

ANATOMY IPHY 3410 LEARNING GOALS

OVERALL COURSE GOALS

Students will be able to:

- 1) Demonstrate understanding of structure/function relationships.
- 2) Integrate multiple systems to explain how an organ works.
- 3) Predict the epithelial tissue type present in a structure based on function.
- 4) Connect different concepts presented at different times on the same structure
- 5) Predict the location or meaning of the word based on the roots that comprise
- 6) Understand and apply the hierarchical organization of structure
- 7) Work with images or tactile representations of anatomy

CELLS, HISTOLOGY, AND TISSUE TYPES (1 lecture)

Explain how cells and tissues are related in the organization of the body

STRUCTURE: MICROSCOPIC ANATOMY OF CELL

- 1) Describe the functions and characteristics of plasma membrane, ER, Golgi, lysosomes, and mitochondria.
- 2) Describe the function of three cytoskeletal elements
- 3) Understand the limitations that reliance on diffusion imposes on cell shape and size

CELL CONTACTS

- 4) Describe the function of three specialized contacts/junctions
- 5) Predict the location of specialized contacts base on their functions

CLASSIFICATIONS: TISSUE TYPES AND ROLE IN ORGANIZATION OF AN ORGAN

- 6) Define tissue and illustrate the definitions of cell, organ, and organ system using examples from Chapters 1 and 2.
- 7) List the four types of tissues found in the body.

EPITHELIUM (1 Lecture)

- A. Describe the characteristics of epithelium that distinguish it from other types of tissues.
- B. Throughout the course be able to predict the type of epithelium presented based on a given function

CLASSIFICATIONS & STRUCTURE

- 1) Describe the characteristics of epithelium that all epithelia have in common.
- 2) Describe structural classifications of epithelial tissue by layering: simple or stratified.
- 3) Illustrate epithelial tissues by shape: squamous, cuboidal, or columnar.
- 4) List epithelial types and their function.
- 5) Name the specialized structures associated with the lateral, basal, and apical surfaces of epithelial cells.

FUNCTION OF EPITHELIUM

- 6) Predict which epithelial tissue type you would expect to find in an organ given the tissue functions.

CONNECTIVE TISSUE (1 lecture)

- 1) Define connective tissue.
- 2) Name characteristic components of connective tissue, including cells, ground substance, and fiber types.
- 3) Identify components of living and nonliving tissue.
- 4) Describe areolar connective tissue as a model of connective tissue proper.
- 5) Describe the role of areolar connective tissue in exchange.
- 6) Classify and compare the general types (connective tissue proper, bone, cartilage and blood) and their subtypes in terms of characteristic cells, matrix, and general features.
- 7) Predict if a tissue is a connective tissue based on the definition.
- 8) Compare and contrast the structure and functions of epithelial and connective tissue.

MEMBRANES,

- 1) Define serous, mucous, and cutaneous membranes.
- 2) Describe where each membrane type would be located.
- 3) Identify which serous membranes are located within the pericardium, pleural cavities, and abdominopelvic cavity.
- 4) Describe the anatomy of each of the membranes.

INTEGUMENT AND HAIR (1 lecture)

- 1) List the components of the integument system.
- 2) Explain how skin and its appendages are organs of the integumentary system.

STRUCTURE: MICROSCOPIC ANATOMY

- 3) List the tissue types that compose epidermis and dermis.
- 4) Describe the structure and function of all 5 layers of the skin, from deep to superficial; list the key functions and cell types of each stratum.
- 5) Distinguish between thick skin and thin skin.
- 6) Indicate which type of skin has hair.
- 7) Describe the anatomy of dermis and structures found within dermis
- 8) Describe the structure and function of the hypodermis.

FUNCTION

- 9) Describe the functions of the integument.
- 10) Explain how variations in melanin distribution in human skin creates different skin tone
- 11) List the parts of a hair and a hair follicle; explain how the structure of the hair shaft contributes to hair type, including color and shape.
- 12) Identify major disorders of the integument system, including skin cancer and burns.
- 13) Predict the consequence of skin loss (e.g., burn victim)

GROWTH OF SKIN

- 14) Explain why the superficial part of the skin is dead
- 15) Illustrate the differences in the length of hair growth cycles, comparing hair of the head to hair of the arms or legs.
- 16) Differentiate terminal hairs from vellus hairs.
- 17) Compare and contrast oil glands and sweat glands; identify locations, secretions, and special modifications.
- 18) Explain the structure and function of nails.

CARTILAGE AND BONE (2 lectures)

A. Explain the difference between cartilage and bone

CARTILAGE:

STRUCTURE/FUNCTION OF CARTILAGE

- 1) Describe the characteristics of cartilage
- 2) Identify the specific locations of cartilages in the adult body
- 3) Explain the functional properties of cartilage as a tissue.
- 4) Define the unique characteristics and locations of hyaline, fibro-, and elastic cartilages.

BONE:

CLASSIFICATIONS

- 1) Classify bones according to shape; include several bony examples for each category.

GROSS ANATOMY

- 2) Explain why bones are considered organs. Select a specific bone, such as the femur, and discuss the tissues comprising it.
- 3) List tissue types that compose bones as organs
- 4) Describe the gross anatomy of a typical long bone. (Optional: and a typical flat bone)

MICROSCOPIC ANATOMY/HISTOLOGY OF BONE

- 5) Describe the structure, function, and relationship among Haversian canal, perforating (Volkmann's) canal, lamellae, lacunae, and canaliculi.
- 6) Diagram the microscopic structure of compact bone tissue; include the osteon (Haversian system), central canal, lamellae, canaliculi, and osteocytes.
- 7) Summarize the organic and inorganic composition of bone.

STRUCTURE/FUNCTION RELATIONSHIPS

- 8) List and explain the main functions of the bony skeleton
- 9) Describe where compact and spongy bones are located in a long bone.
- 10) Differentiate the histology of compact and spongy bone.
- 11) Explain why spongy bone and compact bone are found where they are in a long bone.

PROCESSES INVOLVED IN BONE GROWTH:

- 12) Explain the processes of endochondral and intramembranous bone formation.

- 13) Explain the difference between epiphyseal plate and epiphyseal line.
- 14) Explain the anatomy of epiphyseal growth areas. Describe how the presence of epiphyseal plates determine whether bone is still growing in length.
- 15) Explain the process of longitudinal bone growth.
- 16) Describe the cause of osteoporosis, and osteomalacia; predict their pathologies.
- 17) Describe the role of osteoblasts and osteoclasts in bone tissue remodeling.

Optional

- 18) List some diagnostic features of osteoporosis, osteomalacia, rickets, Paget's disease, and osteosarcoma.
- 19) Identify the basic steps in the healing of a bone fracture.

INTRODUCTION TO SKELETAL JOINTS AND ARTICULATIONS

(2 lectures)

A. Be able to compare different joint types on their relative degree of movement, explaining what structures contribute to this movement.

STRUCTURE

- 1) Define *joint (articulation)*.
- 2) Explain and diagram the following basic structural features of synovial joints: articular cartilage, joint cavity, articular capsule, fibrous capsule, synovial membrane, synovial fluid, reinforcing ligaments, nerves, vessels, and articular disc or meniscus.
- 3) Explain the function of synovial fluid.
- 4) Compare bursae and tendon sheaths; explain the structure and function of these associated synovial joint structures.

CLASSIFICATIONS OF JOINTS & SKELETON

- 5) Differentiate between the three general categories of joints; fibrous, synovial and cartilaginous
- 6) Differentiate between the movement types of joints: synarthrotic, amphiarthrotic, and diarthrotic.

STRUCTURE/FUNCTION RELATIONSHIPS

- 7) Describe the general structure of fibrous joints; identify the three main types of fibrous joints and give examples of each, indicating the degree of movement for each type.
- 8) Describe the general structure and function of cartilaginous joints; identify the two main subtypes of cartilaginous joints and give examples of each, indicating the degree of movement for each.
- 9) Describe the general structure and function of synovial joints; Explain how synovial joints are classified by shape. Name the six classes, describe permitted movements of each class, degree of movement and give specific examples of these joints. Explain how the shape of the joint influences the movement permitted by the joint.
- 10) Differentiate between the general structure and function of the 3 types of joints (fibrous, cartilaginous, synovial).

FUNCTION: MOVEMENTS

- 11) Define all movements allowed by synovial joints including gliding, angular, rotational, and special movements that do not fit into the previous categories.
- 12) Given a scenario, identify the plane and axis of movement.

APPLICATION OF STRUCTURE/FUNCTION RELATIONSHIPS

13) Describe the bones and joints of the knee based on shape and movements allowed, location, structures, function, and any other significant features.

Optional:

14) Discuss disorders of joints and compare physical injuries, such as sprains, with inflammatory and degenerative conditions, such as arthritis.

15) Explain the etiology and symptoms of each type of arthritis.

16. Compare and contrast the movement and stability in the shoulder and elbow.

SKELETAL MUSCLE

(1 lecture)

CLASSIFICATION

1) Explain how muscles are classified into several functional types; give specific muscle examples and describe the functions of prime movers (agonists), antagonists, synergists, and fixators.

STRUCTURE: MACROSCOPIC ANATOMY

- 2) Name the layers of connective tissue that occur in and around a skeletal muscle.
- 3) Define *muscle fascicles*.

STRUCTURE: MICROSCOPIC ANATOMY

- 4) List # general characteristics of skeletal muscle fibers.
- 5) Explain the sliding filament theory in the simplest form.
- 6) Describe the role of titin in the sarcomere.
- 7) Describe and explain the structural and organizational levels of skeletal muscle. Begin with the muscle as an organ followed by the fascicle, muscle fiber, myofibril, and sarcomere, then end with the myofilament.
- 8) Define motor unit
- 9) Describe the organization of a sarcomere and its role in contraction.
- 10) Describe the various ways in which muscles attach to their origins and insertions.

SMOOTH AND CARDIAC MUSCLES
STRUCTURE & FUNCTION RELATIONSHIPS

1) Compare and contrast skeletal, cardiac, and smooth muscle tissue. Devise a comparison chart for key characteristics such as location, cell shape, type of innervation, and function.

DIGESTIVE SYSTEM: GASTROINTESTINAL TRACT, PANCREAS, AND LIVER (3 lectures)

- 1) Define alimentary canal (also called gastrointestinal tract), naming its organs and distinguishing it from the accessory digestive organs.
- 2) Define the six essential food-processing activities that occur during digestion: ingestion, propulsion, mechanical breakdown, chemical digestion (including secretion), absorption, and defecation.
- 3) Describe how the process of digestion is an extracellular process that occurs outside the body.
- 4) Define and distinguish between peristalsis and segmentation.
- 5) Describe the four major layers and their sublayers of the alimentary canal wall
- 6) Describe the function and location of nerve plexuses of enteric nervous system
- 7) Describe the location, anatomy, and functions of the oral cavity and salivary glands.
- 8) Describe the location, function and anatomy of the pharynx, esophagus, stomach, small intestine, large intestine, liver, pancreas, and gallbladder.
- 9) Understand the flow of blood from the small intestine, through the liver, and to the heart.
- 10) Describe how the anatomy and function of the epithelium changes as you move from the oral cavity through the large intestine.
- 11) Trace the flow of bile through the system of ducts ultimately into the duodenum, explaining the role bile plays in the digestive process.
- 12) Classify the teeth of adult dentition and describe the anatomical layers of teeth
- 13) Distinguish between the visceral peritoneum and parietal peritoneum.
- 14) Define and describe mesentery, including functions.
- 15) Describe the role of lacteals in fat absorption, and the difference in how fats enter the bloodstream compared to other nutrients.

FUNCTION

- 16) Define the six essential food-processing activities that occur during digestion: ingestion, propulsion, mechanical digestion, chemical digestion, absorption, and defecation.
- 17) Describe how the process of digestion is an extracellular process that occurs outside the body.
- 18) Define and distinguish between *peristalsis* and *segmentation*.

FLOW PATHWAYS

- 19) Trace the flow of bile through the system of ducts ultimately into the duodenum, explaining the role bile plays in the digestive process.
- 20) Trace the flow of blood through the vascular system from the small intestine, through the liver, and to the heart.

Optional:

21) Describe disorders of the digestive system which could include: intestinal obstruction, inflammatory bowel disease, viral hepatitis, cirrhosis, or the effects of cystic fibrosis on the pancreas.

RESPIRATORY SYSTEM (2 lectures)

STRUCTURE: MACROSCOPIC ANATOMY

- 1) Describe the structure of the epiglottis and the larynx, including thyroid and arytenoid cartilages true and false vocal cords.
- 2) Describe the gross structure of the lungs (including lobes, and segments) and the pleurae.

STRUCTURE: MICROSCOPIC ANATOMY

- 3) Describe seromucous glands and their function.
- 4) Differentiate between the epithelial lining of each segment of the respiratory tract, and how that contributes to the function of each segment.
- 5) Describe the structure of a lung alveolus and of the respiratory membrane.

PATHWAYS

- 6) Identify the respiratory tubes and passageways in order, from the nose to the alveoli in the lungs.
- 7) Identify the three regions of the pharynx and discuss the passage of air and/or food through the pharynx during breathing and swallowing.
- 8) Identify the structures of the conducting zone and of the respiratory zone.

FUNCTION: SOUND PRODUCTION

- 9) Explain the role of structures of the larynx in sound production

FUNCTIONS: VENTILATION

- 10) Explain the roles of the ventilatory muscles (e.g. diaphragm) and lung elasticity in the act of ventilation.
- 11) Define *surfactant*, and explain its function in ventilation.

Optional:

12) Describe the causes and consequences of various respiratory disorders (e.g. asthma, chronic bronchitis, emphysema, pneumonia, tuberculosis, cystic fibrosis, sinus infections, and nosebleeds).

CARDIOVASCULAR SYSTEM (2 lectures)

STRUCTURE: MACROSCOPIC ANATOMY OF HEART

- 1) Describe the orientation and location of the heart in the thorax; define *mediastinum*.
- 2) Describe the structural coverings of the heart.
- 3) Identify the layers of the heart wall.
- 4) Identify the four chambers of the heart.
- 5) List the important anatomical features of each chamber (papillary muscles, chordae tendineae).
- 6) Name the heart valves; describe the locations and functions.

STRUCTURE: GROSS ANATOMY OF VASCULATURE

- 7) Identify the main types of blood vessels (arteries, veins, capillaries).
- 8) Identify the three tunics that form the walls of arteries and veins; indicate the specific functions of each.
- 9) Compare and contrast the locations, structures, and functions of elastic arteries, muscular arteries, and arterioles.
- 10) Identify the different types of veins; explain the structural and functional features of veins (eg valves).
- 11) Describe the structure and function of capillaries (continuous, fenestrated, and sinusoidal) and their permeabilities.
- 12) Explain how to distinguish a vein from an artery in histological sections.

PATHWAY: MOVEMENT OF BLOOD

- 13) Describe the mechanism for opening and closing of heart valves during ventricular contraction; and associated heart sounds.
- 14) Distinguish between *pulmonary circuit* and *systemic circuit* (including coronary flow). Trace a drop of blood through the heart, pulmonary, and systemic systems.
- 15) Identify the direction of blood flow and state of oxygenation in the main types of blood vessels (arteries, veins, capillaries)
- 16) Explain the pathway of blood flow through capillary beds, and the role of precapillary sphincters.
- 17) Define a portal system and its function.

PATHWAY: ELECTRICAL CONDUCTION

- 18) Identify the components of the conducting system of the heart (SA node, gap junctions, AV node, bundle of His, left and right bundle branches, and Purkinje fibers)
- 19) Trace the electrical conduction pathway of the heart.

BLOOD

- 20) Describe the composition of blood.

Optional:

- 21) Discuss the causes and consequences of coronary artery disease and heart failure, conduction pathway disorders, valve disorders (murmurs), and hypertension.
- 22) Blood types; hematopoiesis; blood cell function.

NERVOUS SYSTEM: GENERAL (1 lecture)

A. Identify the main structures and functions of the nervous system and summarize the relationships between sensory input, integration, and motor output.

STRUCTURES

- 1) Define *nerve*; describe the structural components of nerves. Explain why a nerve is also an organ.
- 2) Distinguish between neuron, nerve fiber, nerve tract, ganglion, and brain nucleus.
- 3) List six types of supporting cells (astrocytes, ependymal cells, microglia, oligodendrocytes, Schwann cells, satellite cells) in nervous tissue; distinguish supporting cells in terms of location, shape, and function.

STRUCTURE: NEURON:

- 4) Define *neuron*. Identify the structural features of the cell body and cell processes; describe their functional roles.
- 5) Define *synapse*; explain the structural components and describe how a synapse functions.
- 6) Draw and label a simplified illustration of a synapse.
- 7) Define *myelin sheath* and describe its structure and functions; distinguish between development in the CNS and PNS.
- 8) Classify neurons by structure (unipolar, bipolar, multipolar); relate the structure (shape) of the neurons to their functional classifications (motor, sensory, interneurons).

NERVOUS SYSTEM ORGANIZATION

- 9) Name the basic divisions of the nervous system and list the basic structural components of the CNS and PNS.
- 10) Describe the functional organization of the PNS. For the sensory (afferent) division, compare somatic sensory and visceral sensory subdivisions; for the motor (efferent) division, compare somatic motor and visceral motor subdivisions.

INFORMATION FLOW:

- 11) Identify the main functions of the nervous system and summarize the relationships between sensory input, integration, and motor output.
- 12) Distinguish functionally between the terms afferent and efferent.
- 13) Explain why a nerve can contain both afferent and efferent messages, and why a neuron cannot.

NERVOUS SYSTEM I: BRAIN / SPINAL CORD (2 lectures)

- A. Understand main functions of regions of the brain
- B. Explain the structures involved in the protection of the brain
- C. Explain the flow of cerebrospinal fluid through the brain and spinal cord

STRUCTURE: GROSS ANATOMY OF SPINAL CORD

- 1) List and describe the gross anatomical features of the spinal cord. Be sure to include the arrangement of the gray and white matter.

STRUCTURE: GROSS ANATOMY OF BRAIN

- 2) Identify the major segments of the developing brain, starting from telencephalon, diencephalon, mesencephalon, metencephalon, and myelencephalon.
- 3) Identify the major regions (parts) of the adult brain that arise from each brain segment: cerebral cortex, basal ganglia, hypothalamus, thalamus, epithalamus, midbrain, pons, cerebellum, and medulla. Define which areas make up the brain stem.
- 4) Name and identify the locations of the ventricles of the brain.
- 5) Describe the functions and locations of the divisions of the human cerebral cortex: frontal lobes, parietal lobes, temporal lobes, occipital lobe, and the insula
- 6) Name and distinguish between the tracts of cerebral white matter: commissural tracts, projection tracts, and association tracts.
- 7) Identify specific examples, functions, and locations of deep gray matter (basal ganglia) of the cerebrum.
- 8) Describe the location of the diencephalon. List the individual parts (the thalamus, the hypothalamus, and the epithalamus), and describe functions and locations of each part.
- 9) Describe the relationship of the brain stem to the rest of the brain; list the individual components (the midbrain, the pons, and the medulla), and describe the functions and locations of each part.
- 10) Describe the functions and location of the cerebellum.
- 11) Compare and contrast the two important functional brain systems—the limbic system and the reticular formation—then describe the locations and functions of each system.

FUNCTION: PROTECTION OF THE BRAIN:

- 12) Explain how the skull, meninges, cerebrospinal fluid, and the blood-brain barrier protect the CNS.

PATHWAY: FLOW OF CEREBROSPINAL FLUID

- 13) Trace the pathway of CSF circulation from its formation in the choroid plexuses to where it is removed back into the blood at the arachnoid villi of the dural sinuses.

Optional:

- 14) Discuss the disorders of Alzheimer's, Parkinson's, meningitis, Huntington's chorea, and personality disorders.

PERIPHERAL NERVOUS SYSTEM / AUTONOMIC NS (1½ lectures)

- A. Compare and contrast the PNS to the CNS
- B. Describe the structures and organization of the PNS
- C. Describe the main functions of the different parts of the PNS

ORGANIZATION OF PNS:

- 1) Define *peripheral nervous system*. Contrast components of the PNS and CNS; identify the basic divisions and subdivisions. (identify/organize the basic divisions and subdivisions (autonomic and somatic, visceral (sensory and motor)
- 2) Define *autonomic nervous system*; identify its effectors, describe its basic functions, and explain the relationship of the ANS to the PNS as a whole; stress that ANS is not a part of the CNS.

STRUCTURES OF THE PNS:

- 3) Compare locations of cranial nerves and spinal nerves.
- 4) Classify sensory receptors based on stimulus detected (mechanoreceptors, thermoreceptors, chemoreceptors, nociceptors, photoreceptors).
- 5) Differentiate between *root* and *ramus*.

FUNCTIONS OF THE PNS:

- 6) Describe the autonomic nervous system in terms of types of effectors, number of neurons forming the pathway, ~~speed of conduction along fibers~~, types of ganglia associated with each system, and neurotransmitters released.
- 7) Identify the basic divisions of the ANS. Describe the functional differences between the sympathetic and parasympathetic divisions; explain “fight, flight, or fright” and “rest and digest.”
- 8) Describe the basic anatomical features of the parasympathetic division; explain how the parasympathetic system relates to the brain, cranial nerves, and sacral spinal cord.
- 9) Describe the basic anatomical features of the sympathetic division; explain how the sympathetic division relates to the spinal cord and spinal nerves.

Optional

- 10) Compare and contrast the effects of parasympathetic and sympathetic divisions on the following organs: heart, blood vessels, gastrointestinal tract, and (optional) lungs.
- 11) Explain the role of the adrenal medulla as a major organ in the sympathetic division.
- 12) Describe the causes and symptoms of paraplegia, quadriplegia, shingles, migraine headaches, myasthenia gravis, polio, and postpolio syndrome.
- 13) Explain how dermatomes are related to sensory innervation regions of spinal nerves.
- 14) Discuss ANS disorders such as Raynaud’s.

THE SPECIAL SENSES (1 1/2 LECTURES)

- A. Explain the structures (in appropriate order) involved in the pathway that leads to sight and sound.

CLASSIFICATION:

- 1) Define the special senses (taste, smell, sight, hearing, equilibrium).

STRUCTURE/FUNCTION OF EYE

- 2) Identify and describe the anatomical and functional features of the three tunics of the eye, the lens, and the humors of the eye.
- 3) Describe the structure and function of the retina (pigmented and neural layers), photoreceptors (rods and cones), and bipolar and ganglion cells. Emphasize that photoreceptors are the only cells that detect light.

INFORMATION FLOW FOR VISION:

- 4) Trace the pathway of light as it passes through the cornea, aqueous humor, lens, vitreous humor, ganglion cells, bipolar cells, and then is detected by the photoreceptors.
- 5) Explain how light is focused for close vision in the context of hyperopia, myopia.
- 6) Trace the pathway nerve impulses travel from the retina to the optic nerve.

STRUCTURE/FUNCTION OF HEARING

- 7) Describe the features of the external ear (auricle, external acoustic meatus, and tympanic membrane) that accommodate the gathering of sound waves and transmission of sound waves to the middle ear.
- 8) Describe the bony location of the middle ear; explain the function of the associated structures: the pharyngotympanic tube and the ossicles (malleus, incus, stapes), round window, and oval window.
- 9) Explain the events occurring in the cochlea that participate in the mechanism of hearing.
- 10) Describe the three chambers of the cochlea (scala vestibuli, scala media, scala tympani), and the fluids within these chambers (perilymph, endolymph).
- 11) Describe the structures and functions of the spiral organ of Corti (tectorial membrane, hair cell/stereocilia, basilar membrane, supporting cells).

INFORMATION FLOW FOR SOUND:

- 12) Trace the pathway of a sound wave, starting from the tympanic membrane, auditory ossicles (malleus, incus, stapes), oval window, perilymph (scala vestibuli, scala tympani), endolymph (scala media), until it dissipates at the round window.

STRUCTURE/FUNCTION OF BALANCE:

- 13) Differentiate between the bony and membranous labyrinths of the inner ear.
- 14) Categorize the structures of the bony labyrinth according to their locations and functions, including semicircular canals, vestibules, and cochlea.
- 15) Categorize the structures of the membranous labyrinth according to their locations and functions, including semicircular ducts, utricles, saccules, and cochlear ducts.

Optional:

- 16) Identify the causes and symptoms of motion sickness, Ménière's syndrome, and deafness.
- 17) Distinguish between static equilibrium and linear acceleration.
- 18) Explain how the maculae and otoliths contribute to the sense of static equilibrium.
- 19) Describe the structures of the maculae (otolithic membrane, hair cells, stereocilia, and supporting cells).
- 20) Describe the structures of the crista ampullaris (cupula, hair cells, stereocilia, and supporting cells).
- 21) Define *taste*; describe taste bud histology and explain the gustatory pathway.
- 22) Identify five basic taste sensations.
- 23) Define *smell*; describe olfactory epithelium, explain how smell is relayed to the brain.

THE LYMPHATIC AND IMMUNE SYSTEMS (INTEGRATED INTO OTHER SYSTEMS IF NOT GIVEN THEIR OWN LECTURE)

- 1) Define and distinguish between the *lymphatic system* and the *immune system*.
- 2) Identify the cells of the immune system.
- 3) Distinguish between primary and secondary lymphoid organs and tissues.
- 4) Describe the tissue structure, location, and function of GALT and Peyer's patches.
- 5) Compare and contrast blood and lymph circulation.
- 6) Identify where blood and lymph can exchange fluid/materials

THE URINARY SYSTEM (1 LECTURE)

- A. Explain the structures involved in the pathway of urine formation, focusing on relating the microscopic and macroscopic anatomy of the kidney in this process.
- B. Trace the flow of urine through the urinary system.
- C. Predict and explain what epithelium is present along the pathway that allows for urine formation

STRUCTURE: MACROSCOPIC ANATOMY:

- 1) Describe the location of the kidneys, ureters, urinary bladder, and urethra; and summarize the basic functions of each organ.
- 2) Describe the internal gross anatomy of the kidney, identifying structures of the renal cortex and renal medulla.

STRUCTURE: MICROSCOPIC ANATOMY

- 3) Define and describe the main structural and functional unit of the kidney, the *uriniferous tubule*, noting its two major parts: the nephron (including proximal convoluted tubules, Loop of Henle, distal convoluted tubules) and the collecting duct (tubule).
- 4) Explain in detail the microscopic anatomy (including epithelial lining) and function of the renal corpuscle of the nephron.
- 5) Explain the microscopic blood vessels, including peritubular capillaries and vasa recta, associated with uriniferous tubules.
- 6) Describe the location, gross anatomy, and epithelial lining of the ureters.
- 7) Describe the urinary bladder in the following ways: location, shape, epithelial lining, and function.
- 8) Describe the location, structure, and function of the urethra of both sexes

FUNCTION

- 9) Explain and define the three major interacting mechanisms of urine formation: *filtration*, *resorption*, and *secretion*, using a single, generalized uriniferous tubule

PATHWAY: MOVEMENT OF FILTRATE

- 10) Trace the path of the filtrate throughout the nephron, naming each section and continuing into the collecting tubules.
- 11) Trace the path taken by the filtrate (urine) from the glomerulus to the collecting duct, describing the changes in epithelial linings along the path.

Optional:

- 12) Describe the basic features of one or more disorders of the urinary system: urinary tract infections, renal calculi, urinary bladder cancer, or kidney cancer.

THE REPRODUCTIVE SYSTEM (1 LECTURE)

- A. Explain the structures specific to male and reproductive systems
- B. Explain the structures (in appropriate order) involved in the route sperm and egg take beginning with site of formation.

STRUCTURE/FUNCTION: MALE/FEMALE REPRODUCTION

- 1) Describe basic functions of the male and female reproductive systems.

- 2) Describe the gross anatomy of the scrotum, distinguishing between the dartos muscle and the cremaster muscles.
- 3) Describe the location, gross anatomy, and function of the testes.
- 4) Describe the location and function of the epididymis, ductus deferens, spermatic cord, and urethra.
- 5) Describe the location, structure, and function of the ovaries.
- 6) Describe the location, structure, and function of the uterine tubes, including how an ovulated oocyte enters the tube, as well as how it is propelled along the tube.
- 7) Describe the location, anatomy, and function of the uterus.
- 8) Describe the location, anatomy, and functions of the vagina.

PATHWAY: MOVEMENT OF GAMETES

- 9) Describe the formation of immature sperm within the testes and the maturation of the sperm in the epididymis.
- 10) Trace the route traveled by sperm cells from the testis, through the epididymis, ductus deferens, ejaculatory duct, urethra, external urethral orifice.
- 11) Describe the location, structure, and function of the uterine tubes, including how an ovulated oocyte enters the tube, as well as how it is propelled along the tube.

Optional:

- 13) Identify the location, structure, and functions of the accessory glands involved in semen production: the seminal vesicles, the prostate, and the bulbourethral glands.
- 14) Identify examples of disorders of the reproductive system.