

STRUCTURE OF THE HUMAN BODY 2009

Behavioral Learning Objectives

I. Preliminary SHB Behavioral Learning Objectives

The following objectives will be accomplished during the MCBG course preceding the Structure of the Human Body course:

1. Distinguish between regional and systemic approaches to learning anatomy.
2. Describe the fundamental descriptive characteristics of the cardiovascular, respiratory, integumentary, musculoskeletal, and nervous systems.
3. Define the term "clinical anatomy" and give an example.
4. Describe the anatomical position.
5. List the anatomical planes.
6. List the terms used to describe positional relationships in the body.
7. Define terms of laterality and movement for the head and neck, thorax, limbs, and spine.
8. Describe the difference(s) between anatomical variation and pathology
9. Define the terms dissection, prosection, visualization, and imaging.
10. Define the fundamental differences between radiography, computerized tomography, magnetic resonance, and ultrasonography as imaging techniques
11. Discuss how two dimensional representations of an anatomical region can be interpreted by a cross-section of the same region
12. Describe how muscles act across joints, and what is meant by origin and insertion.
13. Define a nerve plexus.
14. Define the terms innervation and anastomosis.
15. Describe the major body cavities.
16. List terms and their meanings for movements.

Relevant Integrated Learning Objectives from MCBG:

1. Describe the serous epithelial surfaces that line the pleural, pericardial, and abdominopelvic cavities.
2. Describe the histological structure of dense regular connective tissue (e.g. a tendon, ligament, bone) and give a gross anatomy example of each.
3. Describe the histology of skin and its innervation and blood supply.

II. Comprehensive SHB Behavioral Learning Objectives

The following objectives will be accomplished during the Structure of the Human Body course:

For each region, the student should be able to:

1. Identify the individual structures using accepted anatomical terminology and describe each structure for its:
 - size, extent, and composition
 - position relative to adjacent structures
 - functional properties
 - interrelationships between structures within the region
2. Identify individual structures as represented in cross-sections and describe the cross-sectional relationships in the region.
3. Identify anatomical variations within the region as compared to textbook and atlas "standard" representations.
4. Describe specific congenital anomalies that might occur in the region on the basis of the embryology objectives for this course.
5. Describe the embryological basis of adult form for the region.
6. Identify the region's structures in radiological images.

A. Back, Dorsal Neck and Vertebral Column

1. Describe the main anatomical features of a typical vertebra. Identify the atlas, axis, typical cervical, thoracic, lumbar vertebrae and sacrum and recognize their characteristic features.
2. Describe the structures, regions and functions of the vertebral column. Describe the range of movement of the entire vertebral column and its individual regions.
3. Describe the anatomy of intervertebral facet joints and intervertebral discs. Explain the role of the discs in weight-bearing by the vertebral column and describe how disc herniation may impinge upon spinal nerve roots and /or the spinal cord.
4. Describe the anatomy of a spinal nerve (e.g. as exemplified by a thoracic spinal nerve, including its origin from dorsal and ventral spinal roots, its main motor and cutaneous branches and any autonomic component.
5. Identify the principal muscle groups and the major longitudinal ligaments of the vertebral column and discuss their functional role in stability and movement of the vertebral column.
6. Describe the anatomical relationships of the meninges to the spinal cord and dorsal and ventral nerve roots. Describe the anatomy of lumbar puncture.
7. Describe the superficial back muscles.
8. Describe the dorsal region of the neck including the suboccipital triangle.

9. Describe the nerves and blood supply to the back and dorsal region of the neck.
10. Interpret standard diagnostic images of the vertebral column.

B. Upper Limb

1. Describe and demonstrate the main anatomical landmarks of the clavicle, scapula, humerus, radius and ulna. Identify the carpal, metacarpal and phalanges of the wrist and hand and their relative positions.
2. Describe the close relations of the bones and joints (e.g. bursae, blood vessels, nerves ligaments and tendons), which may be injured by fractures or dislocation.
3. Describe the fascial compartments delimiting the major muscle groups of the upper limb. Explain the functional importance of those compartments and their contents.
4. Describe the origin, course and distribution of the major arteries and their branches that supply the shoulder, arm and forearm in relation to common sites of injury. Explain the importance of anastomoses between branches of these arteries at the shoulder and elbow.
5. Demonstrate the sites at which pulses in the brachial, radial and ulnar arteries may be located.
6. Describe the courses of the main veins of the upper limb; contrast the functions of the deep and superficial veins. Identify the site of phlebotomy and arterial blood gas concentration sampling.
7. Describe the organization of the brachial plexus, its origin in the neck and continuation to the axilla and upper limb.
8. Describe the origin, course and function of the axillary, radial, musculocutaneous, median and ulnar nerves in the arm, forearm, wrist and hand. Name the muscles these nerves supply as well as their sensory distribution. Predict the consequences of injury to these nerves.
9. Describe the boundaries of the axilla. List its contents, including the major vessels and parts of the brachial plexus.
10. Describe the movements of the pectoral girdle: identify the muscles responsible for its movements and summarize their main attachments and motor nerve supply.
11. Describe the muscles and ligaments that contribute to the stability of the shoulder joint and explain the anatomy of a dislocated humeral head.
12. Describe the anatomy of the elbow joint. Demonstrate the movements of flexion and extension, identify the muscles responsible for these movements and summarize their main attachments and motor nerve supply.
13. Explain the movements of supination and pronation; identify the muscles responsible for these movements and summarize their main attachments and motor nerve supply.
14. Describe the anatomy of the wrist and articulations of the radius and ulna with the carpal bones. Describe and demonstrate movements at the wrist and identify the muscle groups responsible for the movements. Describe the relative positions of the tendons, vessels and nerves at the wrist.

15. Name and demonstrate the movements of the fingers and thumb. Describe the position, function and nerve supply of the muscles and tendons involved in these movements, differentiating between those in the forearm and those intrinsic to the hand.
16. Describe the vascular supply to the hand.
17. Describe the position and function of the retinacula of the wrist and the tendon sheaths of the wrist and hand. Explain carpal tunnel syndrome and the spread of infection in tendon sheaths.
18. Describe the functional consequences of injuries to the axillary, musculocutaneous, radial, median and ulnar nerves.
19. Explain the loss of function resulting from injuries to the roots and trunks of the brachial plexus.
20. Describe the anatomical basis of the assessment of cutaneous sensation in the dermatomes of the upper limb.
21. Describe the elbow joint and its major ligaments.
22. Identify the anatomical features of standard diagnostic images of the upper limb.

C. Thorax

1. Demonstrate the main anatomical landmarks of the thoracic vertebrae, ribs and sternum.
2. Describe the anatomy of the joints between the ribs and vertebral column, the ribs and costal cartilages and the costal cartilages and sternum. Explain the movements made at those joints during respiration.
3. Describe how the boundaries of the superior and inferior thoracic apertures are formed by the vertebrae, ribs, costal cartilages and sternum.
4. Describe the surface projection, attachments and relationships of the diaphragm and the structures that pass through it. Explain the movements it makes during respiration and the motor and sensory nerve supply to it and its pleural and peritoneal coverings.
5. Explain the anatomy of the intercostal muscles. Describe a neurovascular bundle in a typical intercostal space and outline the structures its components supply.
6. Describe the pectoral musculature, vessels and nerves.
7. Describe the anatomy of the breast, axillary lymph nodes and importance of lymphatic drainage of the breast.
8. Demonstrate the surface markings of the heart and great vessels, the margins of the pleura and the lobes and fissures of the lungs.
9. Summarize the anatomy of the bronchial tree.
10. Describe the blood and nerve supply and lymph drainage of the lungs. Describe the structures in the hilum and the mediastinal relations of each lung.
11. Describe the arrangement and contents of the superior, anterior, middle and posterior parts of the mediastinum.
12. Identify the major anatomical features of each chamber of the heart and septa that separate them and explain their functional significance.

13. Describe the structure and position of the atrioventricular, pulmonary and aortic valves.
14. Describe the origin, course and main branches of the left and right coronary arteries and the coronary sulcus and interventricular sulci.
15. Describe the coronary veins.
16. Identify the location of the SA and AV nodes. Understand the anatomical course of the spread of excitation through the chambers of the heart.
17. Demonstrate the arrangement of the fibrous and serous layers of the pericardium.
18. Describe the course of the ascending aorta, the arch of the aorta and the descending thoracic aorta. Name their major branches and the structures they supply.
19. Describe the origins, course and relationships of the brachiocephalic veins, inferior and superior venae cavae and the azygos venous system.
20. Describe the origin, course and distribution of the vagus nerve and its branches and the phrenic nerves on both the right and left sides of the thorax.
21. Describe the composition and function of the sympathetic chains and splanchnic nerves.
22. Describe the course and major relations of the esophagus within the thorax.
23. Describe the course and major relations of the thoracic duct and explain its function.
24. Demonstrate the surface markings of the heart and the position and site of auscultation of the four major valves.
25. Identify major structures on standard diagnostic images of the thorax.

D. Abdomen

1. Demonstrate the surface projections of the abdominal organs and identify the palpable viscera.
2. Demonstrate the descriptive regions of the abdomen.
3. Describe the anatomy, innervation and functions of the muscles of the anterior and posterior abdominal walls.
4. In relation to direct and indirect inguinal hernias, demonstrate the anatomy of the attachments of the inguinal ligament, the anatomy of the superficial and deep inguinal rings and how the anterior abdominal wall muscles form the inguinal canal. Describe the contents of the inguinal canal in both males and females.
5. Describe the relationship between the femoral canal and the inguinal ligament and the anatomy of femoral hernias.
6. Describe the arterial and venous supply to the liver, pancreas, spleen, kidneys, stomach, duodenum, jejunum and ileum of the small intestine, cecum, appendix, ascending, transverse, descending and sigmoid parts of the colon and the rectum.
7. Describe the organization of the parietal and visceral peritoneum, its lesser and greater sacs, mesenteries and peritoneal ligaments.
8. Describe the terms intraperitoneal and retroperitoneal.
9. Summarize the anatomy of the small bowel mesentery, its structure, location and vascular, lymphatic and neural content.

10. Describe the abdominal portion of the sympathetic nervous system and the lumbar plexus.
11. Describe the functional anatomy of the stomach, its position, portions, sphincters, blood and nerve supply and key relations to other abdominal organs.
12. Describe the duodenum, its portions, position, secondary retroperitoneal attachment, blood supply and key relations with other abdominal organs.
13. Describe the regions of the small and large intestine, including the anatomy of the appendix.
14. Describe the position and form of the pancreas and its relationships to other abdominal organs.
15. Describe the position of the liver, the lobes and their key anatomical relations. Explain the peritoneal reflections of the liver. Summarize the anatomy of the portal vein, the portal venous system and portal-systemic anastomosis and its significance.
16. Describe the gall bladder and bile ducts.
17. Describe the position and form of the kidneys and ureters. Demonstrate their relationships to other abdominal and pelvic structures.
18. Describe the relations of the suprarenal (adrenal) glands, their nerve and blood supply.
19. Describe the position (in relation to the ribs) and form of the spleen in relation to its palpation through the abdominal wall. Explain the significance of its anatomical relationships in relation to trauma to the abdomen.
20. Describe the origins, course and major branches of the abdominal aorta, celiac axis, superior and inferior mesenteric arteries, the renal and gonadal arteries. Describe the origins, course and major tributaries of the inferior vena cava.
21. Describe the anatomy of the lymph nodes involved in lymph drainage of abdominal viscera and its significance in relation to spread of malignancy.
22. Interpret standard diagnostic images of the abdomen.

E. Pelvis

1. Describe the bones, ligaments and foramina of the pelvis, and the anatomy of the pelvic inlet and outlet. Identify structures passing through each foramen.
2. Demonstrate the palpable anatomical landmarks of the iliac, ischial and pubic bones.
3. Describe the sacral plexus and its principal branches and the pelvic autonomic nerves.
4. Describe the pelvic floor musculature and the structures passing through it in males and females.
5. Describe the anatomy of the urinary bladder, its base and ureteric openings. Explain how its position changes with filling and its relationship to the overlying peritoneum.
6. Describe the anatomy of the urethra; explain the anatomy of its different parts in males and females.

7. Describe the innervation of the bladder and its sphincters and the mechanism of micturition.
8. Describe the anatomy of the scrotum, testis, epididymis including blood supply and innervation.
9. Describe the structure and course of the spermatic cord and vas deferens.
10. Describe the anatomy of the prostate gland, seminal vesicles and their anatomical relations. Describe the position of the prostate and relationship to the rectum.
11. Describe the position and form of the ovary, uterine tubes, uterus, cervix and vagina and their anatomical relationships, including peritoneal coverings.
12. Describe the origin, course and relations of the uterine, ovarian and testicular arteries and veins.
13. Describe the origin, course and branches of the pudendal nerve.
14. Describe the perineum in the male and female. Explain the anatomy of the urogenital membrane and deep and superficial perineal pouches.
15. Describe the anatomy of the sigmoid colon and rectum and their anatomical relationships and peritoneal coverings. Explain the anatomy of the anal canal and the functional anatomy of the anal sphincters and their innervation.
16. Describe the blood supply and venous drainage of the distal bowel, the arterial supply from the superior, middle, and inferior rectal arteries, and portal-systemic venous anastomosis.
17. Describe the anatomy of the ischio-rectal (ischio-anal) fossa and its contents.
18. Describe the structure of the penis, scrotum and its contents, the clitoris and vulva. Describe the arterial supply to and venous drainage from the penis.
19. Describe the external and internal iliac arteries and the branches of the internal iliac artery.
20. Identify the structures through which a Foley catheter will pass in the male and female.
21. Interpret standard diagnostic images of the pelvis.

F. Lower Limb

1. Recognize the major features and surface landmarks of the femur, tibia, fibula, and bones of the ankle and foot.
2. Identify and describe the muscles of the thigh and leg.
3. Describe the close relations of the blood vessels, nerves, ligaments and tendons which may be injured in fractures or dislocations at the hip, knee and ankle.
4. Describe the fascia and the compartments they invest for the major muscle groups of the thigh and leg.
5. Demonstrate the origin, course and branches of the major arteries that supply the hip and gluteal region, thigh, leg, ankle and foot. Describe the anastomoses between branches of these arteries at the hip and knee.
6. Demonstrate the locations at which the femoral, popliteal, dorsalis pedis and posterior tibial pulses can be felt.
7. Demonstrate the course of the principal veins of the lower limb.

8. Describe the origin of the lumbosacral plexus and the formation of its major branches to the lower limb.
9. Describe the origin, course and function of the sciatic, femoral, obturator, common peroneal and tibial nerves, sural and saphenous nerves and summarize the muscles that each supplies as well as their sensory distribution.
10. Describe the structure and movements of the hip joint. Summarize the muscles responsible for these movements, their innervation and main attachments.
11. Describe the structures responsible for stability of the hip joint and their relative contribution to maintaining the lower limb in different positions.
12. Describe the neural and vascular structures at risk from a fracture of the femoral neck or dislocation of the hip.
13. Describe the boundaries of the femoral triangle and the anatomical relationships of the femoral nerve, artery, vein and lymph nodes to each other and to the inguinal ligament.
14. Describe the anatomy of the gluteal region and the course of the sciatic nerve within it.
15. Describe the structure and movements of the knee joint. Summarize the muscles responsible for these movements, their innervations and attachments.
16. Describe the menisci and knee ligaments.
17. Describe the boundaries and contents of the popliteal fossa.
18. Describe the anatomy of the ankle joint. Explain the movements of flexion, extension, plantarflexion and dorsiflexion. Summarize the muscles responsible for these movements, their innervation, attachments and blood supply.
19. Describe the major ligaments responsible for stability of the ankle joint.
20. Describe the arches of the foot and the ligaments and muscles that maintain them.
21. Describe the movements of inversion and eversion at the ankle, the muscles responsible, their innervation, blood supply and main attachments.
22. Describe the intrinsic muscles of the foot, their nerve and vascular supply.
23. Describe the dermatomes of the lower limb.
24. Interpret standard diagnostic images of the lower limb.

G. Head and Neck

1. Demonstrate the position, palpable and imaging landmarks of the major bones of the skull. Demonstrate the palpable position of the hyoid bone, thyroid and cricoid cartilages, lateral mass of the atlas and the spine of C7.
2. Describe the boundaries, walls and floors of the cranial fossae.
3. Identify the external and internal features of the cranial foraminae and list the structures that each transmits.
4. Identify the boundaries of the triangles of the neck and list their contents..
5. In the posterior triangle, demonstrate the route of the spinal accessory nerve, the roots and trunks of the brachial plexus, the external jugular vein and subclavian vessels.

6. In the anterior triangle, demonstrate the position of the common, internal and external carotid arteries, the internal jugular vein and vagus nerve, the trachea, thyroid cartilage, larynx, thyroid and parathyroid glands.
7. Describe the location and anatomical relations of the thyroid and parathyroid glands, their blood supply and the significance of the courses of the laryngeal nerves.
8. Demonstrate the origin, course and branches of the external carotid artery and locate the carotid pulse.
9. Describe the courses of the vagus and phrenic nerves from their origins to the thoracic outlet.
10. Identify the major structures passing between the neck and the thorax. Describe the courses and important relationships of the subclavian arteries and veins.
11. Describe the anatomy of the scalp, naming its layers and blood supply.
12. Demonstrate the extracranial course of the branches of the facial nerve.
13. Describe the intracranial and intrapetrous course of the facial nerve and the relationships of its major branches to the middle ear in relation to damage of the nerve within the facial canal.
14. Describe the anatomy of the temporo-mandibular joint. Explain the movements of the mandible and describe the muscles involved including their innervation.
15. Describe the origin, function and major branches of the sensory and motor components of the trigeminal nerve and their pathways.
16. Describe the origins and summarize the courses, major branches and pathways of the facial and maxillary arteries, including the course and intracranial relations of the middle meningeal artery and its significance in extradural hemorrhage.
17. Describe the infratemporal fossa and pterygopalatine fissure and their contents.
18. Describe the key anatomical relations of the parotid, submandibular and sublingual salivary glands, the course of their ducts into the oral cavity and their autonomic secretomotor innervation.
19. Describe the functional anatomy of the tongue, including its motor and sensory innervation and the role of the extrinsic and intrinsic muscles. Explain the deviation of the tongue after hypoglossal nerve injuries.
20. Describe the anatomical arrangement and functional significance of the lymphoid tissue in the tonsils, pharyngeal, and posterior nasal walls.
21. Describe the muscles that compose the pharyngeal walls and move the soft palate; summarize their functions and nerve supply.
22. Describe the hyoid bone and cartilages of the larynx.
23. Describe the intrinsic and extrinsic laryngeal muscles responsible for closing the laryngeal inlet, controlling vocal cord position and tension.
24. Describe the origin, course and functions of the motor and sensory nerve supply of the larynx.
25. Describe the fascia of the muscular and visceral portions of the neck.
26. Describe the location, actions and nerve supply of the intrinsic and extra-ocular muscles.
27. Describe the anatomy of the eyelids, conjunctiva and lacrimal glands.

28. Describe the functional anatomy of the external auditory meatus, tympanic membrane, ear ossicles and auditory tube, together with their major anatomical relations.
29. Describe the bones of the nasal cavity and the major features of the lateral wall of the nasal cavity. Describe the major arteries and nerves that supply the lateral wall and nasal septum.
30. Name the paranasal sinuses, describe their relationships to the nasal cavities and sites of drainage on its lateral wall and explain their innervation.
31. Describe the arrangement of the dura mater, and its main reflections within the cranial cavity and their relationship to the major venous sinuses and the brain itself.
32. Describe the arrangement of the venous sinuses of the cranial cavity; explain the entrance of cerebral veins into the superior sagittal sinus in relation to subdural haemorrhage, and how connections between sinuses and extracranial veins may permit intracranial infection
33. Identify the contents (brain) of the anterior, middle and posterior cranial fossae.
34. Describe the major sutures of the skull and name their points of articulation.
35. Describe the relationship of the scalene muscles to the subclavian artery and vein and the course of the phrenic nerve and roots of the brachial plexus.
36. Demonstrate the positions of the external and internal jugular veins and the surface landmarks that are used when inserting a central venous line.
37. Describe the arrangement of the lymphatic drainage of the head and neck and the major groups of lymph nodes.
38. Interpret standard diagnostic images of the head and neck.

SHB Radiology Behavioral Learning Objectives

The following objectives address the correlation between the anatomy seen upon dissection and radiological images of the structures and regions.

It is expected that students will be able to interpret radiological images (using plain film and cross-sectional techniques i.e. computerized tomography, magnetic resonance) of the structures identified in cadaver dissection. The following objectives are the expectations for identification of gross anatomical structures.

The images in support of these objectives are available on LUMEN.

http://www.stitch.luc.edu/lumen/MedEd/Radio/curriculum/radiology-curric1_f.htm

Describe the radiological images of the spine:

1. atlas and odontoid
2. lower cervical spine
3. thoracic spine
4. lumbar spine
5. sacrum and coccyx

Describe the radiological images of the upper extremity:

1. shoulder
2. elbow
3. wrist
4. hand
5. humerus
6. radius and ulna
7. scapula

Describe the radiological images of the head:

1. cranium
2. nasal sinuses
3. pharynx
4. larynx

Describe the radiological images of the thorax:

1. ribs
2. sternum
3. clavicle
4. lungs
5. trachea and bronchi
6. pleural recesses and mediastinum
7. heart chambers
8. great vessels at the heart base and in the posterior mediastinum
8. esophagus
9. coronary arteries of the heart
10. inferior vena cava and pulmonary vessels

Describe the radiological images of the abdomen:

1. stomach, small and large intestine
2. bile passages
3. pancreas
4. liver
5. spleen
6. kidneys, ureters, urinary bladder and urethra
7. aorta and vena cava
8. celiac, superior and inferior mesenteric and renal arteries
9. portal, renal and splenic veins

Describe the radiological images of the pelvis and lower extremity:

1. pelvis
2. hip
3. knee
4. ankle
5. foot
6. femur
7. tibia and fibula
8. bladder and urethra

III. Curricular Integration of SHB Behavioral Learning Objectives

The following objectives support the integration of knowledge after completion of the Structure of the Human Body course.

Students will meet objectives in the following factual and conceptual areas and will be able to integrate this knowledge into subsequent basic science and clinical course material.

General

1. For each area correctly use anatomical terminology for relevant body planes, articulations, positions and movements.
2. For each area describe the surface anatomy for underlying structures.

Back and Vertebral Column

1. Name the skeletal elements of the vertebral column and identify the characteristics of vertebrae at the cervical, thoracic, lumbar, and sacral levels.
2. Describe the meninges of the spinal cord and the location of cerebrospinal fluid.
3. Describe a spinal nerve and the dorsal and ventral primary rami.
4. Describe the anatomy of autonomic outflow from cranial-sacral and thoracolumbar levels.
5. Name the collective group of muscles and ligaments responsible for maintaining spinal alignment and upright posture. Identify the curvatures of the spine.
6. Describe the craniovertebral joints and the nerve and vessel arrangements in the suboccipital region.
7. Describe an intervertebral disc.
8. Name the superficial muscles of the back and their innervation.
9. Identify the dermatomes of the head, neck and back.
10. Describe an intervertebral foramen and its boundaries and contents.
11. Diagram the course of the vertebral artery in the cervical region.
12. Identify key structures in radiologic images of the spine.

Upper Limb

1. Describe the shoulder joint, the glenohumeral articulation, muscles of the rotator cuff, and movements at the shoulder joint.
2. Identify the location of the subacromial and subdeltoid bursae.
3. Describe the elbow joint and the route of the ulnar, median and radial nerves across the elbow joint.
4. Describe the common tendon origin of major flexor and extensor muscles at the level of the medial and lateral humeral epicondyles
5. Describe movements of the hand at the wrist.
6. Name the carpal bones and their relative positions; identify the carpal bones articulating at the distal radioulnar joint.
7. Describe the compartmentalization of the flexor tendons in the wrist and hand.
8. Identify the contents of the carpal tunnel.
9. Describe the axillary artery and identify the level of its bifurcation to the radial and ulnar arteries; list the major branches of the subclavian and axillary arteries and their distribution.
10. Identify the collateral routes of circulation for the shoulder and elbow joints.
11. Identify the veins of the cubital fossa and clavicular region that are used clinically.
12. Name the three cords of the brachial plexus and list the nerves arising from them.
13. Describe the dermatomes of the upper limb and the areas of sensory distribution for C5-T1.
14. Describe the distribution of the ulnar, median and radial nerves above the wrist.
15. Identify the motor and sensory distribution of the ulnar and median nerves in the hand.
16. List the intrinsic muscles of the hand and describe their functions.
17. Identify key structures in radiologic images of the upper limb.

Thorax

1. Define the boundaries of the thorax.
2. Describe a rib, its articulations and the intercostal space and its contents.
3. Describe the sternum and the vessels subjacent to it.
4. Identify the vessels and nerves passing above the first rib. Locate the clavicle in relationship to the major vessels and nerves at the root of the neck.
5. Outline the position of the diaphragm during inspiration and expiration. Name the apertures of the diaphragm and their contents.
6. Describe the innervation of the diaphragm and the anatomical course taken by the phrenic nerve.
7. Identify the scalene muscles and their attachment to the first rib.
8. Define the mediastinum and the contents of mediastinal regions.
9. Describe the breast in relation to underlying pectoral musculature, and its vessels, nerves, and lymphatic supply.

10. Describe the position of the heart and great vessels in relation to the ribs and sternum. Identify the surface projection of heart sounds.
11. Describe the superior mediastinum and the positions of major neurovascular structures including the vagus nerve, sympathetic chain, arteries arising from the aortic arch, the jugular system.
12. Identify the course taken by the subclavian artery and vein as it passes to the subclavian region and across the first rib.
13. Describe the trachea and esophagus at the root of the neck.
14. Name the branches of the thoracic aorta.
15. Describe the azygos venous system and its role in paracaval venous return to the heart.
16. Describe the sympathetic chain and its connections in the thorax. Include in your description the sympathetic supply to the heart and lungs.
17. Identify the surface projection of the lungs and pleura, and name the recesses of the parietal pleura.
18. Name the lobes of the right and left lung and describe the hilum. Describe the course of the main bronchi from the bifurcation to the hilum.
19. Identify the position of the tracheal bifurcation on the surface of the thorax.
20. Describe the pericardium and its parietal attachments at the base of the heart.
21. Identify the surface projection of the heart onto the thorax including the apex.
22. Describe the flow of blood through the heart chambers.
23. Describe the heart valves, interatrial and interventricular septae, and the internal conduction of impulses.
24. Describe the coronary arteries and veins and identify which myocardial regions they supply.
25. Name the remnant structures of fetal circulation.
26. Describe the course of the esophagus and vagus nerve through the posterior mediastinum.
27. Describe lymphatic drainage of the heart and lung. Include in your description the course of the thoracic duct.
28. Identify key structures in radiologic images of the lung and heart.

Abdomen

1. Identify the boundaries of the abdomen.
2. Define the anterior abdominal regions used for clinical examination and procedures.
3. Describe the surface anatomy of the abdomen relative to underlying viscera.
4. Describe the superficial inguinal ring location and its contents in males.
5. Describe the attachments of the muscles of the anterior abdominal wall to the rectus sheath, pelvis, and ribs.
6. Describe the dermatome pattern of the anterior abdominal wall.
7. Describe the liver and gall bladder and the course of the bile duct to the duodenum.
8. Describe the pancreas and spleen and their mesenteric attachments.

9. Define the terms intraperitoneal and retroperitoneal.
10. Name the vessels of the celiac trunk that provide arterial supply to the stomach, liver, pancreas, duodenum and spleen.
11. Describe the portal vein and portal circulation.
12. Name the principle autonomic ganglia of the abdomen and give their locations.
13. Describe the superior, inferior mesenteric arteries and gonadal arteries relative to the viscera they vascularize.
14. Identify the position of the spleen and kidneys on the surface of the body.
15. Describe the course of the ureters from the renal pelvis to the urinary bladder.
16. Identify the surface projection of the cecum and appendix.
17. Describe the greater omentum and the root of the mesentery of the small intestine.
18. Describe the visceral and parietal peritoneum and define the location of abdominopelvic recesses.
19. Identify the level of the renal arteries and veins.
20. Describe the kidney, its fascia, the location and vascularization of the adrenal gland, and the autonomic innervation of both.
21. Describe the location of the cardiac and pyloric sphincters.
22. Describe the lumbar plexus
23. Identify key structures in radiologic images of the abdomen.

Pelvis

1. Define the anatomical boundaries of the true and false pelvis.
2. Name the viscera of the pelvis and describe the relative position of the bladder, uterus and rectum in the female; identify recesses (pouches) anterior and posterior to the uterus.
3. Describe the rectum and its transition zone between portal and systemic circulation.
4. Describe the lumbar and sacral plexuses and describe the course in the pelvis for the lateral femoral cutaneous, femoral, and obturator nerves.
5. Describe the course of the gluteal, sciatic, posterior femoral cutaneous, and pudendal nerves in the pelvis.
6. Describe the anal canal and vascular basis of hemorrhoid formation.
7. Describe the ovary and Fallopian tube and their ligaments.
8. Describe the path of testicular descent through the deep inguinal ring into the scrotum; list the representative coverings of the testis derived from layers of the abdominal wall.
9. Describe the position of the prostate gland relative to adjacent structures.
10. Identify the level of bifurcation of the aorta to the common iliacs.
11. Describe the lymphatics of the inguinal region.
12. Describe the pelvic floor.
13. Describe the external genitalia of the male and female including their sensory nerve supply.
14. Identify key structures in radiologic images of the pelvis.

Lower Limb

1. Describe the passage of the external iliac artery and vein into the femoral triangle and list the medial to lateral relationships of the femoral vein, artery and nerve.
2. List the muscles innervated by the femoral nerve, and tibial and peroneal divisions of the sciatic nerve.
3. Describe the dermatomes of the lower limb.
4. Describe the course taken by the femoral artery in the thigh and leg.
5. Identify the location of pulse points in the thigh and foot; name the artery for each pulse point.
6. Describe the knee joint and the cruciate, lateral and medial collateral ligaments.
7. Name the muscles acting across the hip joint and describe their actions.
8. Name the muscles acting across the knee joint.
9. Identify the roots of the sacral plexus that contribute to formation of the sciatic, obturator, and femoral nerves.
10. Describe the tibio-talar articulation.
11. Describe the ligaments that maintain the arches of the foot.
12. Identify the tarsal bones and describe their relative positions.
13. Name the tendons that pass medial and/or lateral to the malleolus of the tibia and malleolus of the fibula.
14. Describe the relationship of the common peroneal nerve to the head of the fibula.
15. Describe the Achilles' tendon and its function.
16. Describe the deltoid ligament and its function.
17. List the intrinsic muscles of the foot and their actions.
18. Describe the femur.
19. Describe the formation of the femoral and long saphenous veins and identify the point of anastomosis of the long saphenous vein in the femoral triangle.
20. Describe the lymphatic drainage of the lower limb.
21. Describe the action of the gluteal muscles in walking.
22. Identify the vessels and nerves contained in the popliteal fossa.
23. Identify key structures in radiologic images of the lower limb.

Head and Neck

1. Name the bones of the head and face, including bones of the orbit.
2. Identify the regions of trigeminal nerve sensory innervation of the head.
3. Describe the distribution of the facial nerve.
4. Locate the surface representation of the coronal, sagittal, lambdoid, and temporal bones and name the sutures that define their boundaries.
5. Describe the mandible and the muscles of mastication and their nerve supply.
6. Describe the relationship of the external acoustic meatus to the temporomandibular joint.
7. Name the skull base foramina for the cranial nerves, jugular veins, and carotid arteries.

9. Describe the neurovascular and muscular contents of the orbital cavity including the extraocular muscles and their actions and motor nerves, the ophthalmic division of the trigeminal nerve, and the distribution of the ophthalmic artery.
10. Describe the lacrimal gland and its innervation, lacrimal drainage, conjunctiva, and eyelids.
11. Name the major branches of the maxillary and mandibular branches of the trigeminal nerve.
12. Describe the autonomic nerve supply (visceral efferent) to the lacrimal, submandibular, and parotid salivary glands.
13. Describe the middle ear and tympanic membrane.
14. Describe the naso- and oropharynx including the conchae, tonsillar fossae, posterior pharyngeal wall and the sensory nerves supplying the naso and laryngopharynx.
15. Describe the movements of the jaw and tongue.
16. Summarize the motor and sensory innervation of the tongue and pharynx.
17. Describe the course of the vagus nerve in the neck.
18. Describe the carotid arteries and jugular vein in the neck; list the branches of the external carotid and the major structures supplied by each branch.
19. Identify the location of the cervical lymph nodes.
20. Identify surface markings for the larynx, trachea, and thyroid gland.
21. Describe the superficial and deep venous drainage of the face and neck.
22. Name the paranasal sinuses and air cells within the skull and describe their locations.
23. Describe the neurovasculature of the nasal cavity.
24. Identify the tonsillar regions of the pharynx; name the tonsils.
25. Describe the nerve supply to the larynx and vocal apparatus.
26. List the contents of the carotid sheath.
27. Describe the sympathetic chain in the neck.
28. Describe the suprahyoid and infrahyoid muscles, their innervation and functions.
29. Describe the course of the vertebral artery in the neck.
30. Identify the fascial investments and inter-fascial spaces of the neck.
31. Identify key structures in radiologic images of the head and neck.

IV. Embryology * - SHB Behavioral Learning Objectives

***Embryology is taught as a component of SHB and is limited to early development and the development of selected organ systems.**

The following objectives will be accomplished during the Structure of the Human Body course:

For each key developmental process, the student should be able to:

- A. Identify and define structural elements that are involved. For each key developmental process describe:
- the precursor(s) of each structure
 - additional structures to be derived from each structure as development progresses
 - the functional significance of each structure
 - the functional and regulatory inter-relationships between structures at each stage of development
- B. Describe the purpose of the key developmental process. In doing so, identify the key tissues, cells and molecules that play regulatory roles.
- C. Explain the purpose of the key developmental process
- D. Describe in detail specific congenital anomalies and the concepts that are believed to be responsible for anomalies.
- E. Extrapolate embryonic structures present during the developmental period into derivative adult structures
- F. Distinguish the functional and/or morphological consequences of specific teratologic events involving the key developmental process

Fertilization, Implantation, and Germ Layers

1. Describe the menstrual cycle and fertilization of the ovum.
2. Describe the blastocyst, its attachment and implantation in the endometrium.
3. Discuss the development and function of the trophoblast.
4. Describe the development and structure of the bilaminar disc and define the terms ectoderm, mesoderm, and endoderm after gastrulation.
5. Describe migration of the extraembryonic mesoderm.
6. Describe the development and structure of the yolk sac and amnion.
7. Name the components of the chorion and amnion and describe their formation.
8. Describe the development of the amniotic and chorionic cavities.
9. Diagram and label the embryo at day 7, 14, and 21 days of age.
10. Describe the location and significance of the primitive streak and node.
11. Describe the process and outcomes of gastrulation.
12. Describe follicular development and ovulation.
13. Describe the menstrual cycle and endometrial changes.
14. Describe gametogenesis and fertilization.
15. Describe cleavage and blastocyst formation and transport within the Fallopian tube.
16. Describe endometrial implantation of the blastocyst.
17. Identify sites of ectopic pregnancy.

18. Describe the changes in the two germ layer stage leading to the development of the trilaminar germ disc.
19. Identify the origins of the major extraembryonic tissues.
20. Define the notochord and explain its functions in induction of the nervous system.
21. Describe formation of the neural tube and fate of neural crest cells.
22. List representative derivatives of the three germ layers.
23. Discuss the sensitivity of the embryo to teratogens.
24. Describe the notochord and how it develops as a mesodermal derivative.
25. Describe the primitive streak and node and their role in determining left-right determination and fate-mapping of tissues.
26. Describe monozygotic twinning.

Extraembryonic Membranes and Placenta

1. List the structures within the umbilical cord.
2. Describe placental hormone production and identify the cellular components of the placenta that produce the hormones.
3. Describe the placental barrier.
4. Describe the head-tail and lateral folding of the embryo and the development of the amnion around the folding embryo.
5. Describe the initial formation and expansion of the amnion and chorion.
6. Describe the obliteration of the extraembryonic coelom and uterine cavity.
7. Describe the development of the deciduae.
8. Define the changes in the trophoblast relative to the site of development of the placenta.
9. Describe a chorionic villus.
10. List the placental hormones secreted by the syncytiotrophoblast.
11. Describe the formation and structure of the mature placenta.
12. Describe the placental barrier and maternal and fetal blood flow in the placenta.
13. Describe the tissues comprising the afterbirth.
14. Identify human teratogens that can cross the placental barrier and describe their known effects during the embryonic period (weeks 1-8).
15. Describe amniotic fluid.

Limb Development

1. Discuss the formation of somites and identify the paraxial mesoderm.
2. List the regions of the somitic mesoderm and their developmental fate.
3. Explain what is meant by the term morphogen and discuss the effects of morphogens in limb development.
4. Describe pattern formation in the hand and the molecular control of pattern formation.
5. Describe how teratogens might disrupt limb formation.
6. Describe a limb bud region.

7. Identify precursors that migrate into the limb bud.
8. Describe proximal-distal growth of the limb bud and the regulatory regions of the ectoderm and underlying mesoderm of the limb bud.
9. Describe the three axes of limb growth.
10. Describe sclerotome differentiation and formation of a vertebra.
11. Describe proximal-distal and anterior-posterior pattern formation in the hand.
12. Describe the effects of pharmaceuticals and chemicals on embryonic limb development.
13. Describe the fate of the notochord in the vertebral column.
14. Identify the features of fused digits and absent and shortened limbs and discuss possible underlying developmental mechanisms that cause these abnormalities.

Pharynx, Face Formation

1. Describe the mesodermal pharyngeal arches and their neural, vascular, and skeletal derivatives.
2. List the skeletal derivatives of the pharyngeal arches, pouches and clefts.
3. Describe migration of tissues from the pharyngeal pouches to their adult anatomical position.
4. Describe formation of the face and palate.
5. Identify the mesodermal origins of the tongue.
6. Describe the origin of the thyroid gland and its migratory path and remnants.
7. Identify the components of the primary palate and lateral palatine shelves and describe the features of cleft lip and cleft palate.
8. Describe thyroglossal cysts and fistulas, aberrant thyroid tissue, and lateral cervical branchial cysts and their formation.
9. Describe the pharyngeal arch, groove, and pouch components.
10. Describe the remnants of pharyngeal structures that may have clinical relevance.
11. Identify the major components of the face arising from the maxillary and mandibular processes.
12. Describe lateral-to-medial and frontal process migrations in the formation of the face.
13. Describe the formation of the palate and separation of the nasal from the oral cavity.

Circulatory System

1. Describe the origin of the primitive heart tube, the terms applied to the primitive chambers, their inflow and outflow tracts, and the anatomical positioning of the primitive heart.
2. Describe the sequence of events that yield the division the primitive atrium and formation of the foramen ovale.
3. Describe the sequence of events and tissues involved in completing the division the ventricular chambers.

4. Describe partitioning of the aorta and pulmonary trunk from a single outflow tract.
5. List the final prominent adult derivatives of the aortic arch system.
6. Trace the course of blood flow in the fetus and know the changes that occur after birth.
7. List anatomical vestiges in the adult and understand their function in the fetal blood circulation.
8. Describe the anatomical nature of common congenital defects of the heart and the consequences of the defects.
9. Describe the development of the pericardial cavity and how the heart begins to occupy its space.
10. Identify the origin of hematopoietic mesenchyme and blood island tissue in the yolk sac and allantois.
11. Describe the development of the sinus venosus.
12. Describe the development of heart valves.
13. Discuss major heart anomalies including tetralogy of Fallot and patent foramen ovale
14. Describe the fetal circulation and changes occurring at birth.
15. Describe the formation of the atria and ventricles and their septae.
16. Identify the developmental basis for atrial and ventricular septal defects and the transposition of the great vessels.
17. Describe the development of the aortic arches and their adult derivatives.

Digestive System

1. Name the derivatives of the embryonic endoderm and describe their formation from tissue of the foregut, midgut, or hindgut.
2. Describe the vasculature that serves both the developing and definitive portions of the gastrointestinal tract.
3. Describe the tissue growth and rotational events that yield the definitive form and positioning of the stomach, liver, pancreas, and omenta.
4. Describe how the rotations and herniation of the midgut give rise to the definitive position of the adult small intestine and colon.
5. Describe how the cloaca contributes to both the digestive and urinary systems.
6. Identify the origins of the liver, gallbladder, pancreas and spleen.
7. Identify the causes and consequences of selected congenital abnormalities of the digestive system.
8. Describe the formation of omphalocele, congenital umbilical herniation, eventration of abdominal viscera, abnormal gut rotation, esophageal atresia, Meckel's diverticulum, and diaphragmatic herniation.

Urogenital System

1. Describe the early nephrotome and primitive excretory tubular system.

2. Identify the fate of the pronephric and mesonephric systems.
3. Describe the relationship of early gonad development to the primitive tubular system.
4. Describe midline fusion events in the formation of the cloaca.
5. Describe ureteric bud formation and induction of the mesoderm in the formation of the metanephrogenic blastema and renal tubule.
6. Describe ovarian and testicular formation and their use of the tubular system.
7. Describe testicular descent
8. Identify the common components of the external genitalia and how they are modified during sexual differentiation
9. Describe the development of the uterus from the paired paramesonephric tubules; list common variants of uterine structure.
10. Describe the formation of the vagina and the penis.
11. Define cryptorchism and hypospadias.
12. Describe the structures originating at the urogenital ridge that serve both the urinary and genital systems.
13. Explain the role of the mesonephric and paramesonephric ducts in the formation of the pronephros, mesonephros, and metanephros.
14. Describe the formation and regression of the pronephric and mesonephric kidneys.
15. Describe induction of the distal mesoderm in the formation of the ureteric bud and metanephrogenic blastema.
16. Describe the metanephric kidney and its use of the mesonephric duct.
17. Describe differentiation of the cloaca and movement of the urorectal septum to establish the urinary bladder and rectum.
18. Describe the establishment of gonadal gender and differentiation of the testis and ovary.
19. Describe the development of the sexual duct system in the male and female.
20. Describe the development of the external genitalia in the male and female.

V. Curricular Integration of Embryology Behavioral Learning Objectives

The following objectives support the integration of knowledge after completion of the embryology component of the Structure of the Human Body course.

Students will be able to describe factual and conceptual details about the following key developmental structures and processes and will be able to integrate this knowledge into subsequent basic science and clinical course material.

Since embryology is taught as a component of SHB and is limited to early development and the development of selected organ systems the student should review the embryology of other systems in the assigned text, Sadler, T., Langman's Medical Embryology, Lippincott Williams & Wilkins, Baltimore, 10th Edition (or later), 2006 or in an equivalent text, to obtain a more comprehensive understanding of development as it relates to clinical medicine.

Describe the General Features and Definitions of the Following Key Developmental Structures and Processes:

Fertilization, Implantation and Germ Layers

1. gametogenesis and fertilization
2. endometrial implantation and gastrulation
3. ectopic pregnancy
4. formation of intra- and extraembryonic cavities

Extraembryonic Membranes and Placenta

1. formation of the amnion and chorion
2. placental formation and blood flow
3. circulation to and from the placenta
4. the afterbirth

Limb Development

1. the limb bud field
2. limb bud growth and controlling tissue elements
3. teratogens and their effects on limb growth
4. pattern formation in the hand
5. developmental anomalies of the limbs

Circulatory System

1. embryonic hematopoiesis
2. formation of the aortic arches and their derivatives
3. development of the major veins
4. looping of the heart and formation of heart chambers
5. partitioning of the heart chambers
6. partitioning of the outflow tract of the heart
7. innervation of the heart
8. pathway of fetal circulation
9. developmental anomalies of the heart chambers and great vessels

Urinary and Genital Systems

1. formation of the metanephric kidney
2. formation of the urinary bladder
3. establishment of gonadal gender
4. differentiation of the testis and ovary
5. development of the genital duct system in males and females
6. descent of the gonads
7. formation of the external genitalia
8. developmental anomalies of the urinary and genital tract

Pharynx and Face

1. pharyngeal pouches and their derivatives
2. formation of the thyroid and parathyroid glands
3. formation of the face
4. developmental anomalies of the pharynx, larynx, face and neck

Digestive System

1. formation of the fore-, mid-, and hindgut
2. rotation of the gut and adult positioning
3. development of the liver and pancreas
4. developmental anomalies of the digestive tract

Skin and Musculoskeletal System

1. development of the dermis and epidermis
2. epidermal appendages
3. mesenchymal condensation and skeletal patterning
4. development of the axial and appendicular skeleton
5. development of the dermatome and myotome of the somite
6. developmental anomalies of the musculoskeletal system

Nervous System

1. derivatives of the neural crest
2. development of the neural tube and folding of the neural tube
3. formation of the regions of the brain and spinal cord
4. formation of the ventricles and meninges; CSF formation
5. developmental anomalies of the nervous system

Sense Organs

1. formation of the retina and lens
2. formation of the cornea
3. development of the inner ear
4. development of the middle ear
5. developmental anomalies of the eye and ear

Respiratory System

1. formation of the trachea and primary bronchi
2. development of the lung
3. formation of the diaphragm
4. developmental anomalies of the lungs and diaphragm