

## **EDUCATIONAL OBJECTIVES HUMAN ANATOMY (BIOL 2034)**

Major learning outcomes:

- Identify assigned anatomical structures and their relationships.
- State examples of “Rule #2: Variability is the law of Life.” (William Ostler, 19<sup>th</sup> c. Physician)

Realize that listing objectives by chapter artificially separates the body into unnatural segments when in fact it is a beautifully constructed integrated whole. While I organize lectures in this same unnatural systemic approach, each test will include questions requiring integration of material across several chapters. Some examples of those types of objectives are listed at the end of the unit objectives.

*Objectives primarily achieved in lab are followed by “L”.*

### A Note on Terminology

Building an anatomical/physiological vocabulary is essential for success in both courses and your career.

- For each unit/system, be able to define and use each assigned word root.

### **I. Introductory material**

1. Define and give an example of each level of structural organization in the human body.
2. Describe and give examples of the relationships between structure and function at each level of organization.
3. Define anatomy and its subdisciplines.
4. Define the assigned word roots used to construct anatomical terminology. (This objective is to be met in all subsequent topics.)
5. List and give examples of the three parts of a typical medical term.
6. State why medical terms are preferred over eponyms.
7. Define the anatomical position.
8. Give the anatomical terms for assigned body regions.
9. Define all assigned directional terms and use each correctly in a sentence.
10. Define and identify examples of anatomical planes and sections.
11. List and identify the major body cavities and their general contents.
12. Sketch and label the abdominopelvic quadrants and regions.
- 13L. Define and locate (on torso models and yourself) the body cavities and abdominopelvic regions.

### **II. Cells**

1. List the 3 major structural components of the human body.
2. List the 2 major compartments of body fluids.
3. List the 3 major subdivisions of extracellular fluid.
4. List and sketch 9 types of cell shapes.
5. List 4 major structural components of a cell and the major functions of each component.
6. List 3 types of cell extensions and the function of each.
7. Describe, recognize, and give functions for assigned cell organelles.
8. Explain why the cell is considered the body’s unit of structure and function.
9. Describe the fluid-mosaic model of the plasma membrane.

### **III. Tissues**

1. List the four basic tissue types.
2. Sketch an example of how a 3-D structure looks in a 2-D microscopic view.
3. Describe the general structural features and functions of epithelial tissues.
4. Differentiate the two types of glandular epithelium.
5. Describe the criteria used to classify covering and lining epithelia.
6. Give a description, location and function for simple squamous epithelium.
7. Describe the general structural features and functions of connective tissues.

8. Give a description, location and function for areolar connective tissue.
9. Describe the locations and structure of three types of epithelial membranes.
10. Describe the locations of the three types of serous membranes.
11. Describe the general structural features and functions of muscle tissues.
12. Give specific structural descriptions, locations and functions for the three types of muscle tissue.
13. List the two main cell types of nervous tissue.
14. Sketch and label the 3 major parts of a neuron.
15. Describe the two major tissue types and two fiber types found in a neuromuscular junction.
- 16L. For all assigned tissue types: be able to (a) describe and identify the tissue and its key features and (b) give a function and location for that tissue.

#### **IV. Integumentary System**

1. List the organs comprising the integumentary system.
2. List 5 functions of the integumentary system.
3. Describe the structure of the epidermis, including its layers and cell types.
4. Compare and contrast thick skin with thin skin.
5. Compare and contrast the structure, location and function of thick and thin skin.
6. Describe the structure of the dermis.
7. Describe the structure of the following accessory organs of the integumentary system: subcutaneous layer, hair (and arrector pili), nails, merocrine (eccrine) and apocrine glands, sebaceous glands.
8. Compare the location and functional features of the two dermal capillary networks.
9. List the three pigments primarily responsible for skin color.
10. List and define 6 terms relating color of skin to its diagnostic value.
11. Recall and apply the clinical applications assigned for this chapter.
- 10L. Identify the layers and features of the epidermis and dermis on histological slides.
- 11L. Locate and identify on slides and model all assigned structures (and their features).

#### **V. Skeletal System—Bone tissue**

1. List 3 major components of the skeletal system.
2. List 6 functions of the skeletal system.
3. Sketch and label the features of a typical long bone.
4. Describe the blood and nerve supply to a typical long bone.
5. Name and describe the cell types involved in bone formation and remodeling.
6. List the components (and percentage of each) of bone matrix.
7. Sketch, label, and describe the histology of compact and spongy bone.
8. Describe and sketch the processes of intramembranous and endochondral ossification in detail.
9. Describe and sketch the layers of an epiphyseal plate.
10. Compare and contrast the processes of interstitial and appositional growth.
11. Explain the process and purpose of bone remodeling.
12. Describe the causes, consequences, and prevention of osteoporosis.
13. Recall and apply all assigned clinical applications for this chapter.

#### **VI. Skeletal system – Gross Anatomy**

1. List the components and number of bones in the two divisions of the skeleton.
2. List and give an example of the 4 bone types, according to shape.
3. Define and give an example of a sesamoid and a sutural bone.
4. Describe the regions of the vertebral column and the number of vertebrae in each region.
5. Sketch and label the processes of a typical vertebra, stating the function of each.
6. Name and state the structural classification of the two types of intervertebral joints.
7. Describe the structure and function of the two components of an intervertebral disc.
8. Name and describe the formation and function of the normal vertebral curves.
9. Name and describe three abnormal vertebral curvatures.
10. Compare and contrast the structure and function of the pectoral and pelvic girdles.
11. Name and describe the structure and function of the 3 arches of the foot.

- 12L. Compare and contrast the structure of the male and female pelvis, and use this information to identify an unknown pelvis.
- 13L. Compare and contrast the structure and function of the pectoral and pelvic girdles.
- 14L. For each bone of the body, identify all assigned features (and their functions) on bones, APR photographs, and radiographs.
- 15L. State which side of body a given bone is from.
- 16L. List the cranial nerves by name and Roman numeral, their general function, and state through which foramen they exit or enter the skull.

## **VII. Articulations**

1. Define a joint and describe the trade-offs involved in joint strength versus joint mobility.
2. Describe the four structural categories of joints (and their alternative names), and give an example of each.
3. Sketch and label the features of a simple synovial joint.
4. Describe the six subcategories of synovial joints, state the axes of motion of each, and give two examples of each.
5. List six factors that influence the range of motion of any joint.
6. List the terms used to describe the number of axes of movements possible at a synovial joint and give an example of each.
7. Define the assigned list of terms describing movements at synovial joints and demonstrate each movement with your own body.
8. Describe in detail the bones, cartilages, and connective tissues of the knee joint, giving the function of each structure. Be able to identify these features on a sketch.
9. Describe which structures strengthen the knee joint a) anteriorly, b) laterally, c) posteriorly, and d) internally.
10. State which structures of the knee joint primarily prevent a) abduction, b) adduction, c) hyperextension, d) anterior displacement of the tibia, and e) posterior displacement of the tibia.
11. Explain why the knee joint is the most commonly injured joint in the body.
12. State the “3 C’s” which are commonly damaged by a lateral blow to the knee.
- 12L. Identify the assigned articulations on skeletons, APR, or radiographs and give their complete structural classification and axes of movement.
- 13L. Identify the assigned structures on a fresh animal joint and knee joint model.

## **VIII. Muscular System**

1. List four general functions of muscle tissue.
2. List four general properties of muscle tissue.
3. List the connective tissue wrappings of a skeletal muscle from superficial to deep and name the structure enclosed by each.
4. Define origin and insertion with respect to skeletal muscles.
5. Sketch a simple lever system and label the effort, fulcrum and resistance.
6. Describe how the body’s skeletal, articular, and muscular systems form lever systems.
7. Describe the trade-off between mechanical advantage and disadvantage.
8. Sketch 7 different fascicle arrangements.
9. Describe the influence of fascicle arrangement on power and range of motion.
10. Define 4 terms used to describe how muscles work in groups and give an example of each.
11. Sketch a muscle fiber, labeling all assigned features.
12. Differentiate between a myofiber, a myofibril, and a myofilament.
13. Sketch and label the features of a sarcomere.
14. List and locate the three major proteins of the sarcomere.
15. Give a general explanation of the sliding-filament mechanism of muscle contraction.
16. Describe the nerve and blood supply to a skeletal muscle.
17. Describe the growth and regeneration of skeletal muscle.
18. Compare the histology of cardiac and smooth muscle to skeletal muscle.

19. Compare the nerve and blood supply of cardiac and smooth muscle to skeletal muscle.
20. Compare visceral smooth muscle to multi-unit smooth muscle.
21. Define peristalsis and state which smooth muscle type exhibits peristalsis.
22. Compare the growth and regeneration of cardiac and smooth muscle to skeletal muscle.
- 23L. Identify all assigned muscles and connective tissue features on the plastinated limbs, APR, and torso models.
- 24L. State the functional group to which any assigned human muscle belongs, and give a more precise function if included in the lab exercise.
- 25L. Describe the boundaries and contents of the femoral triangle.
- 26L. Contrast the terms *fascia lata*, *iliotibial tract*, and *tensor fasciae latae*.

## **IX. Cardiovascular System**

1. Explain why the heart is described as a double pump.
2. Describe the position of the heart in the body, including its borders and surfaces.
3. Diagram and label the three layers of the pericardium
4. Sketch and name the layers of the heart wall.
5. List, from superficial to deep, the structures a surgeon must cut through to reach a chamber of the heart to repair a patent foramen ovale.
6. Be able to describe and identify all assigned external features of the heart on diagrams.
7. Describe the functional reason for the difference in wall thickness between atria and ventricles.
8. Be able to label all internal features of the heart on a diagram.
9. Describe in detail the path of blood flow through the heart, including all chambers and valves.
10. Describe the structure and function of the heart's fibrous skeleton.
11. Sketch the general scheme of coronary circulation.
12. Describe the histology of blood vessels and the differences between arteries and veins
13. Give the structural and functional differences between conducting arteries, distributing arteries, resistance arteries & arterioles, capillaries, venules, and veins.
14. Describe the structural differences between the three types of capillaries and where each type is found in the body.
15. Diagram and label an arteriovenous anastomosis, indicating its relationship to a capillary bed.
16. Give an example of an arterial anastomosis and a venous anastomosis.
17. Compare and contrast the pulmonary and systemic circulations, relating these to differences in thickness of the ventricular walls.
18. Describe the major vessels and function of the hepatic portal circulation.
19. List and diagram the four tributaries to the cerebral arterial circle.
20. Describe in detail fetal circulation, the modifications that occur at birth, and adult remnants. Be able to identify these features on diagrams.
- 20L. Be able to describe and identify all assigned external features of the heart on diagrams, models, APR, and sheep heart.
- 21L. Sketch the coronary circulation, labeling all assigned arteries and veins. Be able to identify assigned vessels on a model.
- 22L. Diagram and be able to locate on models and APR all assigned vessels of the systemic and pulmonary circulations.

## **X. Lymphatic System**

1. Describe the 4 general structural components of the lymphatic system.
2. List 3 general functions for the lymphatic system.
3. Describe the formation of lymph and state the normal rate of formation.
4. Describe the structure of all lymphatic vessels, comparing them to blood vessels.
5. List the tributaries into the thoracic duct and right lymphatic duct.
6. List, in sequence, the vessels lymph would pass through from its formation in the a) intestinal tract or b) right thumb to its return to the blood.
7. List 4 factors that power or facilitate flow of lymph to the subclavian veins.

8. Describe the location and structure of two types of lymphatic tissues.
9. Describe the location, structure and function of the primary lymph organs.
10. Describe the location, structure and function of the secondary lymph organs.
11. Differentiate a lymphatic nodule from a lymphatic organ, including an example of each.
12. Compare and contrast the structure and function of lymph nodes to that of the spleen.

## **X. Respiratory System**

1. List general functions of the respiratory system.
2. Describe the functional and anatomical divisions of the respiratory system.
3. Describe the gross anatomy and histology of the internal and external nose.
4. Describe the boundaries and characteristic lining epithelium of each division of the pharynx.
5. Describe the gross anatomy of the larynx and list its three major cartilages.
6. Describe the structure of the trachea, explaining why its cartilaginous rings are C-shaped rather than circular.
7. List the branches of the bronchial tree and which portion of the lung each supplies.
8. Describe the histological changes observed as you travel from the trachea to an alveolus.
9. Describe the effect of nicotine on the respiratory tract.
10. Describe the arrangement of the pleural sac and membranes, and sequence them from superficial to deep.
11. Describe the gross anatomy of the lungs and be able to identify the assigned structures on a diagram and/or model.
12. List the anatomical subdivisions of lung structure from largest to smallest (lobe to alveolus).
13. Trace the path of inspired air from the external naris to an alveolus.
14. Describe the blood supply of a lung.
15. Describe the histology and cell types of an alveolus.
16. Describe the structure and function of the alveolar-capillary (respiratory) membrane, sequencing the path of an oxygen or carbon dioxide molecule .
17. Explain the pressure/volume changes required to breathe, differentiating between passive and forceful expiration and passive and forceful inspiration.
18. Describe the relative contributions of the diaphragm and external intercostal muscles to inspiration.
19. Recall and apply the clinical applications assigned for this chapter.
- 20L. Identify all assigned respiratory features on models, torsos, APR, and plastinated organs.

## **XI. Digestive System**

1. Explain the description of the digestive system as a tube-within-a-tube.
2. Give general functions for the digestive system.
3. List the four layers of the digestive tube, from innermost to outermost, including the subdivisions and tissue composition of each layer.
4. Name and describe the location of the two layers of nervous tissue found within the gut wall.
5. Differentiate between an adventitia and a serosa.
6. Describe the general arrangement of the peritoneum and list its major folds. Be able to identify these folds on diagrams and models.
7. Create a list indicating which portions of the digestive tube are retroperitoneal and which are intraperitoneal.
8. Describe the boundaries and contents of the oral cavity.
9. Describe the structure of a tooth, and be able to label these features on a diagram.
10. Compare and contrast the deciduous and permanent dentitions.
11. List the 4 types of teeth (and numbers of each type in adults) and the general function of each type.
12. List the three pairs of major salivary glands and describe their location.
13. Describe the histology and sphincters of the esophagus.
14. List the features and functions of the stomach, and be able to identify these features on a diagram, model, or plastinated organ.

15. List the divisions of the small intestine, the length of each division, and four structural features enhancing digestion and absorption of nutrients.
16. Describe the function, structure, and histology of the large intestine, comparing it to the small intestine.
17. List the four regions of the large intestine and the subdivisions of each region.
18. Relate the histology of the internal and external anal sphincters to their role in defecation.
19. Describe the histology and function of the liver.
20. Describe the dual blood supply to the liver.
21. Describe the structure, location and histology of the pancreas.
22. Sketch and label the biliary/pancreatic duct system, including the role of the gall bladder.
23. Trace the path of a bite of ingested food through the GI tract, listing all features and sphincters it would pass along the way.
- 24L. Be able to identify all assigned digestive tract features on dissections, models, torsos, APR, and plastinated organs.

## **XII. Urinary System**

1. State the general functions of the urinary system.
2. Describe the location and connective tissue coverings of the kidney.
3. Describe the internal features of the kidney and be able to identify assigned features on diagrams and models.
4. Describe the blood supply to a nephron.
5. Sketch a nephron, labeling its components.
6. Compare cortical nephrons to juxtamedullary nephrons.
7. Describe the location and function of the ureters.
8. Describe the location, internal structure, and histology of the bladder.
9. Compare the internal urethral sphincter to the external urethral sphincter.
10. Trace the path of a drop of filtrate in the glomerular capsule to its elimination from the body at the external urethral orifice.
- 11L. Identify all assigned urinary features on the models, APR and plastinated kidney.

## **XIII. Reproductive Systems**

1. Describe the location and contents of the perineum.
2. Define the terms gonad, gamete, and genitalia.
3. Describe the structure and muscular contents of the scrotum.
4. Describe the location and descent of the testes.
5. Describe the internal structure of a testis and the histology of a lobule.
6. List the functions and components of the male duct system.
7. Describe the location and list the contents of the spermatic cord.
8. Describe the location of the male accessory sex glands.
9. Describe the gross anatomy and internal structure of the penis.
10. Trace the path of a sperm cell from site of production to site of ejaculation.
11. Describe the location and histology of the ovary.
12. Compare a primordial follicle to a mature follicle.
13. Describe the attachment and histology of the uterine tubes.
14. Explain how an ovum released into the abdominopelvic cavity is captured by the infundibulum.
15. Describe the location, gross anatomy, internal structure, and histology of the uterus.
16. Compare the location of the vagina to the urethra and rectum.
17. Sketch and label features of the pudendum.
18. Differentiate the exocrine and endocrine portions of each gonad.
- 19L. On a slide, identify the regions of the ovary and other assigned features.
- 20L. Identify all assigned features on models, plastinated specimens, and APR.

#### **XIV. Nervous Tissue**

1. Sketch an overview of the nervous system, indicating the interrelationships between the CNS & PNS, and between the 3 divisions of the PNS.
2. Sketch and label the parts of a typical neuron.
3. Differentiate between the terms axolemma, axoplasm, and axon collateral.
4. Define the 4 structural and 3 functional categories used to classify neurons.
5. Describe how neuroglia differ from neurons.
6. List 6 types of neuroglia and describe their location (CNS, PNS), appearance, and function.
7. Describe the formation and function of the myelin sheath and state the cells responsible for its formation.
8. Differentiate between a nerve, tract, ganglia, and nucleus.
9. List the 3 connective tissue coats of a typical nerve from superficial to deep, and describe what structure each ensheaths.
- 10L. Identify all assigned features on the neuron smear slide.

#### **XV. Spinal Cord & Nerves**

1. Describe the external gross anatomy of the spinal cord, including enlargements and fissures.
2. List, from outermost to innermost, the spinal meninges and spaces that surround the spinal cord. Include the tissue composition of each meninx.
3. Sketch a cross-section of the spinal cord and label all assigned features.
4. State the precise anatomical location of: a skeletal motor neuron's cell body, motor axon, cardiac and smooth muscle motor neuron cell bodies, general sensory neuron cell body, sensory axon.
5. Describe the difference between descending and ascending tracts and give an example of each.
6. Give three general functions for the spinal cord.
7. Sketch and describe the 5 components of a reflex arc.
8. Describe the two structures that join to form a spinal nerve, and the names and distribution of the two branches of a spinal nerve.
9. List the types, and number of each type, of spinal nerves.
10. Define a dermatome and state their clinical importance.
- 11L. Identify all assigned features on the spinal cord model.

#### **XVI. Brain and Cranial Nerves**

1. List the 3 main division of the brain and the components of each.
2. Compare the cranial meninges to the spinal meninges.
3. Describe the location and function of the three cranial folds of dura mater.
4. Sketch the four brain ventricles and their interconnections.
5. Describe the function, formation, circulation, and reabsorption of cerebrospinal fluid.
6. Describe the blood supply of the brain and the significance of the blood-brain barrier.
7. Describe the features and functions of the medulla oblongata.
8. Describe the location and function of the pons.
9. Describe the features and function of the midbrain.
10. Describe the features and functions of the diencephalon.
11. Describe the features and functions of the cerebellum.
12. Describe the gross anatomy of the cerebrum, including all fissures and lobes.
13. State the general location of cerebral white matter, the three types of tracts, and the function of each.
14. Describe the general structure and location of the basal nuclei and limbic system.
15. Give general functions for the assigned features of the cerebrum.
16. List the name, number, function, and point of attachment to the brain of each cranial nerve.
- 17L. Relate cranial skeletal features to brain anatomy.
- 18L. Identify all assigned features on the sheep brain, APR and models.

#### **XVII. General and Special Senses**

1. Differentiate sensation from perception.
2. Sketch the basic pathway by which a stimulus is perceived.

3. Define and give an example of a sensory modality.
4. List and define 5 categories into which sensory receptors are classified according to the stimulus they detect (modality), and give an example of each.
5. Describe the difference between a general sense and a special sense, giving examples of each.
6. List and define the 3 categories into which sensory receptors are classified according to the origin of the stimulus they detect, giving examples of each.
7. Describe the location, structure, and function of tactile corpuscles, lamellated corpuscles, and hair root plexuses.
8. List the three chemical senses, describe the location and histology of their receptors, and the cranial nerves involved with each.
9. Sketch and label the three regions of the ear, including the structures found within each subdivision.
10. List the divisions of the bony labyrinth and the portions of the membranous labyrinth found within each.
11. Describe the location, arrangement, and stimulus detected by the receptor cells for sound, static equilibrium, and dynamic equilibrium.
12. List in sequence the structures vibrated by sound waves as they travel to the hair cells in the spiral organ of Corti.
13. Describe the accessory structures involved with the eyeball.
14. List the six muscles involved in eye movement and the cranial nerve controlling each.
15. Sketch and label the features of an eyeball, organizing structures by layers. List the function of each feature.
16. Describe the histology of the retina.
17. Describe the chambers and fluids within the eyeball.
18. Trace the path of a photon of light through the eye, listing in sequence the structures and fluids through which it passes.
19. Describe the visual pathway taking information to the cerebrum.
- 20L. Identify all assigned features on the sheep eye dissection and ear model.

### **XVIII. Autonomic Nervous System**

1. Compare the general organization of the somatic nervous system to that of the autonomic nervous system.
2. Diagram and label the general anatomy of an autonomic pathway.
3. Describe the specific location of the following features in both the sympathetic and parasympathetic nervous systems: preganglionic neuron (cell body and axon); ganglia; postganglionic neuron (cell body and axon).
4. Diagram and label the anatomy of a sympathetic pathway, indicating 4 possible routes of a sympathetic preganglionic axon.
5. Describe the role of the adrenal medulla as a segment of the sympathetic nervous system.
6. State the name and numbers of the cranial nerves involved with the parasympathetic nervous system.
7. Describe the location & structure of autonomic plexuses, naming one example.
8. Describe the general responses of the sympathetic and parasympathetic systems.
9. Create a summary chart comparing the sympathetic & parasympathetic systems with respect to origin from CNS, location of ganglia, fiber lengths, divergence, and effects.

### **XIX. Endocrine System**

1. Differentiate between an exocrine and an endocrine gland.
2. Create a chart comparing the nervous and endocrine systems with respect to mechanism of control, cells affected, time for onset of action, and duration of action.
3. Describe the role of the hypothalamus as an endocrine gland.
4. Differentiate the two segments of the pituitary gland with respect to embryological origin, blood supply, and connection to the hypothalamus.
5. State the location of and hormone secreted by the pineal gland.
6. Describe the location and structure of the thyroid gland, and the unique chemical component of its hormones.
7. Describe the location of the parathyroid glands.

8. Describe the structural and functional distinctions between the two parts of the adrenal gland.
9. Describe the endocrine portion of the pancreas.
10. State the endocrine portions of the gonads and the chemical nature of the hormones secreted by each.
- 11L. Identify selected endocrine glands on plastinated organs, APR, and human models.

## **XX. Developmental Anatomy**

1. Draw and label a time-line indicating the 3 major stages of development.
2. Describe the location and timing of fertilization.
3. List the 3 major events of the preembryonic stage.
4. State the timing and result of cleavage.
5. Sketch and label the features of a blastocyst, and indicate the developmental fate of each part.
6. Describe the timing, location, and mechanism of implantation.
7. Describe the timing and mechanism of embryogenesis, and the fate of the 3 primary germ layers.
8. List the 4 embryonic membranes and the general function of each.
9. Describe the formation and function of the placenta.
10. Briefly summarize the events of the fetal stage.
11. State some of the significant changes in maternal anatomy during pregnancy, and their physiological consequences.
12. Describe the general anatomy and internal organization of a mammary gland, including the path of milk flow.

## **XXI. Examples of some integrative objectives**

### Exam I

1. Describe the structural differences between a plasma membrane, a basement membrane, and an epithelial membrane.
2. Describe the structural differences between a muscle fiber, a connective tissue fiber, and a nerve fiber.
3. List 3 examples of the use of the word “interstitial” in this unit.
4. Given an unknown slide, be able to identify the tissue composition and any other assigned histological features.

### Exam II

1. List 5 features of the skeletal and articular systems that reduce the shock transmitted to the brain during running and jumping.

### Exam III

1. Given a list of organs, identify which ones are lined with ciliated epithelium, simple epithelium, stratified squamous epithelium, contain smooth muscle in their walls, or contain skeletal muscle in their walls.
2. List the retroperitoneal organs.
3. Which visceral organs have a cortex? medulla? rugae? serosa? mucosa? fundus?
- 4L. Given an unknown slide, be able to identify the organ it was taken from, its tissue composition, and any other assigned histological features.

### Exam IV

1. Which senses are detected by modified epithelial cells rather than neurons?

### Exam V

1. Name at least three types of motor axons that might be found in the anterior ramus of a spinal nerve.
2. List at least 3 classical endocrine organs that also have significant non-endocrine functions.