large intestine.

1. Anatomy
    a. Cecum
    b. Appendix
    c. Ascending colon
    d. Transverse colon
    e. Descending colon
    f. Sigmoid colon

g. Rectum
h. Anus
    i. External sphincter
    ii. Internal sphincter
    iii. Defecation reflex

2. Histology
    a. Taeniae coli
    b. Haustra
    c. Intestinal glands
        i. Absorptive cells – absorb water
        ii. Goblet cells – secrete mucous

Objective 10 Describe anatomy, histology and function of the liver and gallbladder.

1. Anatomy
    a. Gallbladder
    b. Liver
        i. Right and left lobes
        ii. Caudate and quadrate lobes
        iii. Ligaments
            1. Falciform
            2. Coronary
            3. Round
        iv. Lobules
            1. Hepatic triads
                a. Branch of hepatic artery
                b. Branch of hepatic vein
                c. Bile duct
        v. Acini
    c. Histology
        i. Sinusoids
        ii. Bile canaliculi
        iii. Cells
            1. Hepatocytes – inactivates toxins, produces bile, metabolizes carbohydrates, lipids, and proteins, protein production
            2. Kupffer cells – macrophage

Objective 11 Describe the pathway of bile flow from the liver to the duodenum.

Objective 12 Describe anatomy, histology and function of the pancreas.

1. Anatomy
    a. Head
    b. Tail
    c. Body
    d. Pancreatic
    e. Duct
2. Histology
    a. Islet – endocrine function
    b. Acini – exocrine secretions
        i. Amylase
        ii. Lipase
        iii. Sodium bicarbonate
        iv. Protein and nucleic acid enzymes

Objective 13 Compare and contrast mechanical and chemical digestion.

Objective 14 Define and understand the following motility functions:

1. Peristalsis
2. Segmentation
3. Migrating myoelectric complex
4. Mass movement

Standard 16

Urinary System

Objective 1 Describe the general functions of the urinary system.

Objective 2 Identify the major structures and locations of the components of the urinary system.

1. Kidneys
    a. Retroperitoneal
    b. Area of inferior thoracic vertebrae (T11-T12) and superior lumbar vertebrae (L1-L2)
    c. R. kidney slightly lower than left due to space taken up by liver
2. Ureters
    a. Tubes that connect the kidneys to the bladder
    b. Retroperitoneal
3. Bladder
    a. Hollow, distensible organ in pelvic cavity
4. Urethra

Objective 3 Describe the external and internal anatomy of the kidney.

1. External kidney
    a. Renal capsule, adipose capsule, renal fascia
2. Internal kidney
    a. Renal cortex
    b. Renal medulla
    c. Renal pyramids
    d. Renal columns
    e. Renal pelvis
    f. Nephron
    g. Renal papillae
    h. Calyces
        i. Minor
        ii. Major

Objective 4 Trace the path of blood flow through the kidneys. Explain what makes the vascular system of the kidneys unique compared to other organs.

1. Abdominal aorta
2. Renal artery
3. Segmental arteries
4. Interlobar arteries

5. Arcuate arteries
6. Cortical radiate arteries
7. Afferent arterioles
8. Glomerular capillaries
9. Efferent arterioles
10. Peritubular capillaries (including vasa recta in juxtamedullary nephrons)
11. Cortical radiate veins
12. Arcuate veins
13. Interlobar veins
14. Renal vein
15. Inferior vena cava

Objective 5 Identify the structures that comprise the nephron. Differentiate between cortical and juxtamedullary nephrons. Identify 3 basic functions performed by the nephrons (glomerulus and renal tubules).

1. Structures
    a. Renal corpuscle
        i. Glomerulus
        ii. Glomerular (Bowman's) capsule
    b. Renal tubules
        i. Proximal convoluted tubule
        ii. Descending limb
        iii. Nephron loop
        iv. Ascending limb
        v. Distal convoluted tubule
        vi. Collecting duct
2. Functions
    a. Glomerular filtration
    b. Tubular reabsorption
    c. Tubular secretion

Objective 6 Describe the structures and pressures which contribute to the filtering of blood through the glomerular membrane. Compare and contrast the composition of blood and glomerular filtrate.

1. Structures
    a. Three layers of glomerular membrane:
        i. Fenestrated capillaries,
        ii. Basal lamina,
        iii. Podocytes, pedicels, filtration slits
2. Pressures
    a. Net filtration pressure
        i. Glomerular blood hydrostatic pressure
        ii. Blood colloid osmotic pressure
        iii. Capsular hydrostatic pressure

Objective 7 Identify and describe the three regulatory mechanisms to control the glomerular filtration rate (GFR).

1. Renal autoregulation
    a. Tubuloglomerular feedback
    b. Juxtaglomerular apparatus
2. Neural regulation
3. Hormonal regulation
    a. Angiotensin II

b. Atrial natriuretic peptide (ANP)

Objective 8 Compare and contrast tubular reabsorption and secretion.

1. Reabsorption
    a. Tubules to blood
    b. Majority of solutes and water reabsorbed in the proximal convoluted tubule.
    c. Reabsorptive cells: cuboidal epithelium with microvilli
    d. Transport maximum
    e. Water reabsorption
        i. Obligatory reabsorption
        ii. Facultative reabsorption
2. Tubular secretion
3. Blood to tubules
4. Secreted substances include H+, K+, NH4+, creatinine, some drugs

Objective 9 Explain the countercurrent multiplier. Describe how the countercurrent multiplier helps regulate blood osmolarity. Describe the countercurrent exchange mechanism and how it assists with water reabsorption.

Objective 10 Describe the anatomy of the ureters. Identify structures and mechanisms that assist with the flow of urine through the ureters. Compare and contrast male and female urethras.

1. Anatomy
    a. Retroperitoneal
    b. 10-12 inches long
    c. Attach to posterior base of the bladder
2. Urine flow
    a. Smooth muscle in ureters assist with peristaltic contractions
    b. Gravity
    c. Hydrostatic pressure
3. Male and female urethras
    a. Male
        i. 3 regions: prostatic, membranous, spongy
        ii. Also has reproductive functions
        iii. 20 cm in length
    b. Female
        i. External opening between the clitoris and vaginal opening
        ii. 4 cm
        iii. Closer proximity to anus

Objective 11 Describe the anatomy of the bladder. Explain the micturition reflex.

1. Anatomy
    a. Hollow, distensible organ
    b. Posterior to pubic symphysis in pelvic cavity
    c. Female bladder is slightly smaller than males (uterus takes up space)
    d. Rugae (folds)
    e. Transitional epithelium
    f. Detrusor muscle
    g. Trigone (comprised of 2 ureters and urethra at the base of the bladder)
    h. Internal and external sphincters
2. Micturition

Objective 12 Describe physical and chemical characteristics of urine.

Objective 13 Describe the fluid compartments of the body and state the relative volumes for the intra- and extracellular compartments. Relate changes in intracellular and interstitial osmolarity to water movement. Compare the electrolyte and protein anion concentrations in intra- and extracellular compartments.

1. Sodium
2. Chloride
3. Bicarbonate
4. Calcium
5. Protein anion
6. Potassium
7. Magnesium
8. Phosphate, Sulfate

Objective 14 Characterize the role of buffers, ventilation, and renal function in maintaining acid-base homeostasis.

Standard 17

Reproductive System

Objective 1 List the functions of the respiratory system.

Objective 2 Identify male & female reproductive system anatomy.

1. Male:
    a. Testes
    b. Spermatic cord
    c. Ductus deferens (vas deferens)
    d. Scrotum
    e. Dartos muscle
    f. Cremaster muscle
    g. Epididymis
    h. Urethra
    i. Prostate gland
    j. Seminal vesicles
    k. Bulbourethral glands
    l. Penis
    m. Corpus spongiosum
    n. Corpora cavernosa
    o. Glans penis
    p. Prepuce (foreskin)
    q. Seminiferous tubules
    r. Rete testis
2. Female:
    a. Ovaries
    b. Uterine (fallopian) tubes
    c. Uterus
        i. Endometrium

1. Simple columnar epithelium
2. Stratum functionalis
3. Stratum basalis
4. Straight arterioles
5. Spiral arterioles

ii. Myometrium
iii. Perimetrium

d. Clitoris
e. Cervix
f. Vagina
g. Labia minora
h. Labia majora
i. Perineum
j. Mons pubis
k. Mammary glands
   i. Alveolar glands
   ii. Myoepithelial cells
   iii. Areola
   iv. Suspensory ligaments (Cooper's ligaments)

Objective 3 Characterize the process of spermatogenesis and the pathway from sperm production to release through ejaculation. Describe the role of accessory glands in the production of reproductive fluids (semen, pre-ejaculate).

1. Spermatogenesis:
   a. Spermatogonia -> primary spermatocyte -> secondary spermatocyte -> spermatids -> spermatozoon
2. Pathway:
   a. Seminiferous tubules -> rete testis -> efferent ducts -> epididymis -> ductus deferens -> ejaculatory duct -> urethra ->ejaculation
3. Glands:
   a. Bulbourethral glands: secrete alkaline lubricant for urethra and buffer pH (pre-ejaculate)
   b. Seminal vesicles: contribute to semen
   c. Prostate gland: contribute to semen

Objective 4 Identify and describe the stages of the ovarian cycle including oogenesis and follicular development. Describe female gamete transport and the organs involved.

1. Follicular development
   a. Primordial follicles -> primary follicle -> secondary follicle -> mature follicle -> corpus hemorrhagicum -> corpus luteum -> corpus albicans
2. Gamete transport
   a. Ovary -> fimbriae -> uterine tube ->uterus
3. Oocyte development:
   a. Primary oocyte
   b. Secondary oocyte
   c. Ovum

Objective 5 Identify and describe the phases of the uterine cycle including histology and blood supply.

1. Endometrium
   a. Simple columnar epithelium (shed during menstruation)
   b. Stratum functionalis (shed during menstruation)
   c. Stratum basalis

2. Blood supply
    a. Straight arterioles
    b. Spiral arterioles
3. Uterine phases and key days:
    a. Menstrual phase - stratum functionalis and spiral arterioles are shed
    b. Proliferative phase - spiral arterioles are rebuilt and proliferating stratum functionalis
    c. Secretory phase
    d. Day 1 - first day of menstrual flow
    e. Day 14 -ovulation

Objective 6 Compare and contrast the uterine and ovarian cycles and relate the impact of hormone secretions to the timeline of both cycles.

1. Hormones to include:
    a. Estrogen
    b. Progesterone
    c. Luteinizing hormone (LH),
    d. Follicle stimulating hormone (FSH)

Objective 7 Compare and contrast the process of meiosis and gametogenesis for male and female gametes. Define crossing-over.

Objective 8 Explain the process of conception, including coitus, sperm capacitation, slow block to polyspermy, and fertilization. Describe embryonic events from fertilization to gastrulation and the development of extraembryonic membranes. Describe fetal events from gastrulation to organogenesis.

1. Key items:
    a. Zygote (day 0)
    b. Blastocyst (~ day 5)
    c. Implantation (~ day 7)
    d. Gastrulation (~ day 16)
    e. Fetal period versus embryonic period
    f. Placental development

Objective 9 Describe the role of the following hormones in reproduction:

1. hCG – released by chorionic membrane and acts on the gonads (corpus luteum). Maintain corpus luteum activity following implantation if pregnancy occurs.
2. Relaxin – released by placenta and relaxes pubic symphysis and cervix to aid dilation for delivery.
3. hCS – alters maternal metabolism for increased nutritional requirements of the fetus.
4. CRH – role of birth and increased cortisol secretion from adrenal cortex

Objective 10 Describe the stages of labor and the hormones involved. Describe labor as an example of a positive feedback loop. Describe suckling as an example of a positive feedback loop and include the hormones involved.

1. Labor stages:
    a. Dilation stage – uterine contractions and oxytocin release leading to dilate of the cervix
    b. Expulsion stage – end of dilation stage to delivery
    c. Placental stage – after delivery to expelling of the placenta
2. Suckling:
    a. Oxytocin – milk release
    b. Prolactin – milk production

Objective 11 Describe the role of the endocrine system and other factors in male and female puberty. Identify male and female primary and secondary sexual characteristics.

Standard 17 Performance Evaluation included below (Optional)

Workplace Skills

- Communication
- Problem Solving
- Teamwork
- Critical Thinking
- Dependability
- Accountability
- Legal Requirements/expectations

Medical Anatomy and Physiology, Advanced

Performance assessments may be completed and evaluated at any time during the course. The following performance skills are to be used in connection with the associated standards and exam. To pass the performance standard the student must attain a performance standard average of 8 or higher on the rating scale. Students may be encouraged to repeat the objectives until they average 8 or higher.

Student's Name: _____

Class: _____

Performance standards rating scale

0	Limited skills	2	→	4	Moderate skills	6	→	8	High skills	10

Standard 17 – Reproductive System **Score:**

- Create a detailed Personal Healthcare Career Plan.
    - What is your healthcare career goal?
    - Reflect on what you have done so far to prepare for that career. Include coursework, HOSA, internships, employment, volunteerism, etc.
    - Define the steps/requirements or additional training that you will need to complete following high school.
    - Determine the workplace skills (soft skills) that your career will need.
    - How do you plan to finance any additional school or training needed?
- Demonstrate a clinical assessment for each of the twelve cranial nerves. Differentiate whether is testing sensory pathways, motor pathways, or both.
- Create a research-based poster. Determine a health-related topic and pose a research question. Using scientific methods conduct your research. When complete, create a poster to include a title, abstract, methods, results, conclusions, references, and images. (Use HOSA Research Poster competitive guidelines for reference.)

Performance standard average score:

Evaluator Name: _____

Evaluator Title: _____

Evaluator Signature: _____

Date: _____