

BONES

- It is a dense C.T(vascularized &full mineral), about 206 bones in the human body.
- Bone is a living tissue capable of changing its structure as the result of stresses to which it is subjected.
- Like other **connective tissues**, bone consists of cells, fibers, and matrix.
- It is **hard** because of the calcification of its extracellular matrix and possesses a degree of **elasticity** because of the presence of organic fibers.
- Bone has a **protective function**; the skull and vertebral column, for example, protect the brain and spinal cord from injury; the sternum and ribs protect the thoracic and upper abdominal viscera .
- It serves as a **lever**, as seen in the long bones of the limbs,
- important **storage** area for calcium salts.
- It houses and protects within its cavities the delicate blood-forming **bone marrow**.

Types of bone development

- ❖ **Cartilaginous or endochondral**, a cartilagenous model is first laid down and is later replaced by bone ossification.(long bones. e.g humerus)
- ❖ **Intramembranous**, the bone is developed directly from a connective tissue membrane.(flat bones. e.g. skull, clavicle)

Types of bone according to structure:

- ❖ Compact bone(solid mass).e.g long bone
- ❖ Cancellous bone(spongy) consists of branching network of trabeculae .e.g. scapula, skull

Types of bone according to shape

- **Long Bones**

- Long bones are found in the limbs (e.g., the humerus, femur, metacarpals, metatarsals, and phalanges). Their length is greater than their breadth. They have a tubular shaft, the diaphysis, and usually an epiphysis at each end. During the growing phase, the diaphysis is separated from the epiphysis by an epiphyseal cartilage. The part of the diaphysis that lies adjacent to the epiphyseal cartilage is called the metaphysis. The shaft has a central marrow cavity containing bone marrow. The outer part of the shaft is composed of compact bone that is covered by a connective tissue sheath, the periosteum.
- The ends of long bones are composed of cancellous bone surrounded by a thin layer of compact bone. The articular surfaces of the ends of the bones are covered by hyaline cartilage.

- **Short Bones**

- Short bones are found in the hand and foot (e.g., the scaphoid, lunate, talus, and calcaneum). They are roughly cuboidal in shape and are composed of cancellous bone surrounded by a thin layer of compact bone. Short bones are covered with periosteum, and the articular surfaces are covered by hyaline cartilage.

- **Flat Bones**

- Flat bones are found in the vault of the skull (e.g., the frontal and parietal bones). They are composed of thin inner and outer layers of compact bone, the tables, separated by a layer of cancellous bone, the diplo. The scapulae, although irregular, are included in this group.

- **Irregular Bones**

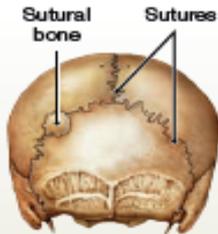
- Irregular bones include those not assigned to the previous groups (e.g., the vertebrae, and the pelvic bones, base of skull). They are composed of a thin shell of compact bone with an interior made up of cancellous bone. It is ill-defined due to bony process.

- **Pneumatic bones.** e.g paranasal sinuses(air cavity inside the bone)

- **Sesamoid bones** are small nodules of bone that are found in certain tendons where they rub over bony surfaces. The greater part of a sesamoid bone is buried in the tendon, and the free surface is covered with cartilage. The largest sesamoid bone is the *patella*, which is located in the tendon of the quadriceps femoris. Other examples are found in the tendons of the flexor pollicis brevis and flexor hallucis brevis. The function of a sesamoid bone is to reduce friction on the tendon; it can also alter the direction of pull of a tendon.

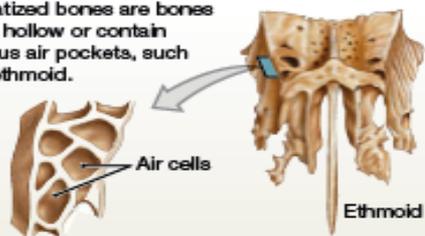
Sutural Bones

Sutural (Wormian) bones are small, flat, oddly shaped bones found between the flat bones of the skull in the suture line. They develop from separate centers of ossification, regarded as a type of flat bone.



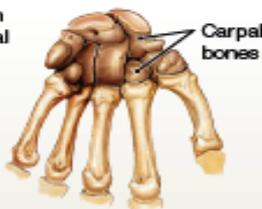
Pneumatized Bones

Pneumatized bones are bones that are hollow or contain numerous air pockets, such as the ethmoid.



Short Bones

Short bones are boxlike in appearance. Their external surfaces are covered by compact bone, but the interior contains spongy bone. Examples of short bones include the carpal bones (wrists) and tarsal bones (ankles).



Irregular Bones

Irregular bones have complex shapes with short, flat, notched, or ridged surfaces. Their internal structure is equally varied. The vertebrae that form the spinal column and several bones in the skull are examples of irregular bones.



Flat Bones

Flat bones have thin, roughly parallel surfaces of compact bone. In structure a flat bone resembles a spongy bone sandwich; such bones are strong but relatively light. Flat bones form the roof of the skull, the sternum, the ribs, and the scapulae. They provide protection for underlying soft tissues and offer an extensive surface area for the attachment of skeletal muscles. Special terms are used when describing the flat bones of the skull, such as the parietal bones. Their relatively thick layers of compact bone are called the internal and external tables, and the layer of spongy bone between the tables is called the diploë.



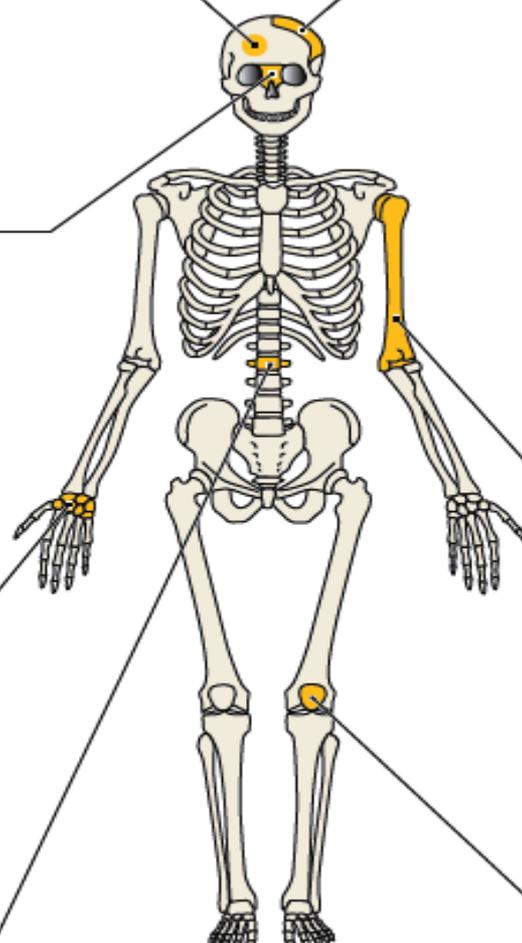
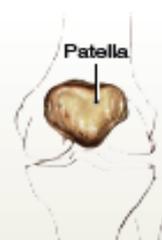
Long Bones

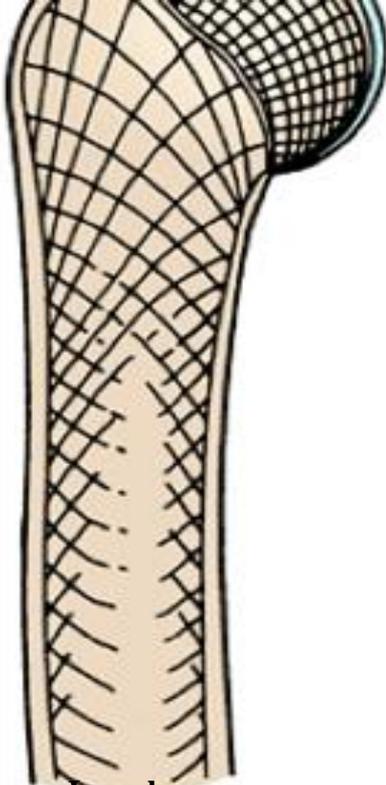
Long bones are relatively long and slender. They have a diaphysis, two metaphyses, two epiphyses, and a medullary (marrow) cavity, as detailed in [Figure 5.3](#). Long bones are found in the upper and lower limbs. Examples include the humerus, radius, ulna, femur, tibia, and fibula.



Sesamoid Bones

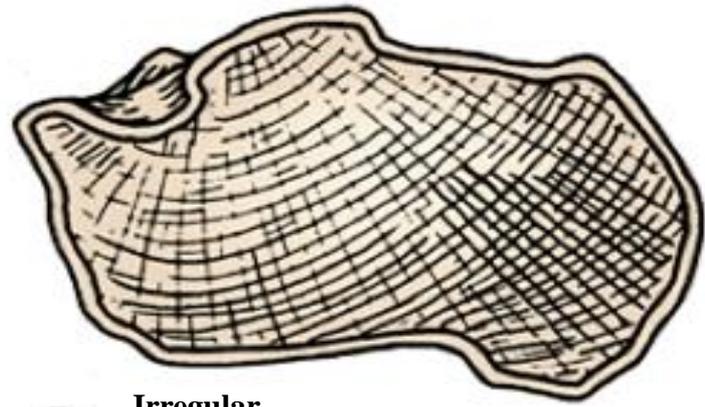
Sesamoid bones are usually small, round, and flat. They develop inside tendons and are most often encountered near joints at the knee, the hands, and the feet. Few individuals have sesamoid bones at every possible location, but everyone has sesamoid patellae, or kneecaps.



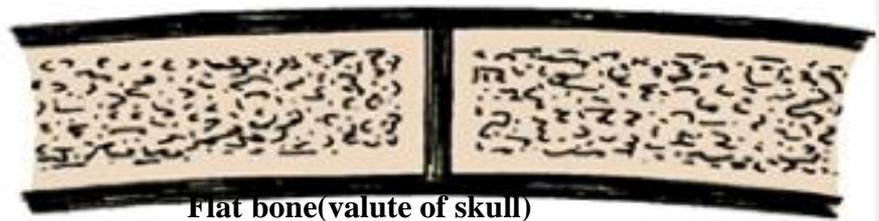


Long bone

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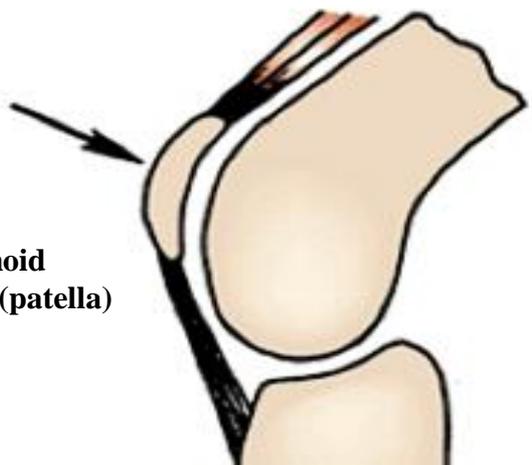


B Irregular bone(calcaneum)



Flat bone(valute of skull)

C



Sesmoid bone(patella)



Arrangement of trabeculae

Surface marking of bones

- **A-Elevations:** Tubercle, trochanter, tuberosity, spine, ridge, process, epichondyle, crest, line
- **Depressions:** Fossa, notch, groove or sulcus
- **Openings:** Foramen, canal, hiatus
- **Expanded for articulation:** Head, condyle, trochlea, facet



Cartilage: It is a dense irregular C.T.(with cells & fibers in a gel-like matrix),no blood vessels, lymph and nerve (insensitive)

Types of cartilage according to matrix:

- Hyaline cartilage. e.g epiphyseal plate
- Elastic cartilage(yellow cartilage). e.g. external ear
- Fibrocartilage(white).e.g. intervertebral disc

Cardiovascular system

It is consists of:-

1-Heart : muscular organ consist of R&L atrium and R&L ventricale.It is Pumping the blood to body.

2- Blood vessels: within it the blood circulate between heart and other body tissues

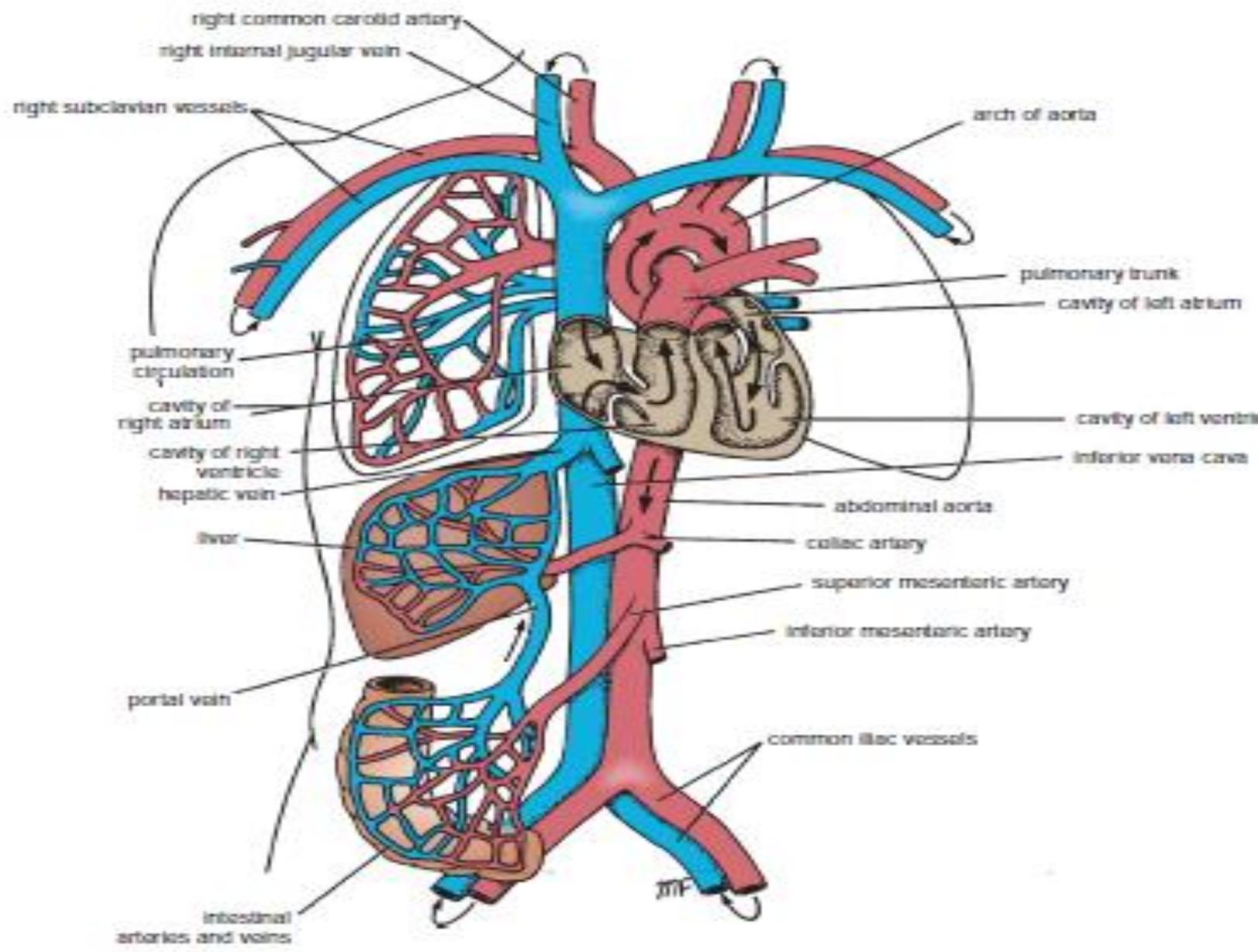


FIGURE 1.16 General plan of the blood vascular system.

BLOOD VESSELS(BV): Are three types :
Arteries, veins and capillaries

Arteries:Transport the blood from the heart to various tissues of the body by their branches, There are three types of arteries:-

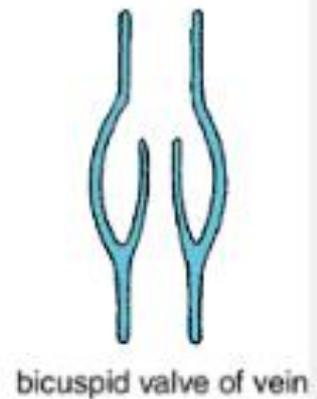
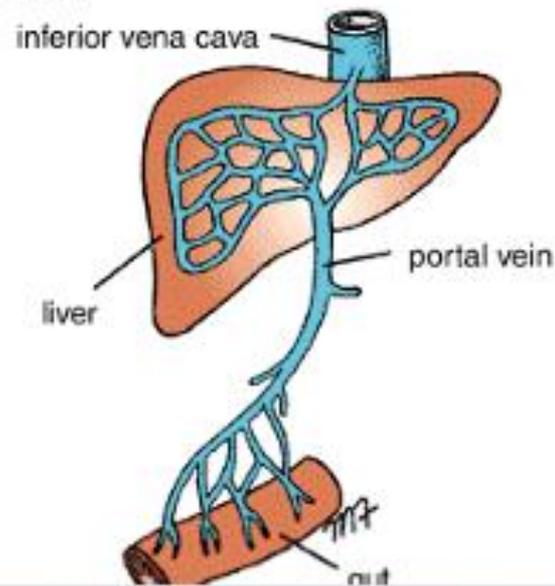
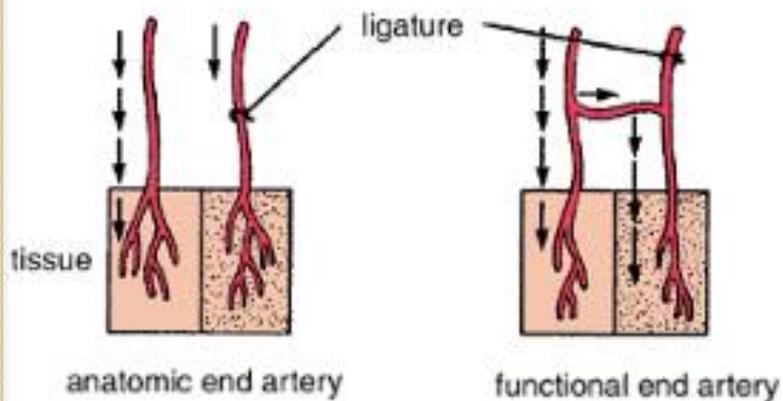
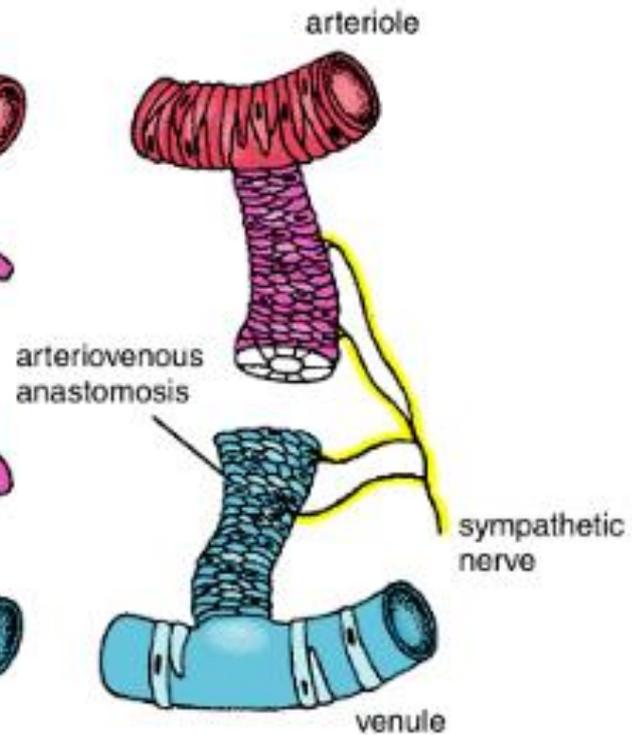
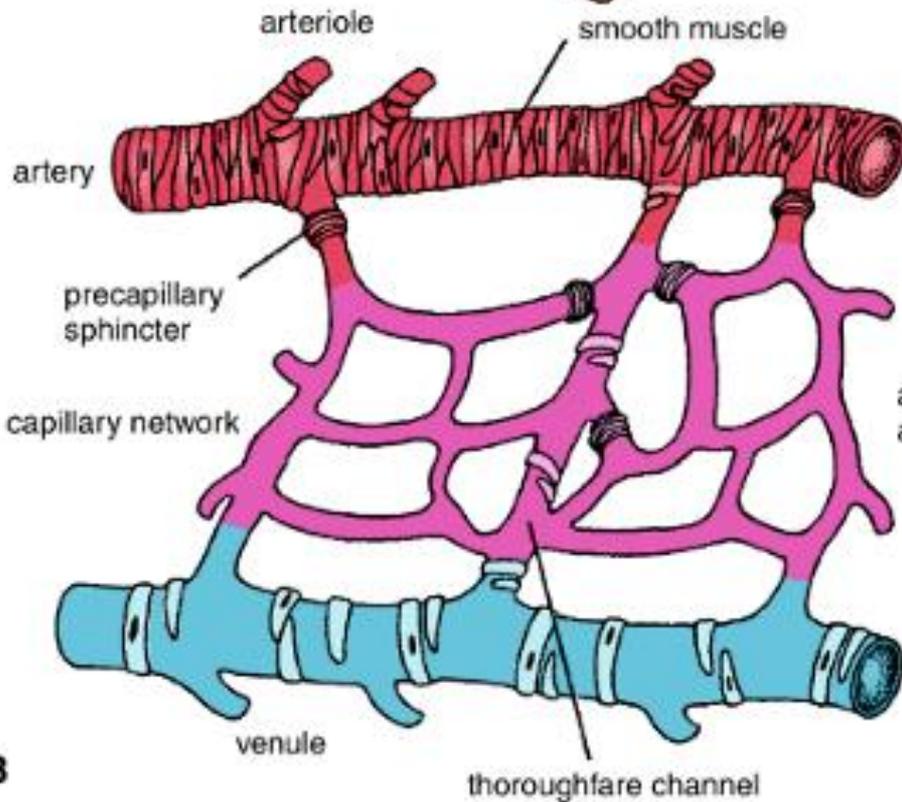
- Large or conducting arteries (elastic)
- Medium size arteries
- Small arteries & arterioles(<0.1mm)

The joining of branches of arteries called **anastomosing**

- ❖ **Anatomical end arteries:** Are vessels whose terminal branches do not anastomosing with branches of arteries supplying adjacent areas. e.g. retinal artery
- ❖ **Functional end arteries:** Are vessels whose terminal branches do anastomosing with branches of arteries supplying adjacent areas, but the caliber insufficient to keep the tissue alive should one of the arteries become blocked .e.g. coronary artery.

The blood circulate inside three systems of vessels

- Pulmonary circulation(from lung to heart)
- Portal circulation (from GIT to liver)
- Systemic circulation(between the hear and body tissue)



Veins: Are vessels that transport blood back to the heart, many of them possess valves

The smallest vein are called venules.

The smaller veins or tributaries unite to form large veins, which commonly join with one another to form venous plexuses.

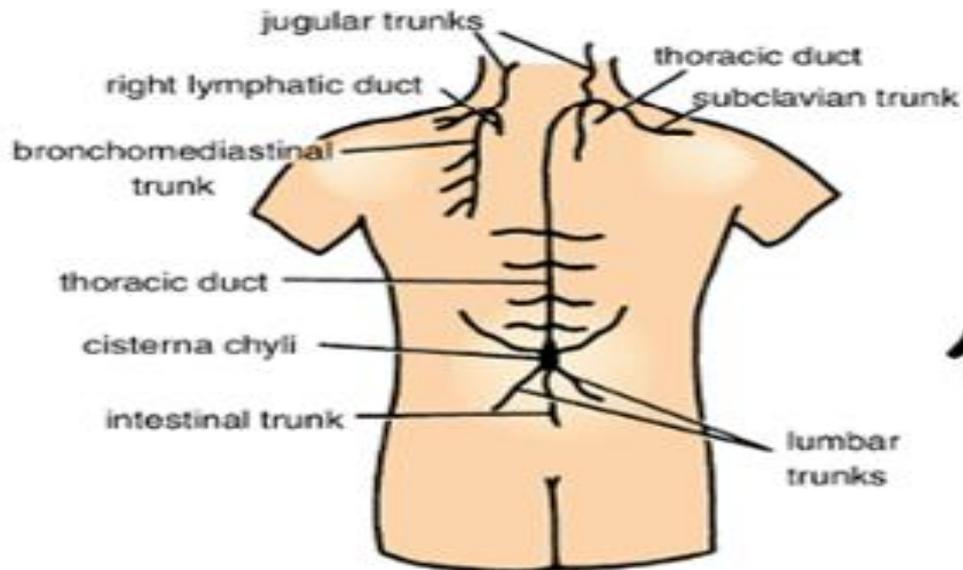
Medium size deep arteries often accompanied by two veins, one on each side, called venae comitantes

Capillaries: are microscopic vessels in the form of a network connection the arterioles to venules.

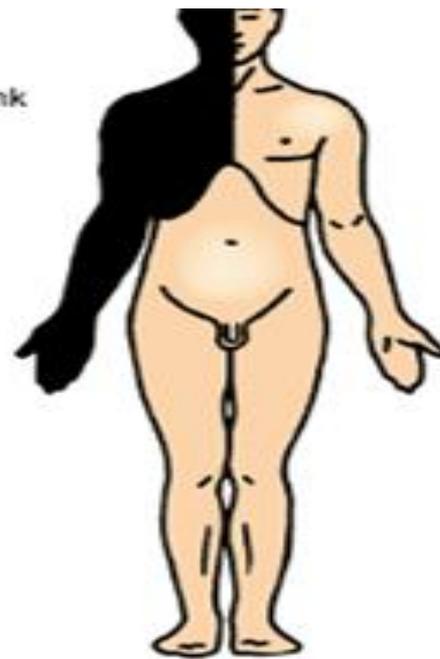
Arteriovenous anastomoses: Is the site of direct connection between arteries and veins without intervention of capillaries, e.g at tip of fingers and toes

Lymphatic System

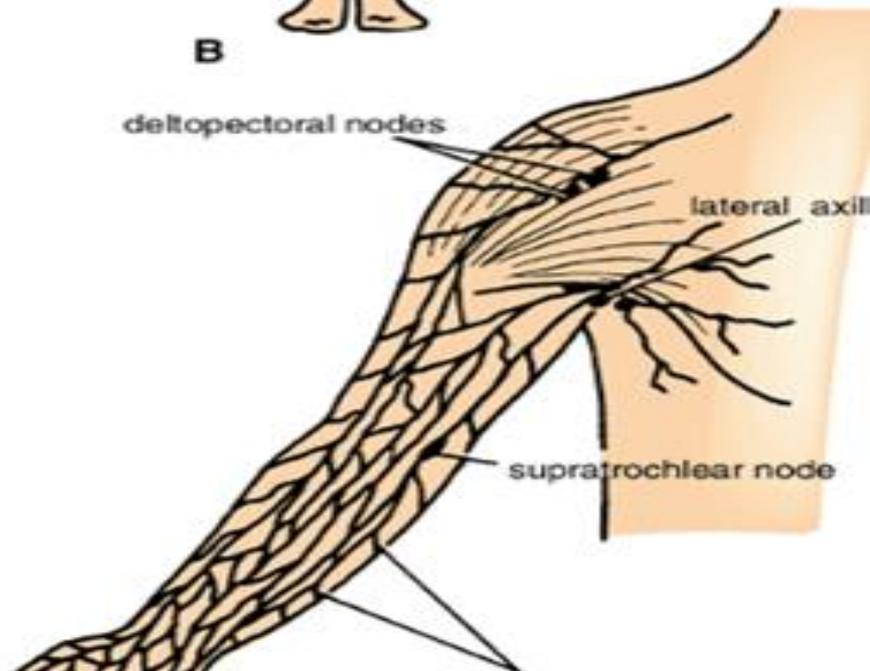
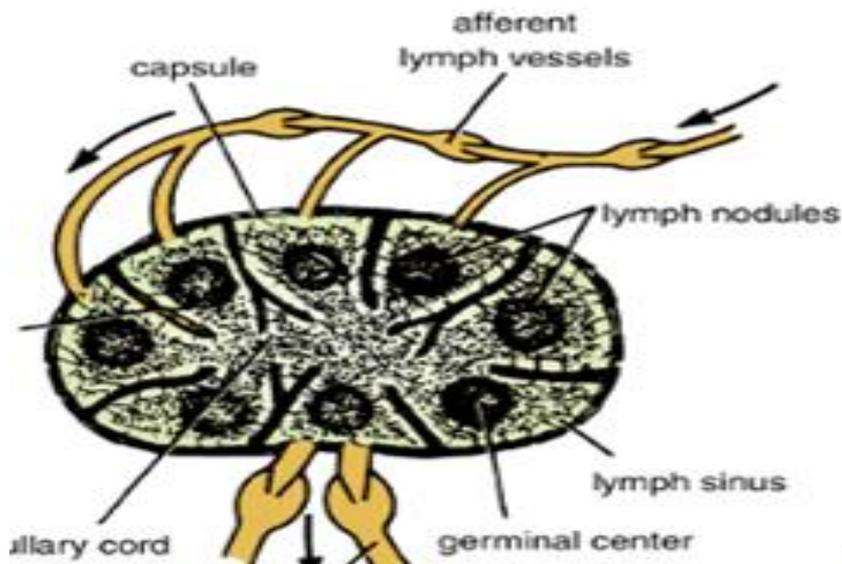
- The lymphatic system consists of lymphatic tissues and lymphatic vessels .
- Lymphatic tissue is organized into the following organs or structures: the thymus, the lymph nodes, the spleen, and the lymphatic nodules. Lymphatic tissue is essential for the immunologic defenses of the body against bacteria and viruses.
- Lymphatic vessels are tubes that assist the cardiovascular system in the removal of tissue fluid from the tissue spaces of the body; the vessels then return the fluid to the blood.
- Lymph is the name given to tissue colourless fluid once it has entered a lymphatic vessel. Lymph capillaries are a network of fine vessels that drain lymph from the tissues. The capillaries are in turn drained by small lymph vessels, which unite to form large lymph vessels. Lymph vessels have a beaded appearance because of the presence of numerous valves along their course.
- Lymph pass through at least one lymph node before it is returned to blood stream and it is reaches the blood stream at root of neck by Right lymphatic duct and thoracic duct
- Lymphatic vessels are found in all tissues and organs of the body except the central nervous system, eyeball, internal ear, epidermis, cartilage and bone



A

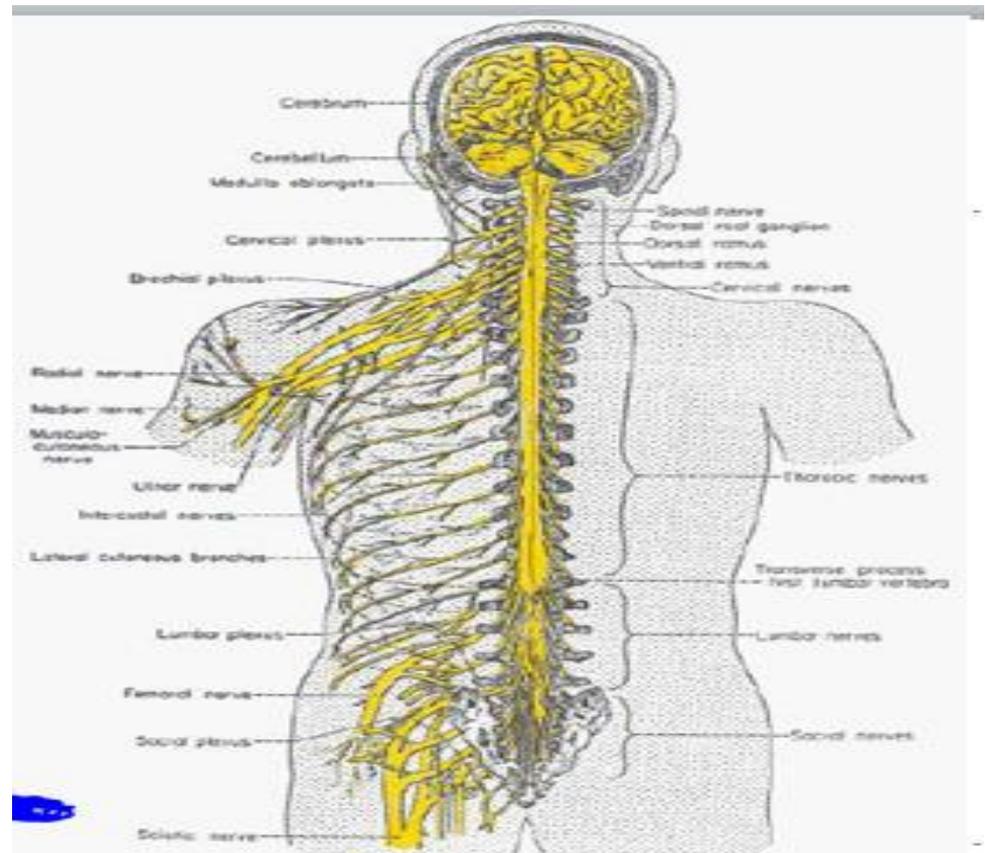


B



NERVOU SYSTEM

- The nervous system together with the endocrine system, controls and integrates the activities of the body.



Division of nervous system(NS)

- **Functionally divided into:**

A- Somatic N.S (controls voluntary activity)

B-Autonomic N.S (controls involuntary activity), Which sub divided into Sympathetic & parasympathetic.

- **Anatomically divided in to:**

A- Central N.S (Brain & spinal cord)

B- Peripheral N.S (Cranial nerves(12 pairs) & spinal nerves(31 pairs))

Central nervous system(CNS)

Composed of neurons that are support by neuroglia.

- Neurons: are nerve cells and their process(axons are Longest process and dendrites are short processes)
- CNS is organized into:-
- Gray matter consist of nerve cells embedded in neuroglia
- White matter consist of nerve fibers(axons) embedded in neuroglia

Peripheral nervous system(PNS)

1-Cranial nerves: 12 Pairs that leave brain through the foramina in the skull. All the nerves distributed in the head and neck except the xth (vagus)nerve which also supply thorax and abdomen.

2- Spinal nerve: 31 pairs that leave the spinal cord through the intervertebral foramina and take its name according to the region of vertebral column with which they are associated (**8 cervical, 12 thoracic, 5 Lumber, 5sacral, 1 coccygeal**)



During development, the spinal cord grows in length more slowly than the vertebral column. In the adult, when growth ceases, the lower end of the spinal cord reaches inferiorly only as far as the lower border of the 1st lumbar vertebra. To accommodate for this disproportionate growth in length, the length of the roots increases progressively from above downward. In the upper cervical region, the spinal nerve roots are short and run almost horizontally, but the roots of the lumbar and sacral nerves below the level of the termination of the cord form a vertical bundle of nerves that resembles a horse's tail and is called the **cauda equina**

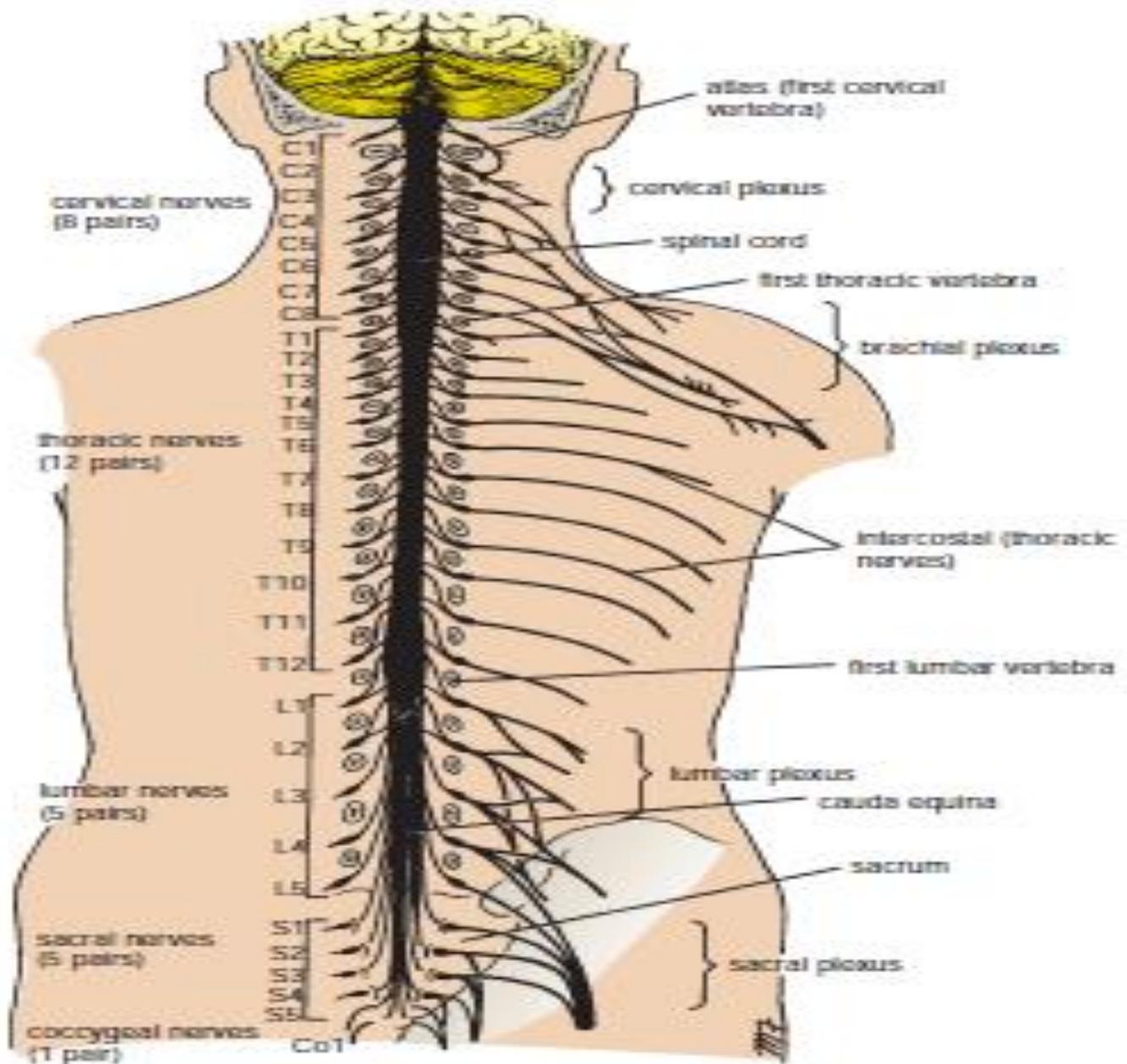


FIGURE 1.20 Brain, spinal cord, spinal nerves, and plexuses of limbs.

- Each spinal nerves is connected to the spinal cord by two roots(**anterior & posterior roots**)
- **The anterior root** consists of bundles of nerve fibers carrying nerve impulse from C.N.S, these called efferent fibers(motor fibers) go to skeletal muscle, their cell bodies lie in the anterior gray horn of spinal cord
- **The posterior root** consists of bundles of nerve fibers that carry impulses to the central nervous system and are called afferent(sensory), these fibers are conveying sensation of touch, pain, temperature and vibrations, their cell bodies are situated in swelling on the posterior root called posterior root ganglia

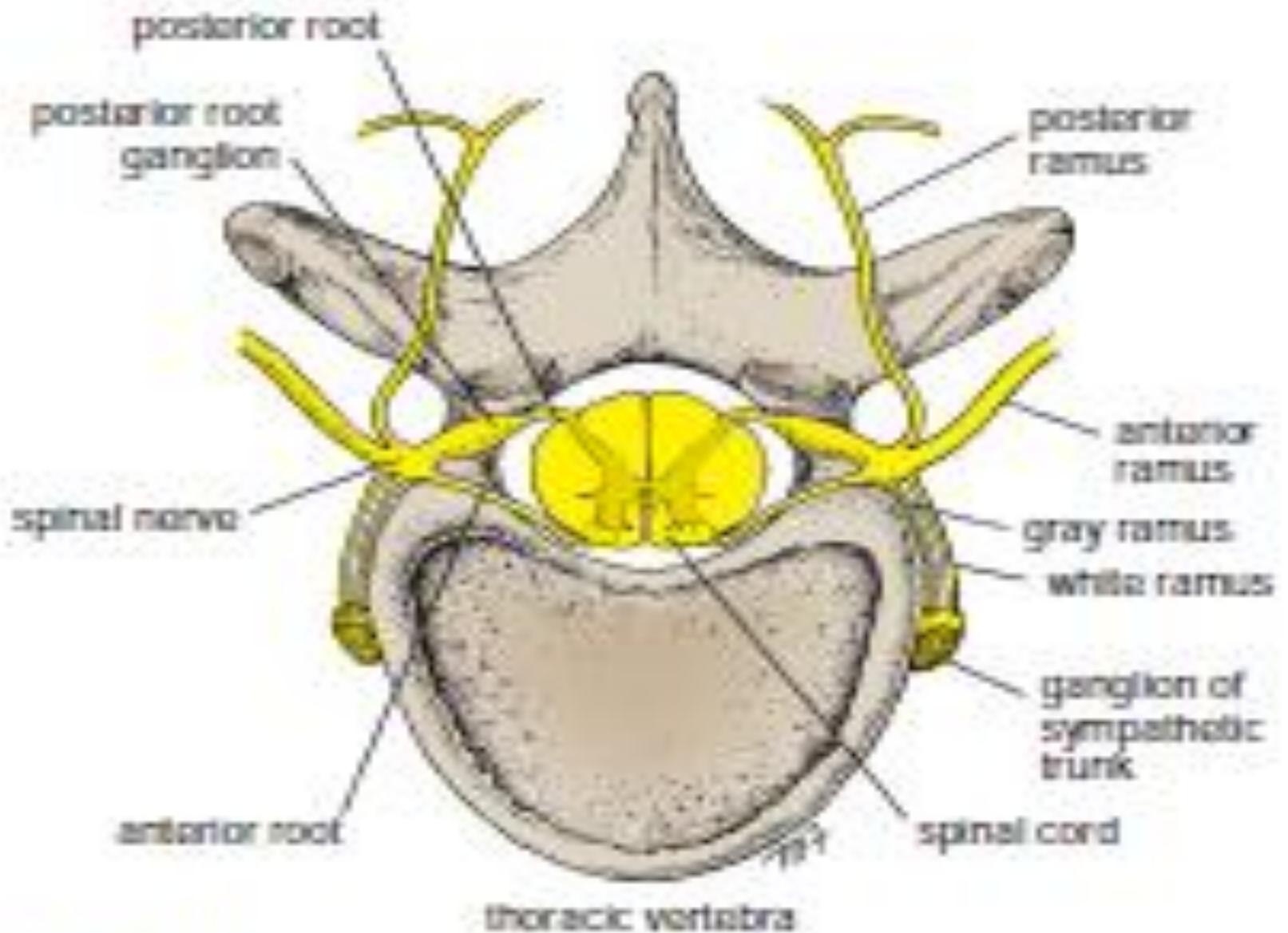
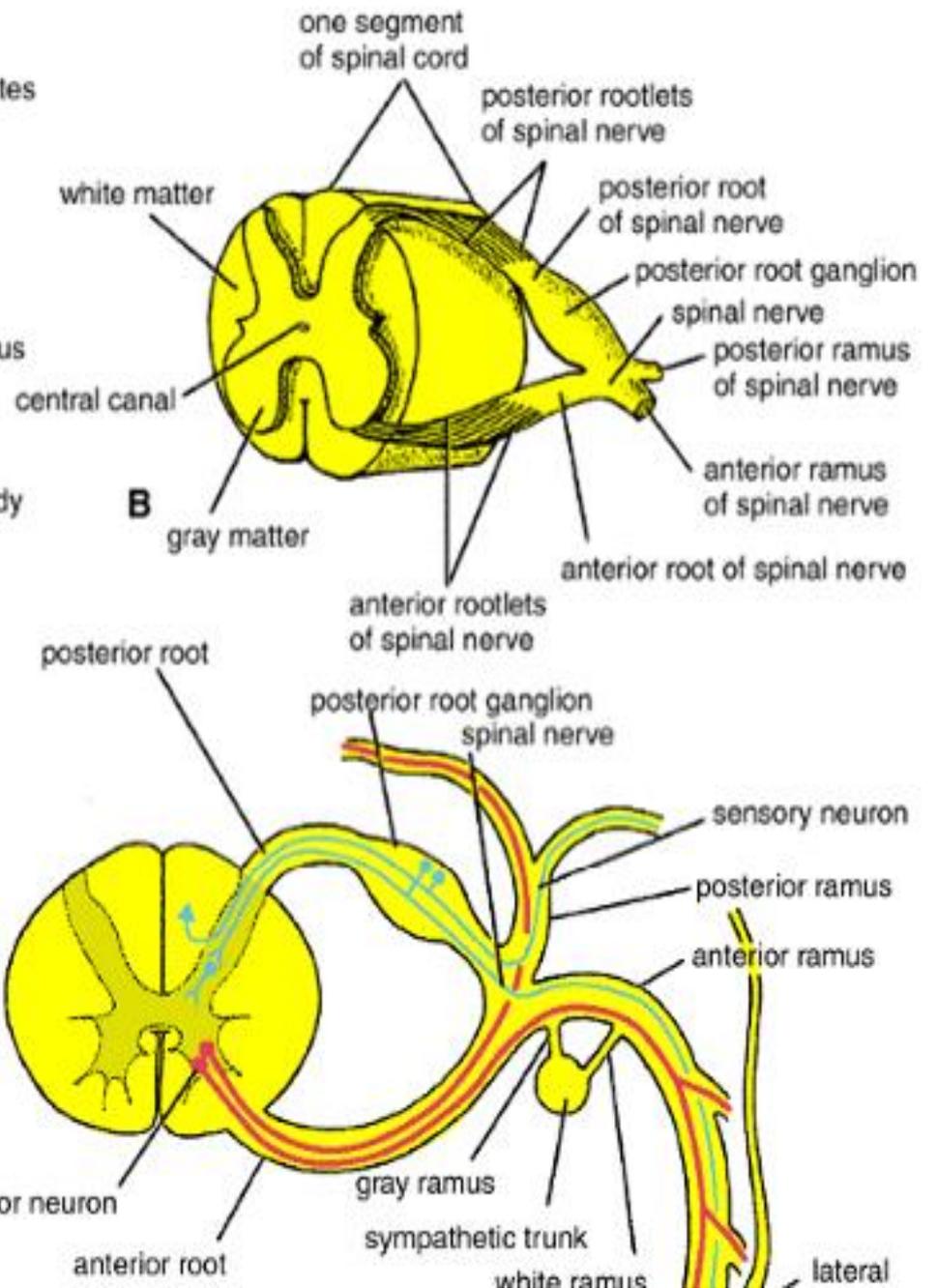
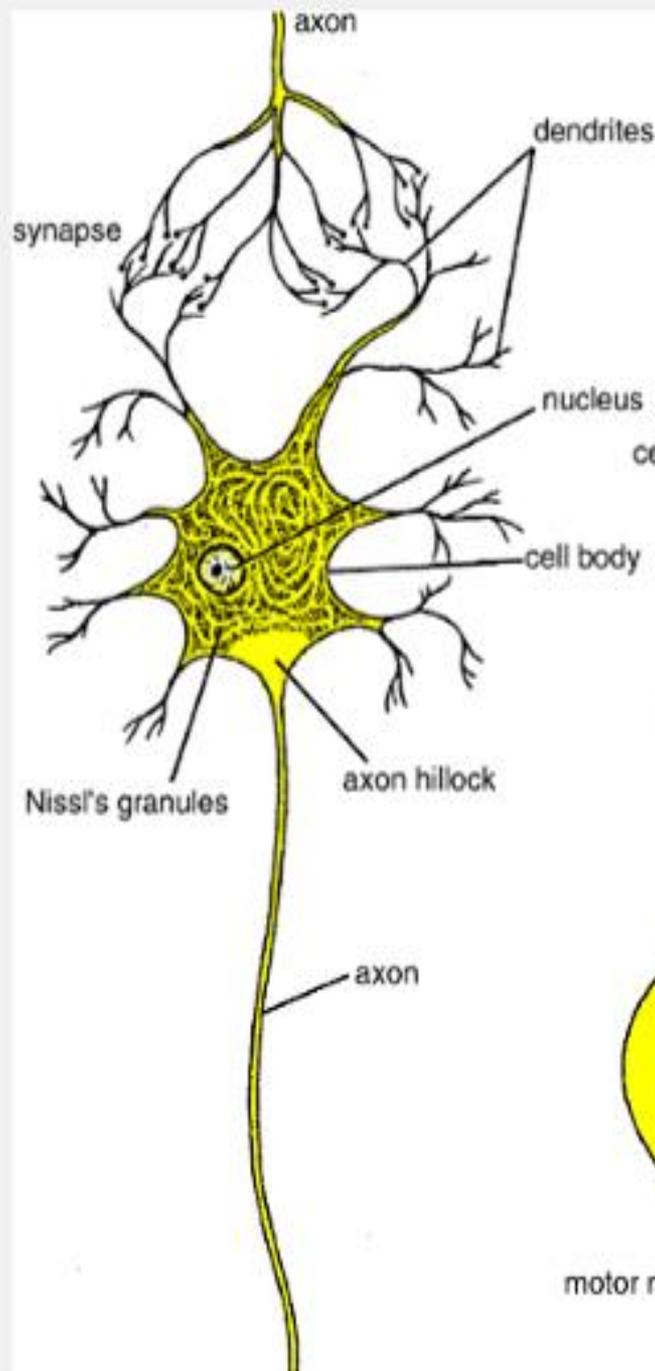


FIGURE 1.21 The association between spinal cord, spinal nerves, and sympathetic trunks.

- **Trunk of spinal nerve:** It is union of anterior and posterior root at each intervertebral foramen to form spinal nerve(mixed motor& sensory) On emerging from the vertebral foramen, spinal nerve branching into:
- **Anterior rami:** Pass anteriorly and supply muscles and skin over antero-lateral body wall & limbs.
- **Posterior rami:** Pass posteriorly to supply muscles and skin of back of body
- **Meningeal branches:** In addition to previous branches the spinal nerves give a small branches that supplies the vertebra an meninges covering spinal cord.

- **Rami communicants:** Branches of thoracic spinal nerves those associated with sympathetic part of the autonomic nervous system.
- **Plexus:** joining of anterior(ventral) rami at root of limbs form cervical plexus and brachial plexus at the root of upper limbs and lumbar and sacral plexus at the root of the lower limbs.
- **Dermatome:** Unilateral area of skin innervated by the fibers of a single spinal nerve.
- **Myotome:** unilateral muscle mass receiving innervation from fibers conveyed by a single spinal nerve.
- Sympathetic trunks are two ganglionated nerve trunks that extend the whole length of the vertebral column, there are 3 ganglia in each trunk of the neck, 11 or 12 in the thorax, 4 or 5 in lumbar and 4 or 5 in pelvis, the two trunks lie close to the vertebral column and end below by joined together as single ganglia called ganglion impar.



Autonomic nervous system

- It is concerned innervation of involuntary structures such as heart, smooth muscles and glands, it is distributed throughout CNS& PNS and divided into:
- **Sympathetic N.S:** It is prepare the body for emergency through accelerates the heart rates, constriction of the peripheral blood vessels, raised blood pressure, inhibit peristalsis of intestinal tract and close sphincters. Their efferent fibers have cell bodies of connector neuron are located in gray matter of spinal cord from T1(1st thoracic)to L2(2nd lumber)segments(Thoraco-Lumber),that possesses a lateral horn, in which are located the cell bodies of the sympathetic connector neurons.
- **Parasympathetic N.S:** They slow heart rate, increase peristalsis of the intestine, and glandular activity and open sphincters. Their efferent fibers have connector cells are located in brain form parts of nuclei of origin of cranial nerves III,IV,IX and X, and the sacral connector cells are found in the gray matter of 2nd,3rd and 4th sacral segments of spinal cord.

Thank You & Good Luck

