

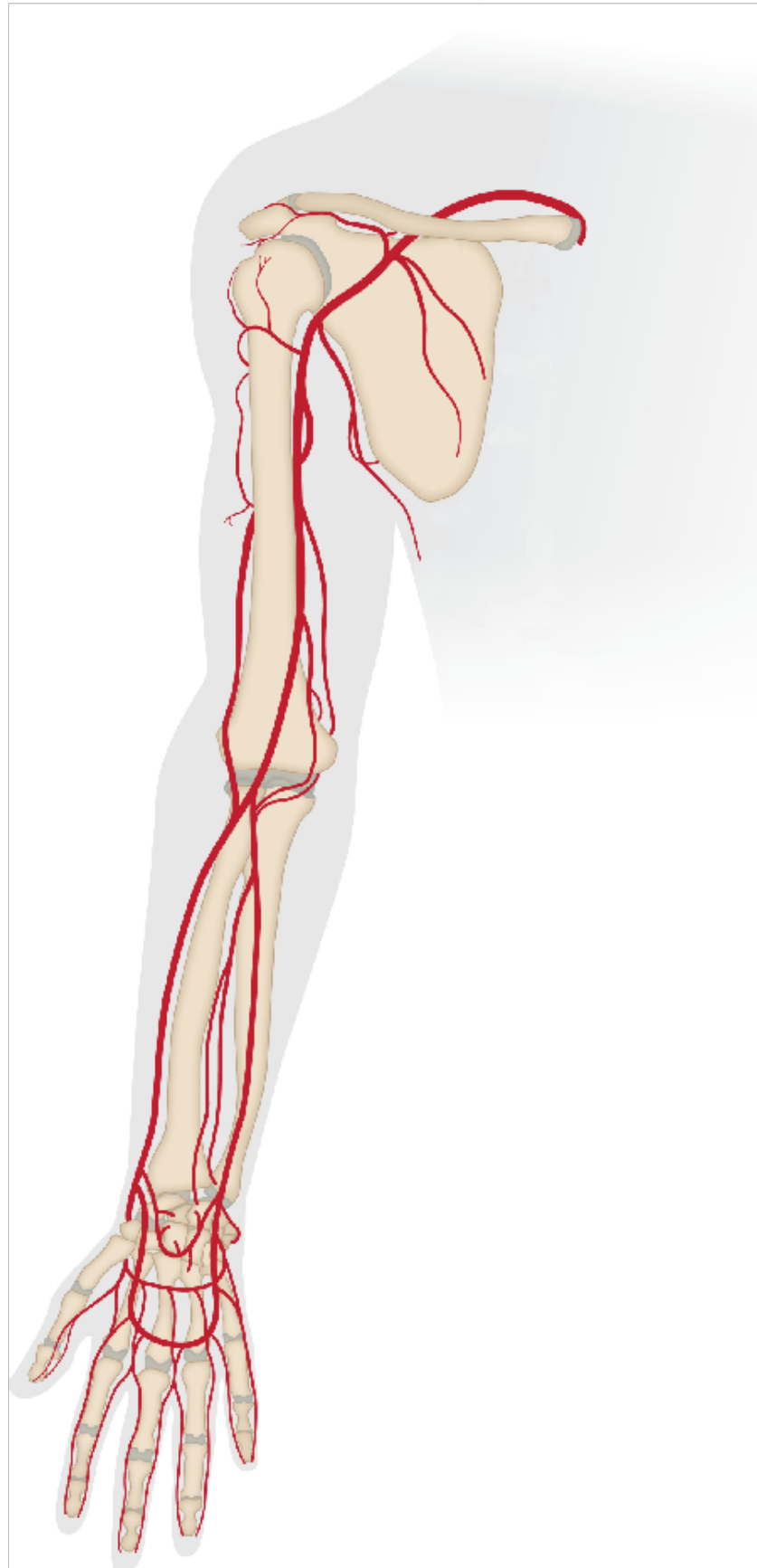


# Anatomy Learning Outcomes

MODULE A  
Body Plan  
and Organization



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# **HAPS Anatomy-only Learning Outcomes**

## **MODULE A: Body Plan & Organization**

### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. Structural organization of the human body**

1. Describe the hierarchical levels of organization in the human body.
2. List examples of each level of organization.

#### **2. Anatomical position**

1. Describe the human body in anatomical position.
2. Describe and explain the purpose of the anatomical position.
3. Identify right and left on anatomic specimens, anatomic drawings, and medical imaging.

#### **3. Body planes and sections**

1. Identify and describe the anatomic planes in which a body might be viewed.

#### **4. Directional terms**

1. List and define the major directional terms used in anatomy.
2. Describe the relative locations of body structures, using appropriate directional terminology.

#### **5. Basic anatomical terminology**

1. Compare and contrast the definitions of anatomy and physiology.
2. List and define the major anatomical regions of the body.

#### **6. Survey of body systems**

1. List the body systems of the human body.
2. Describe each body system's major components.
3. Describe each body system's major functions.

#### **7. Body cavities, abdominopelvic quadrants, and abdominopelvic regions**

1. Describe the location of the body cavities and identify the major organs found in each cavity.
2. Describe the composition of a serous membrane, the function of serous fluid, and the locations of serous membranes in the body.
3. Identify and describe the location of the four abdominopelvic quadrants and the major structures found in each.
4. Identify and describe the location of the nine abdominopelvic regions.



# Anatomy Learning Outcomes

MODULE C  
Cell  
Biology



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE C: Cell Biology**

\*Note: This module is provided for Human Anatomy courses that do not have a prerequisite class which includes cell biology. Content covered by required prerequisite courses does not need to be repeated in the Human Anatomy course.

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

##### **1. Intracellular organization of nucleus and cytoplasm**

1. Identify the three main parts of a cell, and list the general functions of each.
2. Explain the difference between cytoplasm and cytosol.
3. Describe the structure of the cytoskeleton.

##### **2. Plasma (cell) membrane structure and function**

1. Describe the structural composition of the plasma (cell) membrane, and how its composition relates to plasma membrane function.
2. Compare and contrast the processes of endocytosis and exocytosis.

##### **3. Organelles**

1. Define the term organelle.
2. Describe the structure and function of organelles associated with human cells.

##### **4. Nucleus**

1. Describe the structure and function of the nucleus.
2. Describe the structure and function of the components of the nucleus, including chromatin, nucleolus, nuclear envelope, and nuclear pore.
3. Compare and contrast the structure of chromatin, chromatids, and chromosomes.

##### **5. Cell cycle**

1. Describe the different parts of the cell cycle.

##### **6. Mitosis (somatic cell division)**

1. Compare and contrast the different mitotic phases.
2. Distinguish the process of mitosis from the process of cytokinesis.

##### **7. Meiosis (reproductive cell division)**

1. Compare and contrast the different phases of meiosis.
2. Compare the outcomes of meiosis I and meiosis II.
3. Compare and contrast the processes of mitosis and meiosis, including discussing which cell types are involved, chromosome number, and genetic composition of daughter cells.

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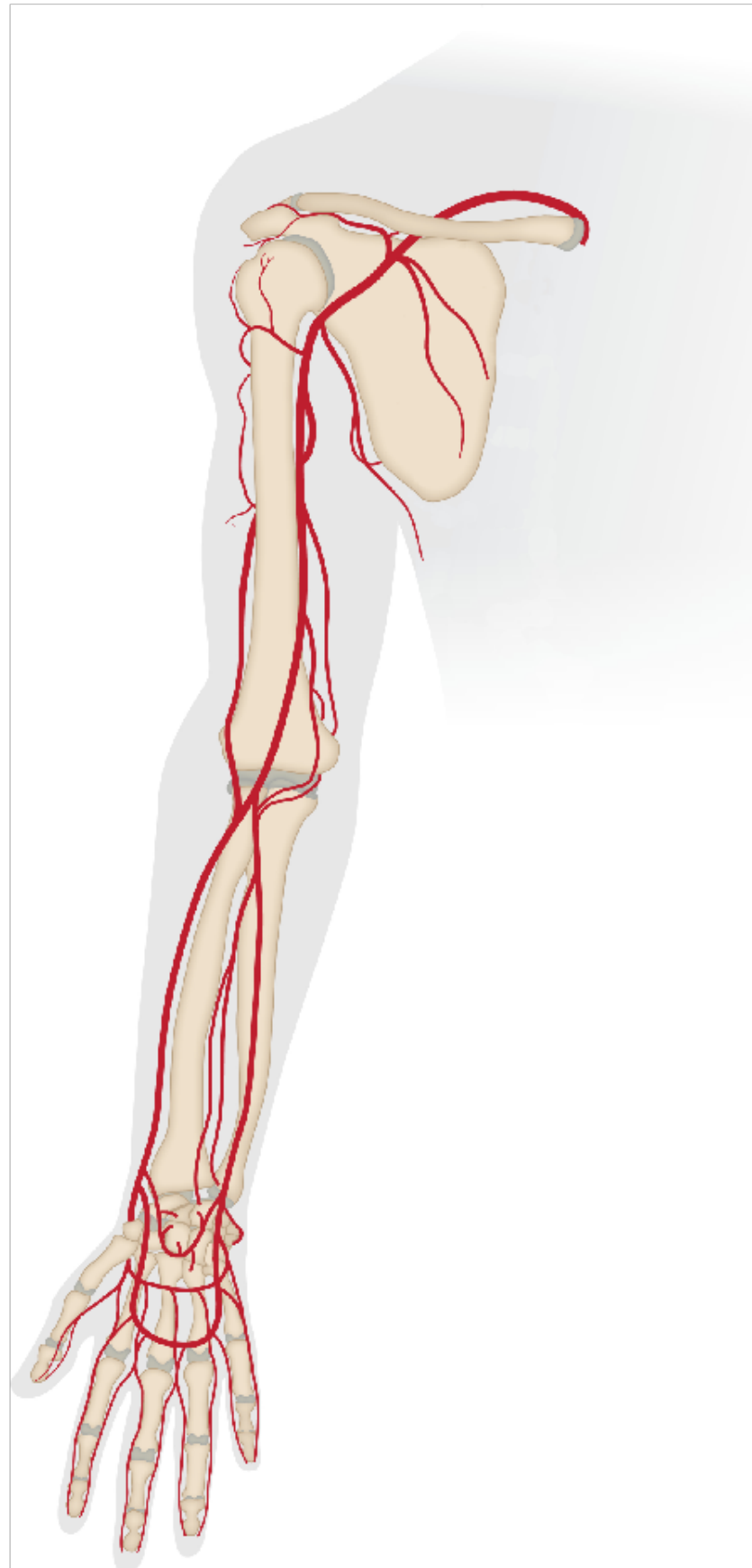
# Anatomy Learning Outcomes

MODULE D

Histology



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE D: Histology**

\*Note: HAPS recognizes that there is a great deal of variability in length and depth of coverage of histology (microscopic anatomy). The learning outcomes listed below are for those courses that include a significant histology component in their human anatomy class.

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented in regular font)

##### **1. Overview of histology and tissue types**

1. Define the term *histology*.
2. List the four major tissue types.
3. Compare and contrast the general features and functions of the four major tissue types.

##### **2. Microscopic anatomy, location, and functional roles of epithelial tissue**

1. Describe the structural characteristics common to all types of epithelia.
2. Classify different types of epithelial tissues based on structural characteristics.
3. Describe the microscopic anatomy, location, and function of each epithelial tissue type.
4. Identify examples of each type of epithelial tissue.
5. Compare and contrast exocrine and endocrine glands, structurally and functionally.
6. Compare and contrast the different kinds of exocrine glands based on structure, method of secretion, and locations in the body.

##### **3. Microscopic anatomy, location, and functional roles of connective tissue**

1. Describe mesenchyme and explain its role in the classification of all connective tissue.
2. Describe the structural characteristics common to all types of connective tissue.
3. Classify different types of connective tissues based on their structural characteristics, functions, and locations in the body.
4. Identify examples of each type of connective tissue.

##### **4. Microscopic anatomy, location, and functional roles of muscle tissue**

1. Describe the structural characteristics common to all types of muscle tissue.
2. Classify different types of muscle tissue based on structural characteristics, functions, and locations in the body.
3. Identify examples of each type of muscle tissue.

##### **5. Microscopic anatomy, location, and functional roles of nervous tissue**

1. Identify the cells of nervous tissue.

2. Compare and contrast neurons and glial cells with respect to cell structure and function.
- 6. Membranes (mucous, serous, cutaneous, and synovial)**
1. Describe the structure and function of mucous, serous, cutaneous, and synovial membranes.
  2. Describe locations in the body where each type of membrane can be found.
- 7. Intercellular connections**
1. Compare and contrast the various intercellular connections (cell junctions) with respect to structure and function.

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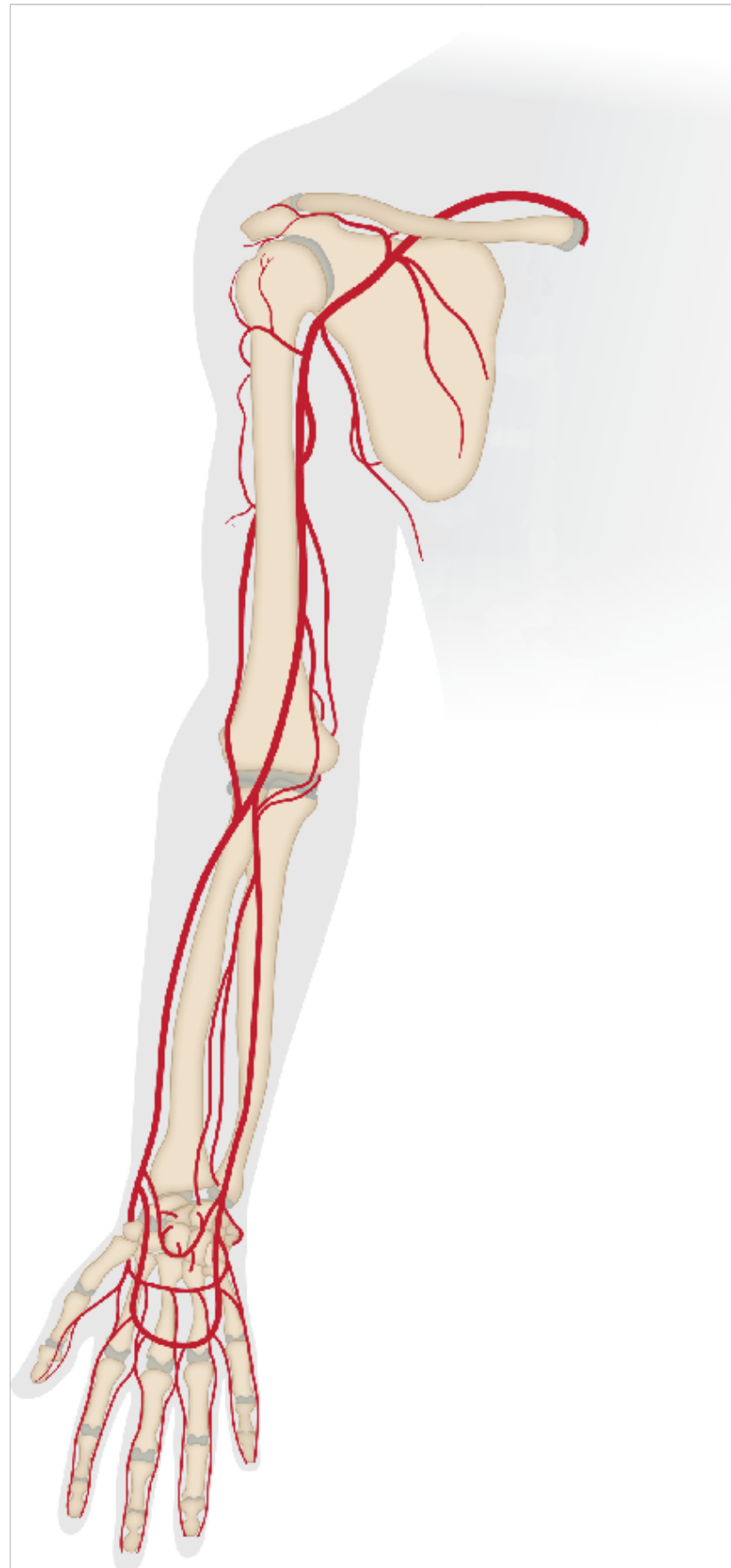
# Anatomy Learning Outcomes

MODULE E  
Integumentary  
System



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE E: Integumentary System**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

- 1. General composition of the integumentary system and subcutaneous layer (hypodermis, superficial fascia)**
  1. List the components of the integumentary system.
  2. Identify and describe the layers of the integument (skin).
  3. Identify and describe the subcutaneous layer (**hypodermis, superficial fascia**).
  4. Explain how the integument is considered an organ.
  
- 2. General functions of the integumentary system and the subcutaneous layer (hypodermis, superficial fascia)**
  1. Describe the general functions of the integumentary system.
  2. Describe the general functions of the subcutaneous layer.
  
- 3. Gross and microscopic anatomy of the epidermis**
  1. Identify and describe the tissue that forms the epidermis.
  2. List and discuss the functions of each cell type located within the epidermis.
  3. Identify and describe the specific layers of the epidermis, including cellular components and their relative positions in the epidermis.
  4. Describe the epidermal difference between thick and thin skin.
  5. Describe the keratinization process that occurs in the epidermis, and discuss which integumentary system functions depend on keratinization.
  
- 4. Gross and microscopic anatomy of the dermis**
  1. Identify and describe the specific layers of the dermis, including the tissue making up each dermal layer.
  
- 5. Gross and microscopic anatomy of the subcutaneous layer (hypodermis, superficial fascia)**
  1. Identify and describe the tissue types that form the subcutaneous layer.
  
- 6. Epidermal derivatives (accessory organs) of the integument**
  1. List the epidermal derivatives of the integument.
  2. Describe the structure and function of hair.
  3. Describe the structure and function of nails.
  4. Describe the structure and function of exocrine glands of the integument.

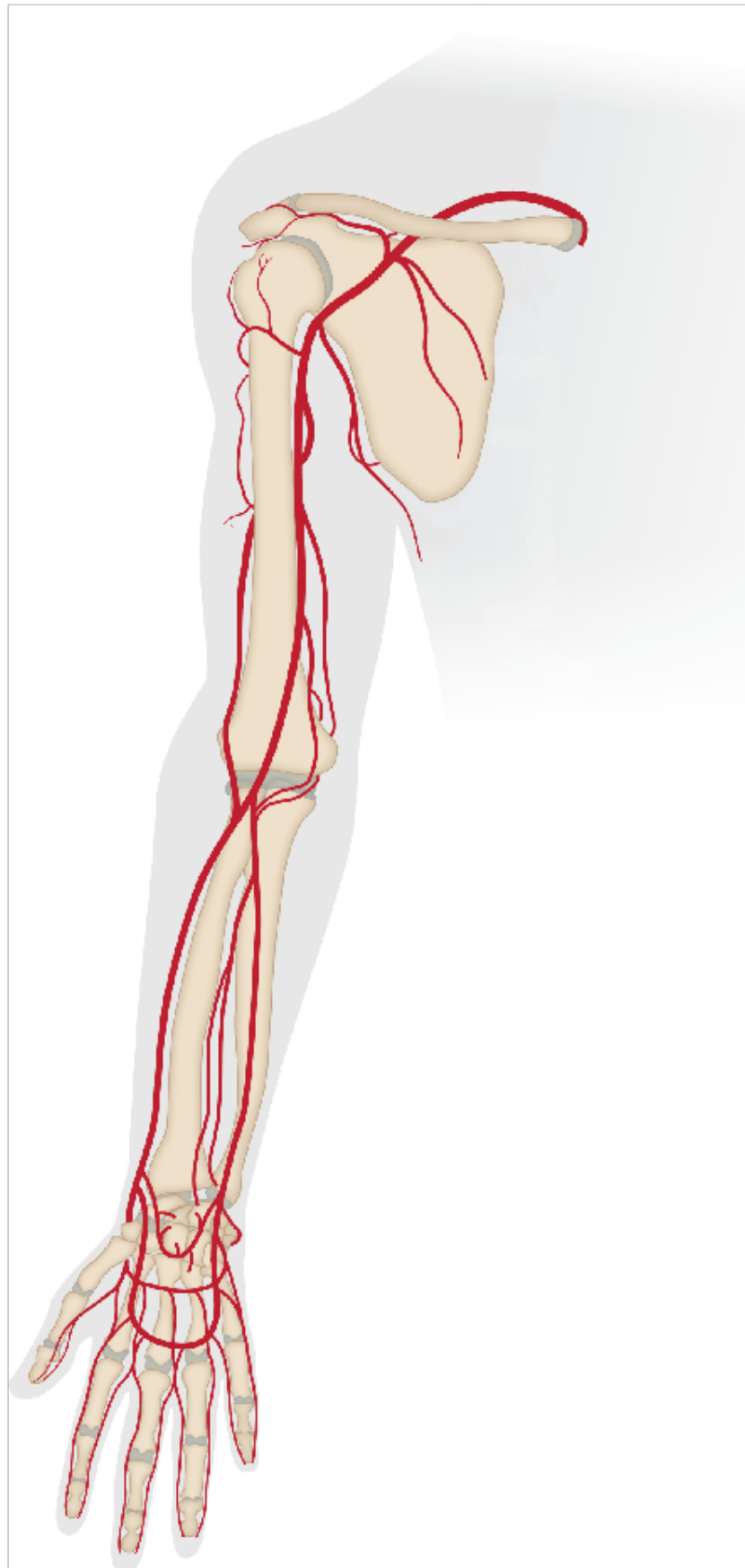


# Anatomy Learning Outcomes

MODULE F  
Skeletal System  
Articulations



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE F: Skeletal System & Articulations**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General attributes of the skeletal system**

1. Describe the major functions of the skeletal system.
2. List and describe the major structural components (e.g., bones, ligaments, tendons, articulations) of the skeletal system.

#### **2. Classification and organization of bones**

1. Define the types of bones based on shape and provide examples of each.
2. Compare and contrast the structure and location of compact bone versus spongy bone.
3. Define the two major divisions of the skeletal system (axial and appendicular) and list the bones contained in each.
4. Define the common bone marking terms (e.g., condyle, tubercle, foramen, canal).

#### **3. Gross anatomy of long bones**

1. Describe the components of a typical long bone.
2. Describe the bone components responsible for either lengthwise or circumferential (width) bone growth in long bones.
3. Compare and contrast the composition and function of red bone marrow and yellow bone marrow.
4. Describe how the location and distribution of red and yellow bone marrow varies during a lifetime.

#### **4. Microscopic components of bone**

1. List and describe the different types of bone cells, with respect to location and function.
2. Describe the microscopic anatomy of bone tissue, including osteon composition.

#### **5. Ossification**

1. Compare and contrast intramembranous and endochondral bone formation.
2. List examples of bones that form through each process.

#### **6. Bone remodeling**

1. Define bone remodeling, and explain how bone remodeling occurs.

#### **7. Axial and appendicular bones**

1. Identify all 206 individual bones and their locations within the body.
2. Identify major bone markings (e.g., spines, processes, foramina) on individual bones.

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## **8. Classification, structure, and function of joints (articulations)**

1. Describe the anatomical classification of joints based on structure—fibrous (i.e., gomphosis, suture, and syndesmosis), cartilaginous (i.e., symphysis and synchondrosis), and synovial (i.e., planar/gliding, hinge, pivot, condylar, saddle, and ball-and-socket)—and provide examples of each type.
2. Describe the functional classification of joints based on amount of movement permitted (e.g., synarthrosis, diarthrosis), and provide examples of each type.
3. Explain how the anatomical classifications of joints are related to the amount of movement(s) permitted at each joint.
4. Identify and describe the major structural components of a typical synovial joint.
5. For each of the six structural types of synovial joints, describe its anatomic features, identify locations in the body, and predict the kinds of movement each joint allows.
6. Define the movements that typically occur at a joint (e.g., flexion, extension, abduction, adduction, rotation, circumduction, inversion, eversion, protraction, and retraction).

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# Anatomy Learning Outcomes

MODULE G  
Muscular  
System



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE G: Muscular System**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General properties and functions of muscle tissue**

1. Describe the major functions and properties common to all types of muscle tissue.

#### **2. Identification, general location, and comparative characteristics of skeletal, smooth, and cardiac muscle tissue**

1. Describe the structure, location in the body, and function of skeletal, cardiac, and smooth muscle.
2. Compare and contrast the general microscopic characteristics of skeletal, cardiac, and smooth muscle.

#### **3. Detailed gross and microscopic anatomy of skeletal muscle**

1. Describe the organization of skeletal muscle, from cell (skeletal muscle fiber) to whole muscle.
2. Name the connective tissue layers that surround each skeletal muscle fiber, fascicle, entire muscle, and group of muscles, and indicate the specific type of connective tissue that composes each of these layers.
3. Describe the components within a skeletal muscle fiber (e.g., sarcolemma, transverse [T] tubules, sarcoplasmic reticulum, myofibrils, thick myofilaments, and thin myofilaments).
4. Define sarcomere.
5. Describe the arrangement and composition of the following components of a sarcomere: A-band, I-band, H-zone, Z-disc (line), and M-line.

#### **4. Contraction of skeletal muscle tissue**

1. Explain the sliding filament theory of skeletal muscle contraction.
2. Describe how the structure and composition of the microscopic skeletal muscle components may change through the contraction cycle.

#### **5. Nomenclature of skeletal muscles**

1. Explain how the name of a muscle can help identify its action, appearance, and/or location.

#### **6. Location, general attachments, and actions of the major skeletal muscles**

1. Identify the location, general attachments, and actions of the major skeletal muscles and demonstrate these muscle actions.
2. Describe similar actions (functional groupings) of muscles in a particular compartment (e.g., anterior arm) or region (e.g., deep back).

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# Anatomy Learning Outcomes

MODULE H  
Nervous  
System



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# **HAPS Anatomy-only Learning Outcomes**

## **MODULE H: Nervous System**

### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General functions of the nervous system**

1. Describe the general functions of the nervous system.

#### **2. Organization of the nervous system**

1. Compare and contrast the central nervous system (CNS) and the peripheral nervous system (PNS) with respect to structure and function.
2. Differentiate between the motor (efferent) and sensory (afferent) components of the nervous system.
3. Compare and contrast the somatic motor and autonomic motor divisions of the nervous system.
4. Compare and contrast the somatic sensory and the visceral sensory divisions of the nervous system.

#### **3. General anatomy of the nervous system**

1. Describe the composition and arrangement of the gray and white matter in the CNS.
2. Describe the structure of a typical nerve, including the motor and sensory neuronal elements, neuroglial elements, and connective tissue wrappings.
3. Compare and contrast the structure and location of a nucleus and ganglion.
4. Compare and contrast the structure and location of a tract and nerve.

#### **4. Protective roles of cranial bones and vertebral column, meninges, and cerebrospinal fluid (CSF)**

1. Describe how the cranial bones and the vertebral column protect the CNS.
2. Identify the meninges and describe their anatomical and functional relationships to the CNS (brain and spinal cord).
3. Compare and contrast the structure of the dura mater surrounding the brain and the spinal cord.
4. Describe the structure and location of the dural venous sinuses, and explain their role in drainage of blood from the brain.
5. Identify and describe the structure and function of the cranial dural septa.
6. Identify and describe the epidural space, subdural space, and subarachnoid space associated with the brain and the spinal cord, and identify which space contains cerebrospinal fluid.
7. Describe the general functions of cerebrospinal fluid (CSF).
8. Describe the production, flow, and reabsorption of cerebrospinal fluid (CSF), from its origin in the ventricles to its eventual reabsorption into the dural venous sinuses.

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## 5. Microscopic anatomy of the nervous system—neurons

1. Identify and describe the major components of a typical neuron (e.g., cell body, nucleus, nucleolus, chromatophilic substance [Nissl bodies], axon hillock, dendrites, and axon), and indicate which parts of a neuron receive input signals and which parts of a neuron transmits output signals.
2. Compare and contrast the three structural types of neurons (i.e., unipolar [pseudounipolar], bipolar, and multipolar) with respect to their structure, location, and function.
3. Compare and contrast the three functional types of neurons (i.e., motor [efferent] neurons, sensory [afferent] neurons, and interneurons [association neurons]) with respect to their structure, location, and function.

## 6. Microscopic anatomy of the nervous system—neuroglial cells

1. Describe the structure, location, and function of the six types of neuroglial cells.
2. Define myelination and describe its function, including comparing and contrasting how myelination occurs in the CNS and PNS.

## 7. Integration of neural information

1. Define a neural (neuronal) circuit.<sup>1</sup>
2. Compare and contrast the different types of neural (neuronal) circuits (e.g., converging, diverging).

## 8. Specific anatomical organization of the brain

1. Identify and describe the 3 primary brain vesicles formed from the neural tube.
2. Identify and describe the 5 secondary brain vesicles formed from the neural tube and name the parts of the adult brain arising from each.
3. Identify and define the general terms gyrus, sulcus, and fissure.
4. Identify and describe the four major parts of the adult brain (i.e., cerebrum, diencephalon, brainstem, and cerebellum).
5. Identify and describe the ventricular system components.
6. Describe the blood-brain barrier (BBB) and its significance.

For the cerebrum:

7. Identify and describe the cerebral hemispheres and the five lobes of each (i.e., frontal, parietal, temporal, occipital, insula).
8. Identify and describe the major landmarks of the cerebrum (e.g., longitudinal fissure, lateral sulcus [fissure], central sulcus, transverse fissure, precentral gyrus, and postcentral gyrus).
9. Identify and describe the three major cerebral regions (i.e., cortex, white matter, cerebral nuclei [basal nuclei]).
10. Identify and describe the primary functional cortical areas of the cerebrum (e.g., primary motor cortex, primary somatosensory cortex, and primary auditory cortex, primary visual cortex, primary olfactory cortex, primary gustatory cortex).

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<sup>1</sup> The preferred term is neural (or neuronal) circuit, rather than neural or neuronal pool.

11. Compare and contrast the location and function of the motor speech area (Broca area) and Wernicke area of the cerebrum.
12. Compare and contrast the three cerebral white matter tracts (i.e., association, commissural, projection).

For the diencephalon:

13. Name the major components of the diencephalon.
14. Describe the structure, location, and major functions of the thalamus.
15. Describe the structure, location, and major functions of the hypothalamus, including its relationship to the autonomic nervous system and the endocrine system.
16. Describe and identify the epithalamus, including the pineal gland and its function.

For the brainstem:

17. Name the three subdivisions of the brainstem.
18. Describe the structure, location, and major functions of the midbrain (mesencephalon), including the cerebral peduncles, superior colliculi, and inferior colliculi.
19. Describe the structure, location, and major functions of the pons.
20. Describe the structure, location, and major functions of the medulla oblongata (medulla), including the pyramids and decussation of the pyramids.

For the cerebellum:

21. Describe the structure, location, and major functions of the cerebellum.
22. Identify and describe the cerebellar hemispheres, vermis, arbor vitae (cerebellar white matter), cerebellar peduncles, and cerebellar cortex (folia, cerebellar gray matter).
23. Describe the major components and functions of the limbic system.

## **9. Cranial nerves**

1. List and identify the cranial nerves by name and number.
2. Describe the major functions of each cranial nerve and identify each cranial nerve as predominantly sensory, motor, or mixed (i.e., sensory and motor).
3. List the cranial nerves that have parasympathetic (ANS) components.

## **10. Specific anatomical organization of the spinal cord**

1. Identify and describe the gross anatomy of the spinal cord, including its enlargements (i.e., cervical and lumbar), conus medullaris, cauda equina, and filum terminale.
2. Compare and contrast the location, composition, and function of the anterior (ventral) roots, posterior (dorsal) roots, and posterior (dorsal) root ganglion with respect to the spinal cord.
3. Identify and describe the anatomical features seen in a cross-sectional view of the spinal cord (e.g., anterior horn, lateral horn, posterior horn, gray commissure,

central canal, anterior funiculus [column<sup>2</sup>], lateral funiculus [column], and posterior funiculus [column]).

4. Describe the structure, location, and function of ascending and descending spinal cord tracts.

## 11. Spinal nerves

1. Identify and describe the formation, structure, and branches of a typical spinal nerve, including the roots and the rami (e.g., anterior, posterior).
2. List the number of spinal nerve pairs and their breakdown by region (i.e., cervical, thoracic, lumbar, sacral, coccygeal).
3. Describe the concept of a dermatome and its clinical significance.
4. Define a spinal nerve plexus.
5. For the cervical plexus, list the spinal nerves that form it, describe the plexus' major motor and sensory distributions, and list the major named nerves that originate from the plexus.
6. For the brachial plexus, list the spinal nerves that form it, describe the plexus' major motor and sensory distributions, and list the major named nerves that originate from the plexus.
7. For the lumbar and sacral plexuses, list the spinal nerves that form them, describe the plexus' major motor and sensory distributions, and list the major named nerves that originate from the plexuses.

## 12. Structure and function of sensory and motor pathways

1. Describe the locations and functions of the first-, second-, and third-order neurons in a sensory pathway.
2. Describe the locations and functions of the upper and lower motor neurons in a motor pathway.
3. Describe the concept of decussation and its functional implications.

## 13. Autonomic nervous system (ANS)

1. Compare and contrast the autonomic nervous system (ANS) to the somatic nervous system (SNS) with respect to site of origination, number of neurons involved in the pathway, effectors, and neurotransmitters.
2. Compare and contrast the two main divisions of the ANS (i.e., sympathetic and parasympathetic) with respect to the major functions of each division, their neurotransmitters, the origination of the division in the CNS, the location of their preganglionic and postganglionic (ganglionic) cell bodies, and the length of the preganglionic versus postganglionic axons.
3. Describe the major components of the sympathetic and parasympathetic divisions (e.g., sympathetic trunk [chain], white and gray rami communicantes, splanchnic nerves, pelvic splanchnic nerves, CN III, CN VII, CN IX, CN X) and the major ganglia of each division (e.g., terminal ganglia, intramural ganglia, sympathetic trunk [chain] ganglia, and prevertebral [collateral] ganglia).

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<sup>2</sup> Terminologia Anatomica (TA) states that the term funiculus should be used to describe the white matter regions, whereas "column" should refer to structures within the gray matter of the spinal cord. We include column in parentheses because we recognize the prevalence of the use of the term "column" relating the white matter.

4. Describe the different anatomic pathways through which sympathetic and parasympathetic neurons reach target effectors.
5. Compare and contrast the effects (or lack thereof) of sympathetic and parasympathetic innervation on various effectors (e.g., heart, iris of eye, airways of lungs, sweat glands, gastrointestinal [GI] tract).

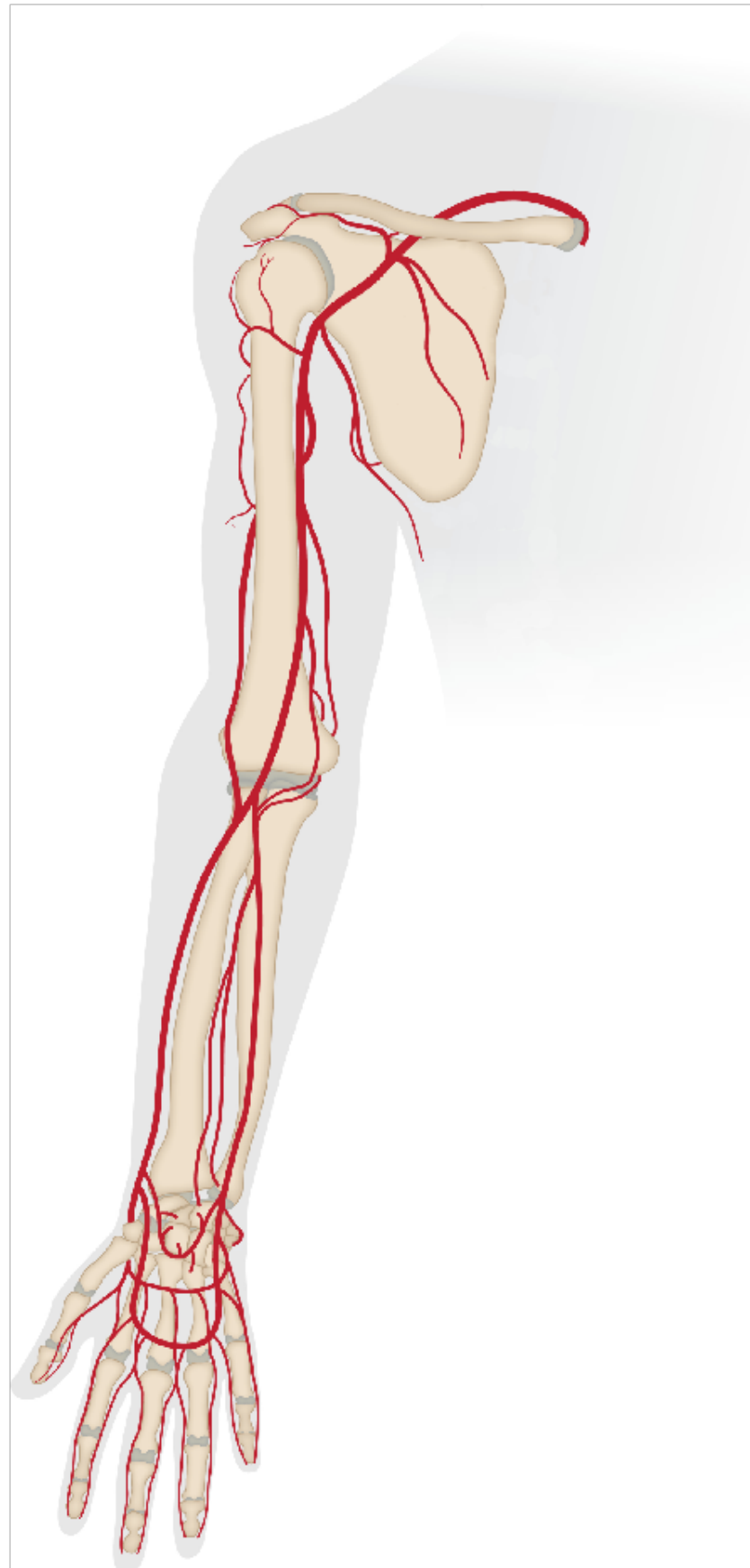


# Anatomy Learning Outcomes

MODULE I  
General and  
Special Senses



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# **HAPS Anatomy-only Learning Outcomes**

## **MODULE I: General and Special Senses**

### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. Sensory receptors**

1. Define the term sensory receptor.
2. Compare and contrast the three types of sensory receptors, based on their stimulus origin (i.e., exteroceptors, interoceptors [visceroreceptors], and proprioceptors).
3. Compare and contrast the types of sensory receptors based on the type of stimulus (i.e., thermoreceptor, photoreceptor, chemoreceptor, baroreceptor, nociceptor, and mechanoreceptor).
4. Compare and contrast a general sense receptor and a special sense receptor.

#### **2. Tactile receptors**

1. Compare and contrast the location, structure, and function of the different types of tactile receptors (e.g., tactile [Merkel] disc and lamellated [Pacinian] corpuscle)].

#### **3. Gross and microscopic anatomy of the eye**

1. Identify and describe the accessory structures of the eye and their relationships to the skull bones. Identify and describe the accessory structures of the eye and their relationships to the skull bones.
2. Identify the tunics of the eye and their major components (e.g., cornea, sclera, iris, ciliary body), and describe the structure and function of each.
3. Identify and describe the anterior and posterior cavities of the eye and their associated humors.
4. Describe the lens and its role in vision.
5. Identify and describe the components of the retina, (e.g., optic disc, macula lutea, fovea centralis, rods, cones).
6. Identify and describe the anterior and posterior cavities of the eye and their associated humors.
7. Identify and describe the actions of the extrinsic eye (extraocular) muscles.

#### **4. Visual pathways**

1. Trace the path of light as it passes through the eye to the retina, and describe which structures are responsible for refracting the light rays.
2. Trace the path of nerve impulses from the retina through the optic nerve, optic chiasm, optic tract, and to the various parts of the brain.
3. Compare and contrast the functions and locations of rods and cones.

#### **5. Olfaction**

1. Identify and describe the location and structure of the olfactory epithelium.
2. Classify an olfactory receptor cell based on the type of stimulus (i.e., modality).

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3. Trace the path of olfaction from the olfactory receptors, to the initiation of a nerve impulse in the olfactory nerves, through the olfactory bulb, olfactory tract, and to the various parts of the brain.

## **6. Gustation**

1. Identify and describe the location and structure of taste buds.
2. Classify a gustatory receptor cell based of type of stimulus (i.e., modality).
3. List the cranial nerves that transmit taste information from the tongue to the brain.
4. Trace the path of nerve impulses from the gustatory receptors to the various parts of the brain.

## **7. Gross and microscopic anatomy of the ear**

1. Identify the structures of the external (outer) ear and describe the structure and function of each.
2. Identify the structures of the middle ear and describe the structure and function of each.
3. Describe the general structures and locations of the bony and membranous labyrinths of the inner ear, and discuss the location of perilymph and endolymph.
4. Describe specific membranous labyrinth structures related to equilibrium and their functions.
5. Identify and describe the microscopic structures within the cochlea (e.g., spiral organ [of Corti], scala vestibuli [vestibular duct], and scala tympani [tympanic duct]).

## **8. Auditory pathways**

1. Trace the path of sound waves as they travel from the external ear to the internal ear. Describe where sound is amplified and how sound is converted to a nerve impulse at the spiral organ.
2. Trace the path of nerve impulses from the spiral organ to the cochlear branch of the vestibulocochlear nerve (CN VIII), and to the various parts of the brain.

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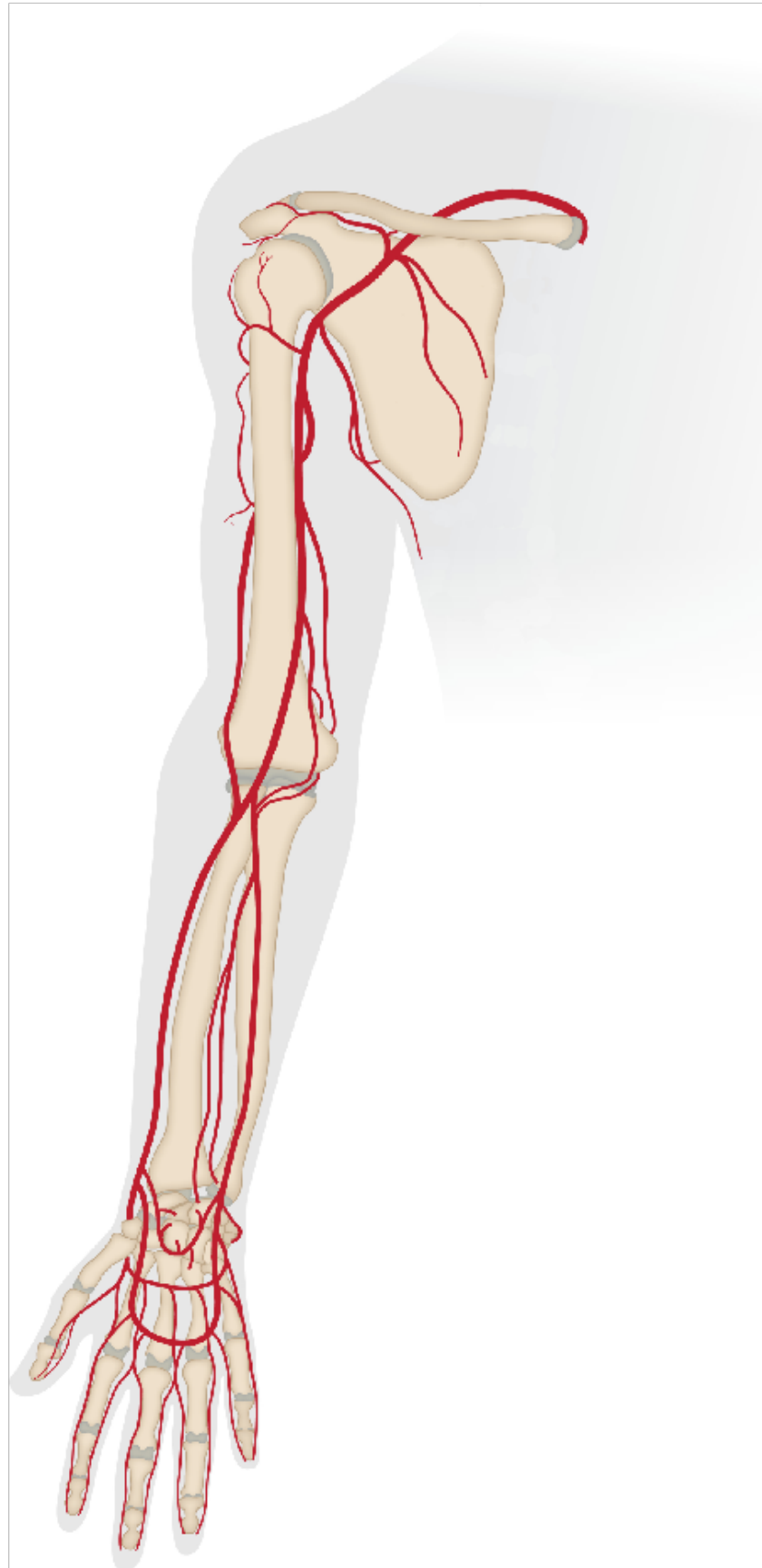


# Anatomy Learning Outcomes

MODULE J  
Endocrine  
System



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## HAPS Anatomy-only Learning Outcomes

### MODULE J: Endocrine System

#### Topic from HAPS Guidelines (in bold font)

Learning Outcomes (indented, in regular font)

#### **1. General functions of the endocrine system**

1. Describe the major functions of the endocrine system.
2. Define the terms *hormone*, *endocrine gland*, *endocrine tissue*, *endocrine cell*, and *target cell*.
3. Describe how an endocrine gland is different from an exocrine gland.
4. Compare and contrast how the nervous system and endocrine system control body function.

#### **2. Control by the hypothalamus and pituitary gland**

1. Describe the locations of and the anatomical relationships between the hypothalamus, anterior pituitary, and posterior pituitary.
2. Explain the role of the hypothalamus in the release of anterior pituitary hormones.
3. Explain the role of the hypothalamus in the production and release of posterior pituitary hormones.

#### **3. Endocrine structures and their hormones**

1. Describe the anatomy of the anterior pituitary, its location, and the major hormones secreted.
2. Describe the anatomy of the thyroid gland, its location, and the major hormones secreted.
3. Describe the anatomy of the parathyroid glands, their location, and the major hormone secreted.
4. Describe the anatomy of the adrenal cortex, its location, and the major hormones secreted.
5. Describe the anatomy of the adrenal medulla, its location, and the major hormones secreted.
6. Describe the anatomy of the pancreas, its location, and the major hormones secreted.
7. Describe the anatomy of the thymus gland, its location, and the major hormones secreted.

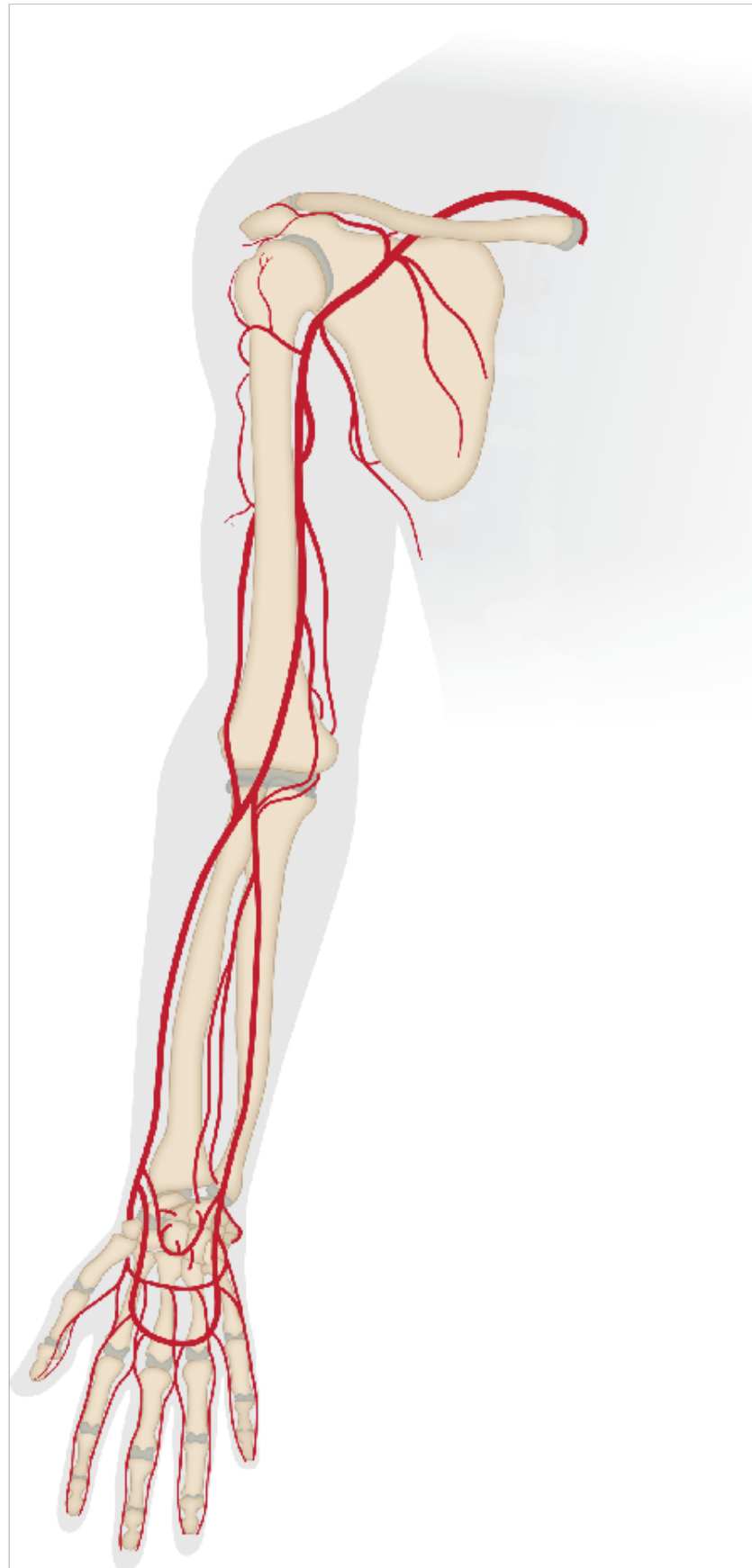


# Anatomy Learning Outcomes

MODULE K  
Cardiovascular  
System



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE K: Cardiovascular System**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General functions and structure of the cardiovascular system**

1. Describe the general functions of the cardiovascular system.
2. Compare and contrast pulmonary circulation and systemic circulation.

#### **2. Blood**

1. Explain why blood is considered a connective tissue, and describe the cells, protein fibers, and plasma that compose it.
2. Compare and contrast the morphological features and general functions of erythrocytes, leukocytes, and platelets.
3. List the five types of leukocytes in order of their relative prevalence in normal blood, and the specific function of each type.

#### **3. Gross and microscopic anatomy of the heart**

1. Describe the position of the heart in the thoracic cavity.
2. Identify and describe the location, structure, and function of the fibrous pericardium, parietal and visceral layers of the serous pericardium, serous fluid, and the pericardial cavity.
3. Explain the structural and functional differences between the atria and the ventricles.
4. On the external surface of the heart, identify the 4 chambers, the coronary (atrioventricular) sulcus, anterior interventricular sulcus, posterior interventricular sulcus, apex, and base.
5. Identify and describe the structure and function of the primary internal structures of the heart, including chambers, septa, valves, papillary muscles, chordae tendineae, fibrous skeleton, and venous and arterial openings.
6. Trace the path of blood flow to and from the heart wall.
7. Describe the structure and functions of each layer of the heart wall (i.e., epicardium, myocardium, and endocardium).
8. Describe the microscopic anatomy of the myocardium, including the location and function of the intercalated discs.
9. Define systole and diastole.

#### **4. Blood flow through the heart**

1. Trace the path of blood through the right and left sides of the heart, including its passage through the heart valves.
2. Describe the general timing of the opening and closing of the heart valves relative to blood flow through the heart, along with the related heart sounds.

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## 5. Conduction system of the heart

1. Identify and describe the parts of the conduction system in the order of nerve impulse transmission, and explain how the system functions.
2. Define *automaticity* and explain why the sinoatrial (SA) node normally paces the heart.

## 6. General gross and microscopic anatomy of blood vessels

1. Define the terms *artery*, *capillary*, and *vein*.
2. Compare and contrast which blood vessels transport oxygenated versus deoxygenated blood within the pulmonary and systemic circulations.
3. List the three tunics associated with most blood vessels and describe the composition of each tunic.
4. Identify and describe the structure and function of specific types of blood vessels (i.e., elastic [conducting] arteries, muscular [distributing] arteries, arterioles, capillaries, venules, veins).
5. Trace the path of blood from the heart, through the specific types of blood vessels, and back to the heart.
6. Define the terms *vasodilation* and *vasoconstriction*.
7. Define *anastomosis*.
8. Define a *portal system*.

## 7. Systemic blood flow through the body regions

1. List the general systemic flow out of the heart, including the major branches of the aortic arch.
2. Describe which regions of the body drain their blood into the superior vena cava versus inferior vena cava.
3. Trace the blood flow to, through, and from the head and neck.
4. Trace the blood flow to, through, and from the thoracic wall.
5. Trace the blood flow to, through, and from the abdominal wall.
6. Trace the blood flow to, through, and from the thoracic organs, including the esophagus, trachea, and bronchi.
7. Trace the blood flow to, through, and from the gastrointestinal tract and accessory digestive organs.
8. Describe the structure and function of the hepatic portal system.
9. Trace the blood flow to, through, and from the major posterior abdominal organs (e.g., kidneys).
10. Trace the blood flow to, through, and from the pelvic organs (e.g., urinary bladder and uterus).
11. Trace the blood flow to, through, and from the upper limb.
12. Trace the blood flow to, through, and from the lower limb.

## 8. Fetal versus postnatal circulation

1. Describe the role of the placenta, umbilical vessels, ductus venosus, foramen ovale, and ductus arteriosus in fetal circulation.

2. Trace the pathway of blood flow from the placenta, through the fetal heart and body, and back to the placenta.
3. Describe the changes in major fetal cardiovascular structures (i.e., umbilical vessels, ductus venosus, ductus arteriosus, and foramen ovale) that typically occur beginning at birth, and the ultimate postnatal remnants (fates) of these structures.



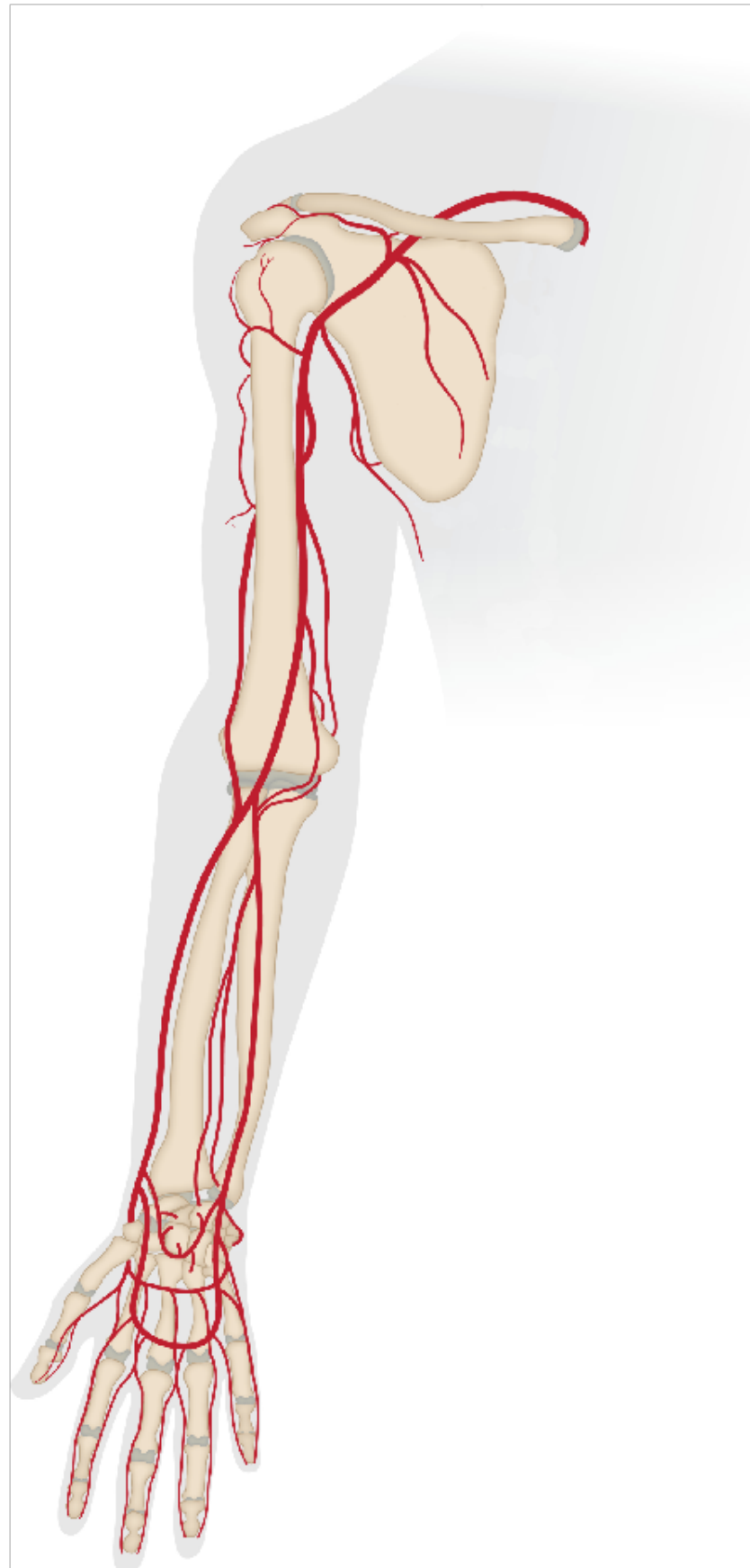


# Anatomy Learning Outcomes

MODULE L  
Lymphatic  
System



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE L: Lymphatic System**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General functions of the lymphatic system**

1. Describe the major functions of the lymphatic system.

#### **2. Lymph, lymph vessels, and lymph drainage**

1. Compare and contrast blood, interstitial fluid, and lymph.
2. Compare and contrast lymph vessels and blood vessels in terms of structure and function.
3. Describe the mechanisms of lymph formation and circulation.
4. Trace the path of lymph circulation from lymphatic capillary to lymphatic vessel to lymphatic trunk to lymphatic duct, to the venous circulation.
5. Describe which body regions drain their lymph to the thoracic duct, and which regions drain their lymph to the right lymphatic duct.

#### **3. Lymphatic cells, structures, and organs**

1. Compare and contrast the functions of T-lymphocytes and B-lymphocytes.
2. Describe the structure, function, and major locations of lymphatic nodules, including mucosa associated lymphoid tissue (MALT) and tonsils.
3. Describe the structure, functions, and major locations of the following lymphatic organs: lymph nodes, thymus, and spleen.



# Anatomy Learning Outcomes

MODULE M  
Respiratory  
System



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## **HAPS Anatomy-only Learning Outcomes**

### **Module M: Respiratory System**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General functions of the respiratory system**

1. Define the terms *respiration*, *inhalation* (inspiration), and *exhalation* (expiration).
2. Describe the major functions of the respiratory system.

#### **2. General anatomy of the respiratory tract**

1. Compare and contrast the general locations and functions of the conducting and respiratory portions of the respiratory tract.
2. Identify the anatomical division of the upper versus lower respiratory tract.
3. List, in order, the respiratory structures that air passes through during inhalation and exhalation.

#### **3. Gross and microscopic anatomy of the nasal cavity, paranasal sinuses, and pharynx**

1. Describe the major functions, gross anatomical features, and epithelial lining of the nasal cavity, paranasal sinuses, and pharynx.

#### **4. Anatomy of the larynx**

1. Describe the major functions of the larynx.
2. Describe the anatomical features of the larynx, including the laryngeal cartilages.
3. Compare and contrast the location, composition, and function of the vestibular folds (false vocal cords) and vocal folds (true vocal cords).
4. Briefly explain how the vocal folds and the larynx function with phonation.

#### **5. Gross and microscopic anatomy of the trachea**

1. Describe the major functions of the trachea.
2. Describe the gross anatomical features of the trachea, including its positioning with respect to the esophagus.
3. Describe the microscopic anatomy of the trachea, including the significance of the C-shaped hyaline cartilage rings.

#### **6. Gross and microscopic anatomy of the bronchial tree**

1. Compare and contrast the main anatomical differences between bronchi and bronchioles.
2. Identify and describe the gross anatomic features of the bronchial tree (e.g., main [primary] bronchi, lobar [secondary] bronchi, segmental [tertiary] bronchi, bronchi, bronchioles, terminal bronchioles, respiratory bronchioles, alveolar ducts, alveolar sacs and alveoli).
3. Pair each bronchus (e.g., main, lobar, segmental) with the general portion of the lung it supplies (e.g., lung, lobe, bronchopulmonary segment).
4. Identify and describe the respiratory membrane, and explain its function.

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5. Describe the histological changes that occur along the bronchial tree, from larger air passageways to smaller air passageways.
6. Compare and contrast the effects of sympathetic and parasympathetic innervation on the bronchioles.

## **7. Gross anatomy of the pleura and lungs**

1. Identify and describe the location, structure, and function of the visceral and parietal pleura, serous fluid, and the pleural cavity.
2. Compare and contrast the gross anatomic features of the left and right lungs, and explain the reasons for these differences.
3. Describe the hilum of the lung, including the relationship of structures at this location.
4. Identify and describe the bronchopulmonary segments, and explain their clinical significance.

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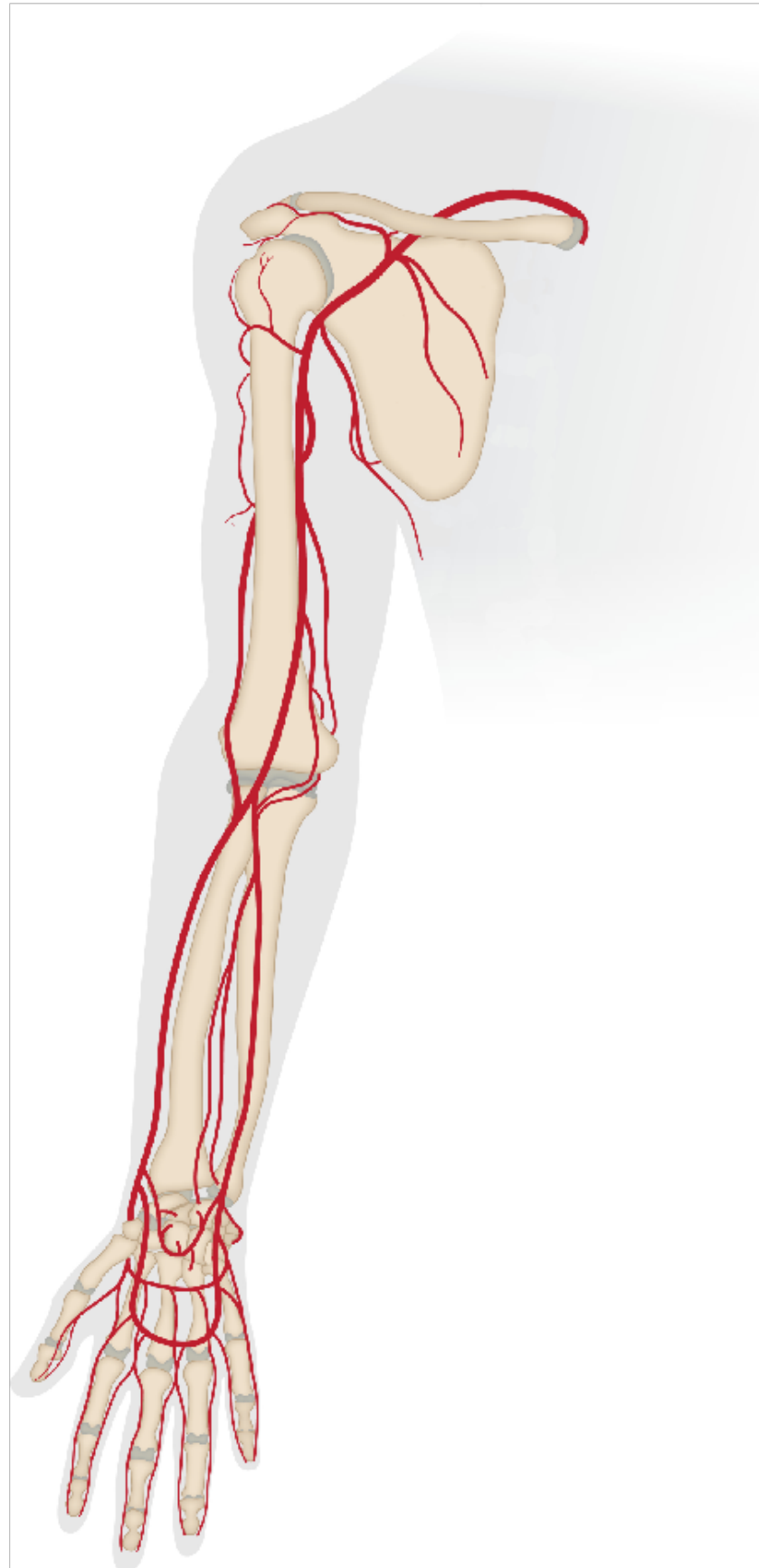


# Anatomy Learning Outcomes

MODULE N  
Digestive  
System



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## **HAPS Anatomy-only Learning Outcomes**

### **Module N: Digestive System**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. Structure and functions of the digestive system**

1. Describe the major functions of the digestive system.
2. Explain the differences between the gastrointestinal (GI) tract and the accessory digestive organs.
3. Define *mechanical digestion* and *chemical digestion*.
4. Compare and contrast where mechanical digestion and chemical digestion occur in the digestive system.
5. Define *peristalsis*.
6. Trace the pathway of ingested substances through the gastrointestinal tract.

#### **2. General gross and microscopic anatomy of the gastrointestinal (GI) tract**

1. List and identify the organs that compose the GI tract.
2. Identify and describe the gross anatomic and microscopic structure and function of each of the GI tract tunics: mucosa, submucosa, muscularis (muscularis externa), and serosa or adventitia.

#### **3. Peritoneum and mesenteries**

1. Identify and describe the location, structure, and function of the visceral and parietal peritoneum, serous fluid, and the peritoneal cavity.
2. Define *mesentery* and explain its function.
3. Compare and contrast the locations of the mesenteries (e.g., mesentery proper, mesocolon, lesser omentum, greater omentum).
4. Explain the difference between an intraperitoneal and a retroperitoneal organ.
5. Identify which digestive system organs are intraperitoneal or retroperitoneal.

#### **4. Oral cavity**

1. Identify and describe the boundaries of the oral cavity.
2. Define *mastication*.
3. Compare and contrast the composition and functions of the hard palate, soft palate, and uvula.
4. Identify and describe the structures (e.g., taste buds and papillae) and the functions of the tongue.
5. Compare and contrast the number, function, and first general appearance of deciduous teeth versus permanent teeth.
6. Describe the location of the major salivary glands (i.e., parotid, submandibular, sublingual) and their respective ducts.
7. Describe the composition and functions of saliva.



## **5. Anatomy of the pharynx**

1. Identify and describe the different regions of the pharynx with respect to the passage of air and/or food.
2. Describe the general process of swallowing (deglutition), and the role of the soft palate, uvula, and epiglottis.

## **6. Gross and microscopic anatomy of the esophagus**

1. Identify the esophagus and describe its location relative to other body structures.
2. List the general functions of the esophagus.
3. Describe the anatomic specializations of the esophageal tunics (e.g., composition of the mucosa and muscularis) compared to the tunics of the rest of the GI tract.
4. Relate the anatomic specializations of the esophagus to the organ's functions.

## **7. Gross and microscopic anatomy of the stomach**

1. Identify and describe the gross anatomy of the stomach, including its location relative to other body structures.
2. Describe the general functions of the stomach.
3. Describe the specializations of the stomach tunics compared to the tunics of the rest of the GI tract.
4. Relate the anatomic specializations of the stomach tunics (e.g., number of layers of muscle in the muscularis) to the organ's functions.
5. Identify and describe the gastric glands, including their cells (e.g., parietal cells, chief cells).
6. Identify and describe the gross anatomic regions of the stomach (e.g., cardia, fundus, body, pylorus).
7. Describe the compositions, locations, and functions of the inferior esophageal (cardiac, lower esophageal) sphincter and the pyloric sphincter.
8. Identify gastric folds (rugae) and discuss their functional significance.

## **8. Gross and microscopic anatomy of the small intestine**

1. Identify the small intestine and describe its location relative to other body structures.
2. List the general functions of the small intestine.
3. Identify the specific segments of the small intestine (i.e., duodenum, jejunum, ileum), including their relative length.
4. Describe the anatomic specializations of the small intestine tunics (e.g., circular folds [plicae circulares], villi, microvilli) compared to the tunics of the rest of the GI tract.
5. Relate the anatomic specializations of the small intestine tunics (e.g., circular folds [plicae circulares], villi, microvilli) to the organ's functions.
6. Identify and describe the functions of the following small intestine structures: Duodenal glands (Brunner glands), Intestinal glands (crypts of Lieberkuhn), Peyer patches (lymphatic nodules).

## **9. Gross and microscopic anatomy of the large intestine, rectum, and anal canal**

1. Identify and describe the gross anatomy of the large intestine, rectum, and anal canal, including their locations relative to other body structures.

2. Identify the specific segments and related flexures of the large intestine.
3. Describe the general functions of the large intestine, rectum, and anal canal.
4. Describe the anatomic specializations of the large intestine tunics (e.g., composition of the muscularis) compared to the tunics of the rest of the GI tract.
5. Relate the anatomic specializations of the large intestine tunics (e.g., composition of the muscularis) to the organ's functions.
6. Compare and contrast the location, composition, and innervation (somatic versus autonomic) of the internal and external anal sphincters.

## **10. Gross and microscopic anatomy of the accessory digestive organs**

Liver:

1. Describe the general functions of the liver.
2. Identify and describe the structure of the liver, including the individual lobes, ligaments (e.g., coronary ligament, falciform ligament, round ligament [ligamentum teres]), and the porta hepatis.
3. Describe the location of the liver relative to other body structures.
4. Identify and describe the histological components of the classic hepatic lobule.

Gallbladder:

5. Identify and describe the structure and functions of the gallbladder.
6. Describe the location of the gallbladder relative to other body structures.

Pancreas:

7. Identify and describe the structure and functions of the pancreas.
8. Describe the location of the pancreas relative to other body structures.
9. Identify and describe the major histological components of the pancreas (pancreatic acini and pancreatic islets [islets of Langerhans]) and discuss their major functions.

Biliary Apparatus

10. Describe the major functions of the biliary apparatus.
11. Identify and describe the biliary apparatus components (i.e., left and right hepatic ducts, common hepatic duct, cystic duct, common bile duct, main pancreatic duct, hepatopancreatic ampulla [ampulla of Vater], hepatopancreatic sphincter [sphincter of Oddi], major duodenal papilla).
12. Trace the path of bile and pancreatic juice through the biliary apparatus.

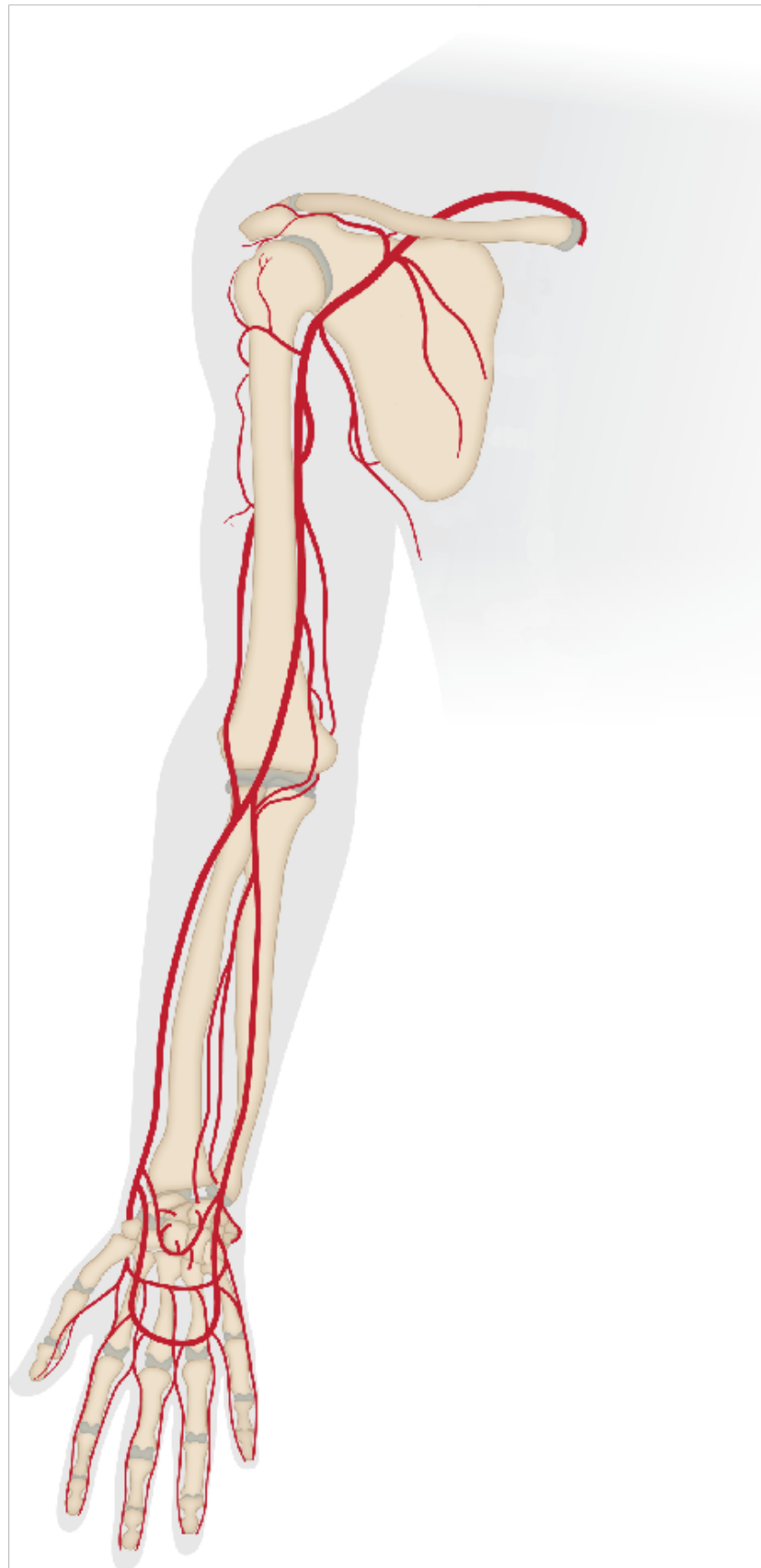


# Anatomy Learning Outcomes

MODULE P  
Urinary  
System



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## **HAPS Anatomy-only Learning Outcomes**

### **Module P: Urinary System**

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General functions of the urinary system**

1. Compare and contrast the functions of the kidney with the functions of the urinary tract (ureters, urinary bladder, and urethra)
2. Define the terms *filtration*, *reabsorption*, and *secretion*.

#### **2. Gross and microscopic anatomy of the kidney**

1. Identify and describe the external structure of the kidney, including its coverings, the renal hilum and renal sinus, and identify all structures included in the renal sinus.
2. Identify and describe the internal divisions of the renal tissue, including cortical and medullary structures.
3. Distinguish histologically between the renal cortex and the renal medulla.
4. Trace the path of blood flow through the kidney, from the descending abdominal aorta and renal artery to the renal vein and inferior vena cava.
5. Identify and describe the structure of a typical nephron, including the renal corpuscle (i.e., glomerular [Bowman's] capsule and glomerulus), renal tubule (i.e., proximal convoluted tubule, nephron loop [loop of Henle], and distal convoluted tubule).
6. Compare and contrast cortical nephrons and juxtamedullary nephrons.
7. Identify and describe the vascular elements associated with the nephron (i.e., afferent and efferent arterioles, glomerulus, peritubular capillaries, vasa recta).
8. Trace the flow of filtrate from the renal corpuscle to the collecting duct.
9. Identify the location, structures, and cells of the juxtaglomerular apparatus and discuss its significance.

#### **3. Gross and microscopic anatomy of the urinary tract (i.e., ureters, urinary bladder, urethra)**

1. Identify and describe the gross anatomy and location of the ureters, urinary bladder, and urethra.
2. Identify and describe the microscopic anatomy of the ureters, urinary bladder, and urethra.
3. Compare and contrast the anatomy of the male urethra versus the female urethra.
4. Compare and contrast the locations, innervation, and functions of the internal urethral sphincter and external urethral sphincter.
5. Trace the path of urine from the collecting duct of the kidney through the external urethral orifice.

#### **4. Urination (micturition)**

1. Describe the process of urination (micturition) and the role of the autonomic nervous system in urination.
2. Describe voluntary and involuntary neural control of urination.

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# Anatomy Learning Outcomes

MODULE R  
Reproductive  
System



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# **HAPS Anatomy-only Learning Outcomes**

## **MODULE R: Reproductive System**

### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

#### **1. General anatomy of the male and female reproductive systems**

1. Compare and contrast the major anatomy of the male and female reproductive systems.
2. Identify male and female homologues of various reproductive system structures (e.g., ovary is homologous to the testis).

#### **2. Gross and microscopic anatomy of the male reproductive system**

1. Identify and describe the gross anatomy, microscopic anatomy, and functions of the testes.
2. Identify and describe the gross anatomy, microscopic anatomy, and functions of the epididymis.
3. Identify and describe the structure and functions of the spermatic cord and male reproductive ducts (e.g., ductus [vas] deferens, ejaculatory duct, urethra).
4. Identify and describe the structure and functions of accessory glands (i.e., seminal glands [seminal vesicles], prostate gland, bulbourethral [Cowper] glands).
5. Identify and describe the structure and functions of the male external genitalia (e.g., scrotum, penis).
6. Describe the pathway of sperm from the seminiferous tubules to the external urethral orifice of the penis.
7. Describe the production, composition, and functions of semen.

#### **3. Gross and microscopic anatomy of the female reproductive system**

1. Identify and describe the gross anatomy, microscopic anatomy, and functions of the ovaries.
2. Identify and describe the gross anatomy, microscopic anatomy, and functions of the uterus and uterine (fallopian) tubes.
3. Identify and describe the ligaments of the female reproductive system (e.g., broad ligament, ovarian ligament, suspensory ligament of the ovary, round ligament of the uterus).
4. Identify and describe the structure and function of the vagina.
5. Identify and describe the structure and functions of the external genitalia (e.g., mons pubis, labia majora, labia minora, clitoris, greater vestibular glands).
6. Identify and describe the structure and functions of the mammary glands.
7. Describe the pathway of the oocyte from the ovary to the uterus.

#### **4. Spermatogenesis and spermiogenesis**

1. Define the processes of spermatogenesis and spermiogenesis.
2. Describe the stages of spermatogenesis in the seminiferous tubule.

#### **5. Oogenesis, folliculogenesis, and the ovarian cycle**

1. Define the process of oogenesis (oocyte development).

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2. Describe the stages of folliculogenesis (ovarian follicle development) during a typical ovarian cycle.
3. Define *ovulation*.
4. Describe a typical ovarian cycle and explain how the process of folliculogenesis spans multiple ovarian cycles.

#### **6. Comparison of male and female gametogenesis**

1. Compare and contrast the timing and number of oocytes produced in oogenesis and spermatogenesis.

#### **7. Uterine (menstrual) cycle**

1. Name the phases of the uterine (menstrual) cycle, and describe the anatomical changes in the uterine wall that occur during each phase.
2. Describe the correlation between the uterine and ovarian cycles.



# Anatomy Learning Outcomes

MODULE T

Embryology



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## **HAPS Anatomy-only Learning Outcomes**

### **MODULE T: Embryology**

\*Note: HAPS recognizes that there is a great deal of variability in length and depth of coverage of embryology. The learning outcomes listed below are for those courses that include an embryology component in their human anatomy class. Due to the variability in coverage, the HAPS Anatomy exam does not ask any questions about the embryology topics listed below.

#### **Topic from HAPS Guidelines (in bold font)**

Learning Outcomes (indented, in regular font)

##### **1. Timeline of human development**

1. Define the pre-embryonic period, embryonic period, and fetal period, and describe the main events that occur in each period.

##### **2. Conception through week 2 (bilaminar germinal disc)**

1. Describe the process and events of fertilization.
2. Describe the changes that occur from zygote to morula to blastocyst.
3. Discuss the timing and importance of cleavage.
4. Compare and contrast the locations and end fates of the embryoblast (inner cell mass) and the trophoblast of the blastocyst.
5. Explain the process and timing of implantation.
6. Describe the process by which the embryoblast transforms into a bilaminar germinal disc.
7. Describe the formation and functions of the extraembryonic membranes (i.e., amnion, yolk sac, allantois, chorion).
8. List the maternal and fetal components of the placenta.

##### **3. Embryonic period**

1. Define the process and timing of gastrulation.
2. Identify the three primary germ layers resulting from gastrulation, and the major structures formed from each primary germ layer.
3. Define *organogenesis*.
4. Define *neurulation* and state when this process occurs.
5. Describe how a neural plate is transformed into a neural tube, and explain how neural crest cells are formed.
6. Compare and contrast the adult fates of the neural tube and the neural crest cells.
7. Describe the processes of craniocaudal and lateral folding of the embryo.

##### **4. Fetal period**

1. Describe the major events of the fetal period.