Lecture 1 Human Anatomy د.صباح عبد الرسول

Anatomy is the science of the structure and function of the body.

Clinical anatomy is the study of the macroscopic structure and function of the body as it relates to the practice of medicine and other health sciences.

Descriptive Anatomic Terms

- **Terms Related to Position:**

All descriptions of the human body are based on the assumption that the person is standing erect, with the upper limbs by the sides and the face and palms of the hands directed forward. This is the so-called **anatomic position**. The various parts of the body are then described in relation to certain imaginary planes.

- **Median Sagittal Plane**

This is a vertical plane passing through the center of the body, dividing it into equal right and left halves. Planes situated to one or the other side of the median plane and parallel to it are termed paramedian.
A structure situated nearer to the median plane of the body than another is said to be medial to the other. Similarly, a sructure that lies farther away from the median plane than another is said to be lateral to the other.

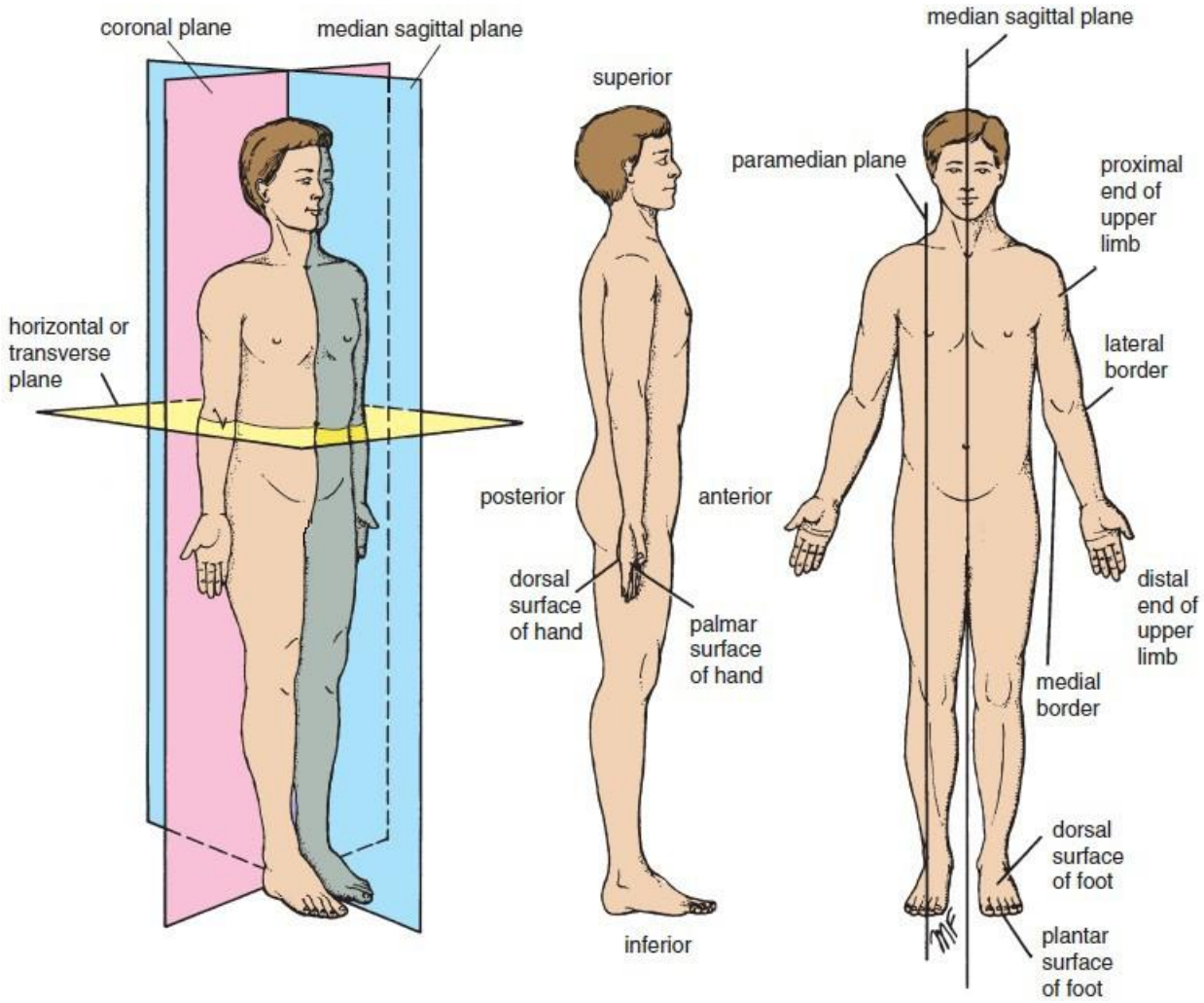
- **Coronal Planes**

These planes are imaginary vertical planes at right angles to the median plane.

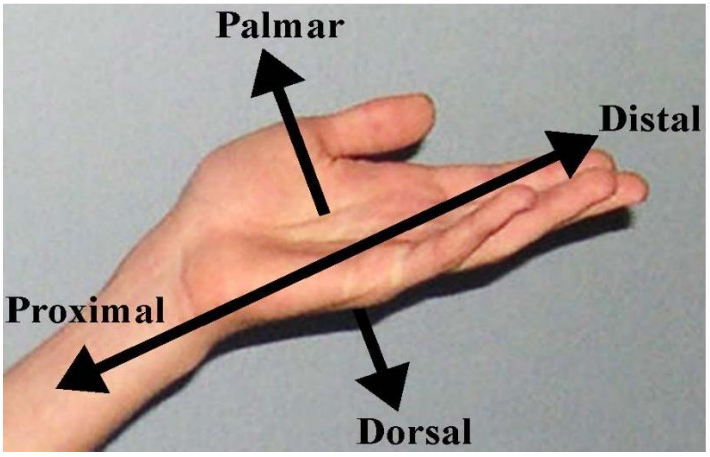
- **Horizontal, or Transverse Planes**

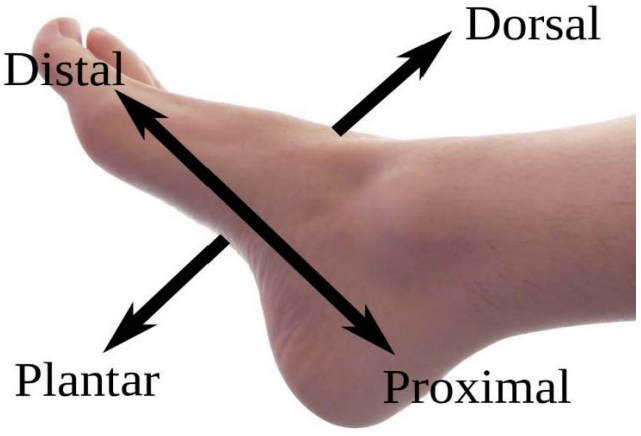
These planes are at right angles to both the median and the coronal planes.
The terms anterior and posterior are used to indicate the front and back of the body, respectively.

To describe the relationship of two structures, one is said to be anterior or posterior to

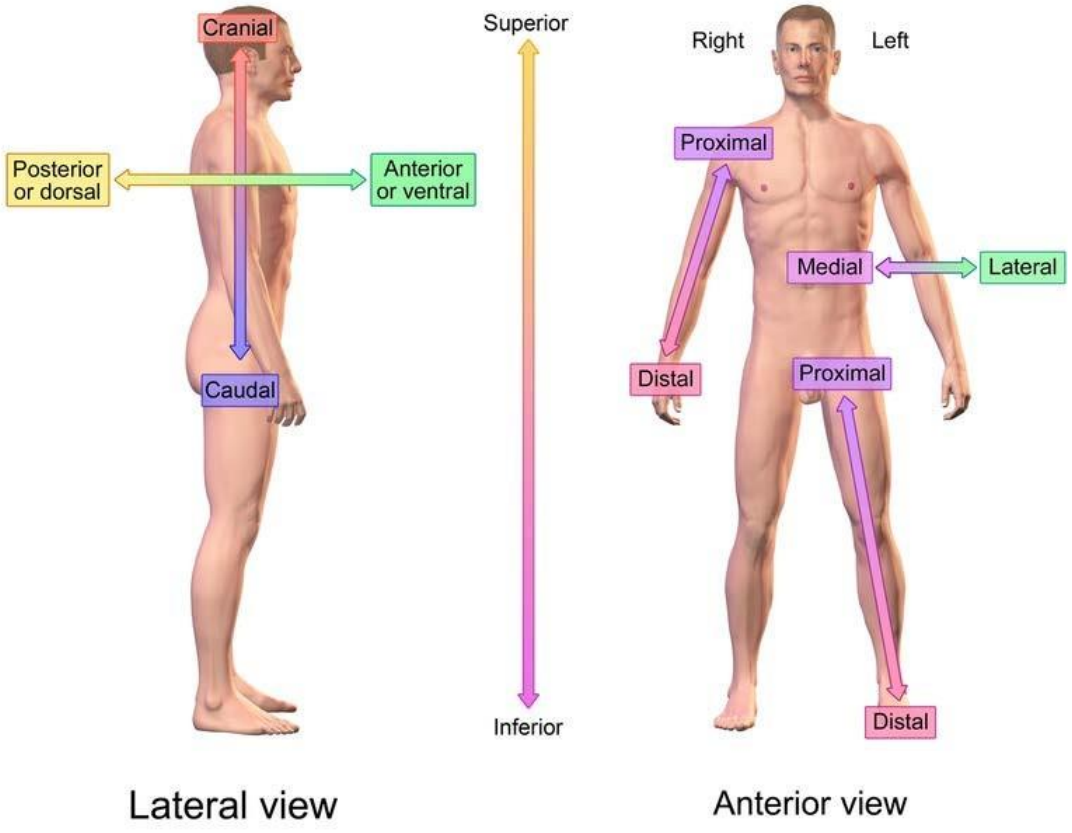


the other insofar as it is closer to the anterior or posterior body surface.
In describing the hand, the terms palmar and dorsal surfaces are used in place of anterior and posterior, and in describing the foot, the terms plantar and dorsal surfaces are used instead of lower and upper surfaces.



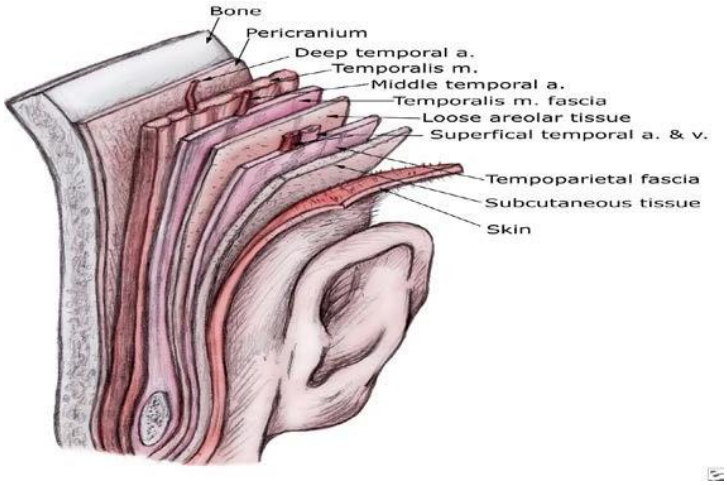


The terms **proximal and distal** describe the relative distances from the roots of the limbs; for example, the arm is proximal to the forearm and the hand is distal to the forearm.

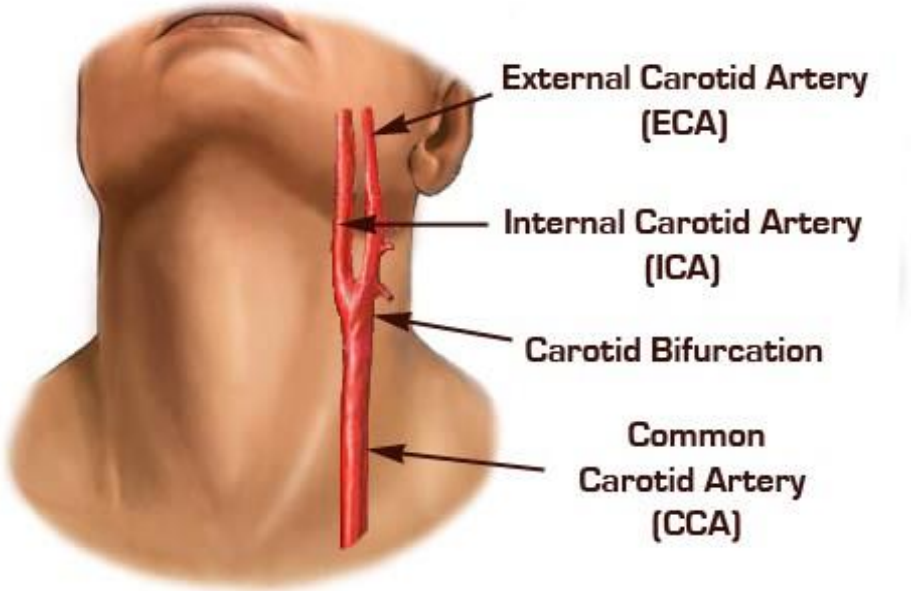


Directional References

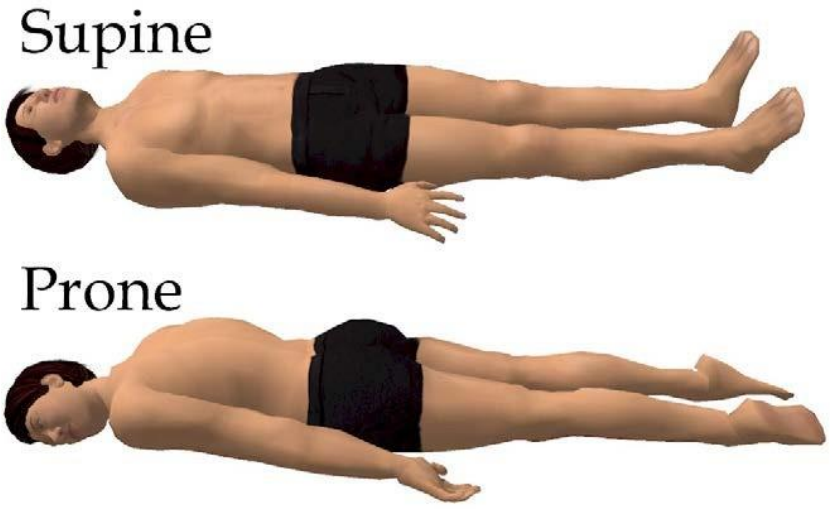
The terms **superficial and deep** denote the relative distances of structures from the surface of the body, and the terms superior and inferior denote levels relatively high or low with reference to the upper and lower ends of the body.



The terms **internal and external** are used to describe the relative distance of a structure from the center of an organ or cavity; for example, the internal carotid artery is found inside the cranial cavity and the external carotid artery is found outside the cranial cavity.



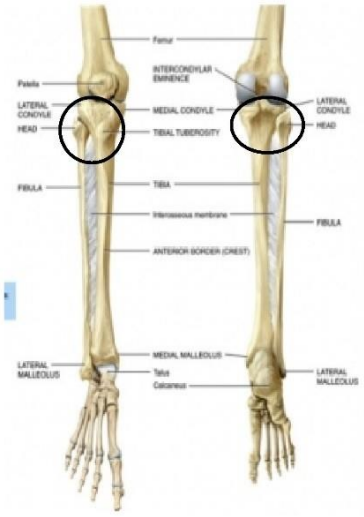
The term **ipsilateral** refers to the same side of the body;for example, the left hand and the left foot are ipsilateral. **Contralateral** refers to opposite sides of the body; forexample, the left eye and the right ear are contralateral.
The **supine position of the body** is lying on the back. The **prone position is** lying face downward.



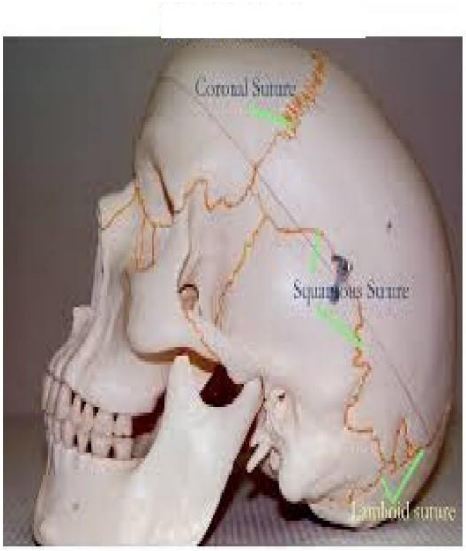
- **Terms Related to Movement**

A site where two or more bones come together is known as a **joint**. Some joints have no movement (sutures of the skull), some have only slight movement (superior tibiofibularjoint), and some are freely movable (shoulder joint).

Shoulder joint



Superior tibiofibular joint



Sutures of the skull

Flexion is a movement that takes place in a sagittal plane. For example, flexion of the elbow joint approximates the anterior surface of the forearm to the anterior surface of the arm. It is usually an anterior movement, but it is occasionally posterior, as in the case of the knee joint.
Extension means straightening the joint and usually takes place in a posterior direction. Lateral flexion is a movement of the trunk in the coronal plane.

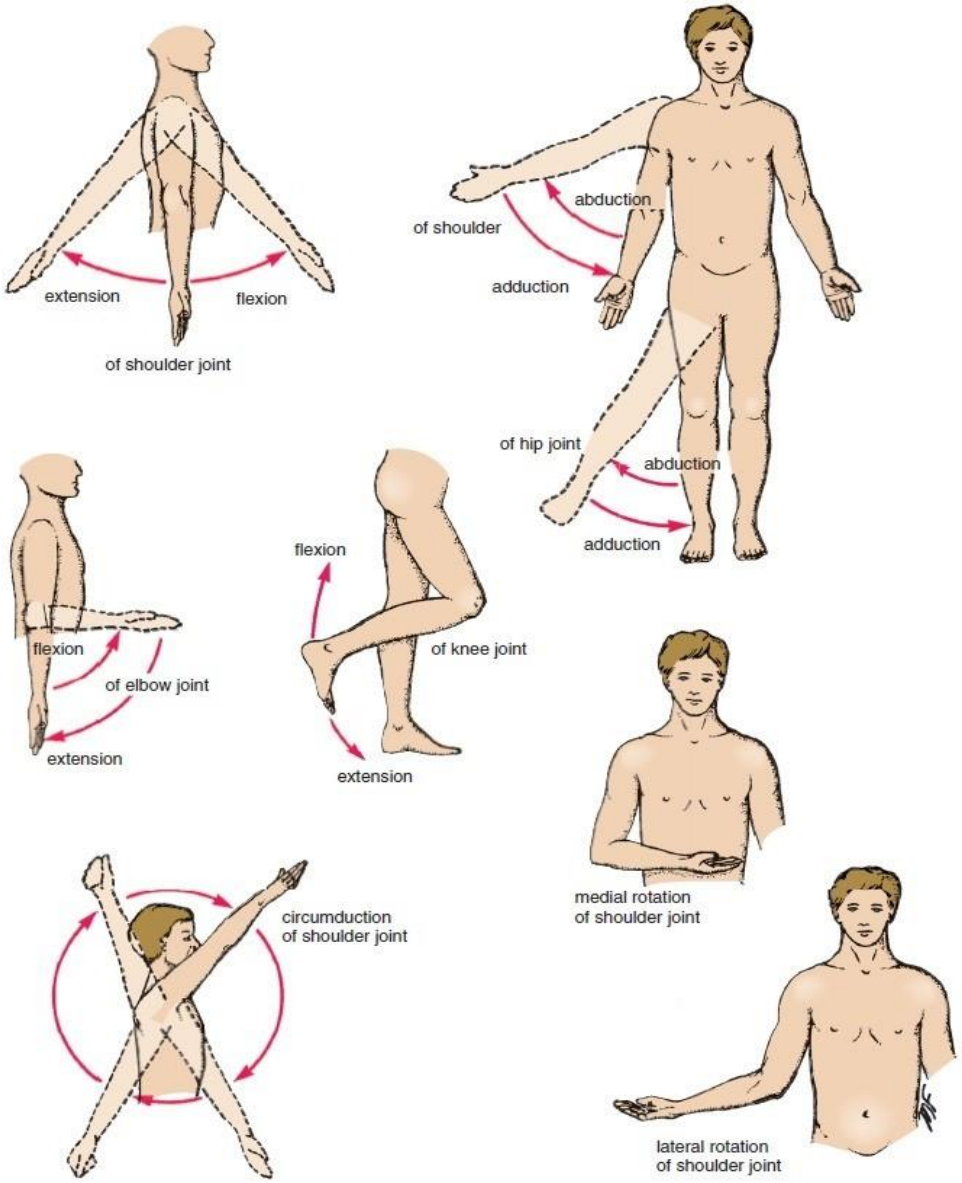
Abduction is a movement of a limb away from the midline of the body in the coronal plane.
Adduction is a movement of a limb toward the body in the coronal plane. In the fingers and toes, abductionis applied to the spreading of these structures and adductionis applied to the drawing together of these structures.

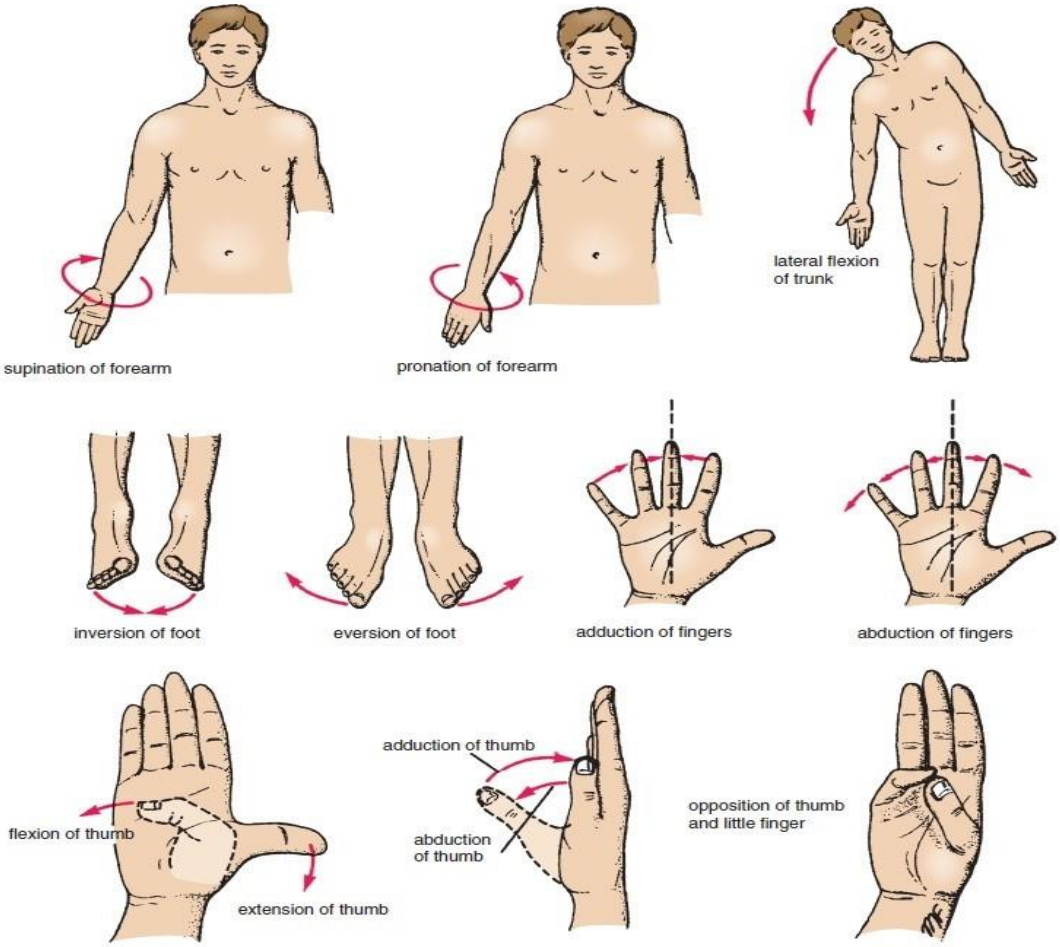
Rotation is the term applied to the movement of a part of the body around its long axis. Medial rotation is the movement that results in the anterior surface of the part facing medially.

Lateral rotation is the movement that results in the anterior surface of the part facing laterally.

Circumduction is the combination in sequence of the movements of flexion, extension, abduction, and adduction.

Inversion is the movement of the foot so that the sole faces in a medial direction. **Eversion** is the opposite movement of the foot so that the sole faces in a lateral direction.





Protraction is to move forward; **retraction** is to move backward (used to describe the forward and backward movement of the jaw at the temporomandibular joints).

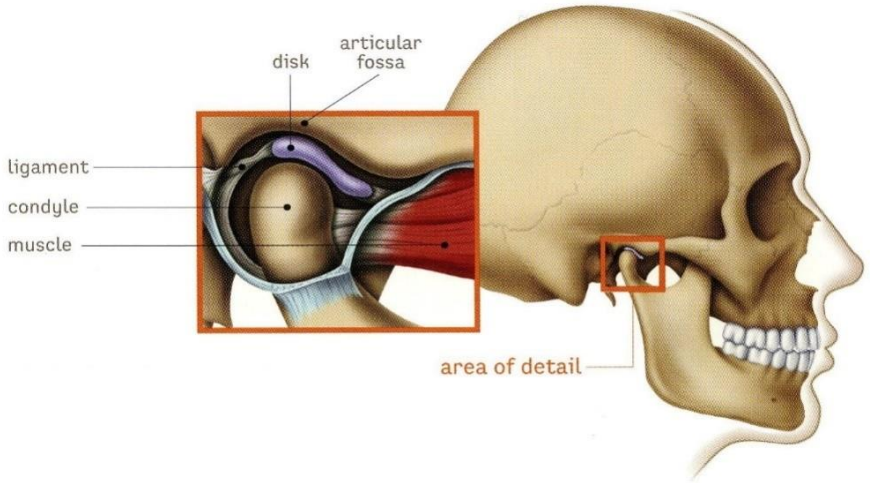
Basic Structures:Part 2

Cartilage

Cartilage is a form of connective tissue in which the cells and fibers are embedded in a gel-like matrix, the latter being responsible for its firmness and resilience. Except on the exposed surfaces in joints, a fibrous membrane called the **perichondrium** covers the cartilage. There are three types of cartilage:

1. **Hyaline cartilage** has a high proportion of amorphous matrix. Throughout childhood and adolescence,it plays an important part in the growth in length of long bones. It has a great resistance to wear and covers the articular surfaces of nearly all synovial joints.

2. **Fibrocartilage** has many collagen fibers embedded in a small amount of matrix and is found in the discs within joints (e.g., the temporomandibular joint and knee joint) and on the articular surfaces of the clavicle and mandible.

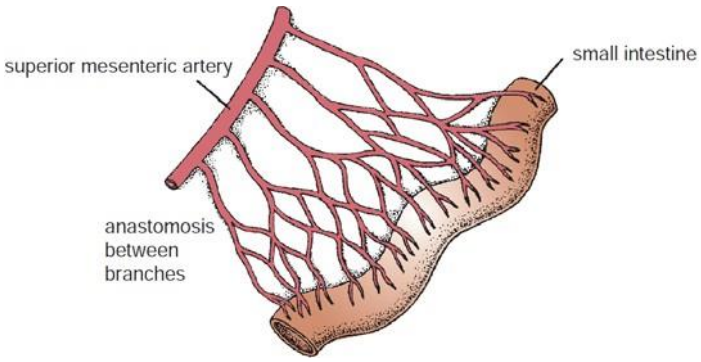


3. **Elastic cartilage** possesses large numbers of elastic fibers embedded in matrix. As would be expected, it is flexible and is found in the auricle of the ear, the external auditory meatus, the auditory tube, and the epiglottis. Hyaline cartilage and fibrocartilage tend to calcify or even ossify in later life.

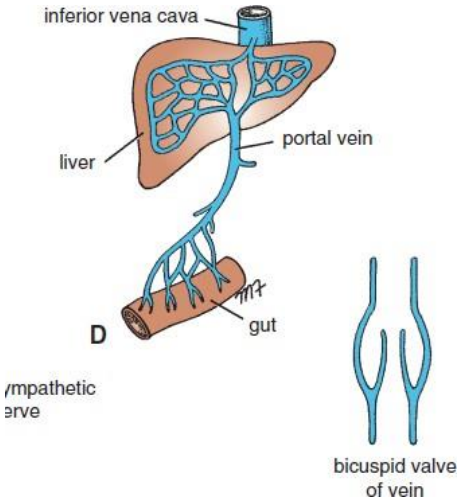
Blood Vessels

Blood vessels are of three types: arteries, veins, and capillaries.

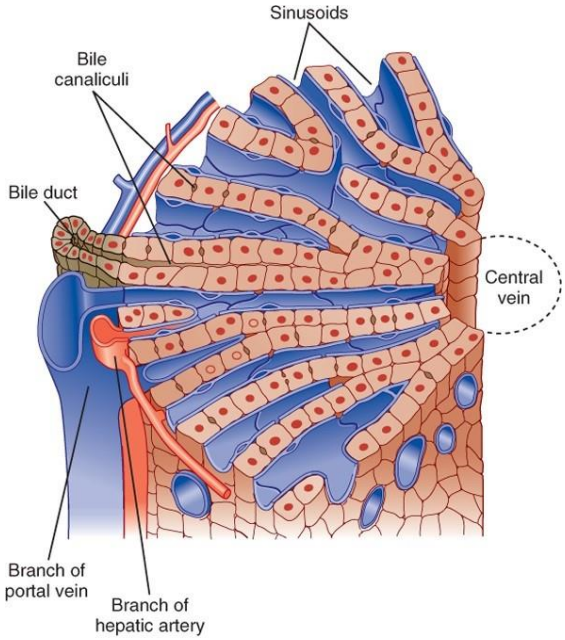
1. **Arteries** transport blood from the heart and distribute it to the various tissues of the body by means of their **branches**. The smallest arteries,<0.1 mm in diameter, are referred to as **arterioles.** The joining of branches of arteries is called an **anastomosis.** Arteries do not have valves.



2. **Veins** are vessels that transport blood back to the heart; many of them possess valves. The smallest veins are called **venules**. The smaller veins, or **tributaries,** unite to form larger veins, which commonly join with one another to form **venous plexuses.** Veins leaving the gastrointestinal tract do not go directly to the heart but converge on the **portal vein;** this vein enters the liver and breaks up again into veins of diminishing size, which ultimately join capillary-like vessels, termed **sinusoids,** in the liver. A **portal system** is thus a system of vessels interposed between two capillary beds.



3. **Capillaries** are microscopic vessels in the form of a network connecting the arterioles to the venules. **Sinusoids** resemble capillaries in that they are thin walled blood vessels, but they have an irregular cross diameter and are wider than capillaries. They are found in the bone marrow, the spleen, the liver, and some endocrine glands.



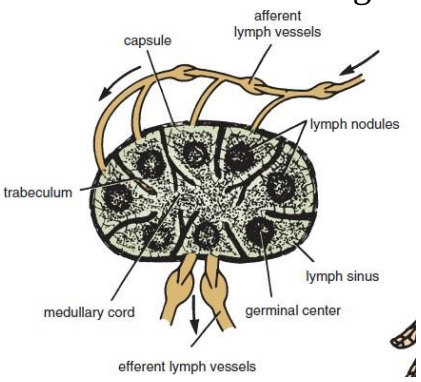
Lymphatic System

The lymphatic system consists of lymphatic tissues, lymphatic vessels, and lymph.

- **Lymphatic tissues** are a type of connective tissue that contains large numbers of lymphocytes. 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. The lymphatic system is essentially a drainage system, and there is no circulation.

Lymph is the name given to tissue 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. Before lymph is returned to the bloodstream, it passes through at least one **lymph node** and often through several. The lymph vessels that carry lymph to a lymph node are referred to as **afferent** vessels; those that transport it away from a node are **efferent** vessels.



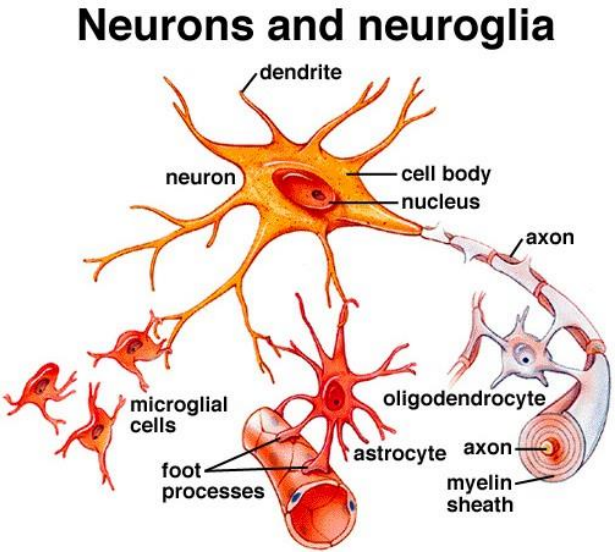
At the root of the neck the lymph reaches the bloodstream by large lymph vessels called the **right lymphatic duct** and the **thoracic duct**.

Nervous System

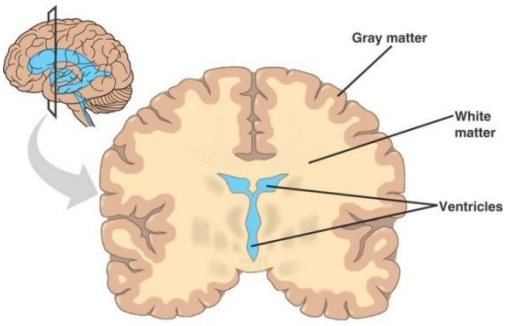
The nervous system is divided into two main parts: the **central nervous system,** which consists of the brain and spinal cord, and the **peripheral nervous system,** which consists of 12 pairs of cranial nerves and 31 pairs of spinal nerves and their associated ganglia. Functionally, the nervous system can be further divided into the **somatic nervous system,** which controls voluntary activities, and the **autonomic nervous system,** which controls involuntary activities. The nervous system, together with the endocrine system, controls and integrates the activities of the different parts of the body.

❖ Central Nervous System

The central nervous system (which consists of the brain and spinal cord) is composed of 2 major cell types; the neuron and the neuroglia. **Neuron** represent the structural and functional cells in the nervous system consist of nerve cells and their processes, **neuroglia** supporting nervous tissue for neurons. The Neurons have 2 types of processes that extend from the nerve cell body, called **dendrites** and an **axon.** Dendrites are the short processes of the cell body that carries nerve impulses toward the nerve cell body; neurons may have multiple dendrites; the axon is the longest process of the cell body that carries nerve impulses away from the nerve cell body; neurons can have only 1 axon.



The interior of the central nervous system is organized into gray and white matter. **Gray matter** consists of nerve cells embedded in neuroglia. **White matter** consists of nerve fibers (axons) embedded in neuroglia.



❖ Peripheral Nervous System

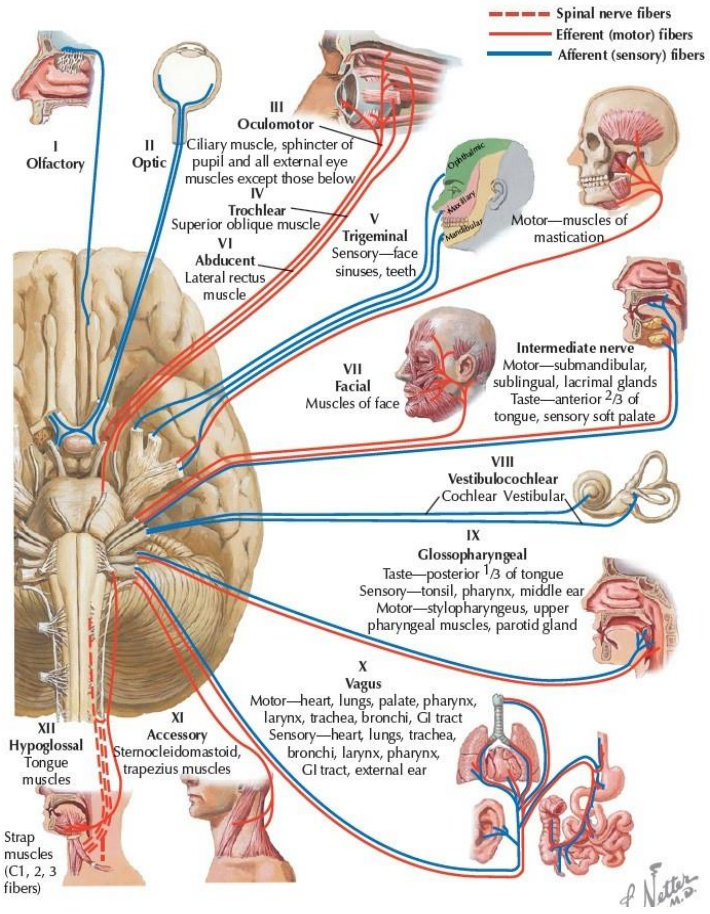
The peripheral nervous system consists of the cranial and spinal nerves and their associated ganglia. On dissection, the cranial and spinal nerves are seen as grayish white cords. They are made up of bundles of nerve fibers (axons) supported by delicate areolar tissue.

▪ Cranial Nerves

There are 12 pairs of cranial nerves that leave the brain and pass through foramina in the skull. All the nerves are distributed in the head and neck except the Xth (vagus), which also supplies structures in the thorax and abdomen.

The cranial nerves are named as follows:

I. Olfactorynerve – sensory for smell
II. Opticnerve – sensory for vision
III. Oculomotornerve – motor fibers to eye muscles
IV. Trochlearnerve – motor fibers to eye muscles
V. Trigeminalnerve – sensory for the face; motor fibers to chewing muscles
VI. Abducentnerve – motor fibers to eye muscles
VII. Facialnerve – sensory for taste; motor fibers to the face
VIII. Vestibulocochlearnerve – sensory for balance and hearing
IX. Glossopharyngealnerve – sensory for taste; motor fibers to the pharynx
X. Vagusnerve – sensory and motor fibers for pharynx, larynx, and viscera
XI. Accessorynerve – motor fibers to neck and upper back
XII. Hypoglossalnerve – motor fibers to tongue



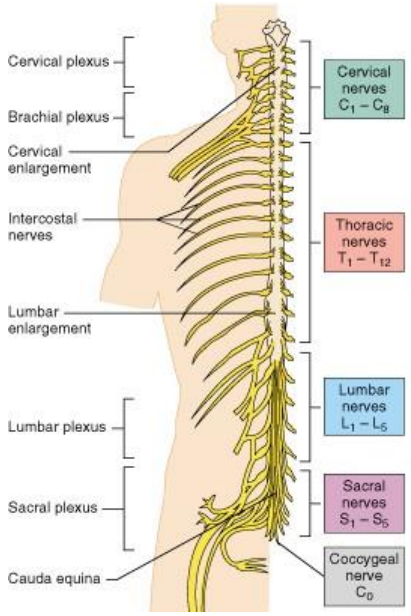
The olfactory, optic, and vestibulocochlear nerves are entirely sensory; the oculomotor, trochlear, abducent,accessory, and hypoglossal nerves are entirely motor;andthe remaining nerves are mixed.

Note: each cranial nerve (CN) has its specific number (No.) e.g. CN I is Olfactory nerve.

- **Spinal Nerves**

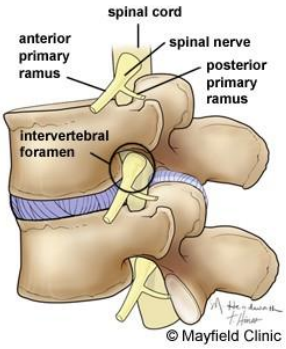
A total of 31 pairs of spinal nerves leave the spinal cord and pass through intervertebral foramina in the vertebral column. The spinal nerves are named according to the region of the vertebral column with which they are associated:

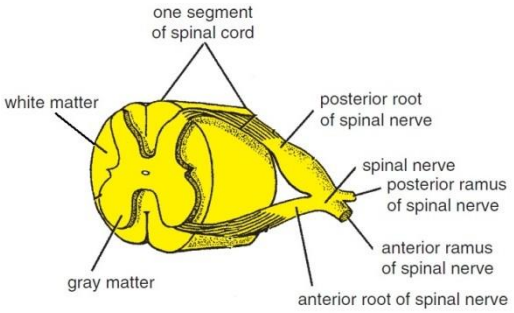
8 cervical (C1-C8), 12thoracic (T1-T12), 5 lumbar (L1-L5), 5 sacral (S1-S5), and **1coccygeal (Co).**



Each spinal nerve is connected to the spinal cord by two roots: the **anterior root** and the **posterior root**. The *anterior root* consists of bundles of nerve fibers carrying nerve impulses away from the central nervous system. Such nerve fibers are called **efferent** fibers. Those efferent fibers that go to skeletal muscle and cause them to contract are called **motor fibers.** The *posterior root* consists of bundles of nerve fibers that carry impulses to the central nervous system and are called **afferent** fibers. Because these fibers are concerned with conveying information about sensations of touch, pain, temperature, and vibrations, they are called **sensory fibers.** At each intervertebral foramen, the anterior and posterior roots unite to form a **spinal nerve**. Here, the motor and sensory fibers become mixed together, so that a spinal nerve is made up of a mixture of motor and sensory fibers.

On emerging from the foramen, the spinal nerve divides into a large **anterior ramus** and a smaller **posterior ramus.** The posterior ramus passes posteriorly around the





vertebral column to supply the **muscles and skin of the back**. The anterior ramus continues anteriorly to supply the **muscles and skin over the anterolateral body wall** and all the **muscles and skin of the limbs**.

Plexuses

At the root of the limbs, the anterior rami join one another to form complicated nerve plexuses. The **cervical** and **brachial plexuses** are found at the root of the upper limbs, and the **lumbar** and **sacral plexuses** are found at the root of the lower limbs (as shown in previous diagram).

❖ Autonomic Nervous System

The autonomic nervous system is the part of the nervous system concerned with the innervation of involuntary structures such as the heart, smooth muscle, and glands throughout the body and is distributed throughout the central and peripheral nervous system.

The autonomic system may be divided into two parts—the **sympathetic** and the **parasympathetic**—and both parts have afferent and efferent nerve fibers.

The hypothalamus of the brain controls the autonomic nervous system and integrates the activities of the autonomic and neuroendocrine systems, thus preserving homeostasis in the body.

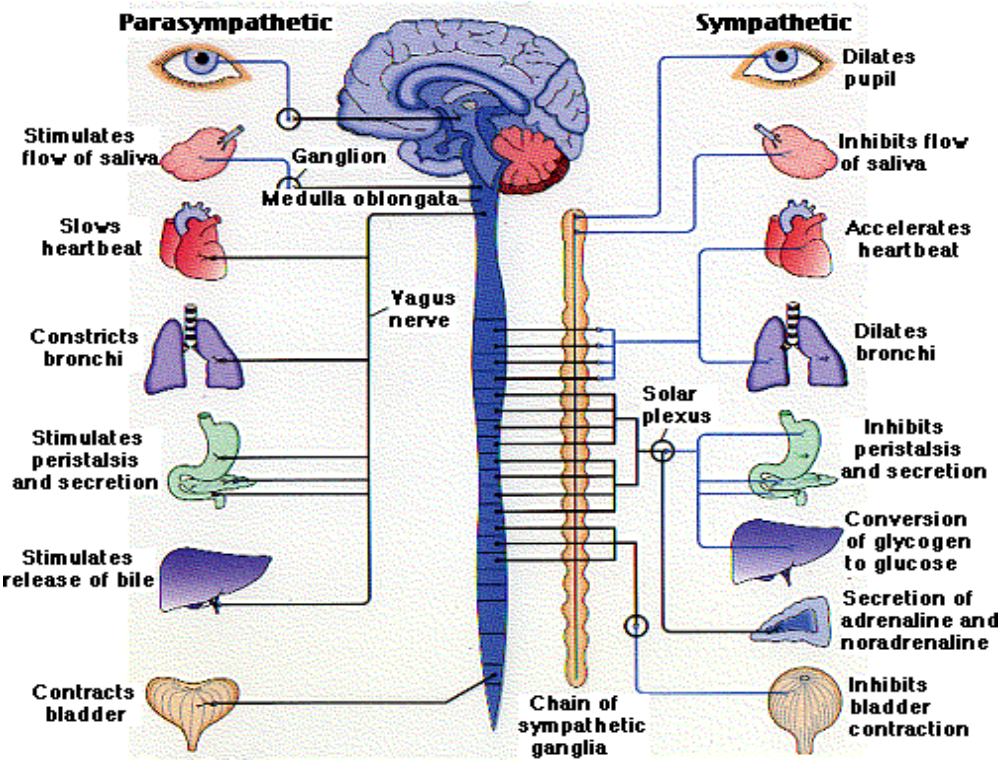
▪ Sympathetic System

The activities of the sympathetic part of the autonomic system prepares the body for action and an emergency—as in the "fight or flight" response—by increasing heart rate, respiration, blood pressure (by constriction of the peripheral blood vessels), and also increase blood flow to the brain, heart, and skeletal muscles; dilating the pupils; and it inhibits peristalsis of the intestinal tract "shutting down" visceral activity and closes the sphincters. Neurons of the sympathetic system originate in the intermedio lateral cell column of the spinal cord in the thoracic and upper lumbar segments (T1to L3). Thus, they are often referred to as the thoracolumbar outflow of visceral efferent fibers.

▪ Parasympathetic System

The activities of the parasympathetic part of the autonomic system aim at conserving and restoring energy and functionsto calm the body— as in "rest or digest"— by decreasing heart rate, respiration,and blood pressure; constricting the pupils; and increase peristalsis of the intestine "increasing visceral activity" and glandular activity, and open the sphincters. Neurons of the parasympathetic system originate either in the brain in certain nuclei of cranial nerves III, VII, IX, and X(cranial outflow) or in the sacral spinal cord from the intermediolateral cell column of spinal nerves S2–S4 (sacral outflow).Together, this system is known as the craniosacral outflow. Both systems (sympathetic and para sympathetic) innervate many organs of

the body where their antagonistic actions serve to balance functioning to maintain homeostasis.

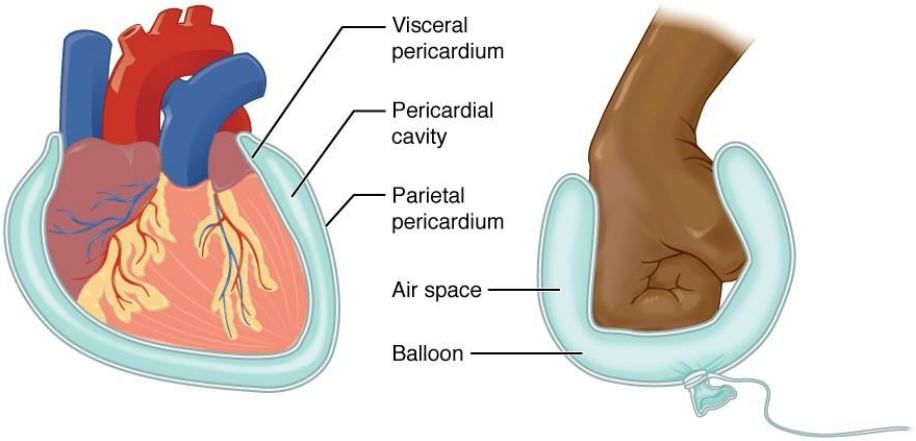


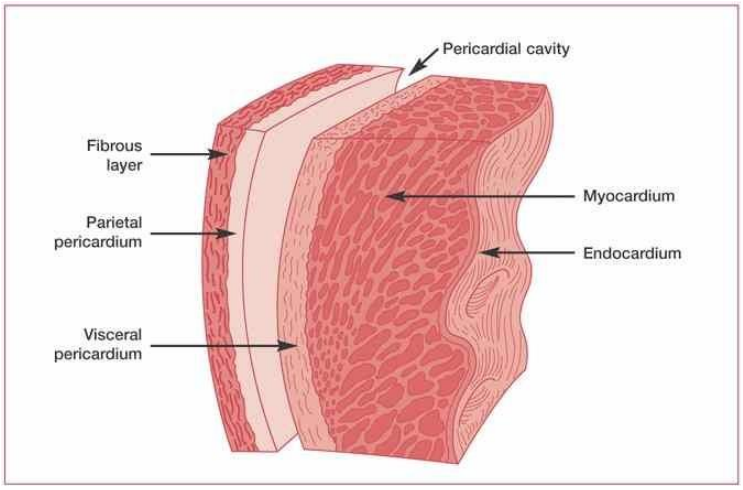
Mucous Membranes

Mucous membrane is the name given to the lining of organs or passages that communicate with the surface of the body. A mucous membrane consists essentially of a layer of epithelium supported by a layer of connective tissue (**lamina propria).** Smooth muscle, called the **muscularis mucosa,** is sometimes present in the connective tissue. A mucous membrane may or may not secrete mucus on its surface.

Serous Membranes

Serous membranes line the cavities of the trunk and are reflected onto the mobile viscera lying within these cavities. The serous membrane lining the wall of the cavity is referred to as the **parietal layer,** and that covering the viscera is called the **visceral layer.** The narrow, slitlike interval that separates these layers forms the **pleural, pericardial,** and **peritoneal cavities** and contains a small amount of serous liquid, the **serous exudate.** The serous exudate lubricates the surfaces of the membranes and allows the two layers to slide readily on each other.


Visceral pericardium
Pericardial cavity
Parietal pericardium
Air space
Balloon


Pericardial cavity
Fibrous layer
Parietal pericardium
Visceral pericardium
Myocardium
Endocardium

Skeletal system of the body

❖ Axial skeleton

- Skull

The skull is composed of several separate bones united at immobile joints called sutures. The connective tissue between the bones is called a sutural ligament. The mandible is an exception to this rule, for it is united to the skull by the mobile *temporomandibular joint.*

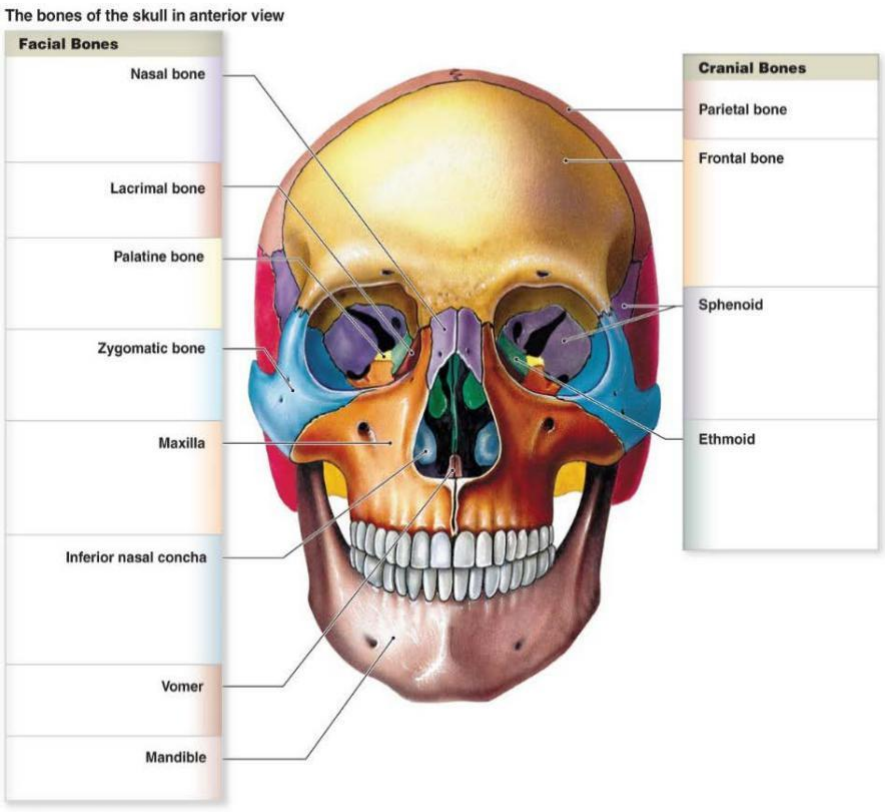
The skull is composed of 22 bones, 8 of these bones form the **cranium** (which contains the brain and meninges), and 14 of these form the **face**. The **vault** is the upper part of the cranium, and the **base of the skull** is the lowest part of the cranium.

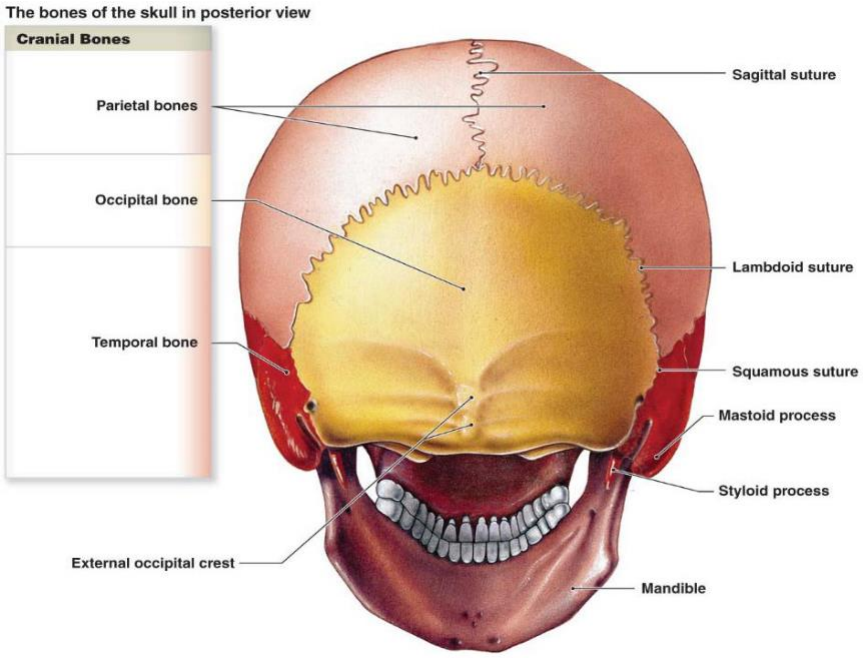
☒ **Cranium** consists of the following bones, two of which are paired :

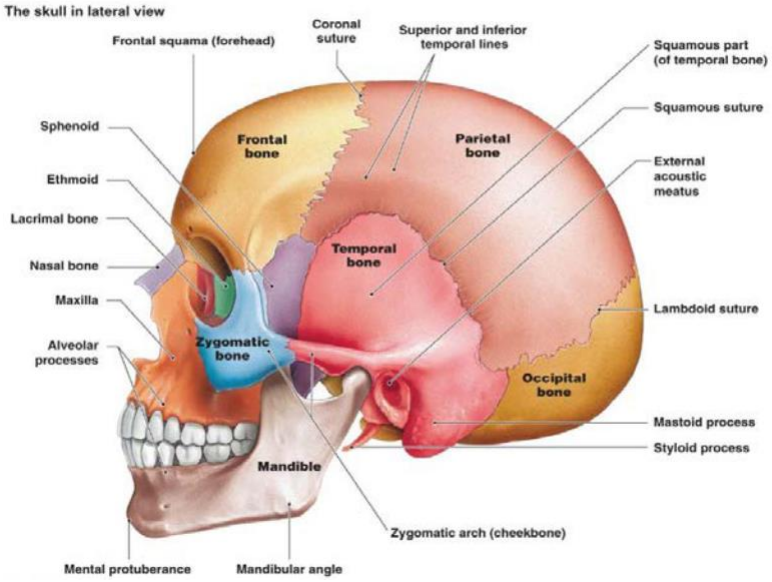
- Frontal bone: 1
- Parietal bones: 2
- Occipital bone: 1
- Temporal bones: 2
- Sphenoid bone: 1
- Ethmoid bone: 1

☒ **Facial** bones consist of the following, two of which are single:

- Zygomatic bones: 2
- Maxillae: 2
- Nasal bones: 2
- Lacrimal bones: 2
- Vomer: 1
- Palatine bones: 2
- Inferior conchae: 2
- Mandible: 1







☒ Cranium

1. **FRONTAL BONE**

➢ **Parts:**

1. <u>Squamous portion</u>

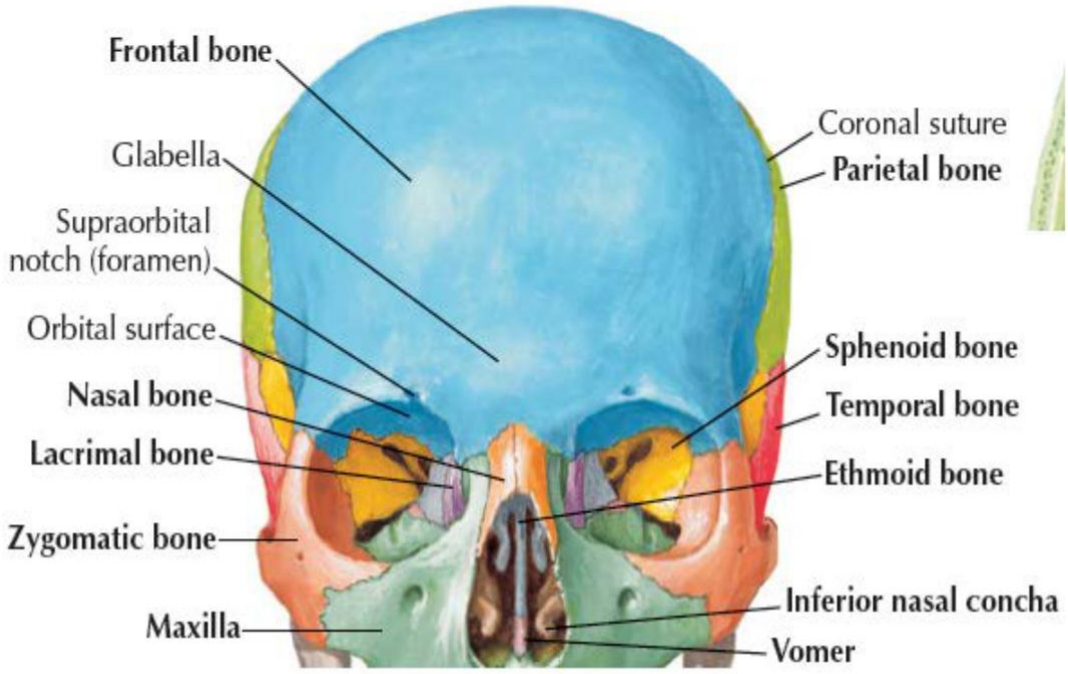
- The largest part of the frontal bone.
- Forms the majority of the forehead.
- The zygomatic process of the frontal bone extends from the posterior part of the supra orbital margin.
- Contains the frontal paranasal sinuses.
- Has supraorbital notch or foramen

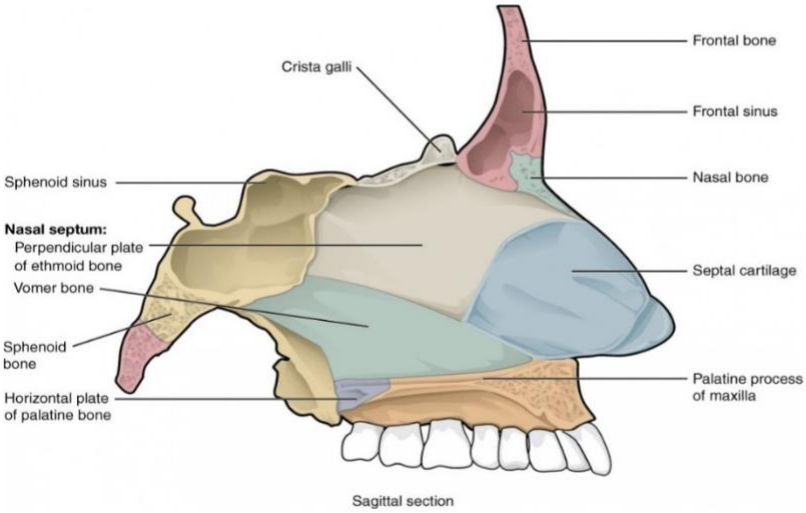
2. Orbital portion

- Forms the roof of the orbit and floor of the anterior cranial fossa.

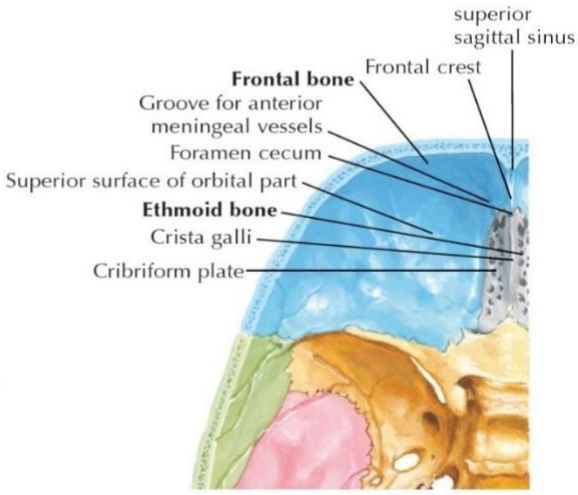
3. Nasal portion

- Articulates with the nasal bones and the frontal process of the maxilla to form the root of the nose.





Sagittal section



Borders	Coronal suture separates it from the parietal bone Sphenofrontal suture separates it from the sphenoid bone Zygomaticofrontal suture separates it from the zygomatic bone Nasofrontal suture separates it from the nasal bone Frontomaxillary suture separates it from the maxilla
Articulations	Twelve bones: the sphenoid, the ethmoid, two parietals, two nasals, two maxillae, two lacrimals, two zygomatics

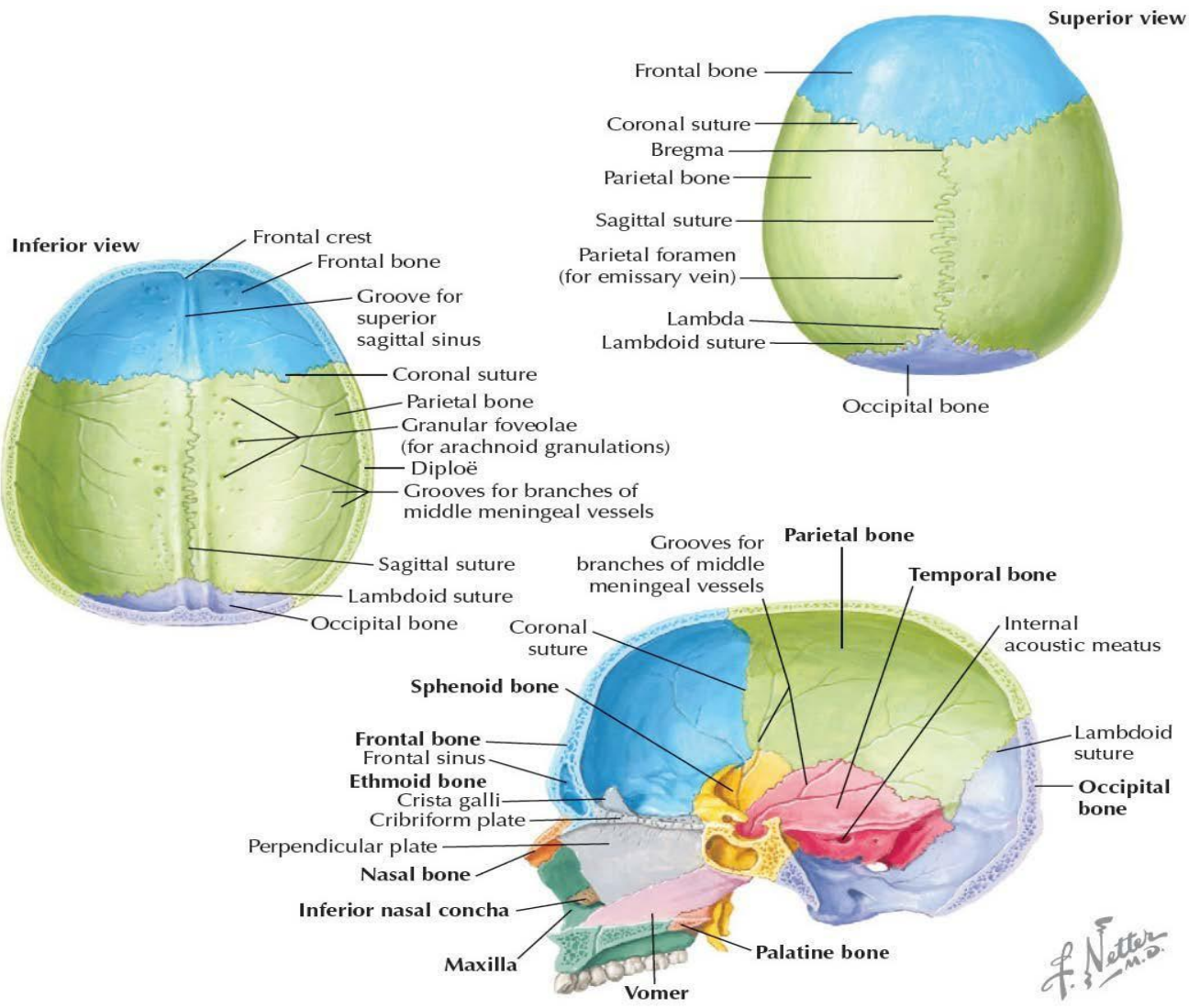
2. PARIETAL BONE

➢ Characteristics

- Forms the majority of the cranial vault
- The four corners of the parietal are not ossified at birth and give rise to the fontanelles.
- There are 2 parietal bones.
- Relatively square, forming the roof and sides of the cranial vault.
- Endocranial surface is filled with grooves made by branches of the middle meningeal artery.
- Has parietal foramen

➢ **Parts:** Has 4 angles

1. Frontal— located at <u>bregma</u>.
2. Sphenoid— located at <u>pterion</u>.
3. Occipital— located at <u>lambda</u>.
4. Mastoid— located at <u>asterion</u>.



Borders

The two parietal bones meet each other in the midline of the skull roof forming a serrated margin known as the sagittal suture. Apart from its opposite counterpart, each parietal bone is surrounded by four other bones:

- anteriorly it borders with the frontal bone (→coronal suture)
- posteriorly with the occipital bone (→ lambdoid suture)
- laterally it comes in contact with the temporal bone (→squamosal suture) and sphenoid bone (→ sphenoparietal suture)

3. OCCIPITAL BONE

➢ Characteristics

- Forms the posteriorpart of the cranial vault.
- Articulates with the atlas.
- There is 1 occipital bone.

➢ Parts:

1. Squamous portion

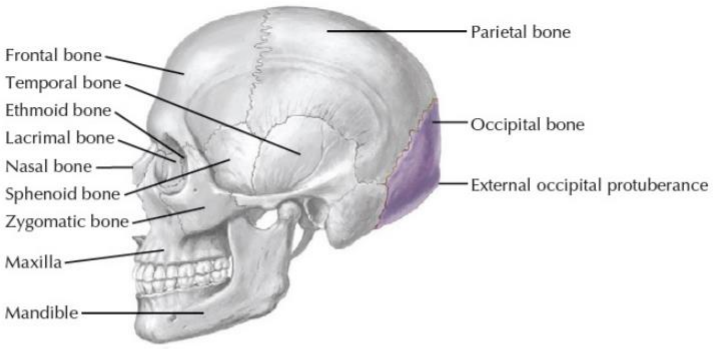
- Articulates with the temporal and parietal bones by occipitomastiod and lambdoid sutures
- The largest portion of the occipital bone.
- Located posterior and superior to the foramen magnum.
- Has the external occipital protuberance (more pronounced in males).
- Has the superior and the inferior nuchal lines.
- Has grooves on the internal surface for 3 of the sinuses forming the confluence of the sinuses (the superior sagittal and the right and left transverse sinuses)
- The depression superior to the transverse sinus is for the occipital lobes of the brain.
- The depression inferior to the transverse sinus is for the cerebellum.

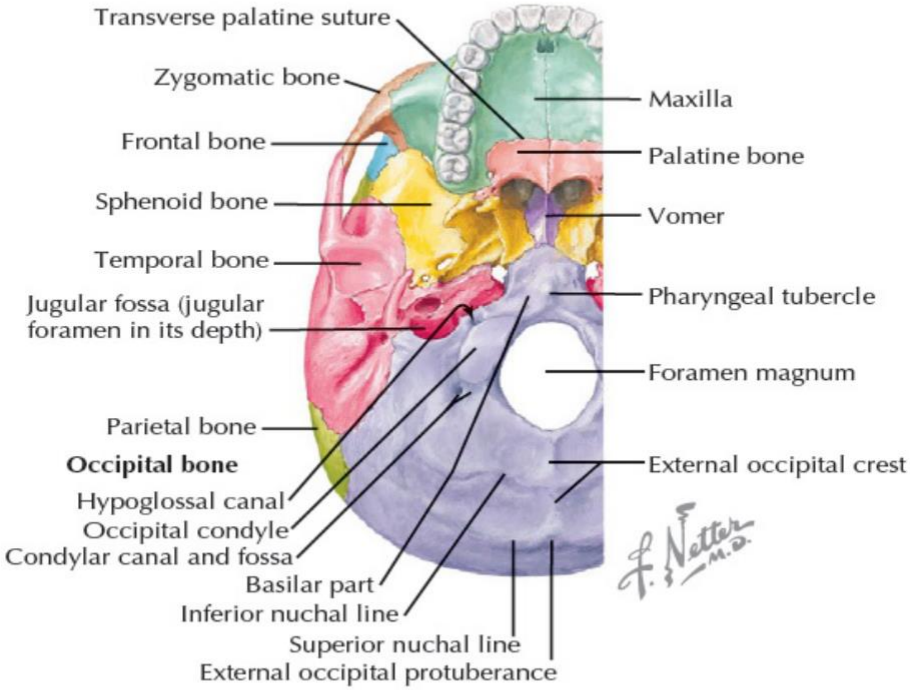
2. Lateral portion

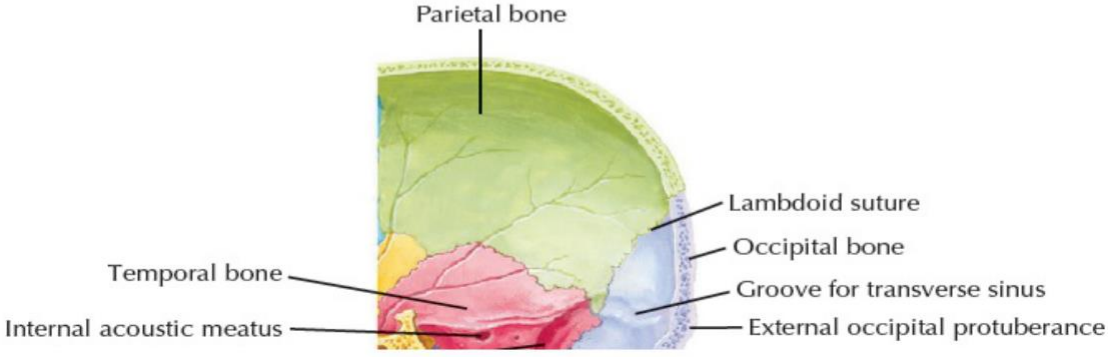
- Articulates with the temporal bone.
- It is the portion lateral to the foramen magnum.
- Has the occipital condyles that articulate with the atlas.
- Contains the hypoglossal canal.
- Forms a portion of the jugular foramen.

3. Basilar portion

- Articulates with the petrous partof the temporal and the sphenoid bones.
- It is the portion immediately anterior to the foramen magnum.
- Pharyngeal tubercle is part of the basilar portion that provides attachment for the superior constrictor muscle.
- Internal surface of the basilar portion is called the **clivus**, and part of the brainstem lies against it.







4. TEMPORAL BONE

➢ Characteristics

- Help form the base and the lateral walls of the skull.
- House the auditory and vestibular apparatuses.
- Contain mastoid air cells.
- There are 2 temporal bones.

➢ Parts:

1. <u>Squamous part:</u>

- The largest portion of the bone.
- Three portions to the squamous part:

☒ Temporal

- Temporal portion is the thin large area on the squamous part of the temporal.
- On the internal surface of the temporal portion lies a groove for the middle meningeal artery.

☒ Zygomatic process

- The zygomatic process extends laterally and anteriorly from the squamous portion; it articulates with the temporal process of the zygomatic bone to make the <u>zygomatic arch.</u>

☒ Glenoid fossa

- Glenoid fossa is inferior and medial to the zygomatic process; it articulates with the mandibular condyle, forming the temporomandibular joint

2. <u>Petrous part:</u>

- Forms the solid portion of bone.
- The auditory and vestibular apparatuses are located within the petrous part.
- Helps separate the temporal and the occipital lobes of the brain.
- It extends anteriorly and medially.
- The medial part articulates with the sphenoid bone to form the foramen lacerum.
- Internal acoustic meatus is observed on the medial side of the petrous part.
- Carotid canal lies on the inferior part of the petrous part.
- Petrotympanic fissure lies between the petrous part of the temporal bone and the tympanic part of the temporal bone.
- On the posterior inferior surfaceof the petrous part lies the jugular fossa.

3. <u>mastoid part</u> :

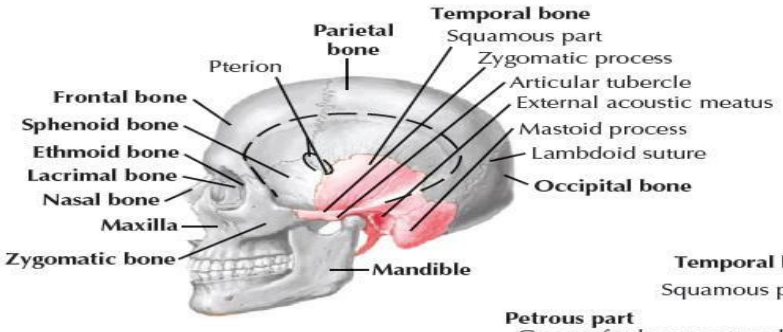
- extends posteriorly and has large mastoid air cells.
- superior serrated edge for the articulation with the mastoid angle of the parietal bone, posterior also serrated for articulation with the inferior border of the occipital bone, anterior fused with the squamous part.

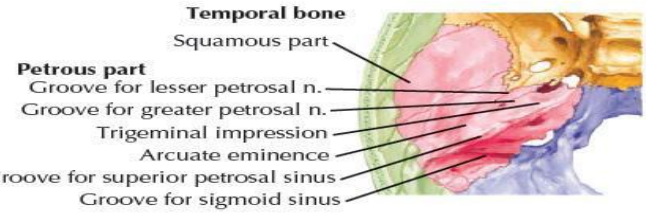
4. <u>Tympanic part:</u>

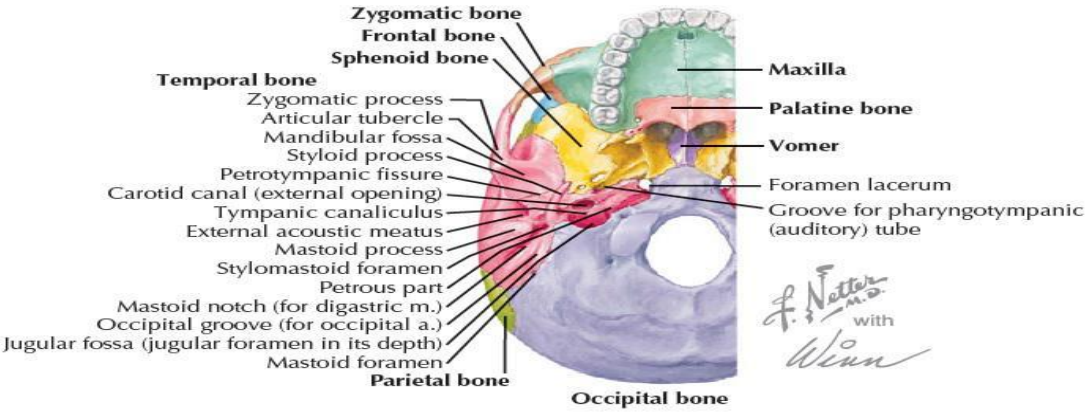
- A plate of bone forming the anterior,posterior, and inferior portions of the external acoustic meatus.
- Anterior part forms the posterior portion of the glenoid fossa

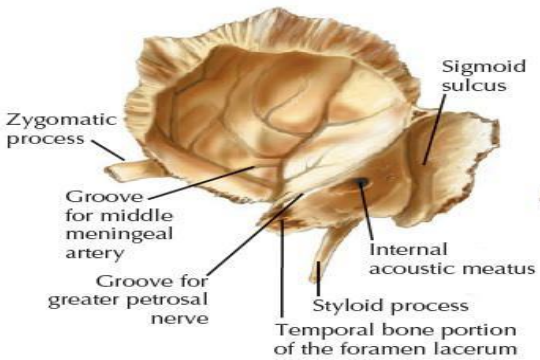
5. <u>Styloid process</u>:

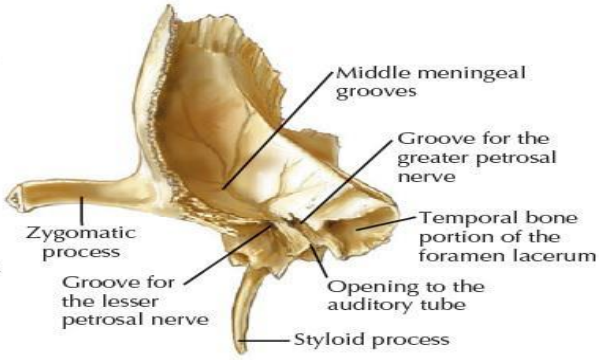
- A projection from the temporal bone.
- The stylomastoid foramen lies posterior to this process.











5. SPHENOID BONE

➢ **Characteristics**

- Forms the majority of the middle portion of the cranial base.
- Forms the majority of the middle cranial fossa.
- Contains the sphenoid paranasal sinus.
- There is 1 sphenoid bone.

➢ **Parts**

1. Body:

- The center of the sphenoid
- Superior part of the body, known as the sella turcica, is saddle-shaped and possesses the anterior and posterior clinoid processes.
- Hypophyseal fossa, the deepest part of the sella turcica, houses the pituitary gland.
- Dorsum sellae is a square-shaped part of the bone that lies posterior to the sella turcica.
- Clivus is the portion that slopes posterior to the body.
- Body contains the sphenoid paranasal sinuses.
- Optic canal is found in the body of the sphenoid.

2. Greater wing:

- Extends laterally and anteriorly from the posterior portion of the body of the sphenoid.
- Helps form a large part of the middle cranial fossa.
- Anterior portion lies in the orbit.
- Contains 3 foramina:

✓ Foramen spinosum.
✓ Foramen rotundum.
✓ Foramen ovale.

3. Lesser wing:

- Extends laterally and anteriorly from the superior portion of the sphenoid body.
- Separated from the greater wing by the superior orbital fissure.

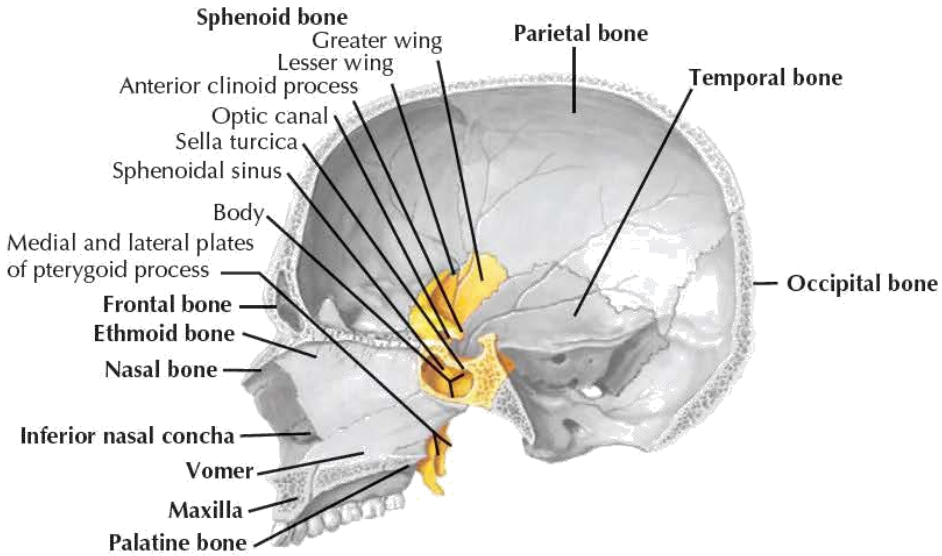
4. Pterygoid process:

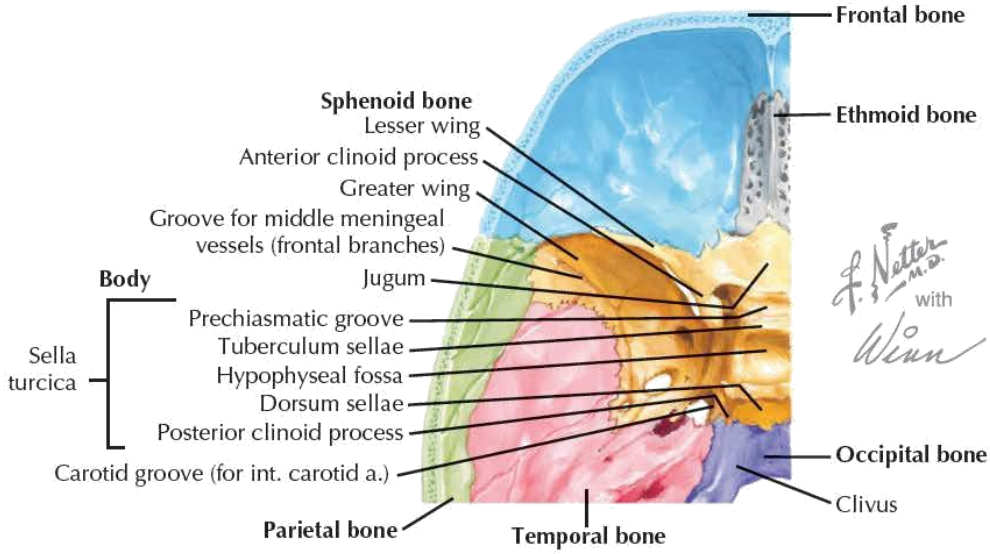
- Arises from the inferior surface of the body.
- There are 2 pterygoid processes each has a:

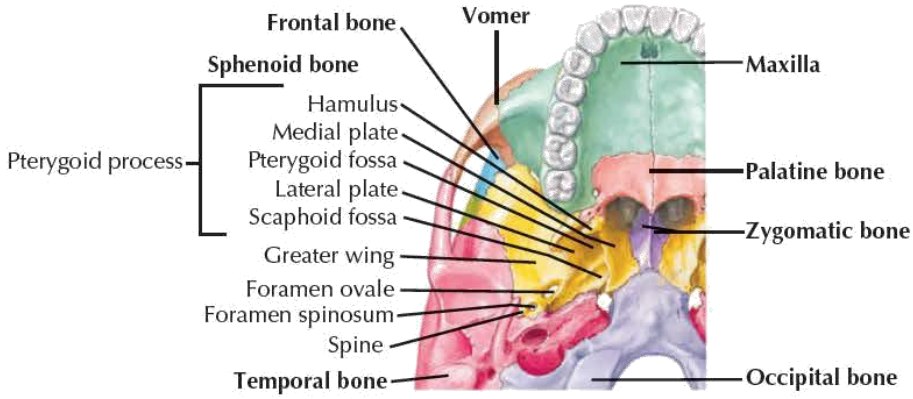
✓ Lateral pterygoid plate.
✓ Medial pterygoid plate.

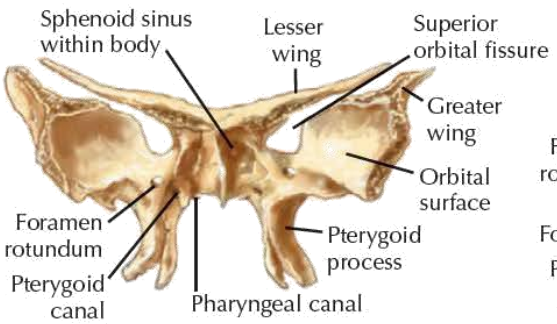
- Pterygoid hamulus extends from the medial pterygoid plate.
- Two canals are associated with the pterygoid process:

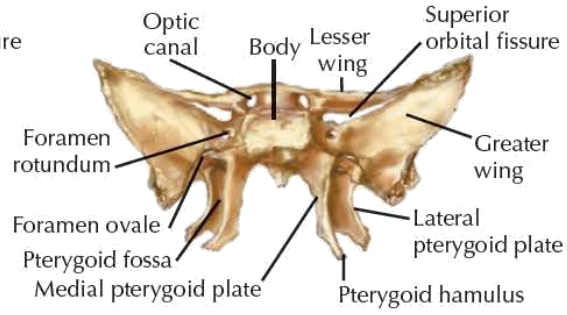
✓ Pterygoid canal.
✓ Pharyngeal canal.


Sphenoid bone
Greater wing
Lesser wing
Anterior clinoid process
Optic canal
Sella turcica
Sphenoidal sinus
Body
Medial and lateral plates of pterygoid process
Frontal bone
Ethmoid bone
Nasal bone
Inferior nasal concha
Vomer
Maxilla
Palatine bone
Parietal bone
Temporal bone
Occipital bone


Frontal bone
Sphenoid bone
Lesser wing
Anterior clinoid process
Greater wing
Groove for middle meningeal vessels (frontal branches)
Body
Jugum
Sella turcica
Prechiasmatic groove
Tuberculum sellae
Hypophyseal fossa
Dorsum sellae
Posterior clinoid process
Carotid groove (for int. carotid a.)
Parietal bone
Temporal bone
Ethmoid bone
Occipital bone
Clivus
F. Netter M.D.
with


Frontal bone
Vomer
Sphenoid bone
Maxilla
Hamulus
Medial plate
Pterygoid process
Pterygoid fossa
Lateral plate
Palatine bone
Scaphoid fossa
Zygomatic bone
Greater wing
Foramen ovale
Foramen spinosum
Spine
Temporal bone
Occipital bone


Sphenoid sinus within body
Lesser wing
Superior orbital fissure
Greater wing
Orbital surface
Foramen rotundum
Pterygoid process
Pterygoid canal
Pharyngeal canal


Optic canal
Body
Lesser wing
Superior orbital fissure
Foramen rotundum
Greater wing
Foramen ovale
Lateral pterygoid plate
Pterygoid fossa
Medial pterygoid plate
Pterygoid hamulus

6. ETHMOID BONE

➢ **Characteristics**

- A porous bone that forms the major portion of the middle part of the face **between the orbits.**
- Helps form the orbit, nasal cavity, nasal septum, and anterior cranial fossa.
- There is 1 ethmoid bone

➢ **Parts:**

1. Perpendicular plate

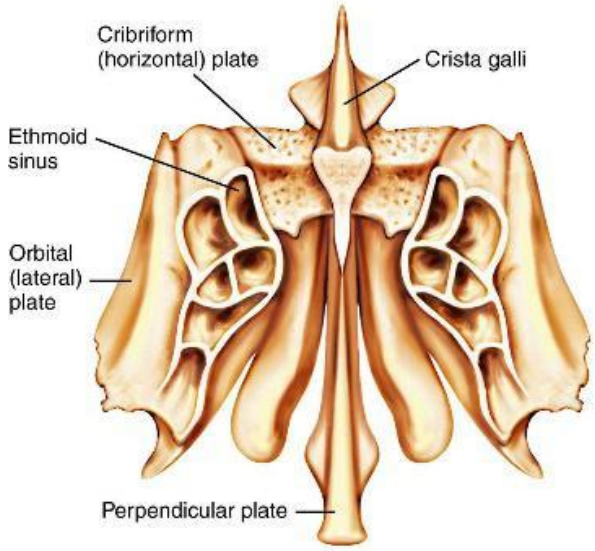
- A flat plate that descends from the cribriform plate to form part of the nasal septum.
- Articulates with the vomer inferiorly.

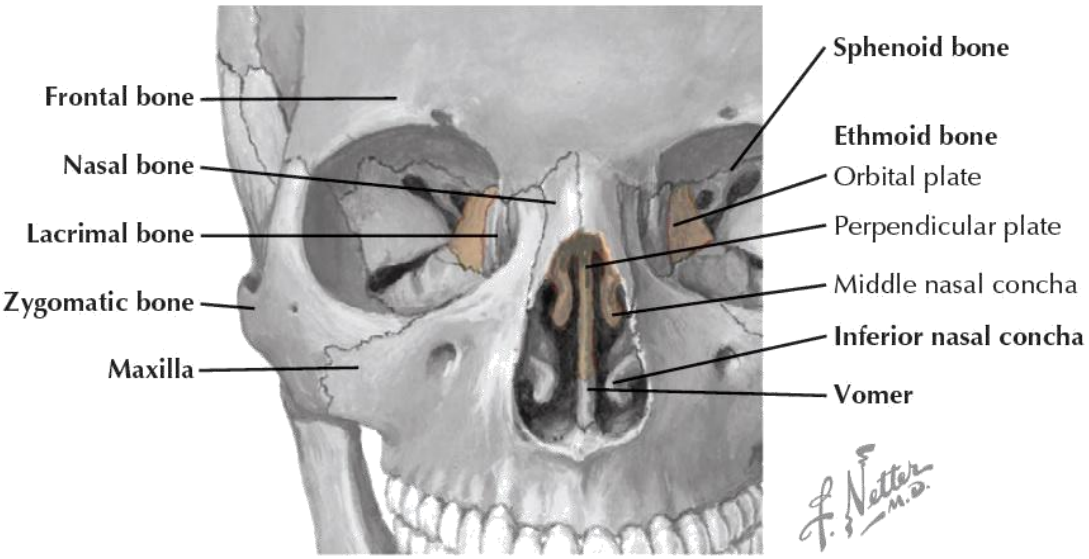
2. Cribriform plate

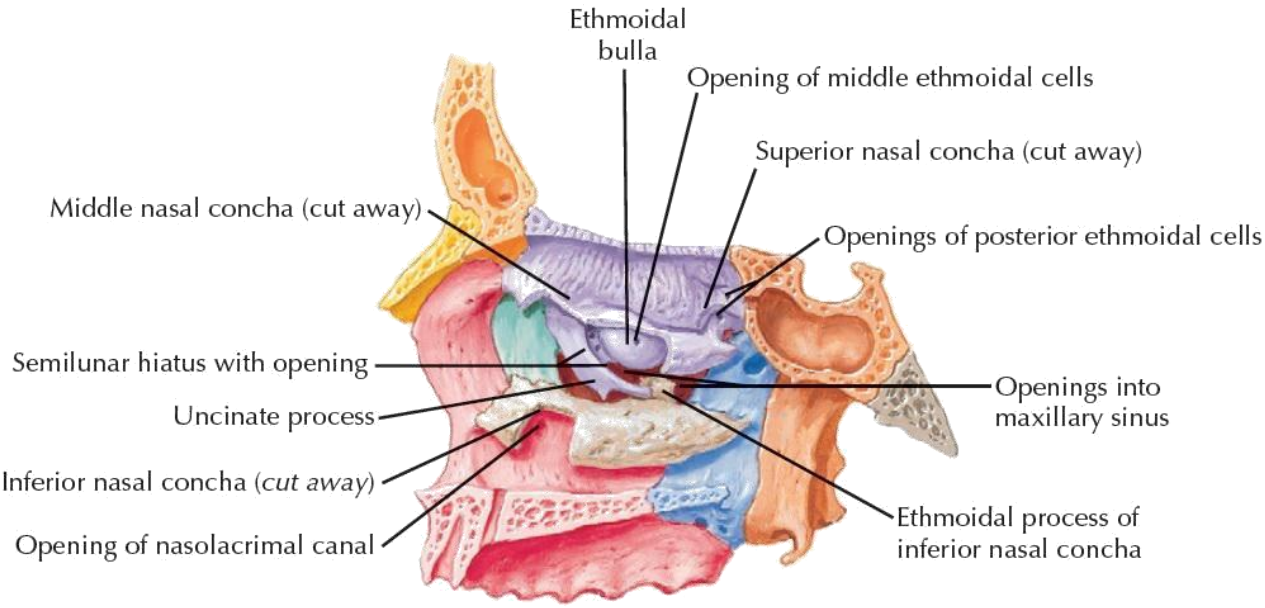
- A horizontal bone that forms the superior surface of the ethmoid and it contains numerous foramina for the olfactory nerve.
- Crista galli is a vertical plate that extends superiorly from the cribriform plate
- Associated with a small foramen cecum, anterior and posterior ethmoidal foramina .

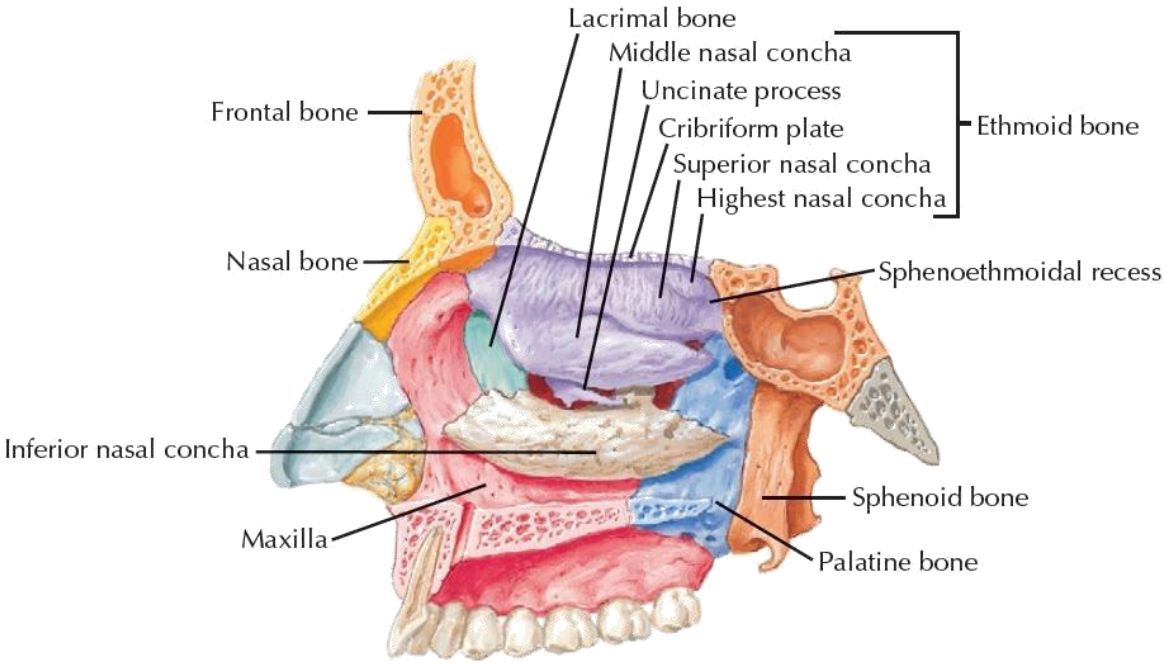
3. Ethmoid labyrinth

- The largest part of the ethmoid bone.
- Descends inferiorly from the cribriform plate.
- Ethmoid paranasal sinuses are located within the ethmoid labyrinth.
- Ethmoid labyrinth forms 2 major structures within the nasal cavity:
  - ✓ Superior nasal concha.
  - ✓ Middle nasal concha.
- Ethmoid bulla is the large elevation of bone located by the middle ethmoid paranasal sinuses.
- Uncinate process is a curved piece of bone.
- Between the uncinate process and the ethmoid bulla is the hiatus semilunaris.




Frontal bone
Nasal bone
Lacrimal bone
Zygomatic bone
Maxilla
Sphenoid bone
Ethmoid bone
Orbital plate
Perpendicular plate
Middle nasal concha
Inferior nasal concha
Vomer
F. Netter M.D.


Ethmoidal bulla
Opening of middle ethmoidal cells
Superior nasal concha (cut away)
Middle nasal concha (cut away)
Openings of posterior ethmoidal cells
Semilunar hiatus with opening
Openings into maxillary sinus
Uncinate process
Inferior nasal concha (cut away)
Ethmoidal process of inferior nasal concha
Opening of nasolacrimal canal


Lacrimal bone
Middle nasal concha
Uncinate process
Cribriform plate
Superior nasal concha
Highest nasal concha
Ethmoid bone
Frontal bone
Nasal bone
Sphenoethmoidal recess
Inferior nasal concha
Sphenoid bone
Maxilla
Palatine bone

Facial bones

1. ZYGOMATIC BONE (ZYGOMA)

➢ Characteristics

- Forms the majority of the skeleton of the cheek.
- Provides attachment of the masseter muscle.
- Three foramina in the zygoma:
  - ✓ Zygomatico-orbital foramen.
  - ✓ Zygomaticofacial foramen.
  - ✓ Zygomaticotemporal foramen.
- There are 2 zygomatic bones.

➢ Parts:

1. Frontal process

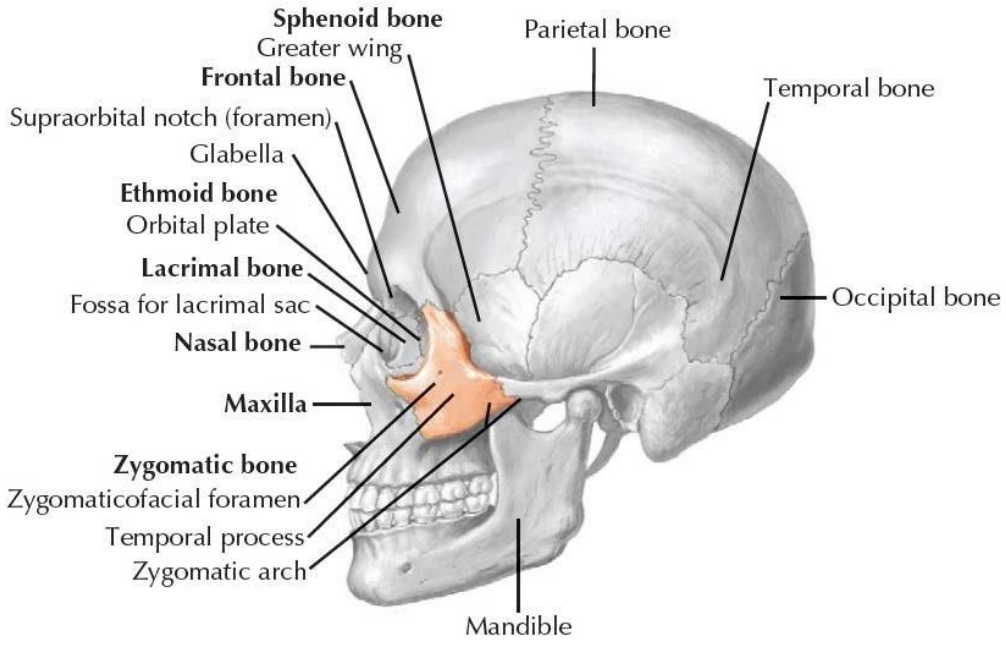
- Articulates with the frontal bone to help form the orbit.

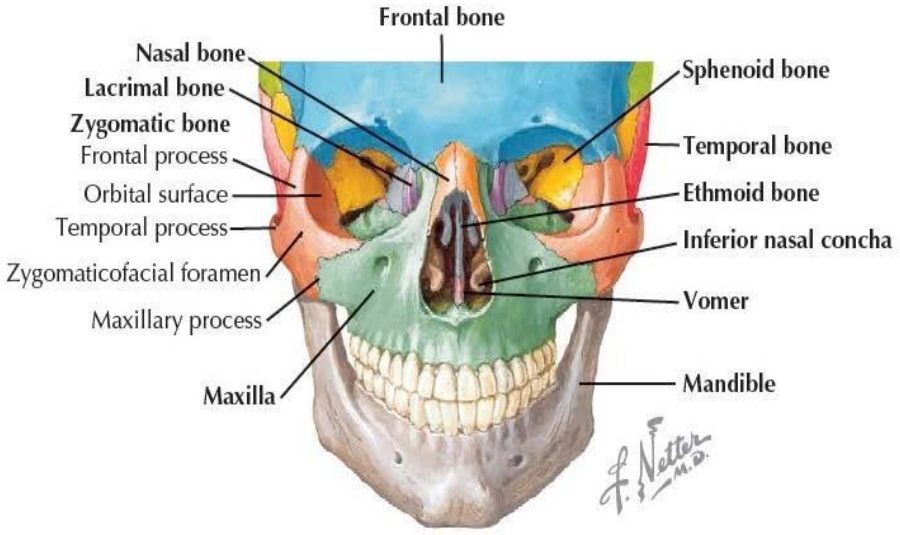
2. Temporal process

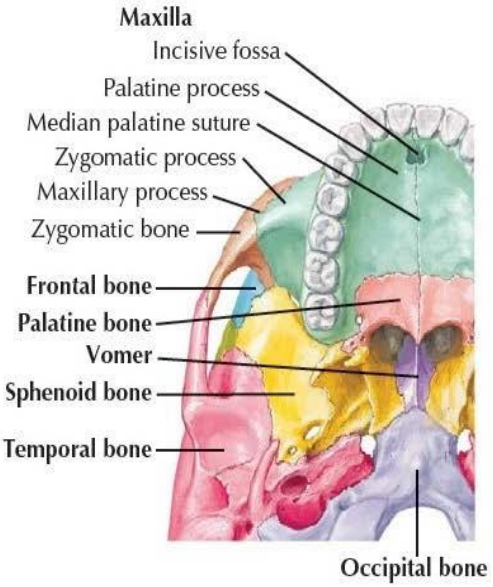
- Articulates with the zygomatic process of the temporal bone to form the zygomatic arch.

3. Maxillary process

- Articulates with the zygomatic process of the maxillary bone to help form the orbit.







2. MAXILLARY BONES (MAXILLA)

➢ Characteristics

- Forms the majority of the skeleton of the face and the upper jaw.
- Contains the maxillary paranasal sinus.
- Articulates with the opposite maxilla and the frontal, nasal, vomer, and ethmoid bones; inferior nasal concha; palatine, lacrimal, and zygomatic bones; and the septal and nasal cartilages
- There are 2 maxilla bones (maxillae)

Parts:

1. Body

- Major part of the bone
- Shaped like a pyramid
- Contains the maxillary paranasal sinus
- Infraorbital canal and foramen pass from the orbit region to the face region

2. Frontal process

- Extends superiorly to articulate with the nasal, frontal, ethmoid, and lacrimal bones
- Forms the anterior boundary of the lacrimal fossa

3. Zygomatic process

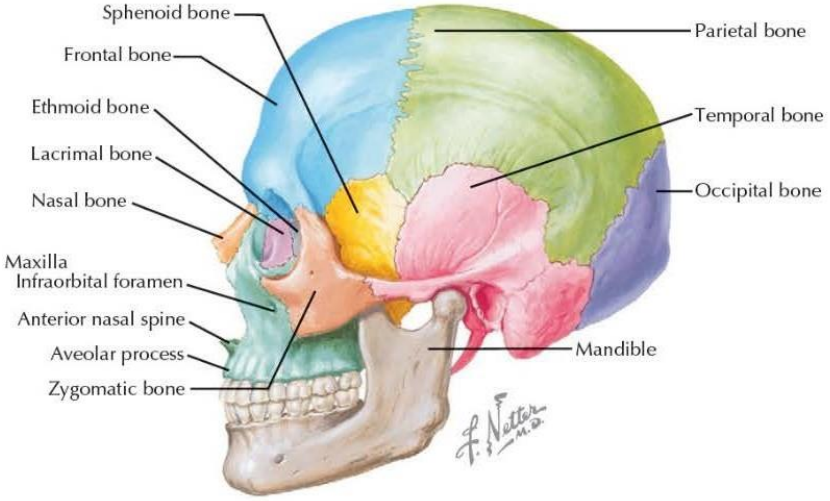
- Extends laterally to articulate with the maxillary process of the zygomatic bone

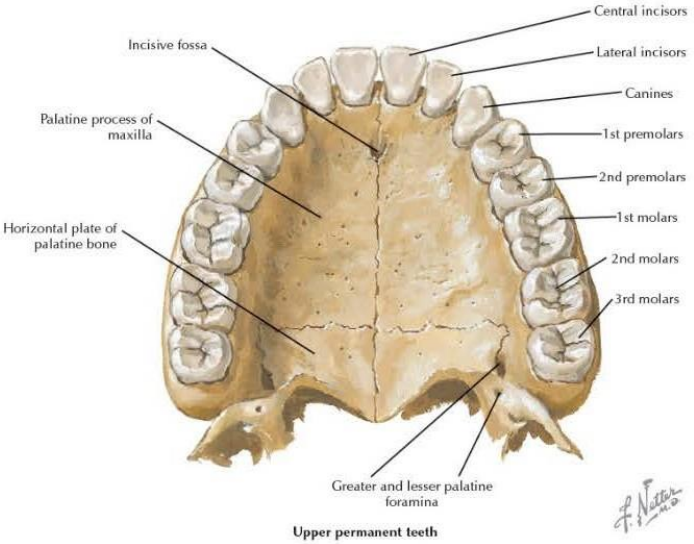
4. Palatine process

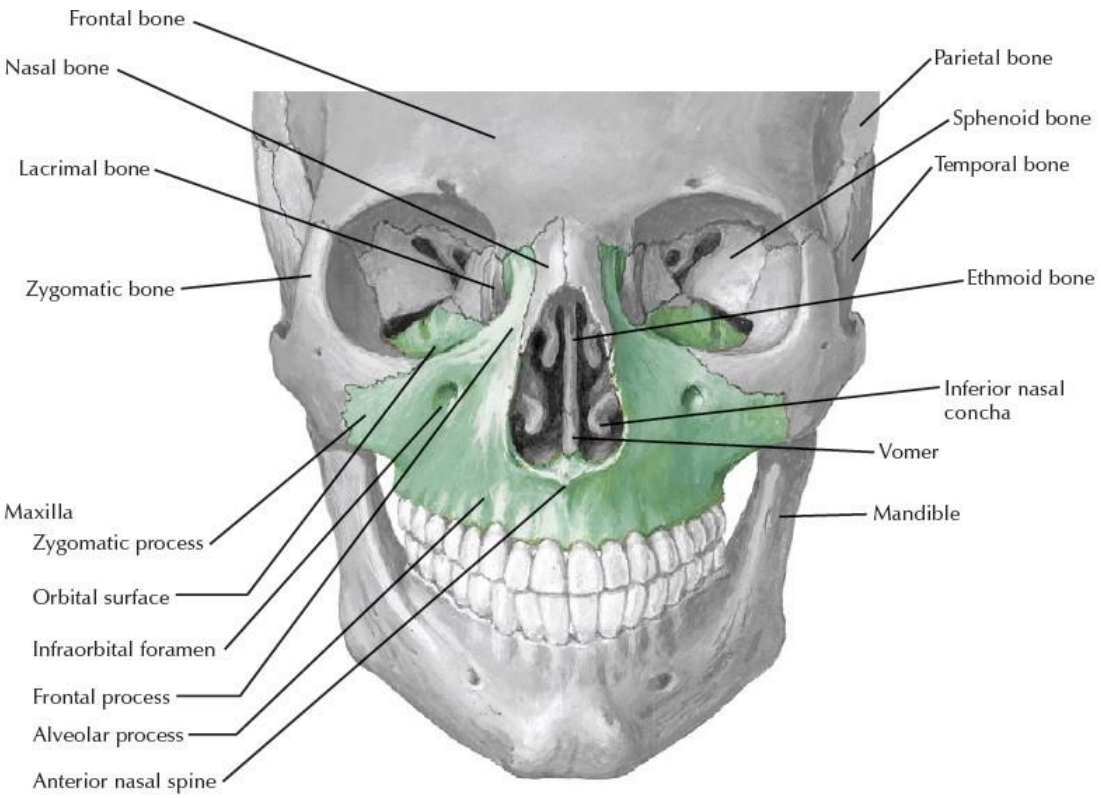
- Extends medially to form the majority of the hard palate
- Articulates with the palatine process of the opposite side and the horizontal plate of the palatine bone
- Incisive foramen is located in the anterior portion

5. Alveolar process

- The part of the maxilla that supports all of the maxillary teeth
- Extends inferiorly from the maxilla
- Each maxilla contains 5 primary and 8 permanent teeth
- Alveolar bone is resorbed when a tooth is lost



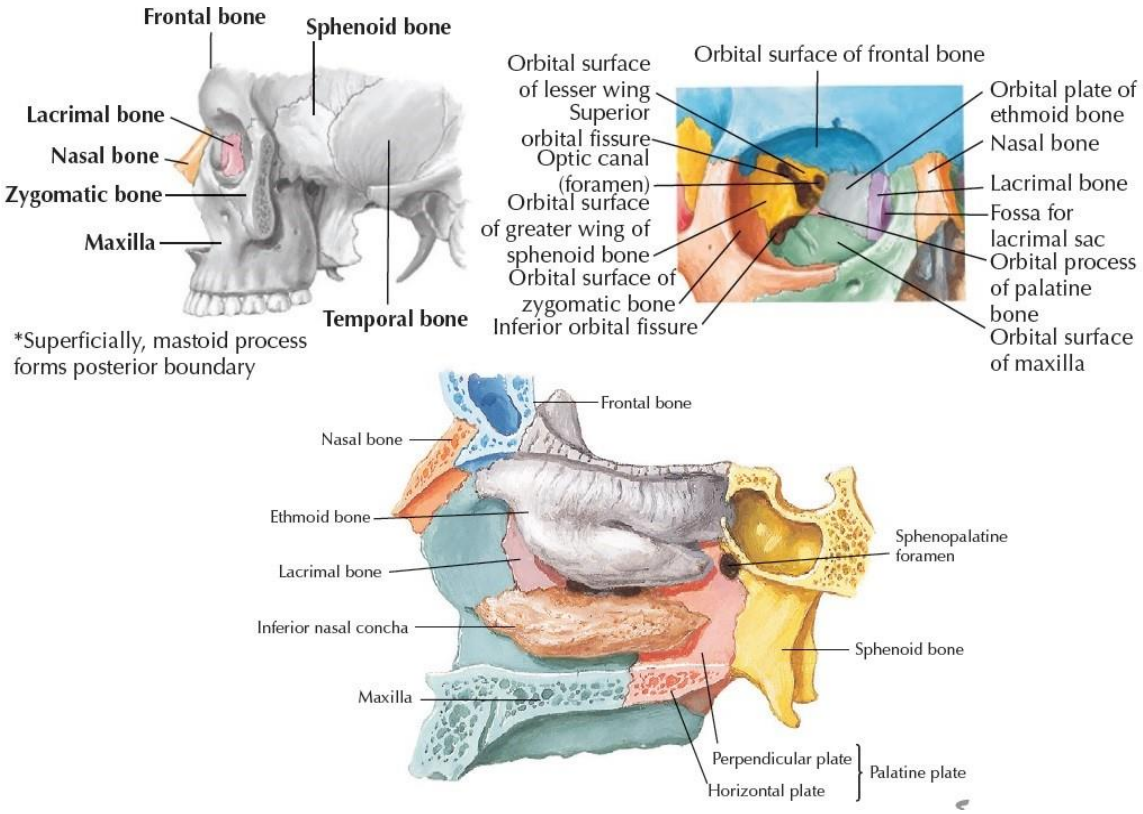




3. NASAL BONE

➢ Characteristics

- Inferior portion forms the superior margin of the nasal aperture.
- Forms the bridge of the nose.
- There are 2 nasal bones.



- Articulates with the nasal bone of the opposite side, the nasal portion of the frontal bone, the frontal process of the maxilla, and the perpendicular plate of the ethmoid.
- Inferior portion of the nasal bones attaches with the lateral nasal cartilages and septal cartilage.

4. LACRIMAL BONE

➢ **Characteristics**

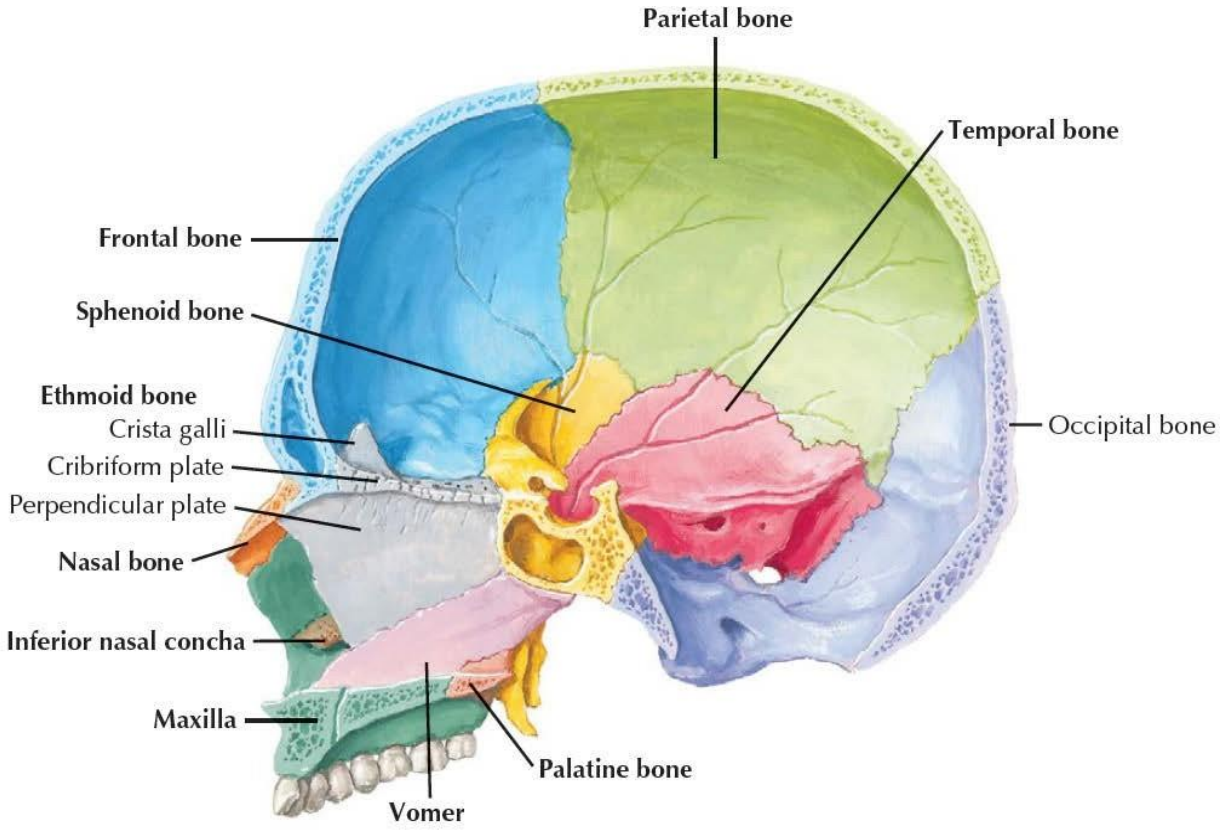
- Lacrimal bone issmall and rectangular in shape and very thin and fragile
- There are 2 lacrimal bones
- Forms a small portion of the medial wall of the orbit
- Articulates with the frontal process of the maxilla, orbital plate of the ethmoid bone, the frontal bone, and the inferior nasal concha
- The region that articulates with the frontal process of the maxilla forms the lacrimal fossa, the location of the lacrimal sac
- The inferior part of the lacrimal forms a small portion of the lateral wall of the nasal cavity

5. VOMER

➢ **Characteristics**

- Shaped like a “plough”
- Forms the posterior inferior part of the nasal septum
- There is 1 vomer bone
- Articulates with the perpendicular plate of the ethmoid, maxilla, palatine, and sphenoid bones and septal cartilage

- Posterior border does not articulate with any other bone



6. PALATINE BONE

➢ Characteristics

- Forms part of the nasal cavity and the hard palate, it is L-shaped
- There are 2 palatine bones

1. <u>Perpendicularplate</u>

- Is in the shape of a vertical rectangle.
- On the superior border is a notch that articulates with the sphenoid bone, forming the sphenopalatine foramen.
- A small orbital process helps form part of the orbit.
- Forms part of the wall of the pterygopalatine fossa and the lateral wall of the nasal cavity.
- Lateral wall articulates with themaxilla to form the palatine canal.

2. <u>Horizontal plate</u>

- Forms the posterior portion of the hard palate.
- Superior to the horizontal plate is the nasal cavity.
- On the medial part, formed by both of the horizontal plates, is the posterior nasal spine.
- Greater palatine foramen is on this plate.

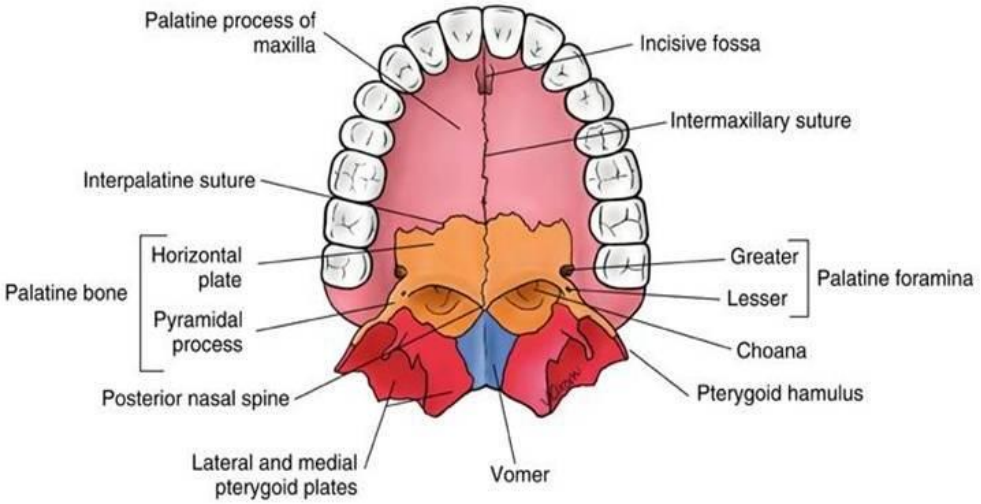
3. Pyramidal process

- Extends posteriorly and inferiorly from the junction of the perpendicular and horizontal plates of the palatine.
- Lesser palatine foramina are located here.

7. INFERIOR NASAL CONCHA

➢ **Characteristics**

- Is described as a curved bone that forms part of the lateral wall of the nasal cavity.
- There are 2 inferior nasal conchae.
- Lies within a curve in the lateral wall of the nasal cavity.
- Articulates with the maxilla and perpendicular plate of the palatine, lacrimal, and ethmoid bones.



8. MANDIBLE

➢ **Characteristics**

- Forms the lower jaw
- Described as horse shoe shaped
- All muscles of mastication attach to the mandible
- There is 1 mandible

➢ **Part:**

1. Body

- Mental foramen lies on the anterior part of the lateral surface of the body
- External oblique line is observed on the lateral side of the mandible
- On the medial side of the body lies the mylohyoid line
- Mylohyoid line helps divide a sublingual from a submandibular fossa
- Posterior border of the mylohyoid line provides for attachment of the pterygomandibular raphe
- At the midline on the medial side are the superior and inferior genial tubercles, as well as the digastric fossa

2. Ramus

- Meets the body of the mandible at the angle of the mandible on each side
- Masseter muscle attaches to the lateral side
-

- Medial pterygoid muscle and sphenomandibular ligament attach to the medial side
- Mandibular foramen is located on the medial side of the ramus
- Superior part divides into a coronoid process anteriorly and a condylar process posteriorly, separated by a mandibular notch

3. Coronoid process

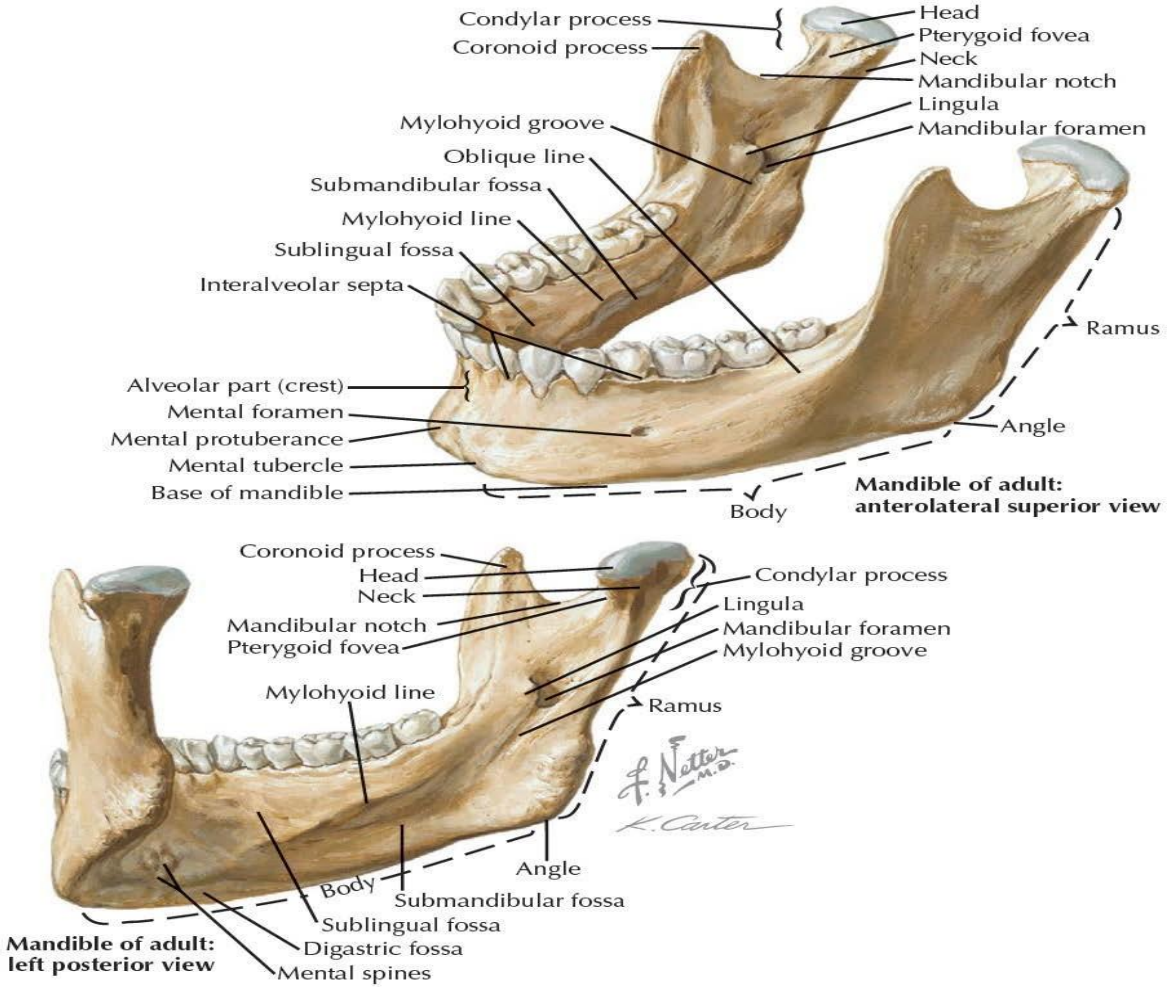
- The anterior most superior extension of each ramus
- Temporalis muscle attaches to the coronoid process

4. Condylar process

- Articulates with the temporal bone in thetemporomandibular joint
- Has a neck that forms a condyle superiorly
- Lateral pterygoid muscle attaches to pterygoid fovea on the neck

5. Alveolar process

- Extends superiorly from the body
- Created by a thick buccal and a thin lingual plate of bone
- The part of the mandible that supports the mandibular teeth
- Each side of the mandible contains 5 primary and 8permanent teeth
- Alveolar bone is resorbed when a tooth is lost

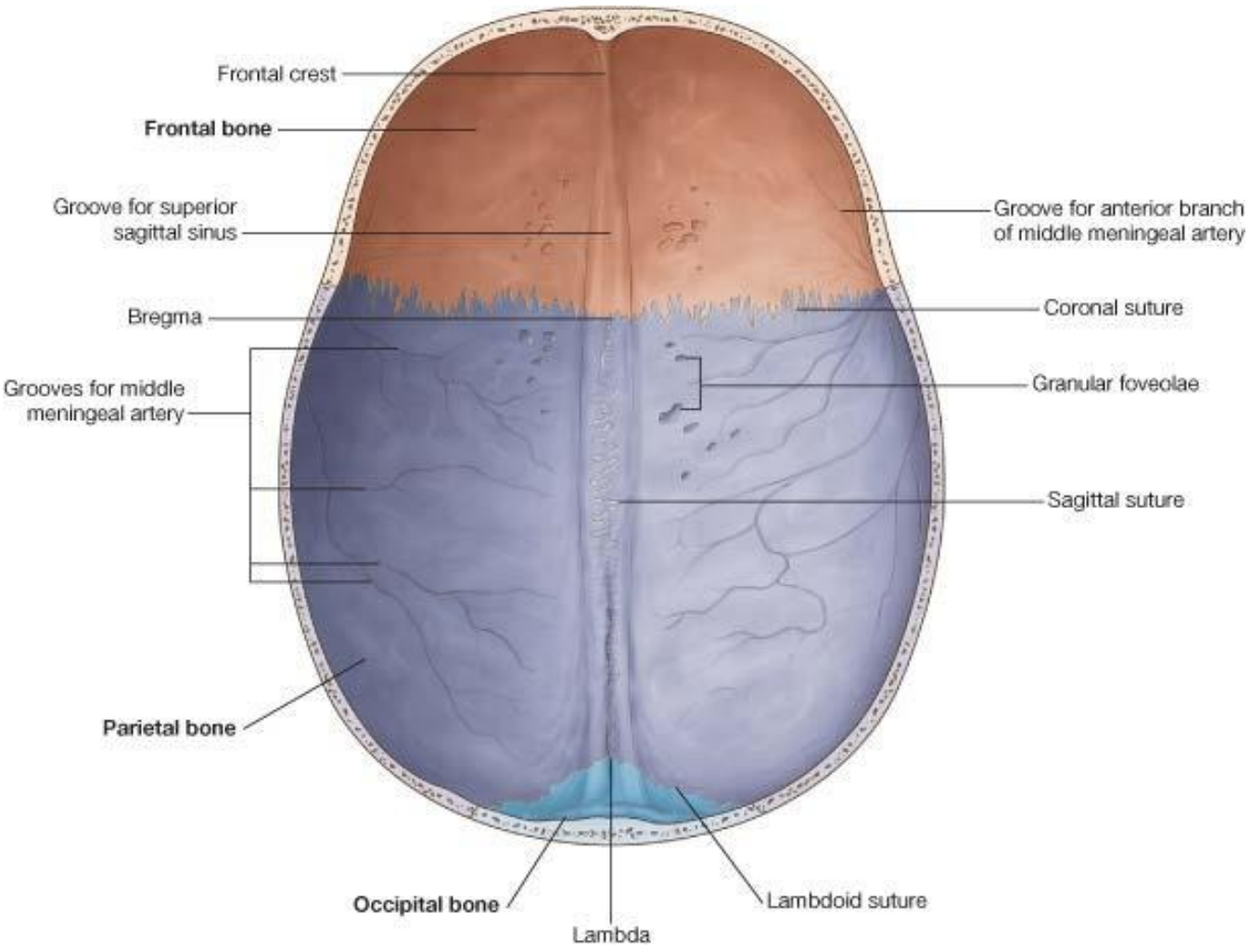


Cranial Cavity

The cranial cavity contains the brain and its surrounding meninges, portions of the cranial nerves, arteries, veins, and venous sinuses.

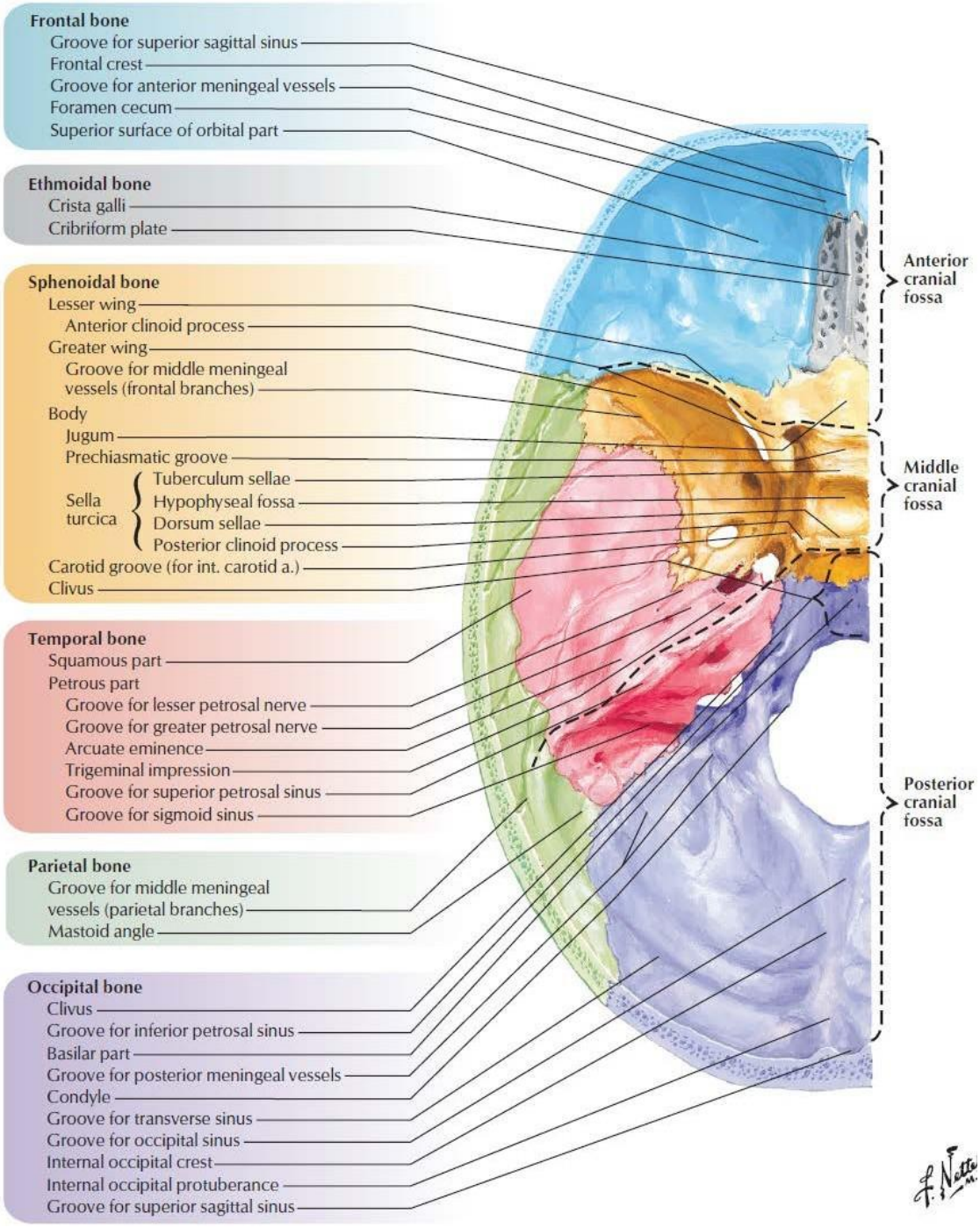
❖ Vault of the Skull

The internal surface of the vault shows the coronal, sagittal,and lambdoid sutures. In the midline is a shallow sagittal groove that lodges the **superior sagittal sinus.** On each side of the groove are several small pits, called **granular pits,** which lodge the **lateral lacunae** and **arachnoid granulations**. Several narrow grooves are present for the anterior and posterior divisions of the **middle meningeal vessels** as they pass up the side of the skull to the vault.



❖ Base of the Skull

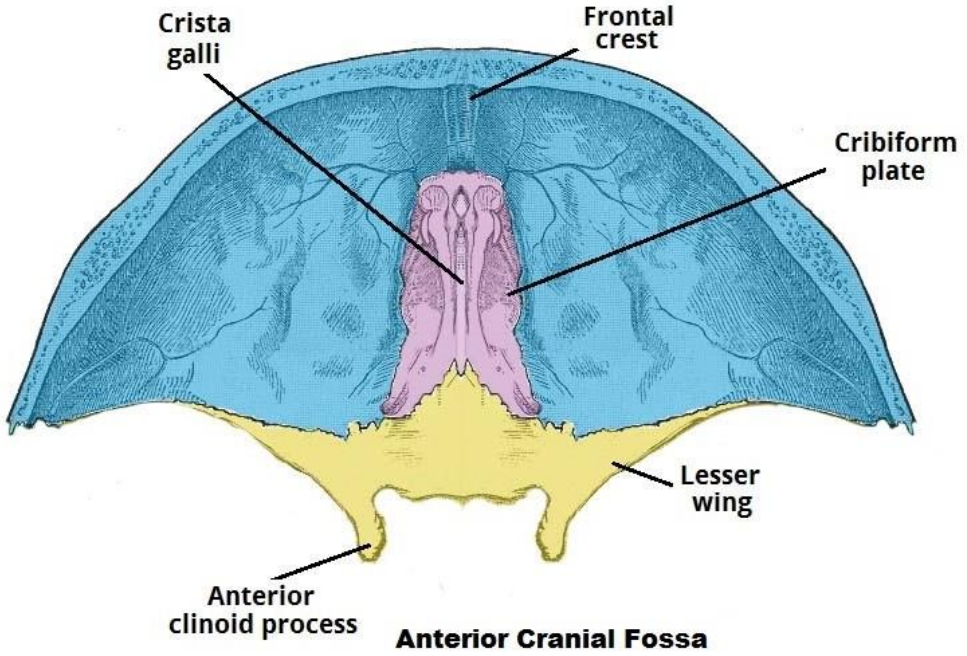
The interior of the base of the skull is divided into three cranial fossae: anterior, middle, and posterior. The anterior cranial fossa is separated from the middle cranial fossa by the lesser wing of the sphenoid, and the middle cranial fossa is separated from the posterior cranial fossa by the petrous part of the temporal bone.



Anterior Cranial Fossa

The anterior cranial fossa lodges the frontal lobes of the cerebral hemispheres. It is bounded anteriorly by the inner surfaceof the frontal bone, and in the midline is a

frontal crest for the attachment of the **falx cerebri.** Its posterior boundary is the sharp lesser wing of the sphenoid. The medial end of the lesser wing of the sphenoid forms the **anterior clinoid process** on each side, which gives attachment to the **tentorium cerebelli.** The median part of the anterior cranial fossa is limited posteriorly by the groove for the optic chiasma. The floor of the fossa is formed by the ridged orbital plates of the frontal bone laterally and by the **cribriform plate** of the ethmoid medially. The **crista galli** is a sharp upward projection of the ethmoid bone in the midline for the attachment of the falx cerebri. The upper surface of the cribriform plate supports the olfactory bulbs, and the small perforations in the cribriform plate are for the **olfactory nerves.**



Anterior Cranial Fossa

Middle Cranial Fossa

The middle cranial fossa consists of a small median part and expanded lateral parts. The median raised part is formed by the body of the sphenoid, and the expanded lateral parts form concavities on either side, which lodge the **temporal lobes** of the **cerebral hemispheres.** It is bounded anteriorly by the lesser wings of the sphenoid and posteriorly by the superior borders of the petrous parts of the temporal bones. Laterally lie the squamous parts of the temporal bones, the greater wings of the sphenoid, and the parietal bones. The floor of each lateral part of the middle cranial fossa is formed by the greater wing of the sphenoid and the squamous and petrous parts of the temporal bone.

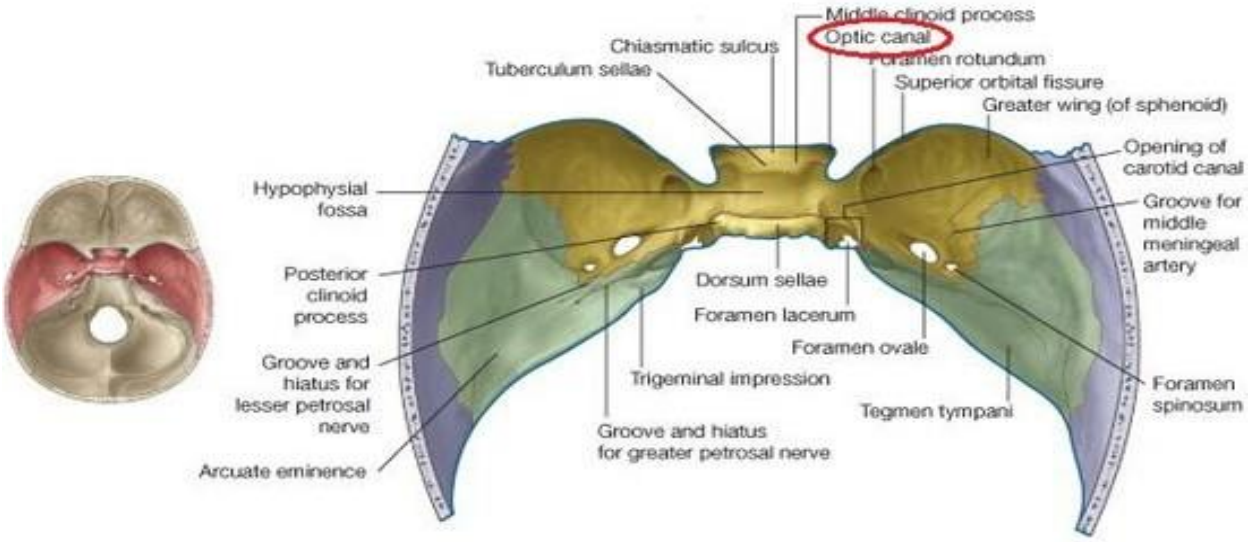
The sphenoid bone resembles a bat having a centrally placed **body** with **greater** and **lesser wings** that are out stretched on each side. The body of the sphenoid contains

the **sphenoid air sinuses,** which are lined with mucous membrane and communicate with the nasal cavity; they serve as voice resonators. Anteriorly, the **optic canal** transmits the optic nerve and the ophthalmic artery (branch of the internal carotid artery, to the orbit). The **superior orbital fissure,** which is a slit like opening between the lesser and the greater wings of the sphenoid, transmits the lacrimal, frontal, and nasociliary branches of ophthalmic division of the trigeminal n., trochlear, oculomotor,, and abducent nerves, together with the superior ophthalmic vein. The sphenoparietal venous sinus runs medially along the posterior border of the lesser wing of the sphenoid and drains into the cavernous sinus. The **foramen rotundum,** which is situated behind the medial end of the superior orbital fissure, perforates the greater wing of the sphenoid and transmits the maxillary nerve from the trigeminal ganglion to the pterygopalatine fossa. The **foramen ovale** lies postero-lateral to the foramen rotundum. It perforates the greater wing of the sphenoid and transmits the large sensory root and small motor root of the mandibular nerve to the infra temporal fossa; the lesser petrosal nerve also passes through it. The small **foramen spinosum** lies postero-lateral to the foramen ovale and also perforates the greater wing of the sphenoid. The foramen transmits the middle meningeal artery from the infratemporal fossa into the cranial cavity. The large and irregularly shaped **foramen lacerum** lies between the apex of the petrous part of the temporal bone, the sphenoid bone and the occipital bone. The inferior opening of the foramen lacerum in life is filled by cartilage and fibrous tissue, and only small blood vessels pass through this tissue from the cranial cavity to the neck. The **carotid canal** opens into the side of the foramen lacerum above the closed inferior opening. The internal carotid artery enters the foramen through the carotid canal and immediately turns upward to reach the side of the body of the sphenoid bone. Lateral to the foramen lacerum is an impression on the apex of the petrous part of the temporal bone for the **trigeminal ganglion.**

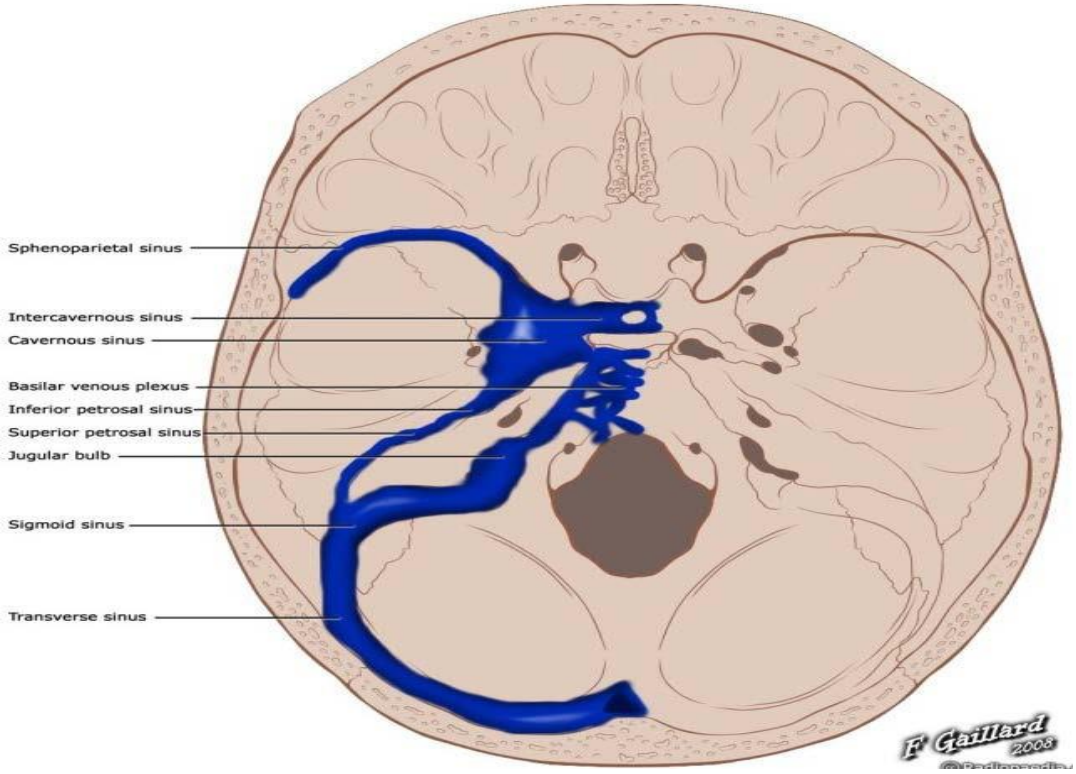
On the anterior surface of the petrousbone are two grooves for nerves; the largest medial groove is for the **greater petrosal nerve,** a branch of the facial nerve; the smaller lateral groove is for the **lesser petrosal nerve,** a branch of the tympanic plexus. The greater petrosal nerve enters the foramen lacerum deep to the trigeminal ganglion and joins the **deep petrosal nerve** (sympathetic fibers from around the internal carotid artery), to form the **nerve of the pterygoid canal.** The lesser petrosal nerve passes forward to the foramen ovale.

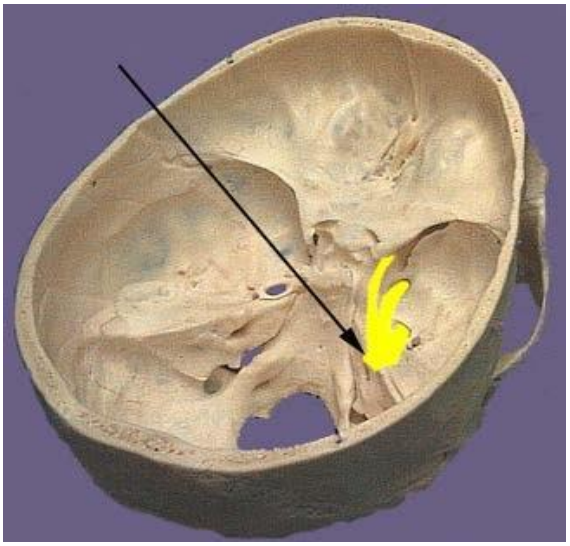
The median part of the middle cranial fossa is formed by the body of the sphenoid bone. In front is the **sulcus chiasmatis,** which is related to the optic chiasma and leads laterally to the **optic canal** on each side. Posteriorto the sulcus is an elevation, the **tuberculum sellae.** Behindthe elevation is a deep depression, the **sella turcica,** which lodges the **pituitary gland.** The sella turcica is bounded posteriorly by a

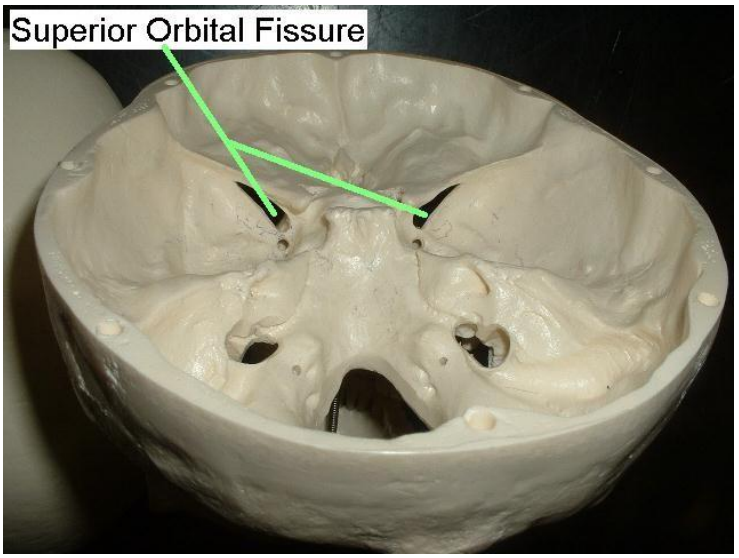
square plate of bone called the **dorsum sellae.** The superior angles of the dorsum sellae have two tubercles, called the **posterior clinoid processes,** which give attachment to the fixed margin of the tentorium cerebelli. The cavernous sinus is directly related to the side of the body of the sphenoid. It carries in its lateral wall the 3rd and 4th cranial nerves and the ophthalmic and maxillary divisions of the 5th cranial nerve. The internal carotid artery and the 6th cranial nerve pass forward through the sinus.



Middle Cranial Fossa







Posterior Cranial Fossa

The posterior cranial fossa is deep and lodges the parts of the hindbrain, namely, the **cerebellum, pons,** and **medulla oblongata.** Anteriorly, the fossa is bounded by the superior border of the petrous part of the temporal bone, and posteriorly it is bounded by the internal surface of the squamous part of the occipital bone. The floor of the posterior fossa is formed by the basilar, condylar, and squamous parts of the occipital bone and the mastoid partof the temporal bone.

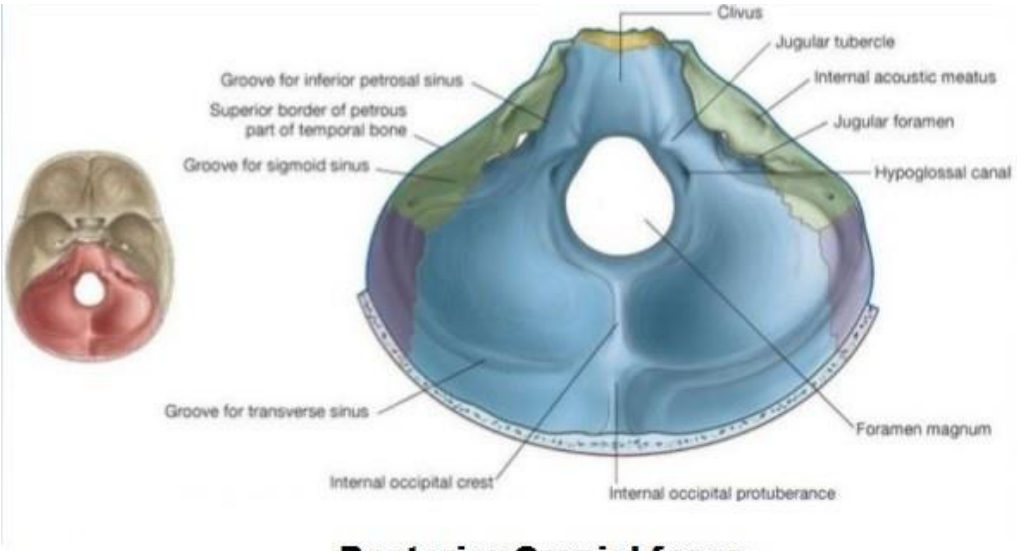
The roof of the fossa is formed by a fold of dura, the **tentorium cerebelli,** which intervenes between the cerebellum below and the occipital lobes of the cerebral hemispheres above.

The **foramen magnum** occupies the central area of the floor and transmits the medulla oblongata and its surrounding meninges, the ascending spinal parts of the accessory nerves, and the two vertebral arteries.

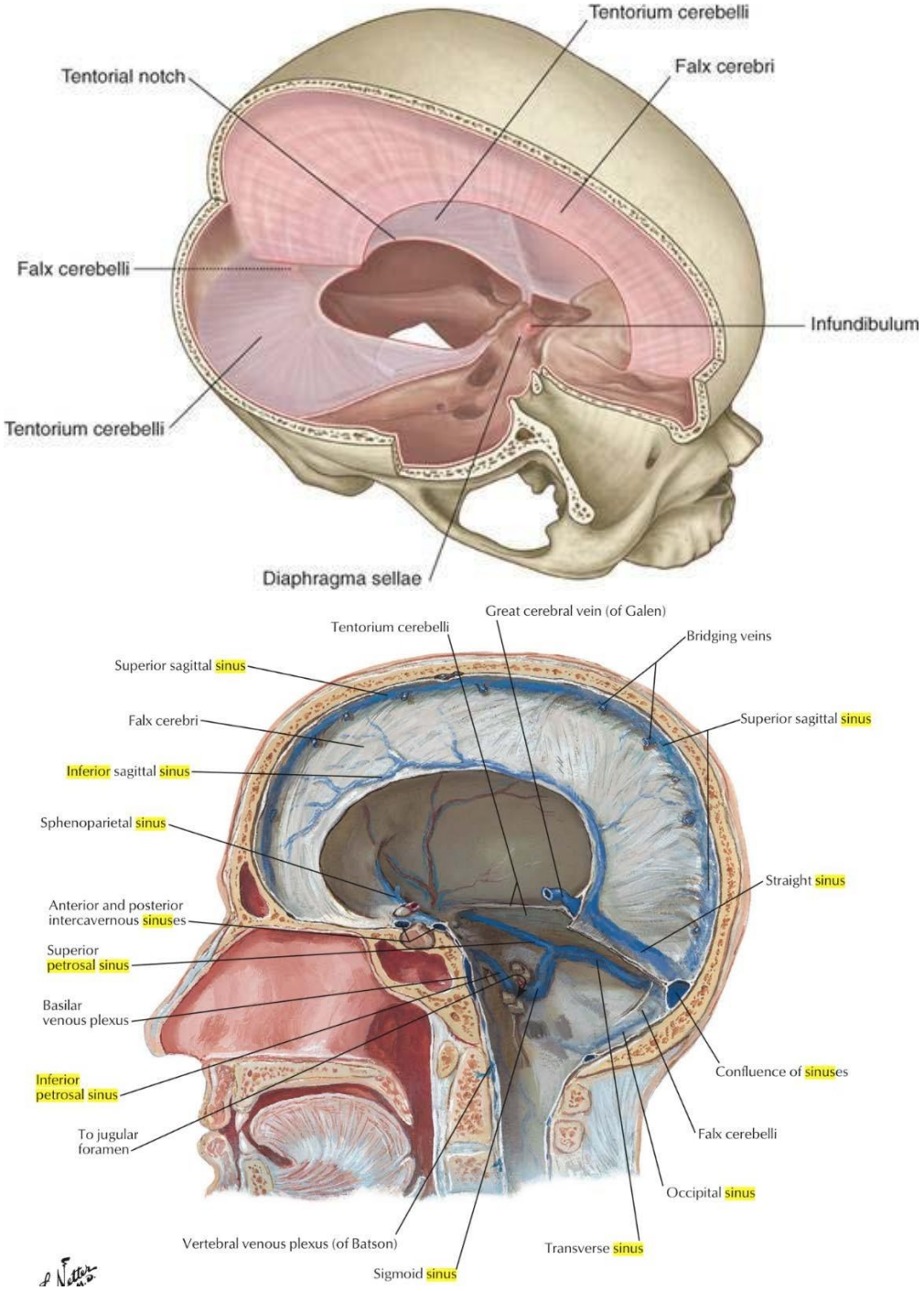
The **hypoglossal canal** is situated above the anterolateral boundary of the foramen magnum and transmits the **hypoglossal nerve.** The **jugular foramen** lies between the lower border of the petrous part of the temporal bone and the condylar part of the occipital bone. It transmits the following structuresfrom before backward: the **inferior petrosal sinus;**the **9th, 10th,** and **11th cranial nerves;** and the large **sigmoid sinus.** The inferior petrosal sinus descends in the groove on the lower border of the petrous part of the temporal bone to reach the foramen. The sigmoid sinus turns down through the foramen to become the **internal jugular vein.** The **internal acoustic meatus** pierces the posterior surfaceof the petrous part of the temporal bone. It transmits the vestibulocochlear nerve and the motor and sensory roots of the facial nerve.

The **internal occipital crest** runs upward in the midline posteriorly from the foramen magnum to the **internal occipital protuberance;** to it is attached the small **falx cerebella** over the **occipital sinus.**

On each side of the internal occipital protuberance is a wide groove for the **transverse sinus**. This groove sweeps around on either side, on the internal surface of the occipital bone, to reach the postero-inferior angle or corner of the parietal bone. The groove now passes onto the mastoid part of the temporal bone, and here the transverse sinus becomes the **sigmoid sinus.** The **superior petrosal sinus** runs backward along the upper border of the petrous bone in a narrow groove and drains into the sigmoid sinus. As the sigmoid sinus descends to the jugular foramen, it deeply grooves the back of the petrous bone and the mastoid part of the temporal bone. Here, it lies directly posteriorto the mastoid antrum.



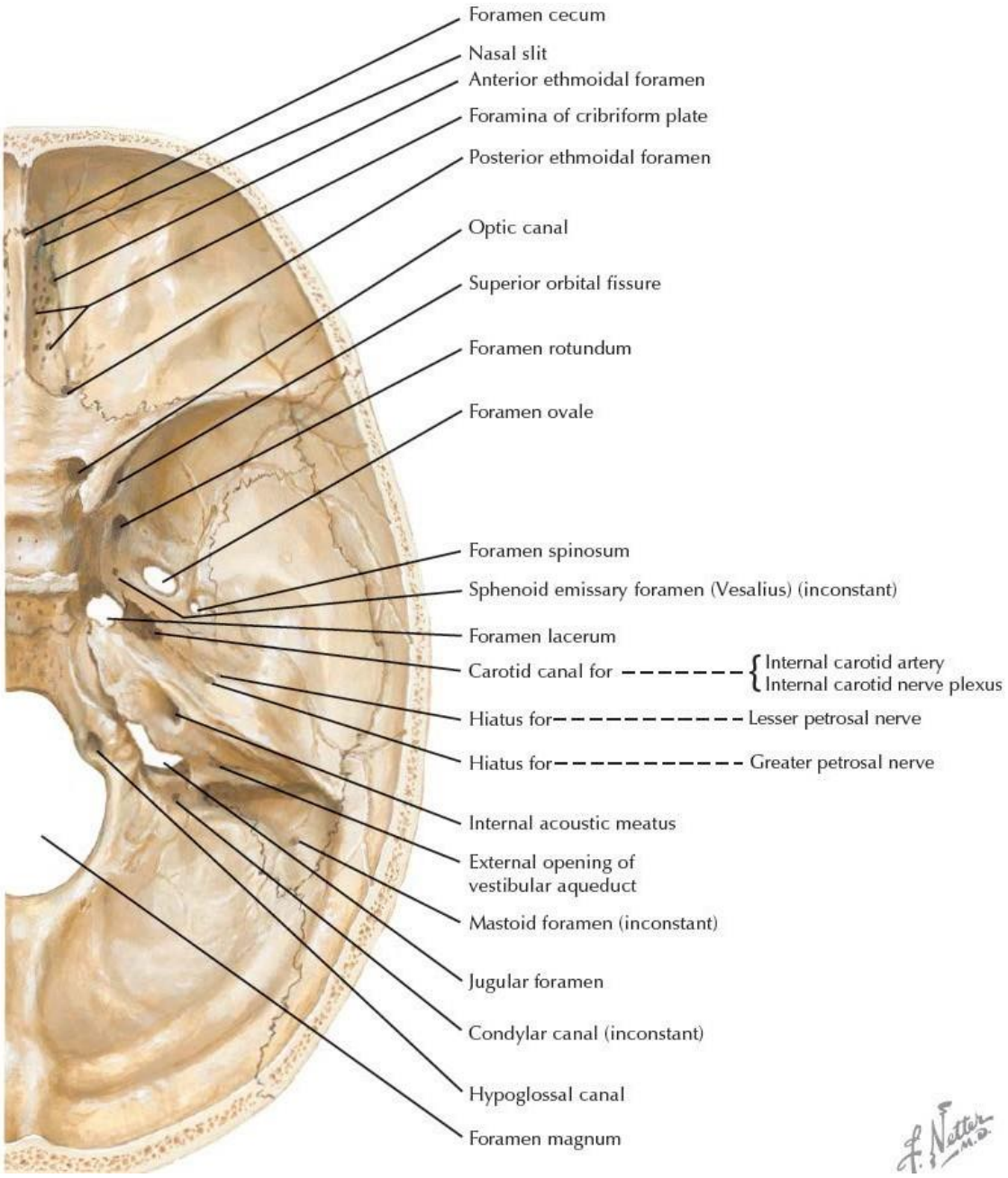
Posterior Cranial fossa


Tentorium cerebelli
Falx cerebri
Tentorial notch
Falx cerebelli
Infundibulum
Tentorium cerebelli
Diaphragma sellae
Great cerebral vein (of Galen)
Tentorium cerebelli
Bridging veins
Superior sagittal sinus
Falx cerebri
Superior sagittal sinus
Inferior sagittal sinus
Sphenoparietal sinus
Straight sinus
Anterior and posterior intercavernous sinuses
Superior petrosal sinus
Basilar venous plexus
Confluence of sinuses
Inferior petrosal sinus
To jugular foramen
Falx cerebelli
Occipital sinus
Vertebral venous plexus (of Batson)
Transverse sinus
Sigmoid sinus

Major Foramina and Fissures

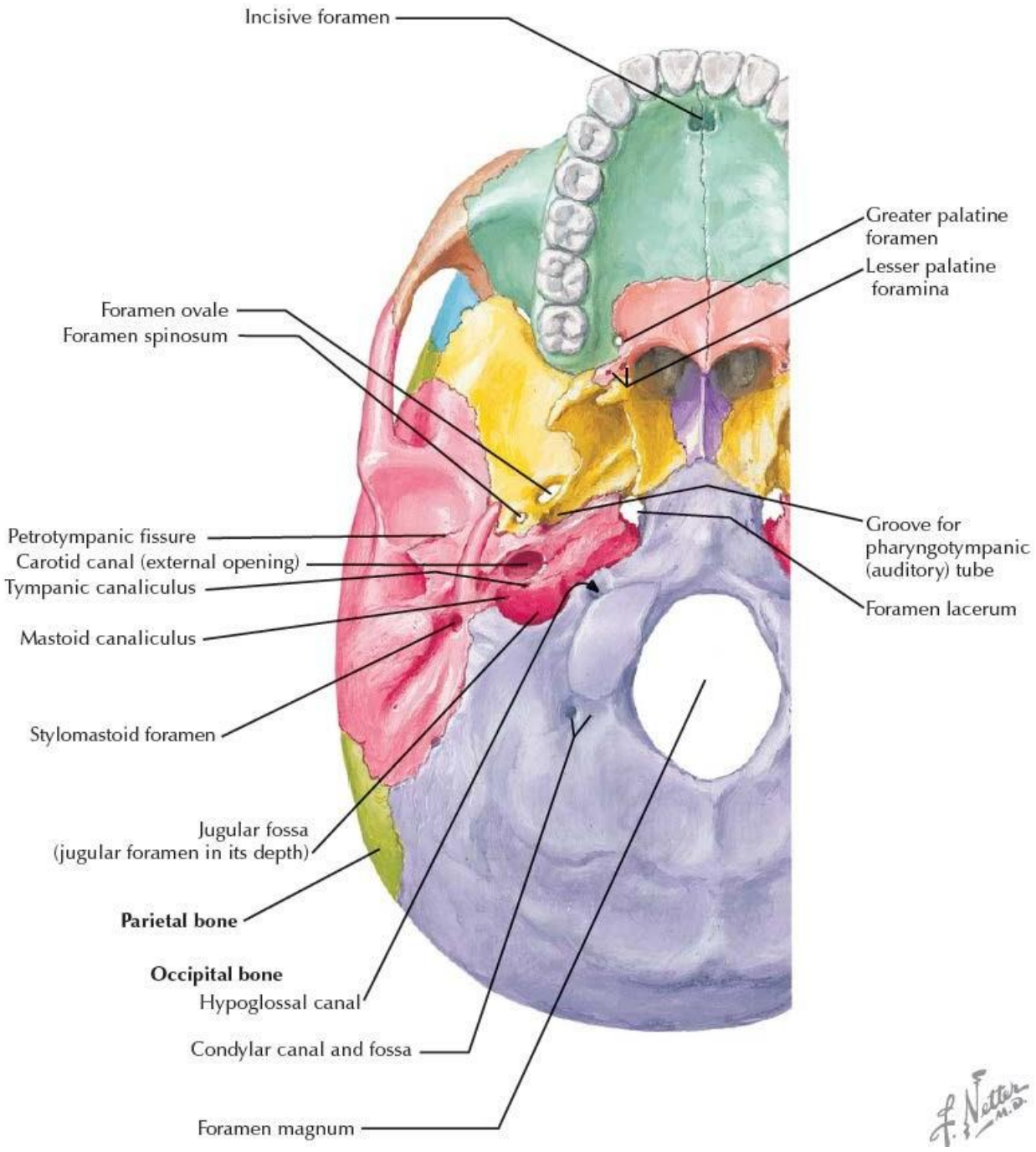
❖ SUPERIOR VIEW OF THE CRANIAL BASE

Foramen/Fissure	Located in or Formed by	Structures Passing through
Cribriformplate	Ethmoid	Olfactorynerves.from the olfactory bulb
Foramen cecum	Between the frontal and the ethmoid bones	Emissary vein. From nasal cavity to the superior sagittal sinus
Anterior ethmoid foramen		Anterior ethmoid n.and vessels
Posteriorethmoid foramen		Posterior ethmoid n. and vessels
Optic canal	Sphenoid	Opticn.,ophthalmic a.
Superior orbital fissure	Between the greater and the lesser wings of the sphenoid	Nasociliary, frontal, and lacrimal branches of the ophthalmic division of the trigeminal n.,oculomotor n., trochlear n.,abducensn.,superior ophthalmic vein.
Foramen rotundum	Sphenoid	Maxillary division of the trigeminal n.
Foramen ovale		Mandibular division of the trigeminal n. ,accessory meningeal a., lesser petrosal n., emissary v.
Foramen spinosum		Middle meningeal vessels and meningeal branch of the mandibular division of the trigeminal n.
Foramen lacerum	Articulation of the sphenoid (greater wing andbody), temporal (petrous portion),and occipital (basilar portion) bones	Nothing passes through it Filled with fibrocartilage during Life (although the anterior wall of the foramen has an opening for the pterygoid canal and the posterior wall has an opening for The carotid canal)
Carotid canal	Temporal (petrousportion)	Internal carotida., internal Carotid n. plexus (sympathetics)
Hiatus for the lesser petrosal n.		Lesser petrosal n.
Hiatus for the greater petrosal n.		Greater petrosal n.
Internal acoustic meatus		Facial n., vestibulocochlear n.
Jugular foramen	Temporal (petrous portion) and occipital	Glossopharyngeal n.,vagus n., spinal accessory n., inferior petrosal sinus,sigmoid sinus.
Hypoglossal canal	Occipital	Hypoglossal n.
Foramen magnum		Medulla oblongata,vertebral arteries,spinal roots of the spinal accessory n.


Foramen cecum
Nasal slit
Anterior ethmoidal foramen
Foramina of cribriform plate
Posterior ethmoidal foramen
Optic canal
Superior orbital fissure
Foramen rotundum
Foramen ovale
Foramen spinosum
Sphenoid emissary foramen (Vesalius) (inconstant)
Foramen lacerum
Carotid canal for
Internal carotid artery
Internal carotid nerve plexus
Hiatus for
Lesser petrosal nerve
Hiatus for
Greater petrosal nerve
Internal acoustic meatus
External opening of vestibular aqueduct
Mastoid foramen (inconstant)
Jugular foramen
Condylar canal (inconstant)
Hypoglossal canal
Foramen magnum
F. Netter M.D.

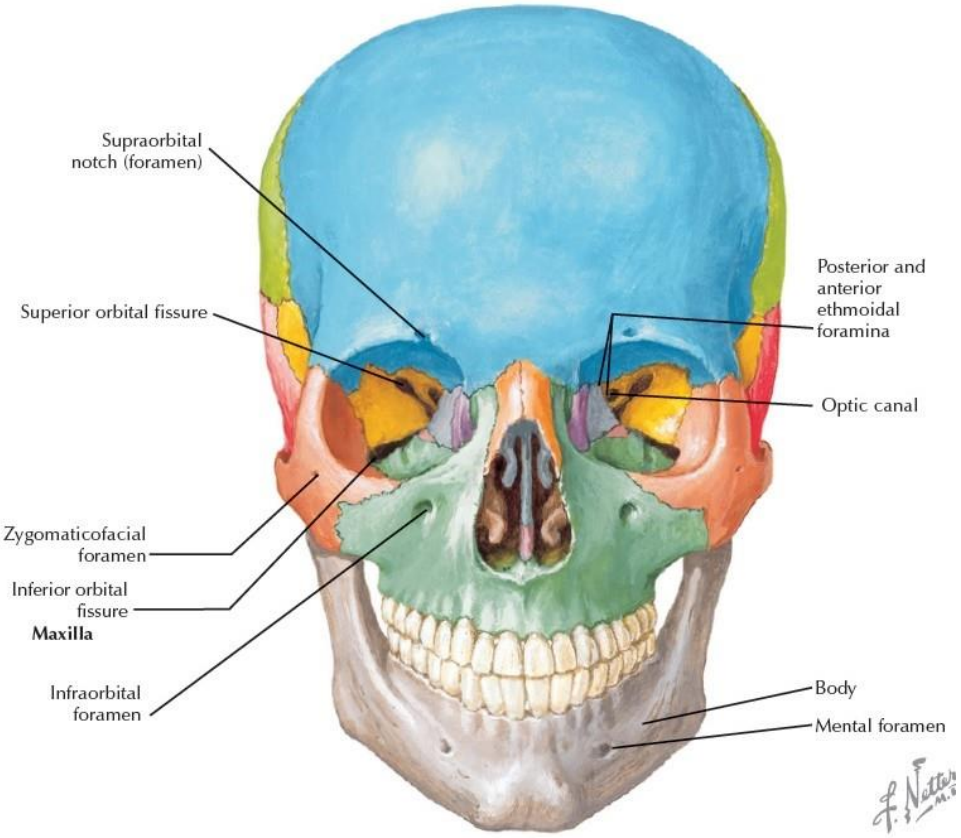
❖ INFERIOR VIEW OF THE CRANIAL BASE

Foramen / Fissure	Located in or Formed by	Structures Passing through
Incisive foramen	Maxilla (palatine process)	Nasopalatine n.,sphenopalatine a.
Greater palatine foramen	Palatine	Greater palatine n. and vessels
Lesser palatine foramina	Palatine	Lesser palatine n. and vessels
Foramenovale	Sphenoid	Mandibular division of the trigeminal n.,accessory meningeal a.,lesser petrosal n.,emissary v.
Foramen spinosum	Sphenoid	Middle meningeal vessels and meningeal branch of the mandibular division of the trigeminal n.
Foramen lacerum	Articulation of the Sphenoid (greater wing and body), temporal (petrous portion), and occipital (basilar portion) bones	Nothing passes through it Filled with fibrocartilage during Life (although the anterior wall of the foramen has an opening for the pterygoid canal and the posterior wall has an opening for the carotid canal)
Carotid canal	Temporal (petrous portion)	Internal carotid a.,internal carotid n. plexus (sympathetics)
Jugular foramen	Temporal (petrous portion) and occipital	Glossopharyngeal n.,vagus n.,spinal accessory n., inferior petrosal sinus, sigmoid sinus, posterior meningeal a.
Petro tympanic fissure	Temporal	Chorda tympani n.,anterior tympanic a.
Stylo mastoid foramen		Facial n., stylomastoid a.
Tympano mastoid fissure		Auricular branch of the vagus n.
Hypoglossal canal	Occipital	Hypoglossal n.
Foramen magnum		Medulla oblongata, vertebral arteries, spinal roots of the spinal accessory n.


Incisive foramen
Greater palatine foramen
Lesser palatine foramina
Foramen ovale
Foramen spinosum
Petrotympanic fissure
Carotid canal (external opening)
Tympanic canaliculus
Mastoid canaliculus
Stylomastoid foramen
Jugular fossa (jugular foramen in its depth)
Parietal bone
Occipital bone
Hypoglossal canal
Condylar canal and fossa
Foramen magnum
Groove for pharyngotympanic (auditory) tube
Foramen lacerum

❖ ANTERIOR VIEW

Foramen/ Fissure	Located in or Formed by	Structures Passing through
Supra orbital foramen	Frontal	Supra orbital n.and vessels
Optic canal	Sphenoid	Optic n.,ophthalmic a.
Superior orbital fissure	Between the Greater and Lesser wing of the sphenoid	Nasociliary, frontal, and lacrimal branches of the ophthalmic division of the trigeminal n., oculomotor n., trochlear n., abducens n., superior ophthalmic vein.
Inferior orbital fissure	Between the Greater wing of the sphenoid and Maxilla and orbital portion of the palatine bones	Maxillary division of the trigeminal n. and its zygomatic n., infraorbital vessels, inferior ophthalmic vein and sympathetic nerves
Anterior ethmoid foramen	Between the Frontal and Ethmoid bones	Anterior ethmoid n.and vessels
Posteriorethmoidforamen		Posteriorethmoidn.andvessels
Zygomatico facial foramen	Zygomatic	Zygomatico facial n. and vessels
Infra orbital foramen	Maxilla	Infra orbital n.andvessels
Mental foramen	Mandible	Mental n. and vessels



Thoracic cavity

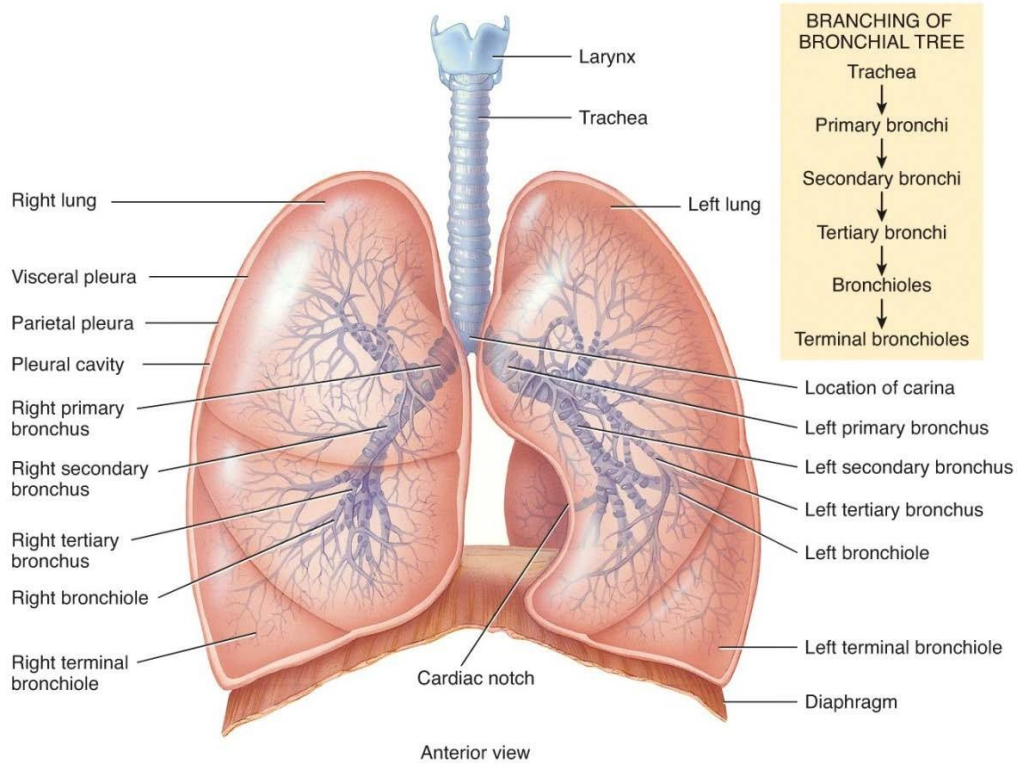
▪ Lungs

The lungs are situated so that one lies on each side of the mediastinum. They are therefore separated from each other by the heart and great vessels and other structures in the mediastinum.

Each lung has a blunt **apex,** which projects upward into the neck for about (2.5 cm) above the clavicle; a concave **base** that sits on the diaphragm; a convex **costal surface,**which corresponds to the concave chest wall; and a concave **mediastinal surface,** which is molded to the pericardium and other mediastinal structures.

At about the middle of this surface is the **hilum,** adepression in which the bronchi, vessels, and nerves thatform the **root** enter and leave the lung.

The **root of the lung** is formed of structures that are entering or leaving the lung. It is made up of the bronchi,pulmonary artery and veins, lymph vessels, bronchial vessels, and nerves.



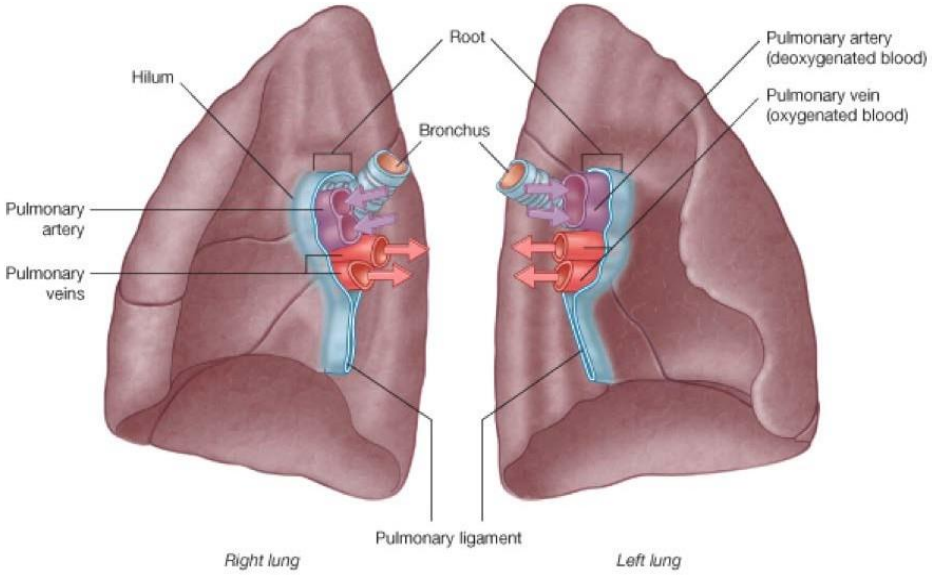
Lobes and Fissures

Right Lung

The right lung is slightly larger than the left and is dividedby the oblique and horizontal fissures into three lobes: the **upper, middle,** and **lower lobes**. The **obliquefissure** runs from the inferior border upward and backward.

Left Lung

The left lung is divided by a similar oblique fissure into two lobes: the **upper** and **lower lobes**. There is no horizontal fissure in the left lung.



Bronchopulmonary Segments

The bronchopulmonary segments are the anatomic, functional,and surgical units of the lungs.The main characteristics of a bronchopulmonary segment may be summarized as follows:

■■It is a subdivision of a lung lobe.

■■It is pyramid shaped, with its apex toward the lung root.

■■It is surrounded by connective tissue.

■■It has a segmental bronchus, a segmental artery, lymphvessels, and autonomic nerves.

■■The segmental vein lies in the connective tissue between adjacent bronchopulmonary segments.

■■Because it is a structural unit, a diseased segment can beremoved surgically.

On entering a bronchopulmonary segment, each segmental bronchus divides repeatedly. The smallest bronchi divide and give rise to **bronchioles,** which are <1 mm in diameter. Bronchioles possess no cartilage in their walls.
The bronchioles then divide and give rise to **terminal bronchioles**, which show delicate out pouching from their walls, the **respiratory bronchiole,.** The diameter of a respiratory bronchiole is about 0.5 mm. The respiratory bronchioles end by branching into **alveolar ducts,** which lead into **alveolar sacs.** The alveolar sacs consist of several alveoli opening into a single chamber. Each alveolus is surrounded by a rich network of blood capillaries. Gaseous exchange takes place between the air in the alveolar lumen through the alveolar wall into the blood within the surrounding capillaries.

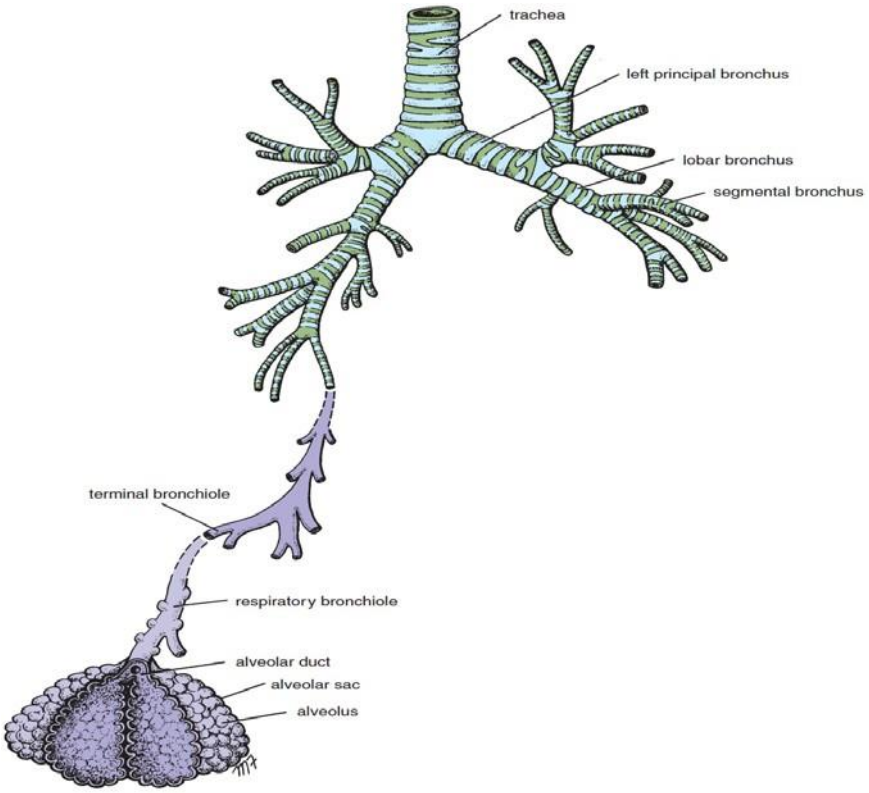
Blood Supply of the Lungs

The bronchi, the connective tissue of the lung, and the visceral pleura receive their blood supply from the **bronchial arteries**, which are branches of the descending aorta. The **bronchial veins** drain into the azygos and hemi azygos veins.

The alveoli receive deoxygenated blood from the terminal branches of the pulmonary arteries. The oxygenatedblood leaving the alveolar capillaries drains into the tributaries of the pulmonary veins, which follow the inter segmental connective tissue septa to the lung root. Two pulmonary veins leave each lung root to empty into the left atrium of the heart.

Nerve Supply of the Lungs

At the root of each lung is a **pulmonary plexus** composedof efferent and afferent autonomic nerve fibers. The plexusis formed from branches of the sympathetic trunk and receives parasympathetic fibers from the vagus nerve. The sympathetic efferent fibers produce bronchodilatationand vasoconstriction. The parasympathetic efferentfibers produce bronchoconstriction, vasodilatation, and increased glandular secretion.



Trachea, bronchi, bronchioles, alveolar ducts, alveolar sacs, and alveoli. Note the path taken by inspired air from the trachea to the alveoli.

Pericardium

The pericardium is a fibro serous sac that encloses the heart and the roots of the great vessels. Its function is to restrict excessive movements of the heart as a whole and to serve as a lubricated container in which the different partsof the heart can contract. The pericardium lies within the middle mediastinum.

- **Fibrous Pericardium**

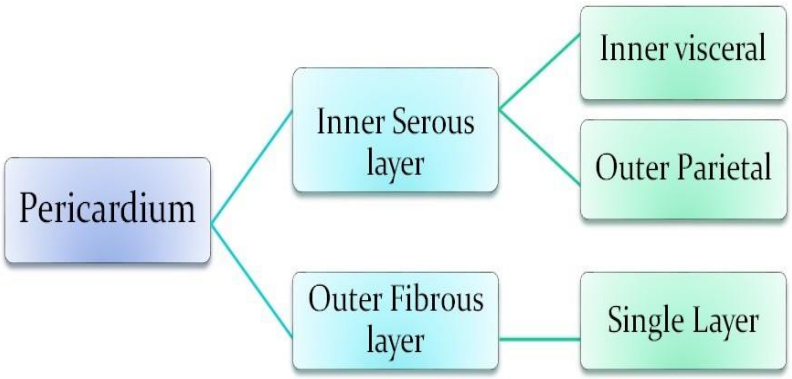
The fibrous pericardium is the strong fibrous part of the sac. It is firmly attached below to the central tendon of the diaphragm.

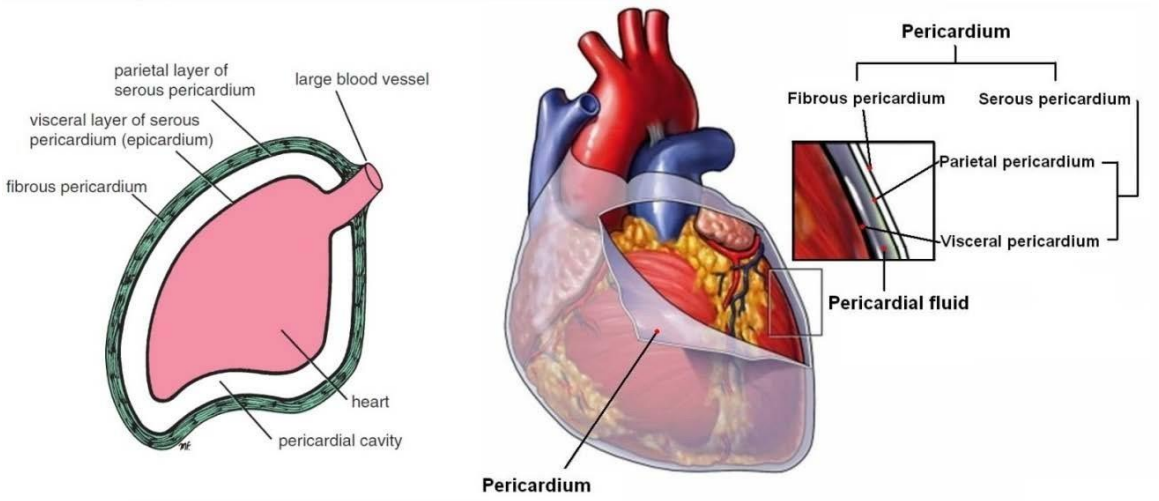
- **Serous Pericardium**

The serous pericardium lines the fibrous pericardium and coats the heart. It is divided into parietal and visceral layers.

The **parietal layer** lines the fibrous pericardium and is reflected around the roots of the great vessels to become continuous with the visceral layer of serous pericardium that closely covers the heart.

The **visceral layer** is closely applied to the heart and is often called the **epicardium.** The slit like space between the parietal and visceral layers is referred to as the **pericardial cavity**. Normally, the cavity contains a small amount of tissue fluid, the **pericardial fluid,** which acts as a lubricant to facilitate movements of the heart.





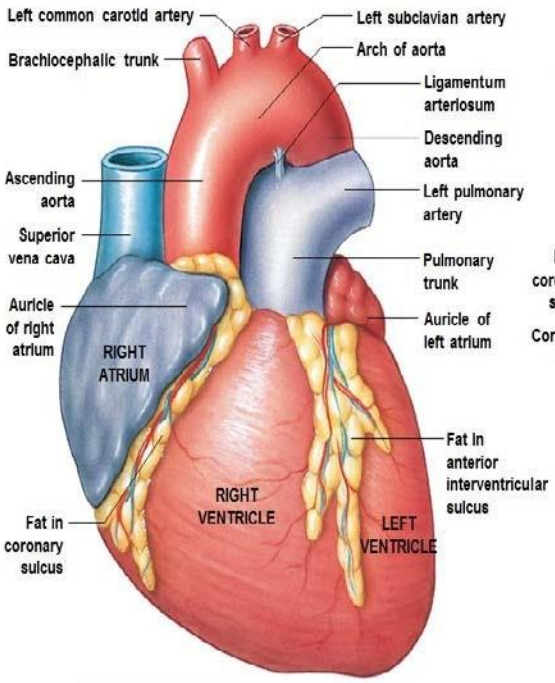
Heart

The heart is a hollow muscular organ that is some what pyramid shaped and lies within the pericardium in the mediastinum. It is connected at its base to the great blood vessels but otherwise lies free within the pericardium.

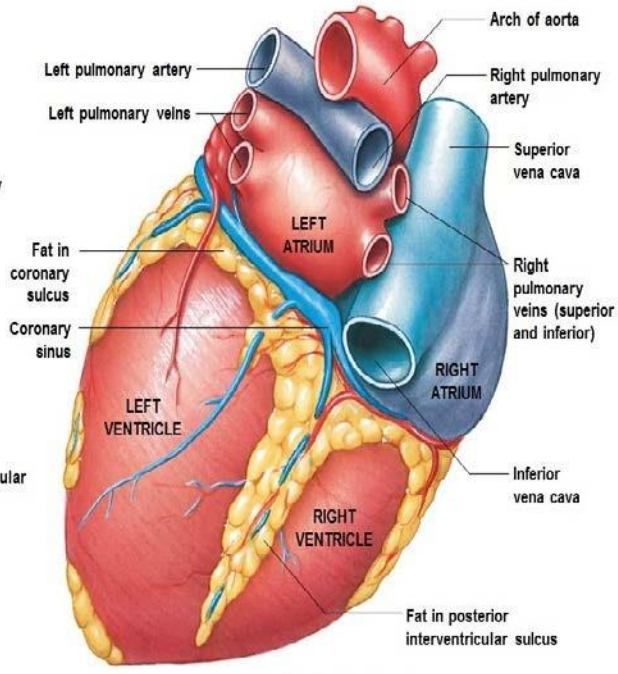
⇨ Surfaces of the Heart

The heart has three surfaces: sternocostal (anterior), diaphragmatic(inferior), and a base (posterior). It also has an apex.

Note that the base of the heart is called the **base** because the heart is pyramid shaped; the base lies opposite the apex.
The heart does not rest on its base; it rests on its diaphragmatic (inferior) surface.
On the interior, it is divided into four chambers. These divisions create grooves on the surface of the heart – these are known as sulci.
The **coronary sulcus** (or atrio ventricular groove) runs transversely around the heart – it represents the wall dividing the atria from the ventricles. The sinus contains important vasculature, such as the right coronary artery.
The **anterior** and **posterior inter ventricular** sulci can be found running vertically on their respective sides of the heart. They represent the wall separating the ventricles.



Anterior view of the heart and great vessels



Posterior view of the heart and great vessels

⇨ Chambers of the Heart

The heart is divided by vertical septa into four chambers:The right atrium lies anterior to the left atrium, and the right ventricle lies anterior to the left ventricle.
The right side of the heart is composed of the right atrium and right ventricle. These chambers receive blood from the systemic circulation and pump it to the pulmonary circulation for gas exchange.The left atrium and left ventricle receive blood from the pulmonary circulation and pump it to the systemic circulation.

❖ Right Atrium

The right atrium consists of a main cavity and a small outpouching, the auricle. On the outside of the heart at the junction between the right atrium and the right auricle is a vertical groove, the **sulcus terminalis.**

Openings into the Right Atrium

1. The **superior vena cava** opens into the upper part of the right atrium; it has no valve. It returns the blood to the heart from the upper half of the body.
2. The **inferiorvena cava** (larger than the superior vena cava) opens into the lower part of the right atrium; it is guarded by a rudimentary, non functioning valve. It returns the blood to the heart from the lower half of the body.
3. The **coronary sinus,** which drains most of the blood from the heart wall. It is guarded by a rudimentary, nonfunctioning valve.
4. The **right atrioventricular orifice** is guarded by the tricuspidvalve.

Many small orifices of small veins also drain the wall of the heart and open directly into the right atrium.

❖ Right Ventricle

The right ventricle communicates with the right atrium through the **atrioventricular orifice** and with the **pulmonary trunk** through the pulmonary orifice.

The walls of the right ventricle are much thicker than those of the right atrium.

The **tricuspid valve** guards the atrioventricular orifice and consists of three cusps.

The **pulmonary valve** guards the pulmonary orifice and consists of three semilunar cusps.

❖ Left Atrium

Similar to the right atrium, the left atrium consists of amain cavity and a left auricle. The left atrium is situated behind the right atrium and forms the greater part of the base or the posterior surface of the heart.

Openings into the Left Atrium

1. The **four pulmonary veins**, two from each lung, open through the posterior wall and have no valves.
2. The **left atrio ventricular orifice** is guarded by the mitral valve.

❖ Left Ventricle

The left ventricle communicates with the left atrium through the **atrioventricular orifice** and with the aorta through the **aortic orifice**. The walls of the left ventricleare three times thicker than those of the right ventricle. (The left intra ventricular blood pressure is six times higher than that inside the right ventricle.)

The **mitral valve** guards the atrioventricular orifice. It consists of two cusps

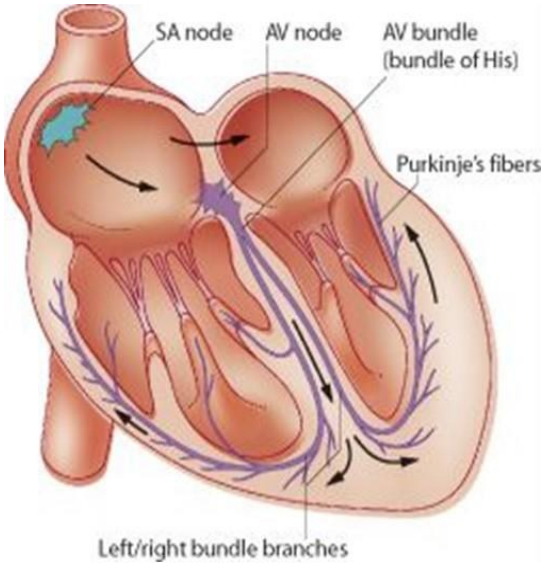
The **aortic valve** guards the aortic orifice with three cusps.
Behind each cusp, the aortic wall bulges to form an **aortic sinus.** The aortic sinuses gives origin to the right and left coronary arteries

Structure of the Heart

The walls of the heart are composed of a thick layer of cardiacmuscle, the **myocardium**, covered externally with serous pericardium the **epicardium** and lined internally with a layer of endothelium, the **endocardium.**
The atrial portion of the heart has relatively thin walls and is divided by the **atrial (inter atrial) septum** into the right and left atria. The ventricular portion of the heart has thick walls and is divided by the **ventricular (inter ventricular) septum** into the right and left ventricles.

Conducting System of the Heart

The normal heart contracts rhythmically at about 70 to 90 beats per minute in the resting adult. The rhythmic contractile process originates spontaneously in the conducting system and the impulse travels to different regions of the heart, so the atria contract first and together, to be followed later by the contractions of both ventricles together. The slight delay in the passage of the impulse from the atria to the ventricles allows time for the atria to empty their blood into the ventricles before the ventricles contract.



The conducting system of the heart consists of specialized cardiac muscle present in the **sinuatrial node,** the **atrio-ventricular node,** the **atrio-ventricular bundle** and its right and left terminal branches, and the subendocardial plexus of **Purkinje fibers** (specialized cardiac muscle fibers that form the conducting system of the heart).

Sinuatrial Node

The sinuatrial node is located in the wall of the right atriumin the upper part of the sulcus terminalis just to the right of the opening of the superior vena cava.

The node spontaneously gives origin to rhythmic electrical impulses that spread in all directions through the cardiac muscle of the atria and cause the muscle to contract.

Atrioventricular Node

The atrioventricular node is strategically placed on the lower part of the atrial septum just above the attachment of the septal cusp of the tricuspid valve.

From it, the cardiac impulse is conducted to the ventricles by the atrioventricular bundle. The atrioventricular node is stimulated by the excitation wave as it passes through the atrial myocardium.

Atrioventricular Bundle

The atrioventricular bundle (bundle of His) is the only pathway of cardiac muscle that connects the myocardium of the atria and the myocardium of the ventricles and is thus the only route along which the cardiac impulse can travel from the atria to the ventricles.

The atrioventricular bundle then descends to reach the ventricular septum.

At the upper border of the septum,it divides into two branches, one for each ventricle. The **right bundle branch (RBB)** passes down on the right side of the ventricular septum then it becomes continuous with the fibers of the Purkinje plexus. The **left bundle branch (LBB)** passes down on its left side which become continuous with the fibers of the Purkinje plexus of the left ventricle.

⇨ The Arterial Supply of the Heart

The arterial supply of the heart is provided by the **right and left coronary arteries**.

Venous Drainage of the Heart

Most blood from the heart wall drains into the right atrium through the **coronary sinus.** The remainder of the blood is returned to the right atrium by **cardiac veins**

⇨ Nerve Supply of the Heart

The heart is innervated by sympathetic and parasympathetic fibers of the autonomic nervous system via the **cardiac plexuses**. The sympathetic supply arises from the cervical and upper thoracic portions of the sympathetic trunks, and the parasympathetic supply comes from the vagus nerves.

Activation of sympathetic nerves results increase the heart rate, increased force of contraction of the cardiac muscle, and dilatation of the coronary arteries.

Activation of the parasympathetic nerves results in a reduction in the rate and force of contraction of the heart and a constriction of the coronary arteries.

Large Veins of the Thorax

1) Brachiocephalic Veins

- The **right brachiocephalic vein** is formed at the root of the neck by the union of the right subclavian and the right internal jugular veins.
- The **left brachiocephalicvein** has a similar originas it formed at the root of the neck by the union of the left subclavian and the left internal jugular veins.

2) Superior Vena Cava

The superior vena cava contains all the venous blood from the head and neck and both upper limbs and is formed by the union of the two brachiocephalic veins. It passes downward to end in the right atrium of the heart. The vena azygos joins the posterior aspect of the superior vena cava just before it enters the pericardium.

3) Azygos Veins

The azygos veins consist of the main azygos vein, the inferior hemiazygos vein, and the superior hemiazygos vein.

4) Inferior Vena Cava

The inferior vena cava pierces the central tendon of the diaphragm opposite the eighth thoracic vertebra and almost immediately enters the lowest part of the right atrium.

5) Pulmonary Veins

Two pulmonary veins leave each lung carrying oxygenated blood to the left atrium of the heart.

Large Arteries of the Thorax

➔ Aorta

The aorta is the main arterial trunk that delivers oxygenated blood from the left ventricle of the heart to the tissues of the body. It is divided for purposes of description into the following parts: ascending aorta, arch of the aorta,descending thoracic aorta, and abdominal aorta.

▪ Ascending Aorta

The ascending aorta begins at the base of the left ventricle and runs upward and forward to becomes continuous with the arch of the aorta. At its root, it possesses three bulges, the **sinuses of the aorta.**

Branches

The **right coronary artery** and **left coronary artery**

- **Arch of the Aorta**

The arch of the aorta is a continuation of the ascending aorta. It arches upward, backward, and to the left to become continuous with the descending aorta.

Branches

- The **brachiocephalic artery** divides into the right subclavian and right common carotid arteries.
- The **left common carotid artery.**
- The **left subclavian.**

Descending Thoracic Aorta

The descending thoracic aorta lies in the posterior mediastinumand begins as a continuation of the arch of the aorta it passes behind the diaphragm (through the aortic opening) continuous with the abdominal aorta.

➔ Pulmonary Trunk

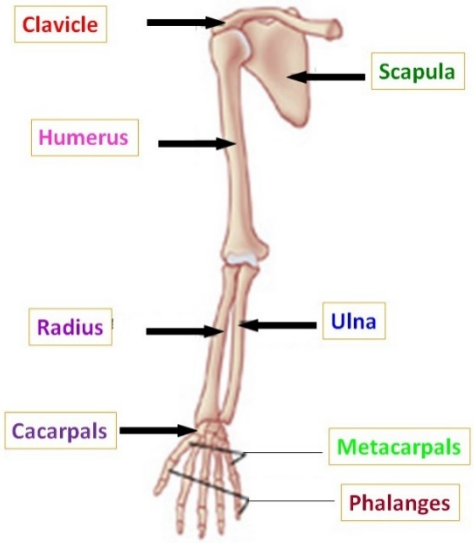
The pulmonary trunk conveys deoxygenated blood fromthe right ventricle of the heart to the lungs. It leaves the right ventricle. It terminates by dividing into right and left pulmonary arteries.

Branches

- The **right pulmonary artery** runs the right lung.
- The **left pulmonary artery** runs to the left lung.

❖ Appendicular skeleton

- ➢ Shoulder (Pectoral girdle) girdles
- ➢ Upper extremities
- ➢ Pelvic girdle
- ➢ Lower extremities



- ➢ Shoulder (Pectoral girdle) girdles
  - ☒ Clavicle 2
  - ☒ Scapula 2
- ➢ Upper extremities
  - ☒ Humerus 2
  - ☒ Radius 2
  - ☒ Ulna 2
  - ☒ Carpals 16
  - ☒ Metacarpals 10
  - ☒ Phalanges 28

➢ Bones of the Shoulder (Pectoral girdle)girdles

The shoulder girdle consists of the clavicle and the scapula, which articulate with one another at the acromioclavicular joint.

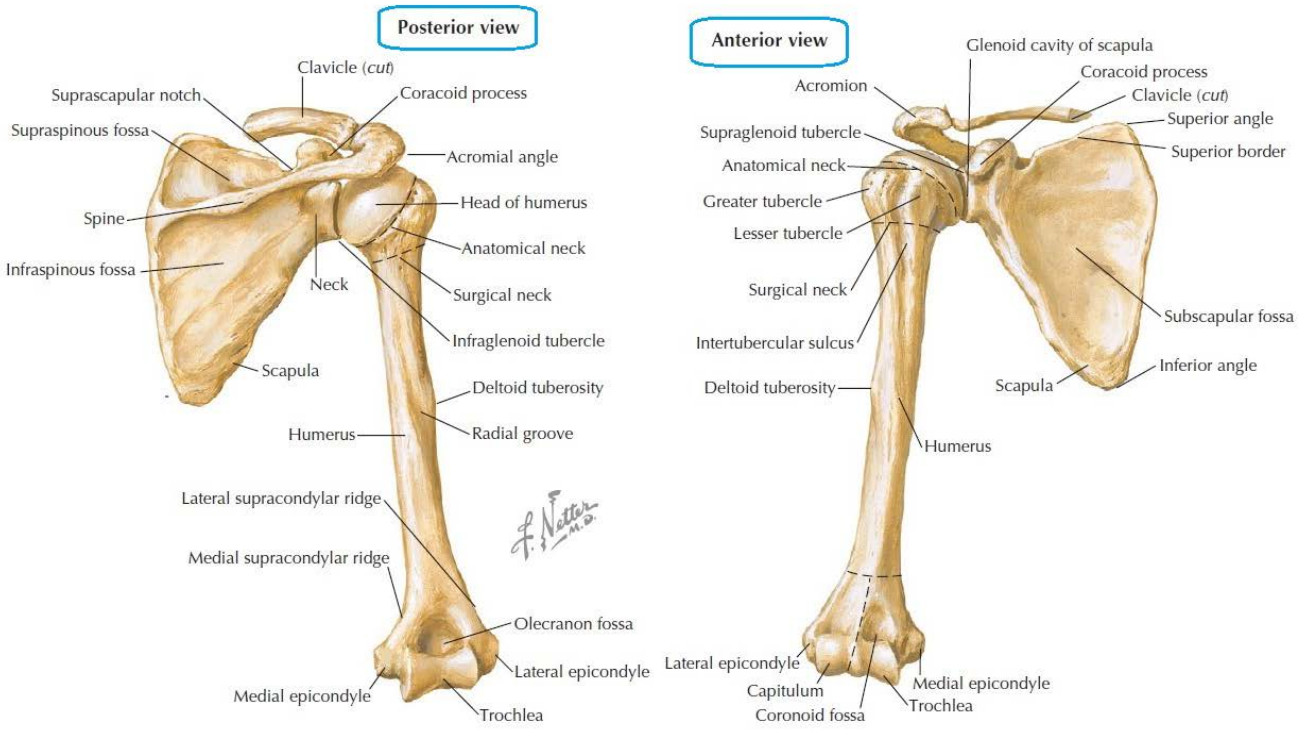
☒ Clavicle

The clavicle is a long, slender bone that lies horizontally across the root of the neck just beneath the skin. It articulates with the sternum and 1st costal cartilage medially and with the acromion process of the scapula laterally.

☒ Scapula

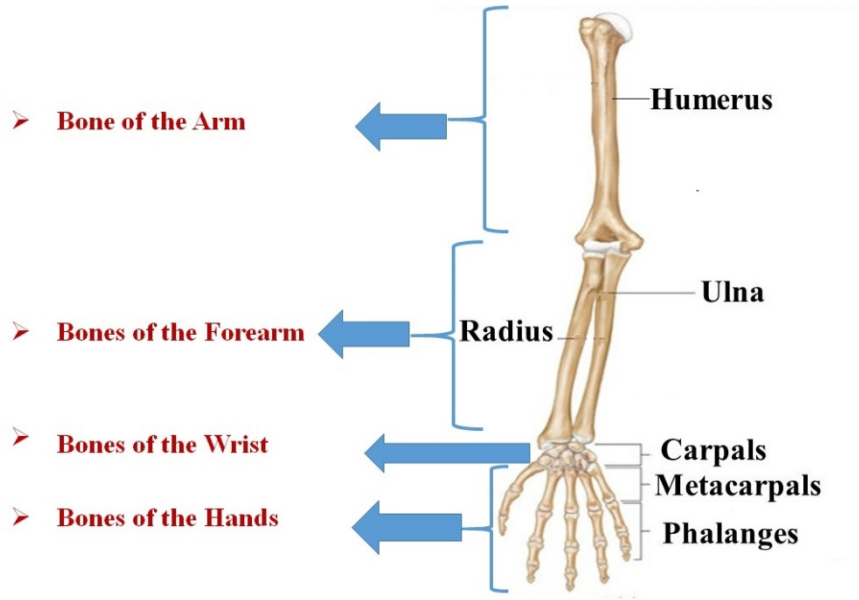
The scapula is a flat triangular bone that lies on the posterior chest wall. On its posterior surface, the **spine of the scapula** projects backward.

The lateral end of the spine is free and forms the **acromion,**which articulates with the clavicle. The superolateral angle of the scapula forms the pear-shaped **glenoid cavity,** or **fossa,** which articulates with the head of the humerus atthe shoulder joint. The anterior surface of the scapula is concave and forms the shallow **subscapular fossa.** The posterior surface of thes capula is divided by the spine into the **supraspinous fossa** above and an **infraspinous fossa** below.



➢ Upper extremities

The bones of the upper extremities is divided into: bone of the arm, bones of forearm, bones of the wrist and bones of the hand.

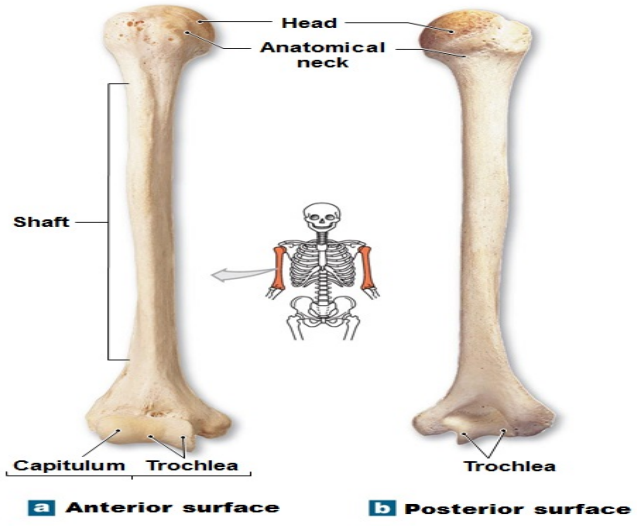


❖ **Bone of the arm**

☒ Humerus

The humerus articulates with the scapula at the **shoulder joint** and with the radius and ulna at the **elbow joint**. The upper end of the humerus has a **head** and articulates with the glenoid cavity of the scapula. Immediately below the head is the **anatomic neck.**

The lower end of the humerus possesses the rounded **capitulum** for articulation with the head of the radius, and the pulley-shaped **trochlea** for articulation with the trochlear notch of the ulna.



❖ Bones of the Forearm

The forearm contains two bones: the radius and the ulna.

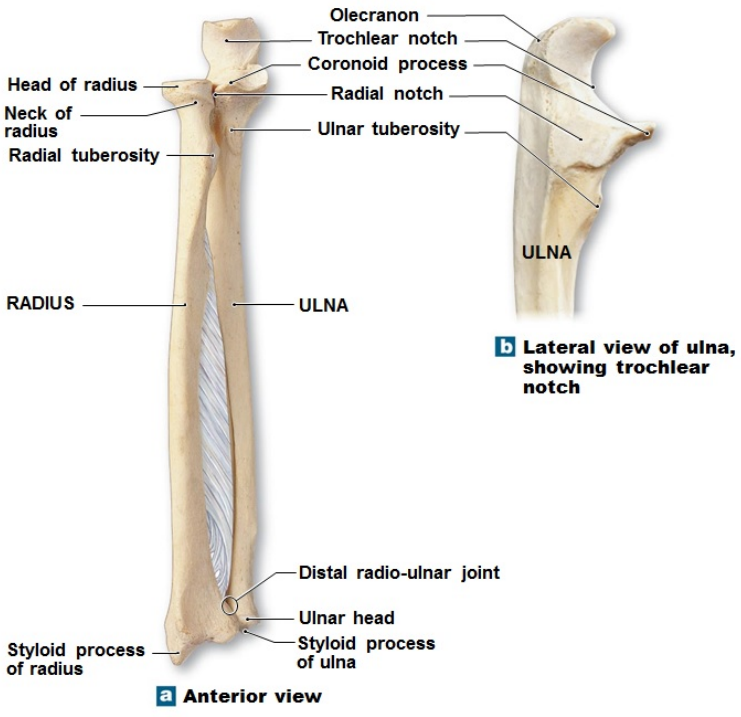
☒ Radius

The radius is the *lateral bone* of the forearm.

Its proximal end articulates with the humerus at the elbow joint and with the ulna at the proximal radioulnar joint. Its distal end articulates with the scaphoid and lunate bones of the wrist at the wrist joint and with the ulna at the distal radioulnar joint.

At the proximal end of the radius is the small circular **head.**The upper surface of the head is concave and articulates with the convex capitulum of the humerus.

At the distal end of the radius is the styloid process; this projects distally from its *lateral* margin. On the *medial* surface is the ulnar notch, which articulates with the round head of the ulna.

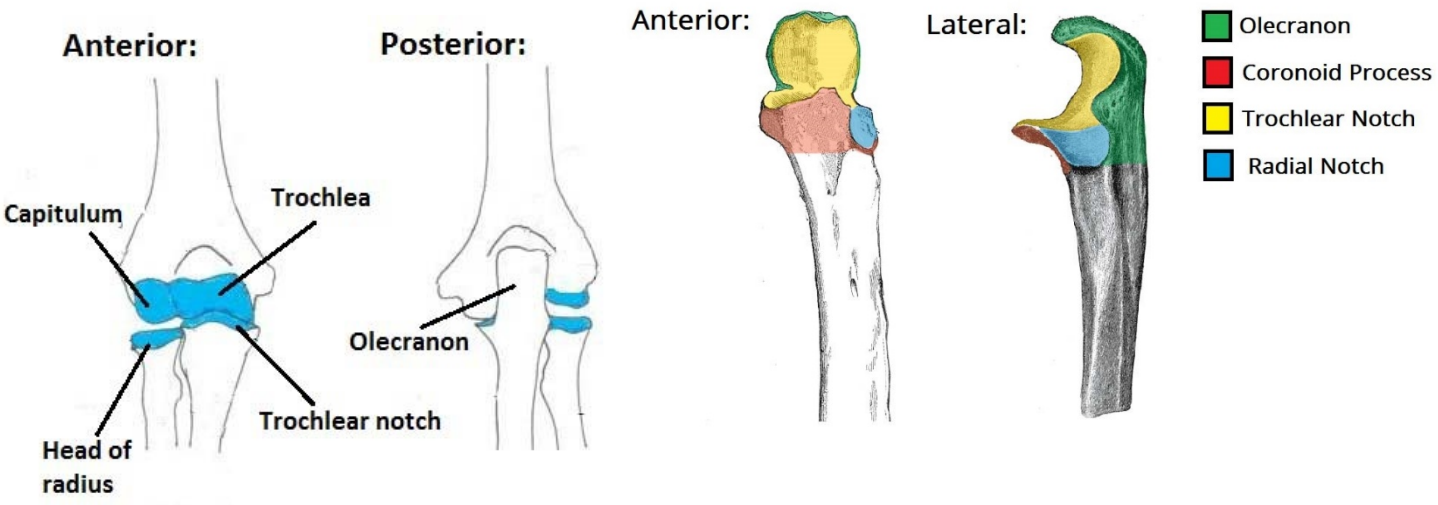


☒ Ulna

The ulna is the *medial bone* of the forearm. Its proximal end articulates with the humerus at the elbow joint and with the head of the radius at the proximal radioulnar joint. Its distal end articulates with the radius at the distal radioulnar joint.

The proximal end of the ulna is large and is known asthe **olecranon process;** this forms the prominence of the elbow. It has a notch on its anterior surface,the **trochlear notch,** which articulates with the trochlea of the humerus.

At the distal end of the ulna is the small rounded head, which has projecting from its medial aspect the styloid process.

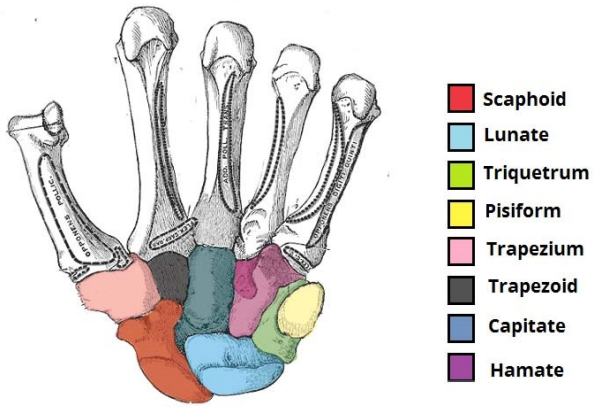


❖ Bones of the Wrist

The wrist connects the hand to the forearm and is composed of eight **carpal bones** aligned in a proximal and distal row (four carpals in each row).

The **proximal row** consists of (from lateral to medial) the **scaphoid, lunate, triquetral,** and **pisiform** bones.

The **distal row** consists of (from lateral to medial) the **trapezium, trapezoid, capitate,** and **hamate** bones.



❖ Bones of the Hand

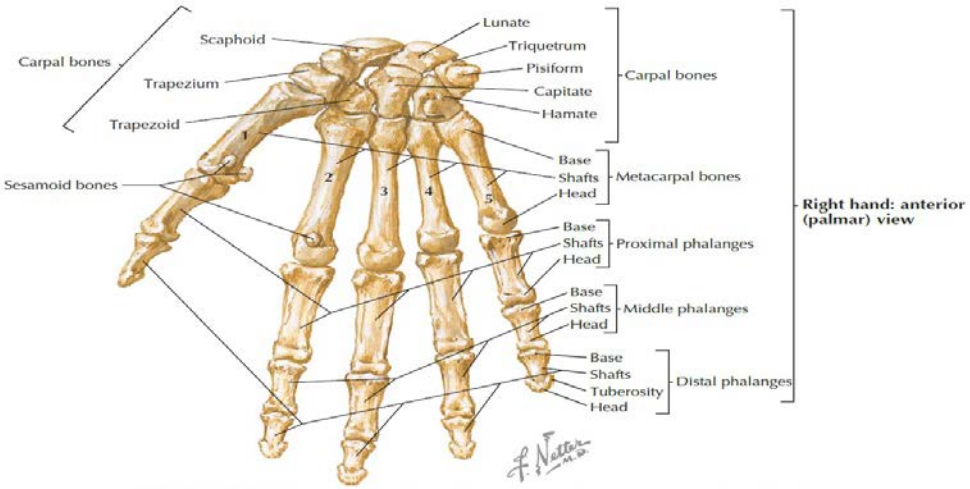
The hand includes the metacarpus (the palm, with five **metacarpal bones**) and five digits with their **phalanges.**

☒ The Metacarpals

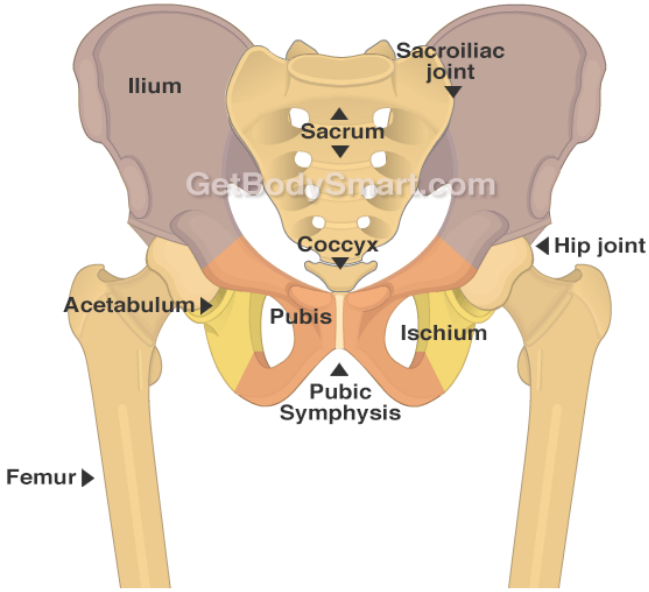
There are <u>five metacarpal bones</u>, each of which has a **base,a shaft, and a head.**
The first metacarpal bone of the thumb is the <u>shortest</u> and <u>most mobile</u>.
The bases of the metacarpal bones articulate with the distal row of the carpal bones; the heads, which form the knuckles, articulate with the proximal phalanges.

☒ The Phalanges

There are <u>three phalanges</u> for each of the fingers but <u>only two for the thumb.</u>It's termed **proximal, middle, and distal phalanges** and possess **base, shaft, and head**.



- **Pelvic girdle**
  - ☒ **Hip bone 2**
- **Lower extremities**
  - ☒ **Femur 2**
  - ☒ **Patella 2**
  - ☒ **Fibula 2**
  - ☒ **Tibia 2**
  - ☒ **Tarsals 14**
  - ☒ **Metatarsals 10**
  - ☒ **Phalanges 28**



- **Pelvic girdle**

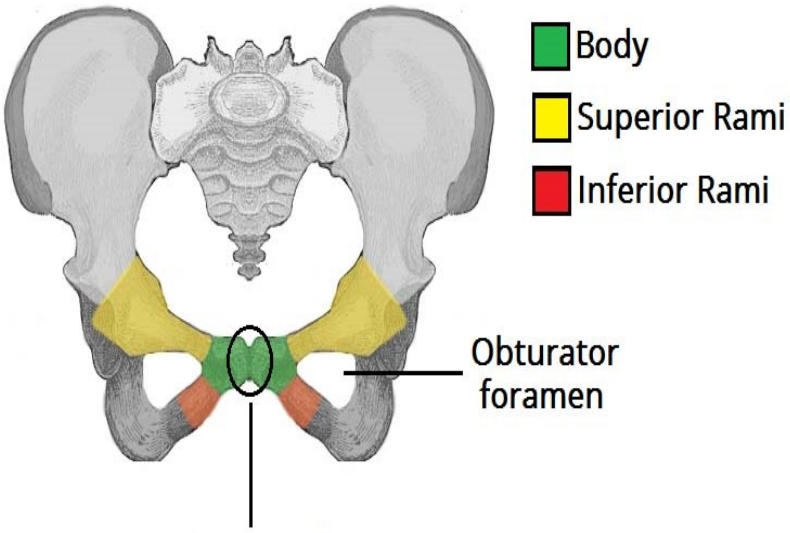
☒ Hip Bone

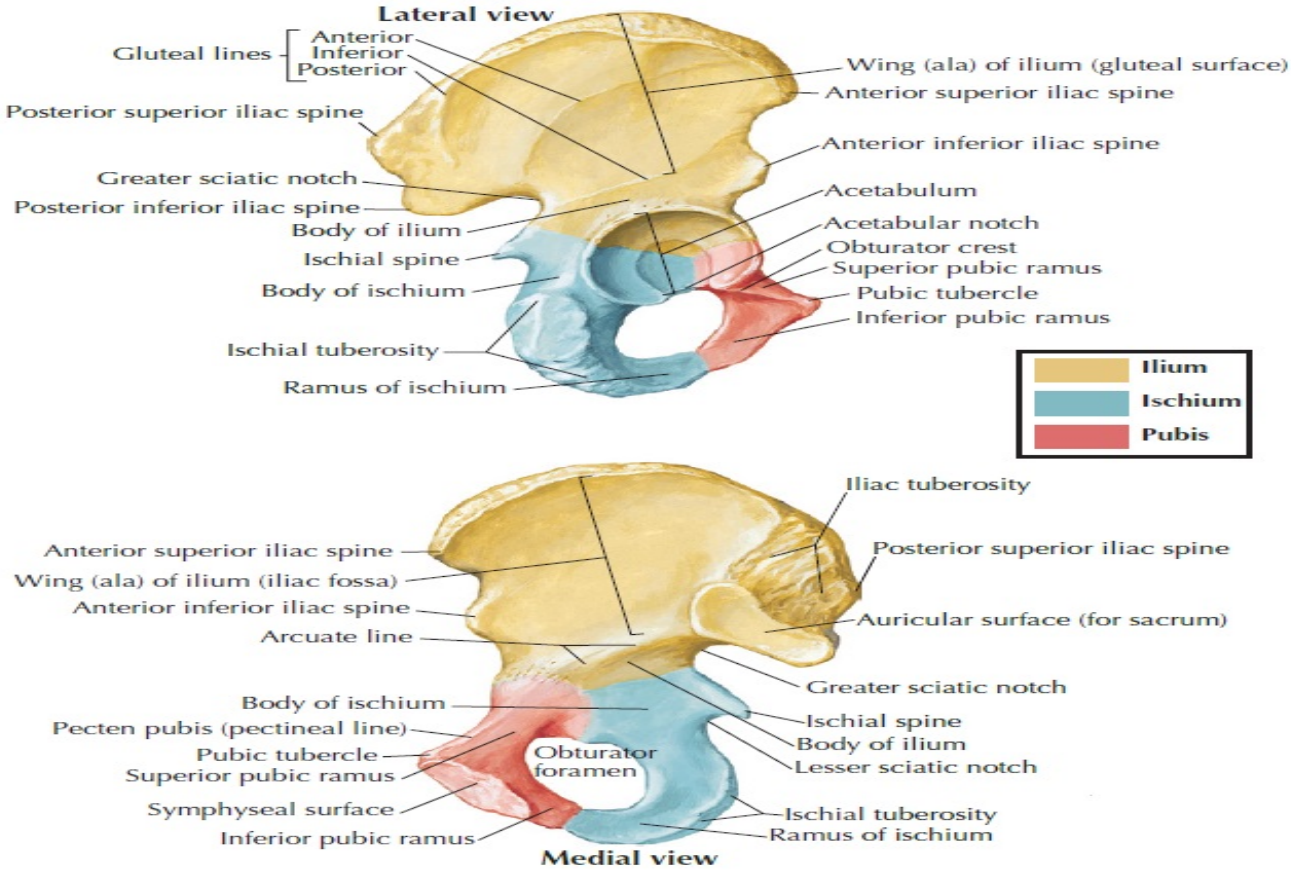
The **ilium, ischium, and pubis** form the hip bone. They meet one another at the **acetabulum**. The hip bones articulate with the sacrum at the sacroiliac joints; they also articulate with one another anteriorly at the symphysis pubis.

- The **ilium,**which is the upper flattened part of the bone, possesses the **iliac crest**. This can be felt through the skin along its entire length; it ends in front at the **anterior superior iliac spine** and behind at the **posterior superior iliac spine.** Below the anterior superior iliac spine is a prominence, the **anterior inferior iliac spine;** a similar prominence, the **posterior inferior iliac spine,** is located below the posterior superioriliac spine.

- The **ischium**is L shaped, possessing an upper thicker part, the **body,** and a lower thinner part, the **ramus**.
- The **pubis** can be divided into a **body,** a **superior ramus,** and an **inferior ramus**. The bodies of the two pubic bones articulate with each other in the midline anteriorly at the **symphysis pubis;** the superior ramus joins the ilium and ischium at the acetabulum, and the inferior ramus joins the ischial ramus below the **obturator foramen.** The obturator foramen in life is filled in by the **obturator membrane**.

On the outer surface of the hip bone is a deep depression,called the **acetabulum,** which articulates with the almost spherical head of the femur to form the hip joint.


Body
Superior Rami
Inferior Rami
Obturator foramen
Pubic symphysis

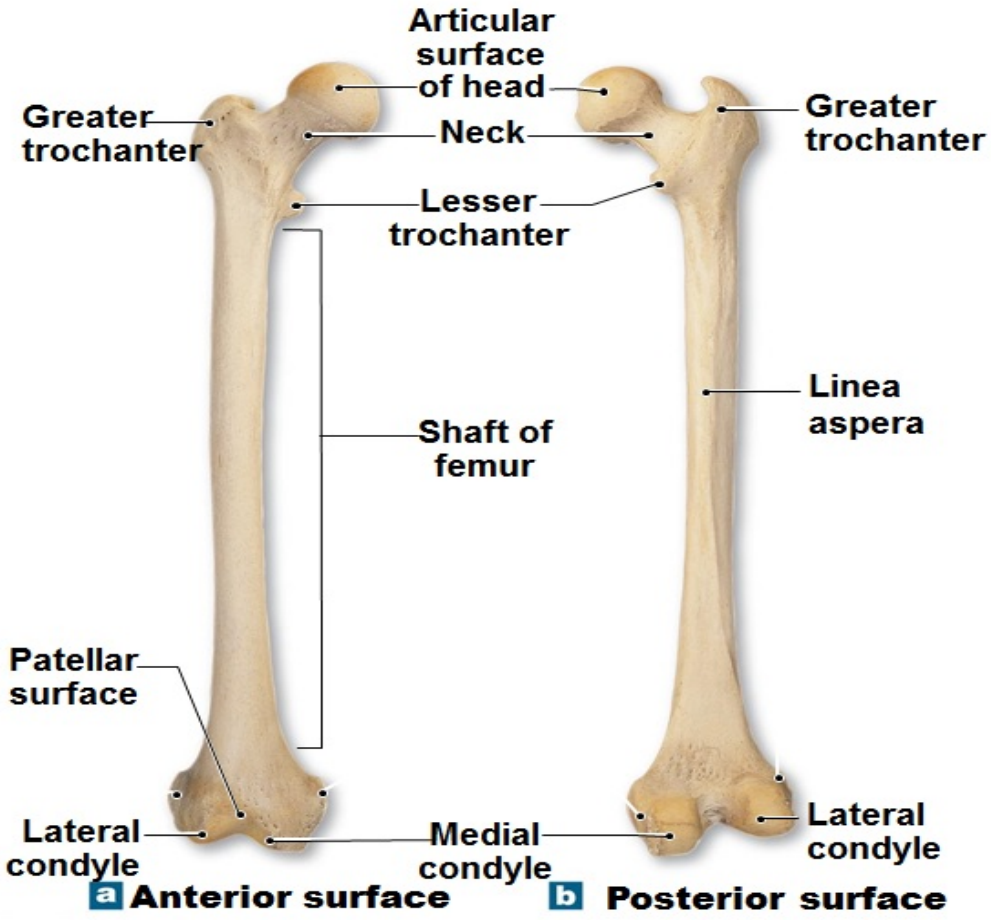

Lateral view
Gluteal lines
Anterior
Inferior
Posterior
Posterior superior iliac spine
Greater sciatic notch
Posterior inferior iliac spine
Body of ilium
Ischial spine
Body of ischium
Ischial tuberosity
Ramus of ischium
Wing (ala) of ilium (gluteal surface)
Anterior superior iliac spine
Anterior inferior iliac spine
Acetabulum
Acetabular notch
Obturator crest
Superior pubic ramus
Pubic tubercle
Inferior pubic ramus
Ilium
Ischium
Pubis
Iliac tuberosity
Anterior superior iliac spine
Wing (ala) of ilium (iliac fossa)
Anterior inferior iliac spine
Arcuate line
Body of ischium
Pecten pubis (pectineal line)
Pubic tubercle
Superior pubic ramus
Symphyseal surface
Inferior pubic ramus
Obturator foramen
Posterior superior iliac spine
Auricular surface (for sacrum)
Greater sciatic notch
Ischial spine
Body of ilium
Lesser sciatic notch
Ischial tuberosity
Ramus of ischium
Medial view

Lower extremities

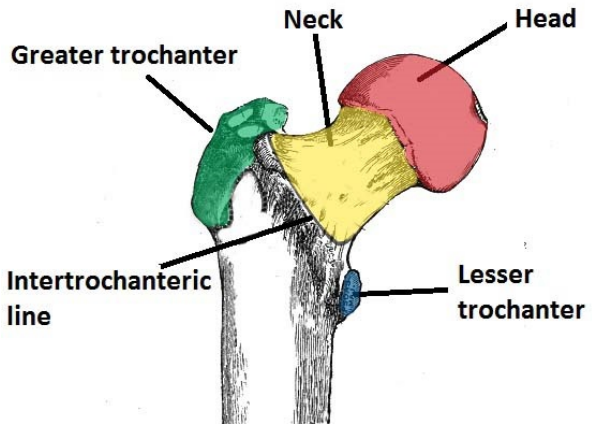
☒ Femur

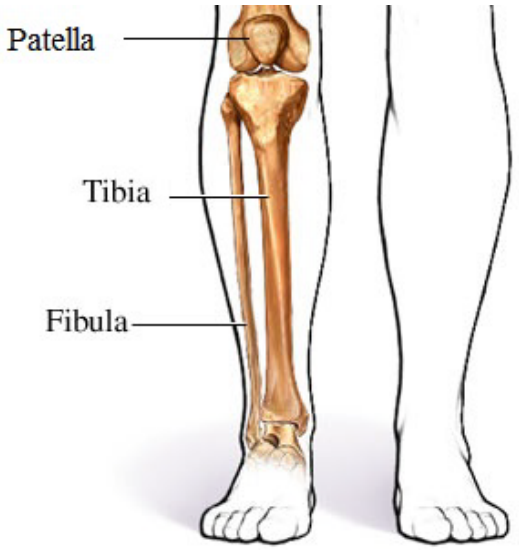
The femur **articulates above** with the acetabulum to form the hip joint and **below** with the tibia and the patella to form the knee joint.

➔ The upper end of the femur has a head, a neck, and greater and lesser trochanters.



➔ The lower end of the femur has **lateral** and **medial** condyles, separated posteriorly by the **intercondylar notch.** The anterior surfaces of the condyles are joined by an articular surface for the patella. The two condyles take part in the formation of the knee joint.





Patella

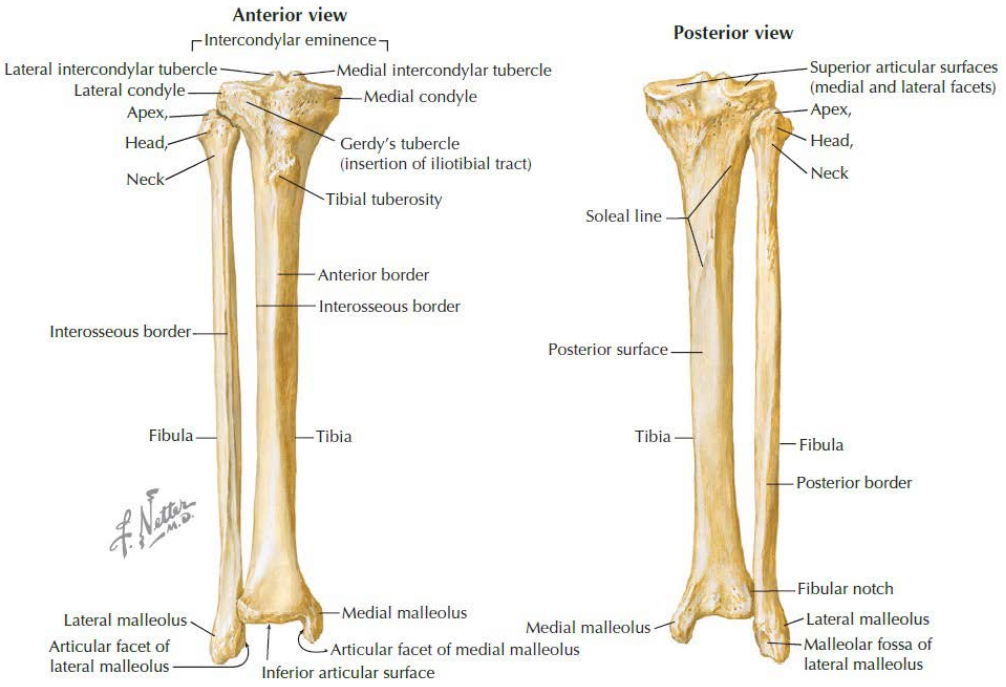
The patella is the largest sesamoid bone.The posterior surface articulates with the condyles of the femur. The patella is situated in an exposed position infront of the knee joint and can easily be palpated through the skin. It is separated from the skin by an important subcutaneous bursa.

Tibia

The tibia is the large weight-bearing medial bone of the leg. It articulates with the condyles of the femur and the head of the fibula above and with the talus and the distal end of the fibula below. It has an expanded **upper end**, a smaller **lower end**, and a **shaft**.

At the **upper end** are the **lateral** and **medial condyles** ,which articulate with the lateral and medial condyles of the femur. The lateral condyle possesses on its lateral aspect a small **circular articular facet for the head of the fibula**.

The **lower end** of the tibia is slightly expanded and on its inferior aspect shows a saddle-shaped articular surfacefor the talus. The lower end is prolonged downward mediallyto form the **medial malleolus**. The lateral surface of the medial malleolus articulates with the talus. The lower end of the tibia shows a wide, rough depression on its lateral surface for articulation with the fibula.



Fibula

The fibula is the slender lateral bone of the leg. It takes no part in the articulation at the knee joint, but below it forms the lateral malleolus of the ankle joint

The **upper end,** or **head,** is surmounted by a **styloid process**. It possesses an **articular surface** for articulation with the lateral condyle of the tibia.

➔ The **shaft of the fibula**

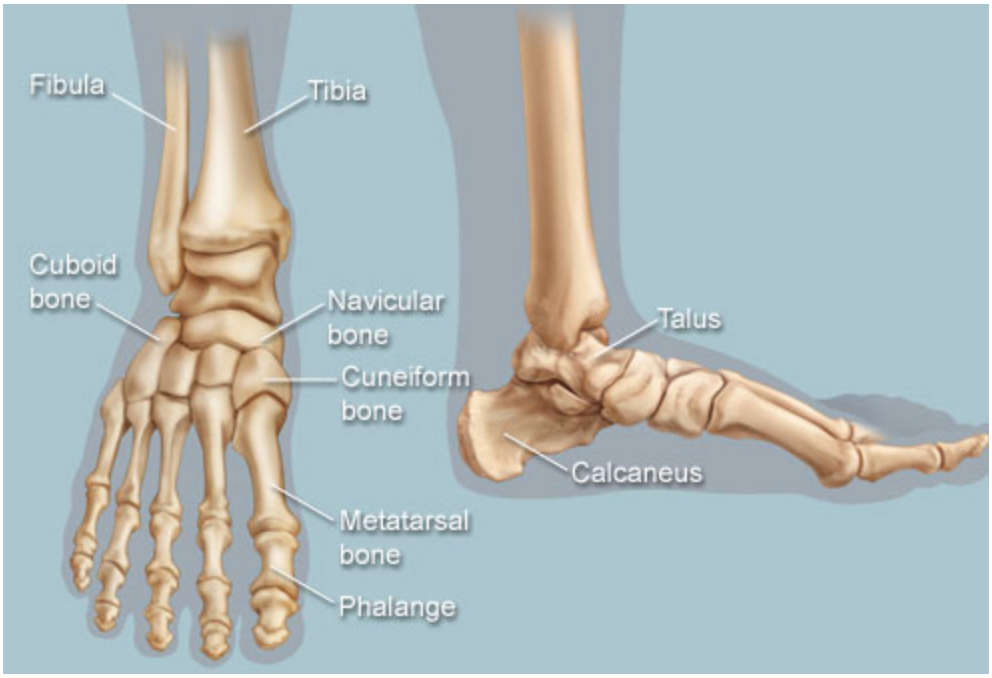
➔ The **lower end of the fibula** forms the triangular lateral malleolus, which is subcutaneous. On the medial surface of the lateral malleolus is a triangular **articular facet** for articulation with the lateral aspect of the talus.

❖ Bones of the Foot

The bones of the foot are the **tarsal bones,** the **metatarsals,** and the **phalanges**.

☒ Tarsal Bones

The tarsal bones are the calcaneum, the talus, the navicular,the cuboid, and the three cuneiform bones. Only the talus articulates with the tibia and the fibula at the ankle joint.



☒ Metatarsal Bones and Phalanges

The metatarsal bones and phalanges resemble the metacarpals and phalanges of the hand, and each possesses a **head** distally, a **shaft,** and a **base** proximally.
The five metatarsals are numbered from the medial to the lateral side.
Each toe has three phalanges except the big toe, which possesses only two.

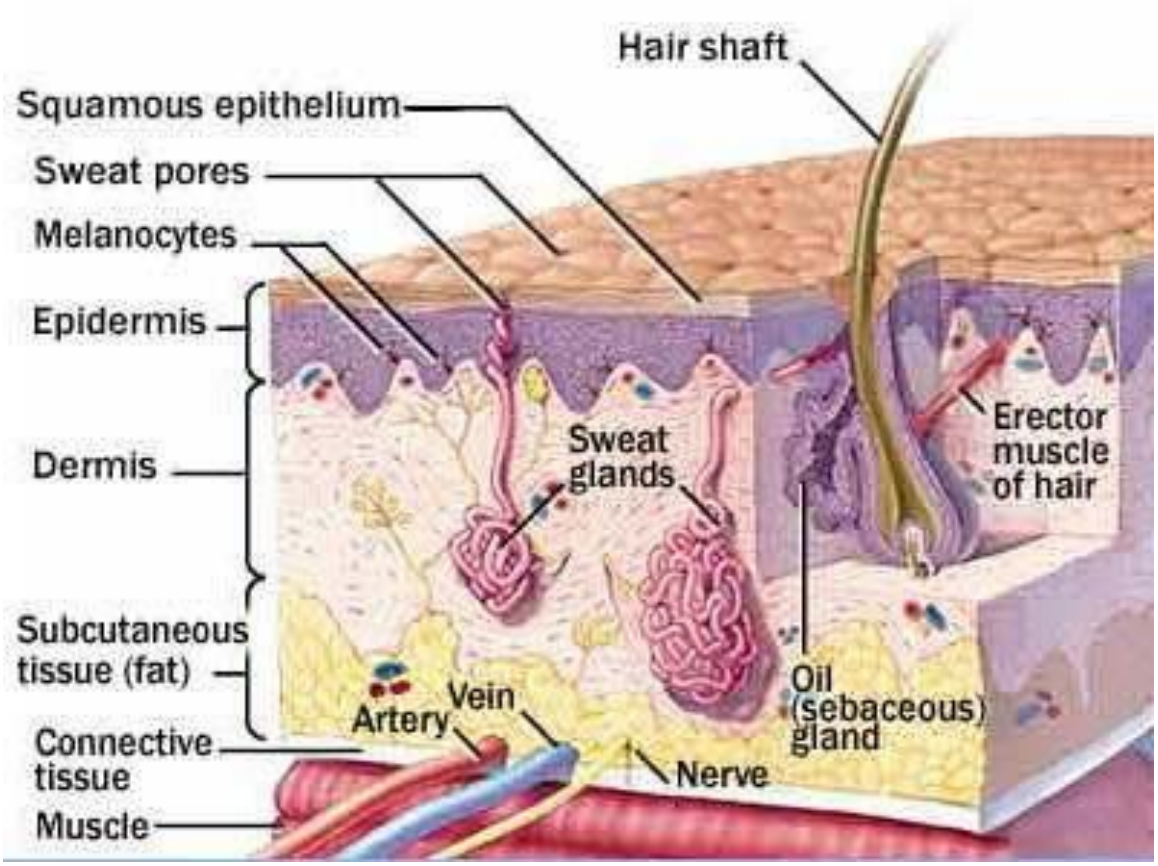
Basic Structures: part1

Skin

The skin is divided into two parts: the superficial part, the epidermis; and the deep part, the dermis. The epidermis is a stratified epithelium. On the palms of the hands and the soles of the feet, the epidermis is extremely thick, to withstand the wear and tear that occurs in these regions.

The dermis is composed of dense connective tissue containing many blood vessels, lymphatic vessels, and nerves. The dermis of the skin is connected to the underlying deep fascia or bones by the superficial fascia, otherwise known as subcutaneous tissue.

The appendages of the skin are the nails, hair follicles, sebaceous glands, and sweat glands.

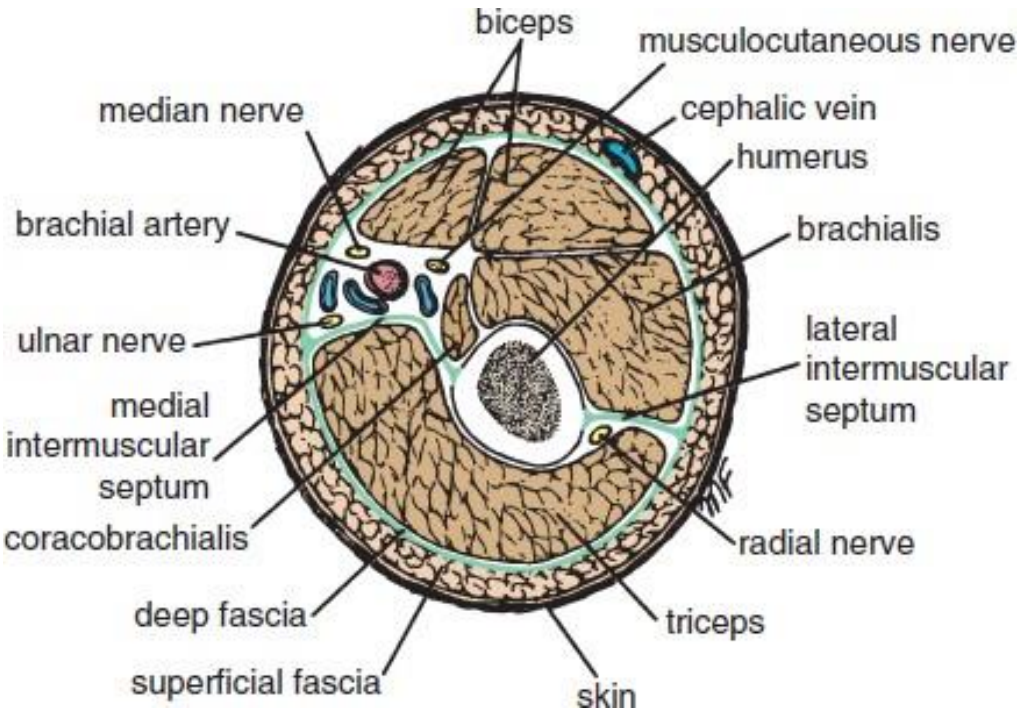


Fasciae

The fasciae of the body can be divided into two types— superficial and deep— and lie between the skin and the underlying muscles and bones.

The **superficial fascia, or subcutaneous tissue**, is a mixture of loose areolar and adipose tissue that unites the dermis of the skin to the underlying deep fascia.

The **deep fascia** is a membranous layer of connective tissue that invests the muscles and other deep structures. In the neck, it forms well-defined layers and in the thorax and abdomen, it is merely a thin film of areolar tissue covering the muscles and aponeuroses.



Muscle

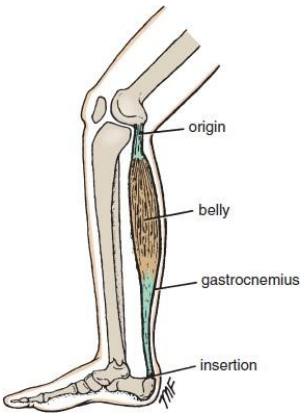
The three types of muscle are skeletal, smooth, and cardiac.

Skeletal Muscle

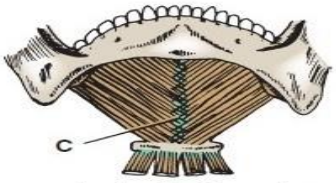
Skeletal muscles produce the movements of the skeleton; they are sometimes called **voluntary muscles** and are made up of striped muscle fibers. A skeletal muscle has two or more attachments. The attachment that moves the least is referred to as the **origin**, and the one that moves the most, the **insertion**. Under varying circumstances, the degree of mobility of the attachments may be reversed;therefore, the terms origin and insertion are interchangeable.

The fleshy part of the muscle is referred to as its **belly**. The ends of a muscle are attached to bones, cartilage, or ligaments by cords of fibrous tissue called

tendons. Occasionally, flattened muscles are attached by a thin but strong sheet of fibrous tissue called an **aponeurosis**. A **raphe** is an interdigitation of the tendinous ends of fibers of flat muscles.



common tendon for the insertion of the gastrocnemius and soleus muscles



raphe of mylohyoid muscles

Examples of (**A**) a tendon, (**B**) an aponeurosis, and (**C**) a raphe.

- Skeletal Muscle Action

All movements are the result of the coordinated action of many muscles. A muscle may work in the following four ways:

Prime mover: A muscle is a prime mover when it is the chief muscle or member of a chief group of muscles responsible for a particular movement. For example, the quadriceps femoris is a prime mover in the movement of extending the knee joint.

Antagonist: Any muscle that opposes the action of the prime mover is an antagonist. For example, the biceps femoris opposes the action of the quadriceps femoris when the knee joint is extended. Before aprime mover can contract, the antagonist muscle must be equally relaxed.

Fixator: A fixator contracts isometrically (i.e., contraction increases the tone but does not in itself produce movement)to stabilize the **origin** of the prime mover. For example, the muscles attaching the shoulder girdle to the trunk contract as fixators to allowthe deltoid to act on the shoulder joint.

Synergist: In many locations in the body, the prime mover muscle crosses several joints before it reaches the joint at which its main action takes place. To prevent unwanted movements in an intermediate joint, groups of muscles called **synergists** contract and stabilize the intermediate joints. For example, the flexor and extensor muscles of the carpus contract to fix the wrist joint, and this allowsthe long flexor and the extensor muscles of the fingers to work efficiently.

- Nerve Supply of Skeletal Muscle

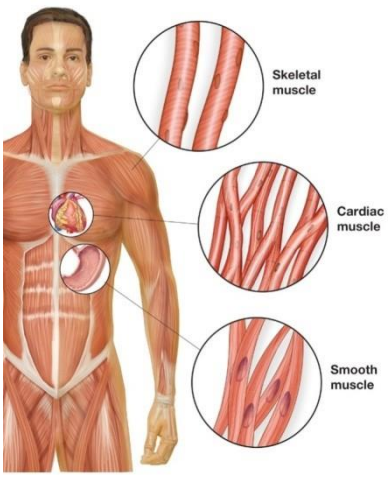
The nerve trunk to a muscle is a mixed nerve, about60% is motor and 40% is sensory.

Smooth Muscle

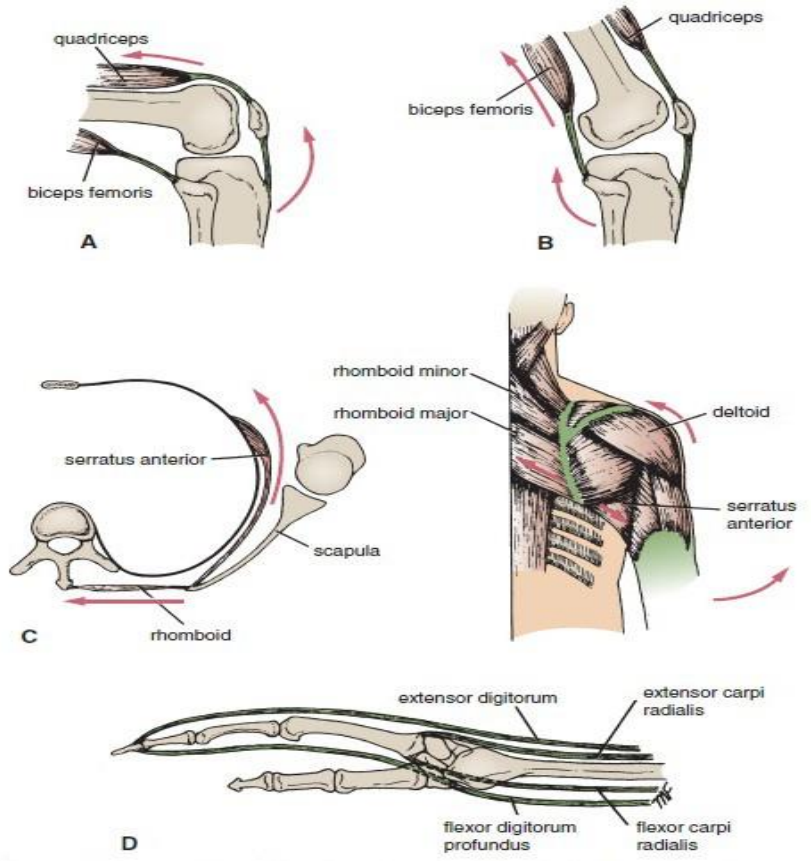
Smooth muscle consists of long, spindle-shaped cells closely arranged in bundles or sheets. In the tubes of the body, it provides the motive power for propelling the contents through the lumen. In the digestive system, it also causes the ingested food to be thoroughly mixed with the digestive juices.

In storage organs such as the urinary bladder and the uterus, the fibers are irregularly arranged and interlaced with one another. Their contraction is slow and sustained and brings about expulsion of the contents of the organs.

In the walls of the blood vessels, the smooth muscle fibers are arranged circularly and serve to modify the caliber of the lumen.



Depending on the organ, smooth muscle fibers may be made to contract by local stretching of the fibers, by nerve impulses from autonomic nerves, or by hormonal stimulation.



A. Quadriceps femoris extending the knee as a prime mover, and biceps femorisacting as an antagonist. **B.** Biceps femoris flexing the knee as a prime mover, and quadriceps acting as an antagonist.
C. Muscles around shoulder girdle fixing the scapula so that movement of abduction can take place at the shoulder joint.
D. Flexor and extensor muscles of the carpus acting as synergists and stabilizing the carpus so that long flexor and extensortendons can flex and extend the fingers.

Cardiac Muscle

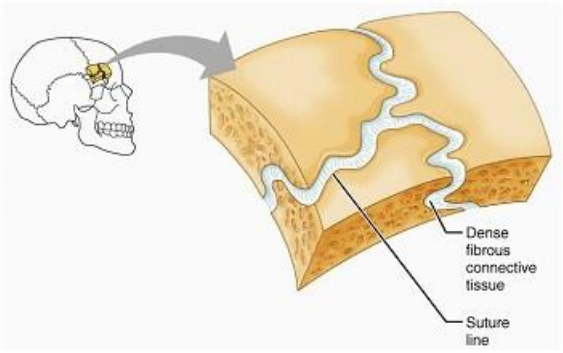
Cardiac muscle consists of striated muscle fibers that branch and unite with each other. It forms the myocardium of the heart. Its fibers tend to be arranged in whorls and spirals, and they have the property of spontaneous and rhythmic contraction.

Joints

A site where two or more bones come together, whether or not movement occurs between them, is called a joint.Joints are classified according to the tissues that lie betweenthe bones: fibrous joints, cartilaginous joints, and synovial joints.

Fibrous Joints

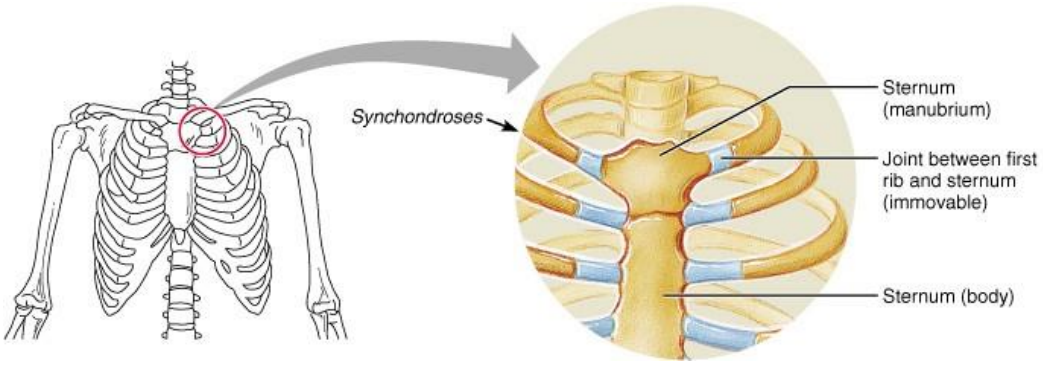
The articulating surfaces of the bones are joined by fibrous tissue, and thus very little movement is possible.Example: The sutures of the vault of the skull.



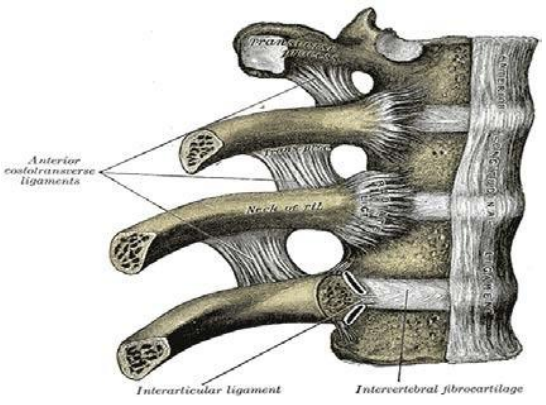
Cartilaginous Joints

Cartilaginous joints can be divided into two types: primary and secondary.

A primary cartilaginous joint is one in which the bones are united by a plate or a bar of hyaline cartilage,like, the union between the 1st rib and the manubrium sterni. No movement is possible.

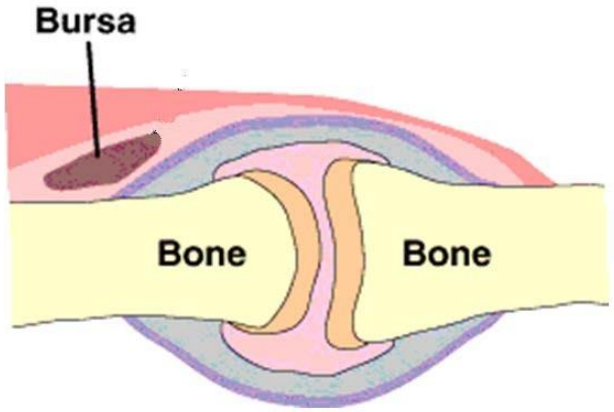


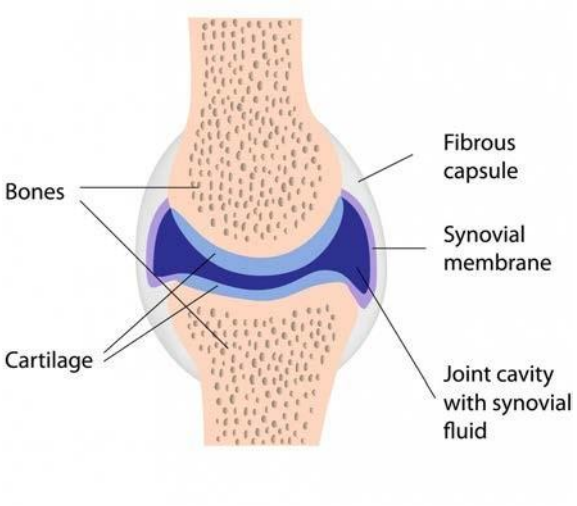
A secondary cartilaginous joint is one in which the bones are united by a plate of fibrocartilage and the articular surfaces of the bones are covered by a thin layer of hyaline cartilage like the joints between the vertebral bodies. A small amount of movement is possible.



Synovial Joints

The articular surfaces of the bones are covered by a thin layer of hyaline cartilage separated by a joint cavity. This arrangement permits a great degree of freedom of movement. The cavity of the joint is lined by **synovial membrane**, which extends from the margins of one articular surface to those of the other. The synovial membrane is protected on the outside by a tough fibrous membrane referred to as the **capsule of the joint**. The articular surfacesare lubricated by a viscous fluid called **synovial fluid**, which is produced by the synovial membrane. In certain synovial joints, for example, in the knee joint, discs or wedges of fibrocartilage are interposed between the articular surfaces of the bones. These are referred to as articular discs.





Ligament:

A ligament is a cord or band of connective tissue uniting two structures. Commonly found in association with joints,ligaments are of two types. Most are composed of dense bundles of collagen fibers and are unstretchable under normal conditions. The second type is composed largely of elastic tissues and can therefore regain its original length after stretching.

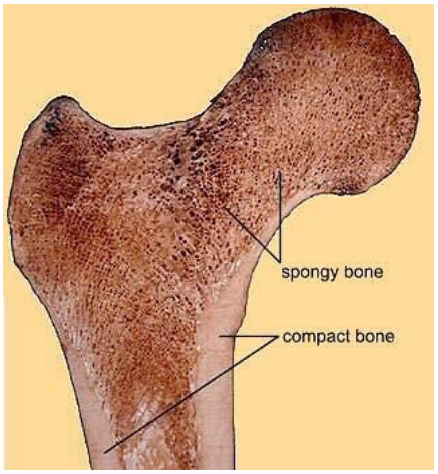
Bursae

A bursa is a lubricating device consisting of a closed fibrous sac lined with a delicate smooth membrane. Its walls are separated by a film of viscous fluid. Bursae are found wherever tendons rub against bones, ligaments, or other tendons. They are commonly found close to joints where the skin rubs against underlying bony structures, for example,the prepatellar bursa.

Bone

Bone is a living tissue 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, and as an important storage area for calcium salts. It houses and protects within its cavities the delicate blood-forming bone marrow. Bone exists in two forms: **compact (cortical)** and **cancellous (spongy).**Compact bone appears as a solid mass; cancellous bone consists of a branching network of *trabeculae*. The trabeculae are arranged in such a manner to resist the stresses and strains to which the bone is exposed.



Classification of Bones

Bones may be classified regionally or according to their general shape.

⊠- Regional Classification of Bones:

❖ **Axial skeleton80 bones**

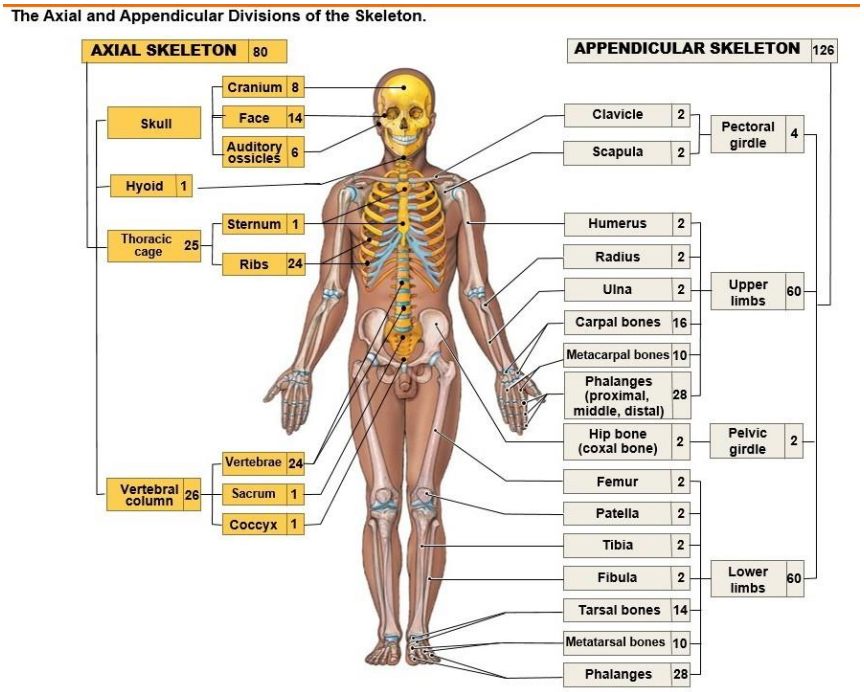
- Skull
  - ⊠ Cranium 8
  - ⊠ Face 14
  - ⊠ Auditory ossicles 6
- Hyoid 1
- Vertebrae (including sacrum and coccyx) 26
- Thoracic cage
  - ⊠ Sternum 1
  - ⊠ Ribs 24

❖ **Appendicular skeleton126 bones**

- Shoulder (**Pectoralgirdle**)girdles
  - ⊠ Clavicle 2

- ☒ Scapula 2

- Upper extremities
  - ☒ Humerus 2
  - ☒ Radius 2
  - ☒ Ulna 2
  - ☒ Carpals 16
  - ☒ Metacarpals 10
  - ☒ Phalanges 28
- Pelvic girdle
  - ☒ Hip bone 2
- Lower extremities
  - ☒ Femur 2
  - ☒ Patella 2
  - ☒ Fibula 2
  - ☒ Tibia 2
  - ☒ Tarsals 14
  - ☒ Metatarsals 10
  - ☒ Phalanges 28



The adult human body contain 206 bones, 80 in axial skeleton and 126 in appendicular skeleton.

☒ - Classification of Bones according to shape:

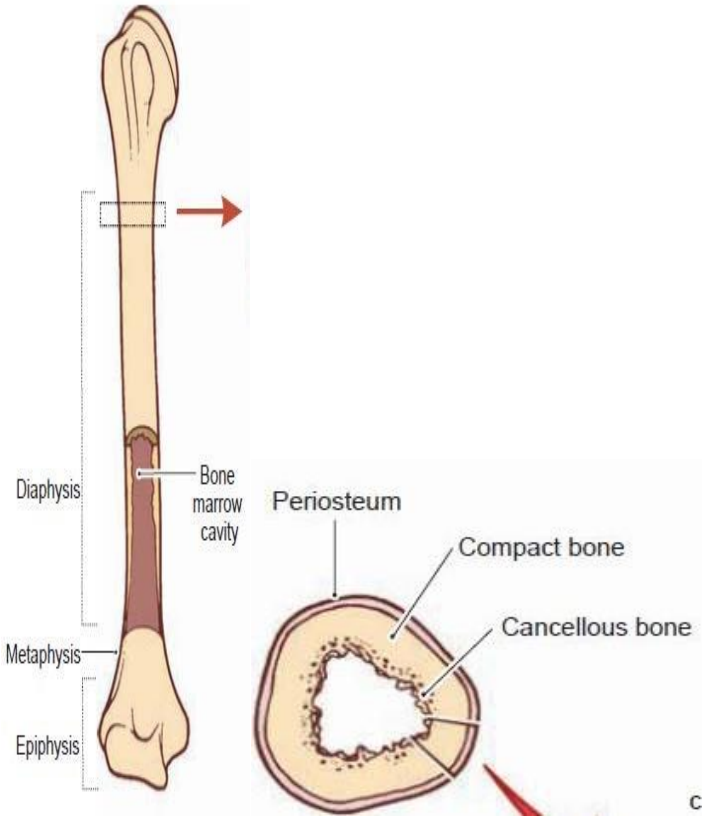
Bones are grouped as follows based on their general shape: long bones, short bones, flat bones, irregular bones, and sesamoid bones.

1. **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. 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.

2. **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.

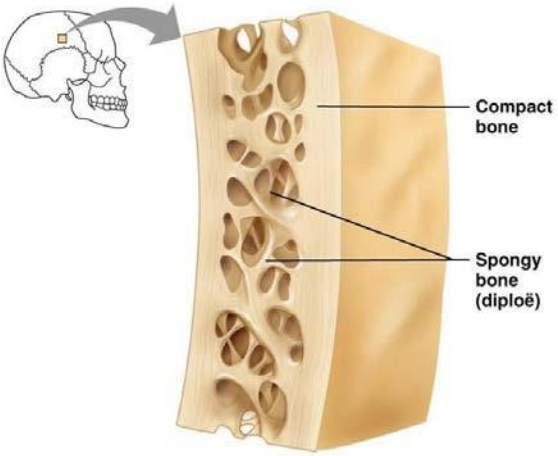


3. Flat Bones

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 **diploë.** The scapulae, although irregular, are included in this group.

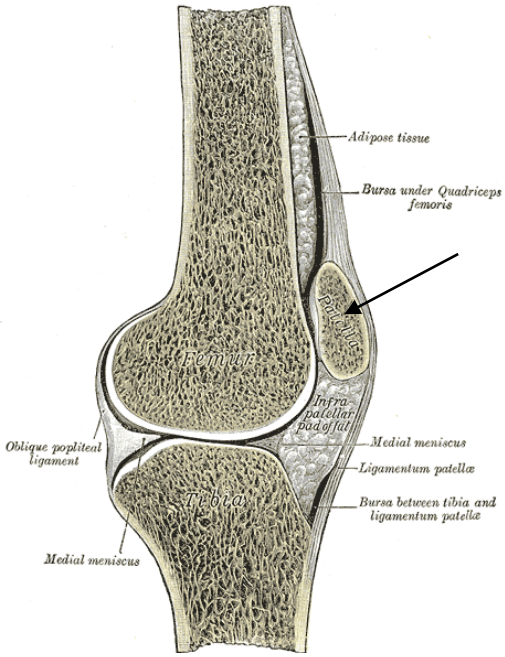
4. Irregular Bones

Irregular bones include those not assigned to the previous groups (e.g., the bones of the skull, the vertebrae, and the pelvic bones). They are composed of a thin shell of compact bone with an interior made up of cancellous bone.



5. Sesamoid Bones

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. The function of a sesamoid bone is to reduce friction on the tendon; it can also alter the direction of pull of a tendon.



Development of Bone

Bone is developed by two processes: membranous and endochondral. In the first process, the bone is developed directly from a connective tissue membrane; in the second, a cartilaginous model is first laid down and is later replaced by bone.The bones of the vault of the skull are developed rapidly by the membranous method in the embryo, and this serves to protect the underlying developing brain.

Human Anatomy

Lecture 8

د. صباح عبد الرسول

The Vertebral Column

The vertebral column is the central bony pillar of the body. It supports the skull, pectoral girdle, upper limbs, and thoracic cage and, by way of the pelvic girdle, transmits body weight to the lower limbs. Within its cavity lie the spinal cord, the roots of the spinal nerves, and the covering meninges, to which the vertebral column gives great protection.

Composition of the Vertebral Column

The vertebral column is composed of 33 vertebrae—7 cervical, 12 thoracic, 5 lumbar, 5 sacral (fused to form the sacrum), and 4 coccygeal. That is the vertebral column consist of 26 bones (7C+12T+5L+Sacrum+Coccyx).

Because it is segmented and made up of vertebrae, joints, and pads of fibrocartilage called **intervertebral discs,** it is a flexible structure. The intervertebral discs form about one quarter the length of the column.

- ### General Characteristics of a Vertebra

Although vertebrae show regional differences, they all possess a common pattern.

A **typical vertebra** consists of a rounded **body** anteriorly and a **vertebral arch** posteriorly. These enclose a space called the **vertebral foramen,** through which run the spinal cord and its coverings. The vertebral arch consists of a pair of cylindrical **pedicles,** which form the sides of the arch, and a pair of flattened **laminae,** which complete the arch posteriorly.

The vertebral arch gives rise to seven processes: one spinous, two transverse, and four articular.

The **spinous process,** or **spine,** is directed posteriorly from the junction of the two laminae. The **transverse processes** are directed laterally from the junction of the laminae and the pedicles. Both the spinous and transverse processes serve as levers and receive attachments of muscles and ligaments.

The **articular processes** are vertically arranged and consist of two superior and two inferior processes. They arise from the junction of the laminae and the pedicles, and their articular surfaces are covered with hyaline cartilage.

The two superior articular processes of one vertebral arch articulate with the two inferior articular processes of the arch above, forming two synovial joints.

The pedicles are notched on their superior and inferior borders, forming the **superior** and **inferior vertebral notches.** On each side, the superior notch of one vertebra and the inferior notch of an adjacent vertebra together form an **intervertebral foramen.**

These foramina, in an articulated skeleton, serve to transmit the spinal nerves and blood vessels. The anterior and posterior nerve roots of a spinal nerve unite within these foramina with their coverings of dura to form the segmental spinal nerves.

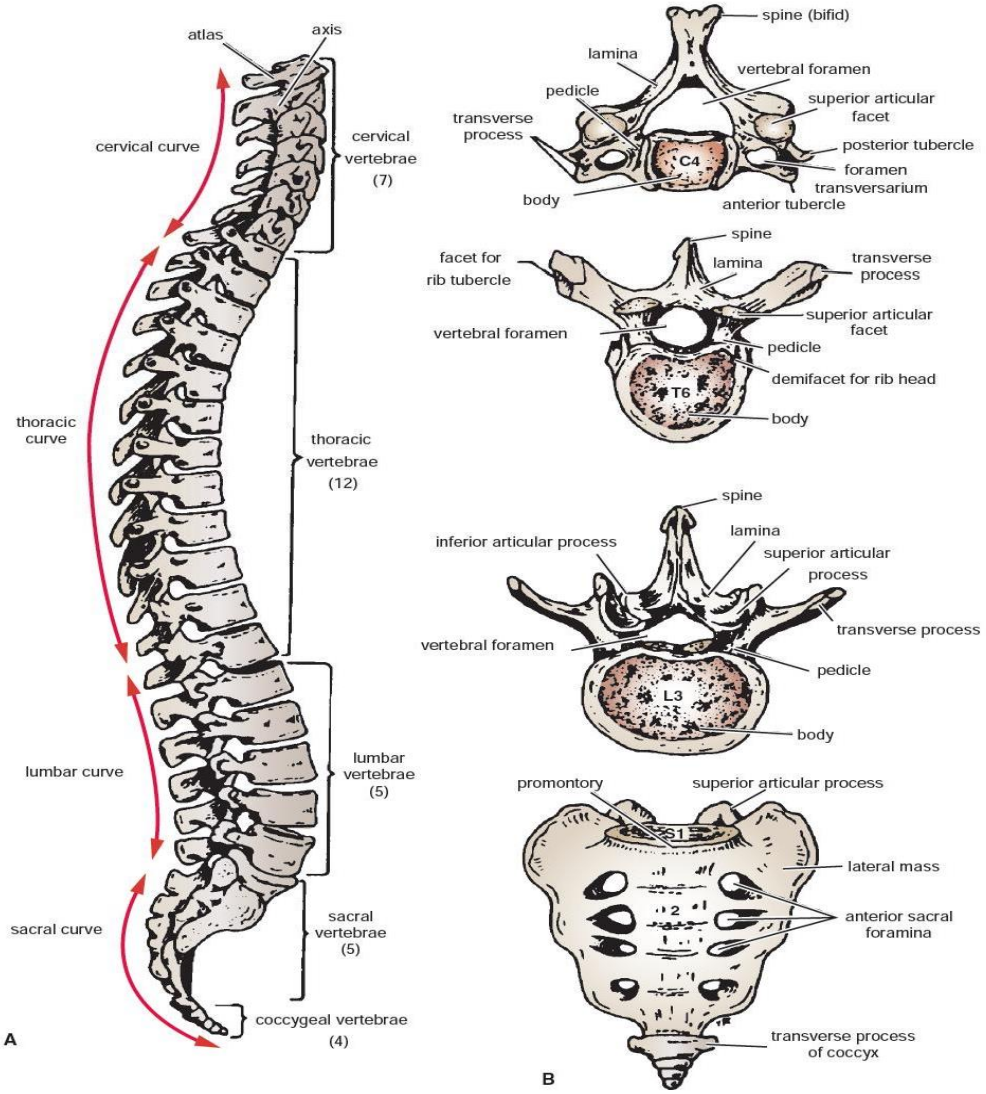


FIGURE 12.2 **A.** Lateral view of the vertebral column. **B.** General features of different kinds of vertebrae.

Cervical Vertebra

▪ Characteristics of a Typical Cervical Vertebra

A typical cervical vertebra has the following characteristics:

■■ The transverse processes possess a **foramen transversarium** for the passage of the vertebral artery and veins (note that the vertebral artery passes through the transverse processes C1 to 6 and not through C7).

■■ The spines are small and bifid.

- The body is small and broad from side to side.
- The vertebral foramen is large and triangular.

The superior articular processes have facets that face posteriorly and superiorly; the inferior processes have facets that face inferiorly and anteriorly.

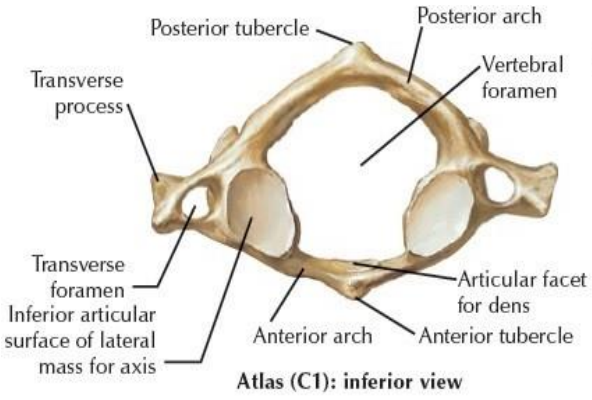
Characteristics of the Atypical Cervical Vertebrae

The 1st, 2nd, and 7th cervical vertebrae are atypical.

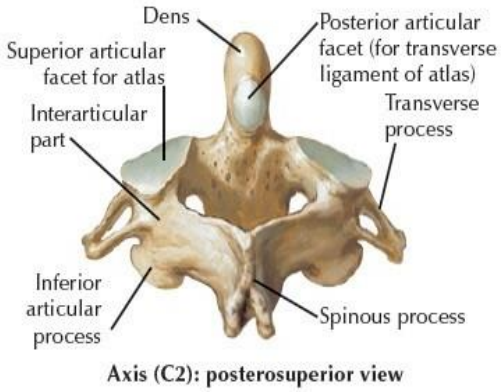
The **1st cervical vertebra,** or **atlas,** does not possess a body or a spinous process. It has an anterior and posterior arch. It has a lateral mass on each side with articular surfaces on its upper surface for articulation with the occipital condyles **(atlanto-occipital joints)** and articular surfaces on its inferior surface for articulation with the axis **(atlantoaxial joints).**

The **2nd cervical vertebra,** or **axis,** has a peglike **odontoid process (dens)** that projects from the superior surface of the body (representing the body of the atlas that has fused with the body of the axis).

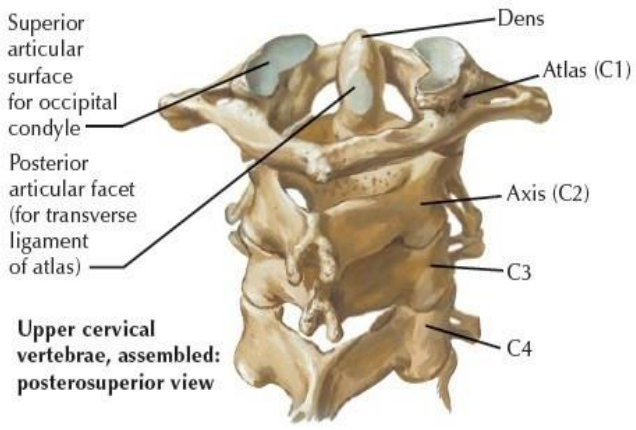
The **7th cervical vertebra,** or **vertebra prominens**, is so named because it has the longest spinous process, and the process is not bifid. The transverse process is large, but the foramen transversarium is small and transmits the vertebral vein or veins.



Atlas (C1): inferior view



Axis (C2): posterosuperior view



Upper cervical vertebrae, assembled: posterosuperior view

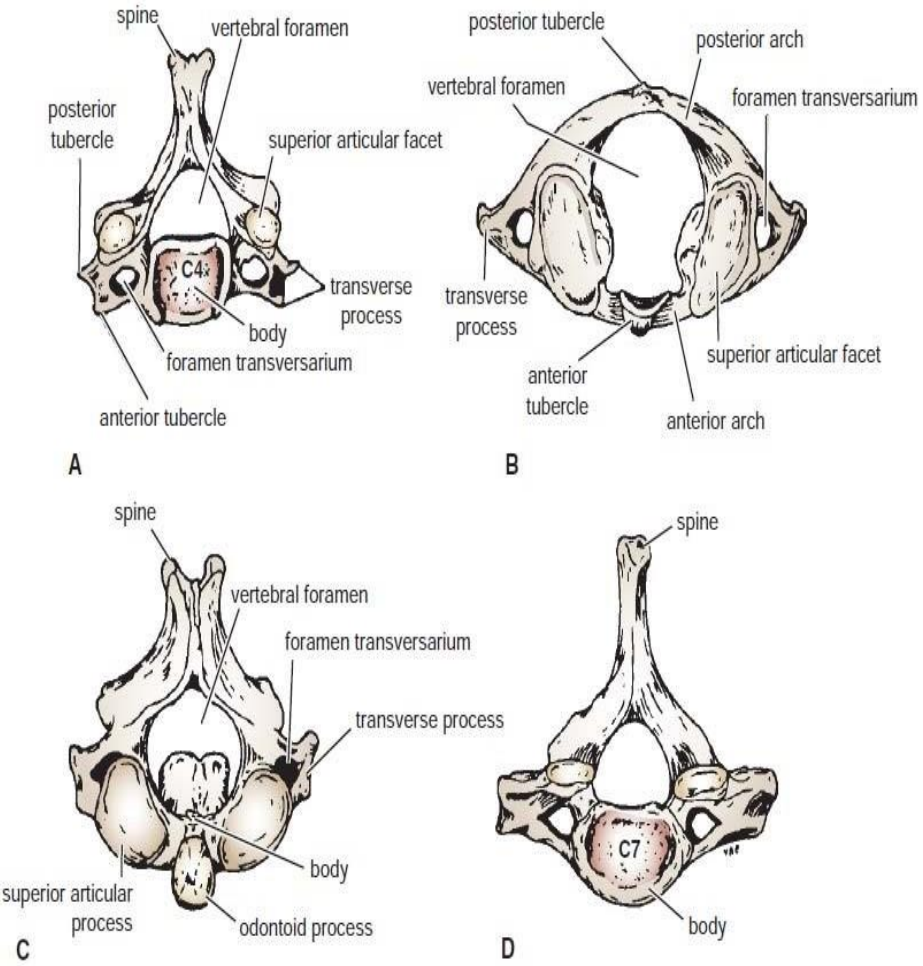


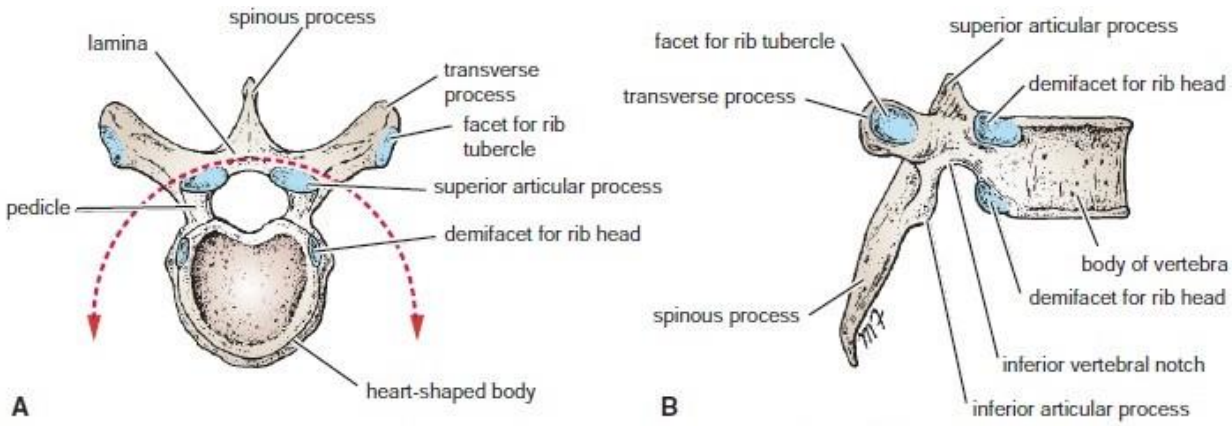
FIGURE 12.3 **A.** Typical cervical vertebra, superior aspect. **B.** Atlas, or 1st cervical vertebra, superior aspect. **C.** Axis, or 2nd cervical vertebra, from above and behind. **D.** 7th cervical vertebra, superior aspect; the foramen transversarium forms a passage for the vertebral vein but not for the vertebral artery.

Thoracic Vertebra

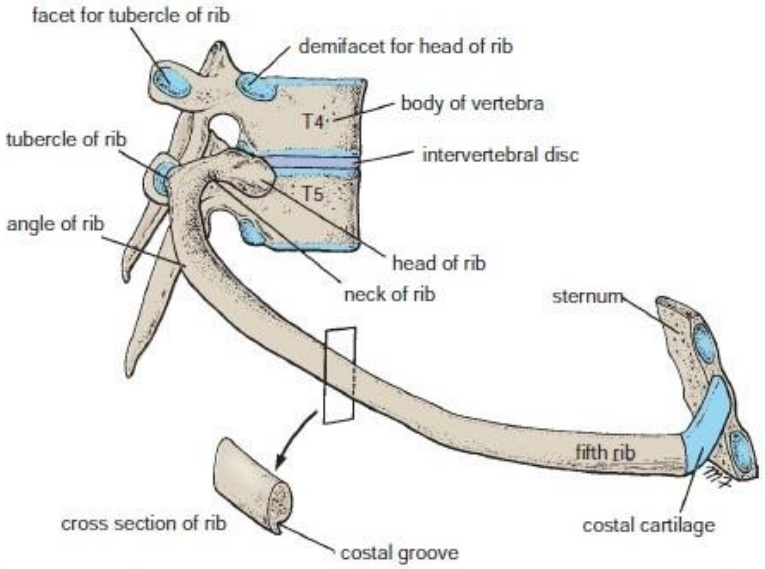
▪ Characteristics of a Typical Thoracic Vertebra

A typical thoracic vertebra has the following characteristics:

- The body is medium size and heart shaped.
- The vertebral foramen is small and circular.
- The spines are long and inclined downward.
- Costal facets are present on the sides of the bodies for articulation with the heads of the ribs.
- Costal facets are present on the transverse processes for articulation with the tubercles of the ribs (T11 and 12 have no facets on the transverse processes).
- The superior articular processes bear facets that face posteriorly and laterally, whereas the facets on the inferior articular processes face anteriorly and medially.



Thoracic vertebra. **A.** Superior surface. **B.** Lateral surface.



Fifth right rib as it articulates with the vertebral column posteriorly and the sternum anteriorly. Note that the rib head articulates with the vertebral body of its own number and that of the vertebra immediately above. Note also the presence of the costal groove along the inferior border of the rib.

Lumbar Vertebra

- ## Characteristics of a Typical Lumbar Vertebra

A typical lumbar vertebra has the following characteristics:

- The body is large and kidney shaped.
- The pedicles are strong and directed backward.
- The laminae are short in a vertical dimension.
- The vertebral foramina are triangular.
- The transverse processes are long and slender.

- The spinous processes are short, flat, and quadrangular and project posteriorly.
- The articular surfaces of the superior articular processes face medially, and those of the inferior articular processes face laterally.

Note that the lumbar vertebrae have no facets for articulation with ribs and no foramina in the transverse processes.

Sacrum

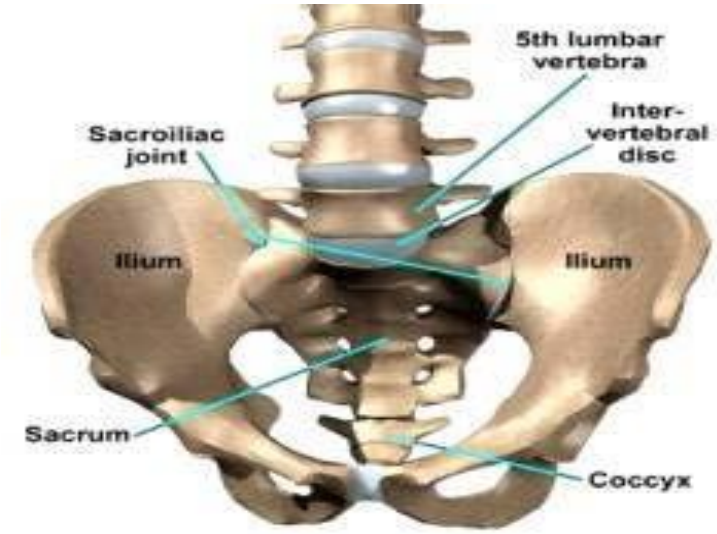
The sacrum consists of five rudimentary vertebrae fused together to form a wedge-shaped bone, which is concave anteriorly. The upper border, or base, of the bone articulates with the 5th lumbar vertebra. The narrow inferior border articulates with the coccyx. Laterally, the sacrum articulates with the two iliac bones to form the **sacroiliac joints**.

The vertebral foramina are present and form the **sacral canal.** The laminae of the 5th sacral vertebra, and sometimes those of the 4th also, fail to meet in the midline, forming the **sacral hiatus**. The sacral canal contains the anterior and posterior roots of the sacral and coccygeal spinal nerves.

The anterior and posterior surfaces of the sacrum each have four foramina on each side for the passage of the anterior and posterior rami of the upper four sacral nerves.

Coccyx

The coccyx consists of four vertebrae fused together to form a single, small triangular bone that articulates at its base with the lower end of the sacrum. The first coccygeal vertebra is usually not fused or is incompletely fused with the second vertebra.



Lecture 9 # Thorax **د.صباح عبد الرسول**

The thorax (or chest) is the region of the body between the neck and the abdomen. It is flattened in front and behind but rounded at the sides. The framework of the walls of the thorax, which is referred to as the **thoracic cage,** is formed by the vertebral column behind, the ribs and intercostal spaces on either side, and the sternum and costal cartilages in front. Superiorly, the thorax communicates with the neck, and inferiorly it is separated from the abdomen by the diaphragm. The thoracic cage protects the lungs and heart and affords attachment for the muscles of the thorax, upper extremity, abdomen, and back.

The cavity of the thorax can be divided into a median partition, called the **mediastinum,** and the laterally placed pleurae and lungs.

Structure of the Thoracic Wall

The thoracic wall is covered on the outside by skin and by muscles attaching the shoulder girdle to the trunk. It is lined with parietal pleura.

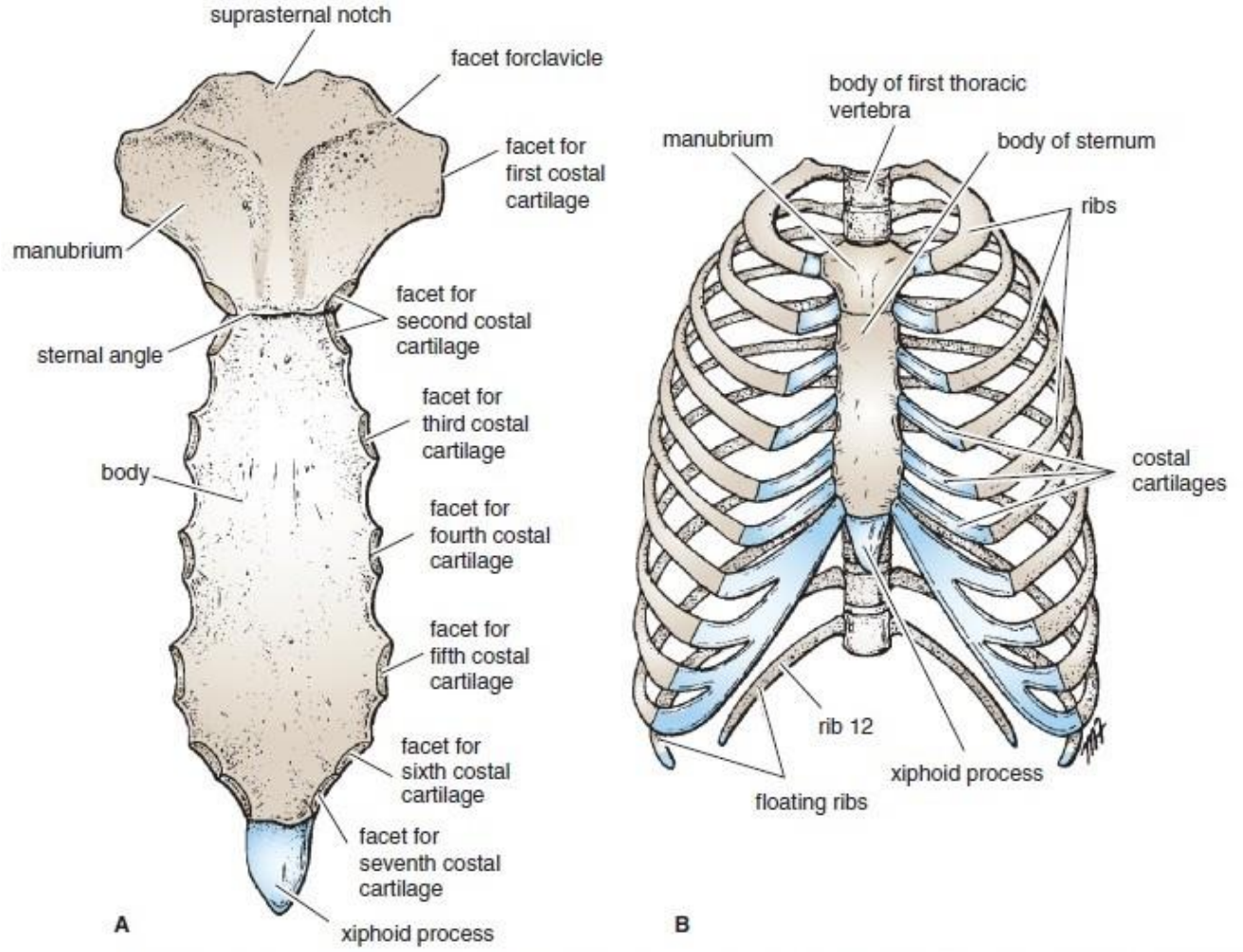
The thoracic wall is formed posteriorly by the thoracic part of the vertebral column; anteriorly by the sternum and costal cartilages; laterally by the ribs and intercostal spaces; superiorly by the suprapleural membrane; and inferiorly by the diaphragm, which separates the thoracic cavity from the abdominal cavity.

❖ Sternum

The sternum lies in the midline of the anterior chest wall. It is a flat bone that can be divided into three parts: manubrium sterni, body of the sternum, and xiphoid process.

- The **manubrium** is the upper part of the sternum. It articulates with the body of the sternum at the manubriosternal joint, and it also articulates with the clavicles and with the 1st costal cartilage and the upper part of the 2nd costal cartilages on each side.
- The **body of the sternum** articulates above with the manubrium at the **manubriosternal joint** and below with the xiphoid process at the **xiphisternal joint.** On each side, it articulates with the 2nd to the 7th costal cartilages.
- The **xiphoid process** is a thin plate of cartilage that becomes ossified at its proximal end during adult life. No ribs or costal cartilages are attached to it.

The **sternal angle** (angle of Louis), formed by the articulation of the manubrium with the body of the sternum. The sternal angle lies opposite the intervertebral disc between the 4th and 5th thoracic vertebrae.



A. Anterior view of the sternum. **B.** Sternum, ribs, and costal cartilages forming the thoracic skeleton.

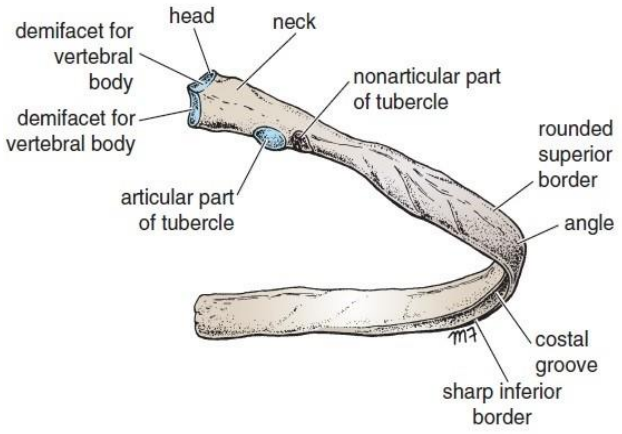
❖ Ribs

There are 12 pairs of ribs, all of which are attached posteriorly to the thoracic vertebrae. The ribs are divided into three categories:

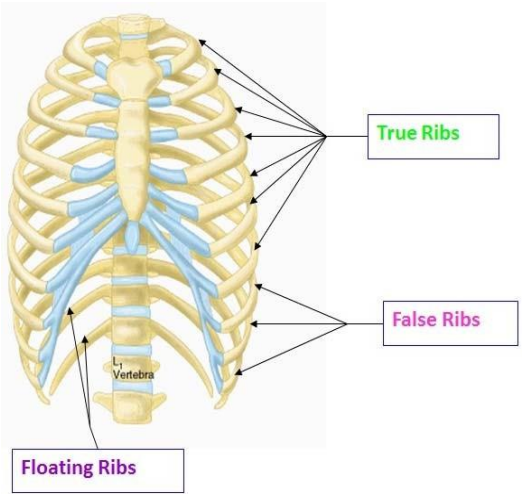
True ribs: The upper seven pairs are attached anteriorly to the sternum by their costal cartilages.

False ribs: The 8th, 9th, and 10th pairs of ribs are attached anteriorly to each other and to the 7th rib by means of their costal cartilages and small synovial joints.

Floating ribs: The 11th and 12th pairs have no anterior attachment.



Fifth right rib, as seen from the posterior aspect.



Typical Rib

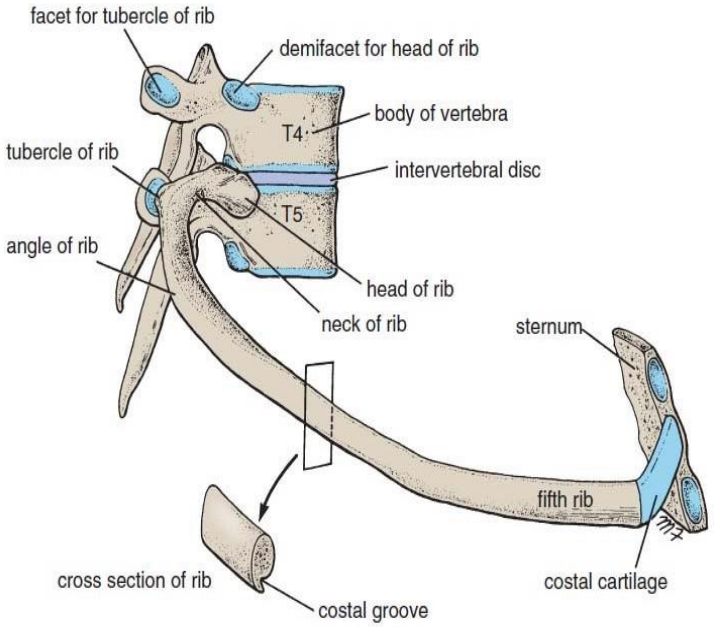
A typical rib is a long, twisted, flat bone having a rounded, smooth superior border and a sharp, thin inferior border. The inferior border overhangs and forms the **costal groove,** which accommodates the intercostal vessels and nerve. The anterior end of each rib is attached to the corresponding costal cartilage.

A rib has a **head, neck, tubercle, shaft,** and **angle**. The **head** has two facets for articulation with the numerically corresponding vertebral body and that of the vertebra immediately above. The **neck** is a constricted portion situated between the head and the tubercle. The **tubercle** is a prominence on the outer surface of the rib at the junction of the neck with the shaft. It has a facet for articulation with the transverse process of the numerically corresponding vertebra. The **shaft** is thin and flattened and twisted on its long axis. Its inferior border has the costal groove. The **angle** is where the shaft of the rib bends sharply forward.

❖ Costal Cartilages

Costal cartilages are bars of cartilage connecting the **upper seven ribs** to the lateral edge of the sternum and the **8th, 9th, and 10th ribs** to the cartilage immediately above. The cartilages of the **11th and 12th ribs** end in the abdominal musculature.

The costal cartilages contribute significantly to the elasticity and mobility of the thoracic walls. In old age, the costal cartilages tend to lose some of their flexibility as the result of superficial calcification.



Fifth right rib as it articulates with the vertebral column posteriorly and the sternum anteriorly. Note that the rib head articulates with the vertebral body of its own number and that of the vertebra immediately above. Note also the presence of the costal groove along the inferior border of the rib.

Joints of the Chest Wall

❖ Joints of the Sternum

The **manubriosternal joint** is a cartilaginous joint between the manubrium and the body of the sternum. A small amount of angular movement is possible during respiration. The **xiphisternal joint** is a cartilaginous joint between the xiphoid process (cartilage) and the body of the sternum. The xiphoid process usually fuses with the body of the sternum during middle age.

❖ Joints of the Ribs

- Joints of the Heads of the Ribs

The 1st rib and the three lowest ribs have a single synovial joint with their corresponding vertebral body. For the 2nd to 9th ribs, the head articulates by means of a synovial joint with the corresponding vertebral body and that of the vertebra above it. There is a strong **intraarticular ligament** that connects the head to the intervertebral disc.

- Joints of the Tubercles of the Ribs

The tubercle of a rib articulates by means of a synovial joint with the transverse process of the corresponding vertebra. (This joint is absent on the 11th and 12th ribs.)

- Joints of the Ribs and Costal Cartilages

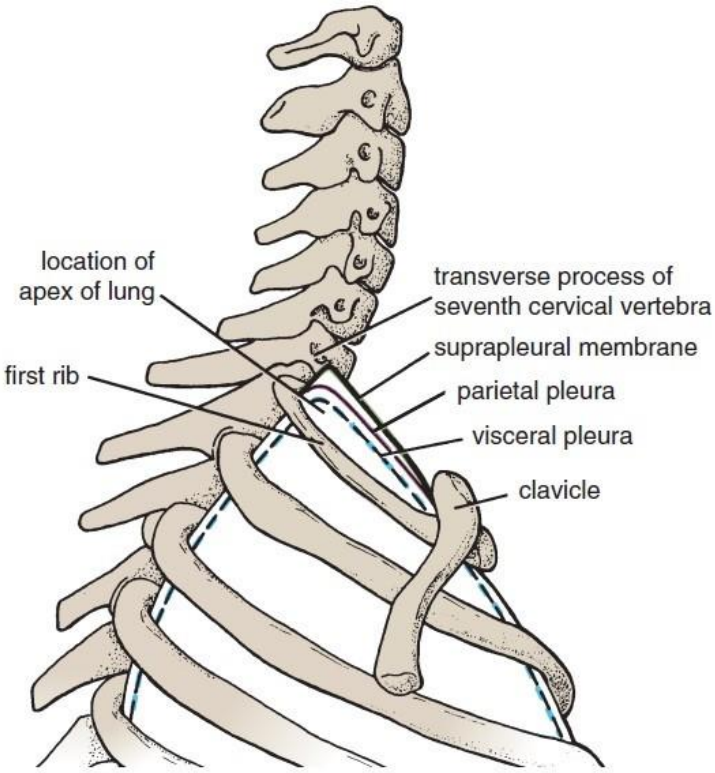
These joints are cartilaginous joints. No movement is possible.

- Joints of the Costal Cartilages with the Sternum

The 1st costal cartilages articulate with the manubrium, by cartilaginous joints that permit no movement.
The 2nd to 7th costal cartilages articulate with the lateral border of the sternum by synovial joints. In addition, the 6th, 7th, 8th, 9th, and 10th costal cartilages articulate with one another along their borders by small synovial joints. The cartilages of the 11th and 12th ribs are embedded in the abdominal musculature.

❖ Suprapleural Membrane

Superiorly, the thorax opens into the root of the neck by a narrow aperture, the **thoracic outlet**. The outlet transmits structures that pass between the thorax and the neck (esophagus, trachea, blood vessels, etc.) and for the most part lie close to the midline. On either side of these structures, the outlet is closed by a dense fascial layer called the **suprapleural membrane.**



❖ Diaphragm

The diaphragm is a thin muscular and tendinous septum that separates the chest cavity above from the abdominal cavity below. It is pierced by the structures that pass between the chest and the abdomen.
The diaphragm is the most important muscle of respiration.
It is dome shaped and consists of a peripheral muscular part, which arises from the margins of the thoracic opening, and a centrally placed tendon.
The origin of the diaphragm can be divided into three parts:

- A **sternal part** arising from the posterior surface of the xiphoid process.
- A **costal part** arising from the deep surfaces of the lower six ribs and their costal cartilages.
- A **vertebral part** arising by vertical columns

- **Shape of the Diaphragm**

As seen from in front, the diaphragm curves up into *right and left domes*. The **right dome** reaches as high as the upper border of the 5th rib, and the **left dome** may reach the lower border of the 5th rib. (The right dome lies at a higher level, because of the large size of the right lobe of the liver.) The central tendon lies at the level of the xiphisternal joint. The domes support the right and left lungs, whereas the central tendon supports the heart.

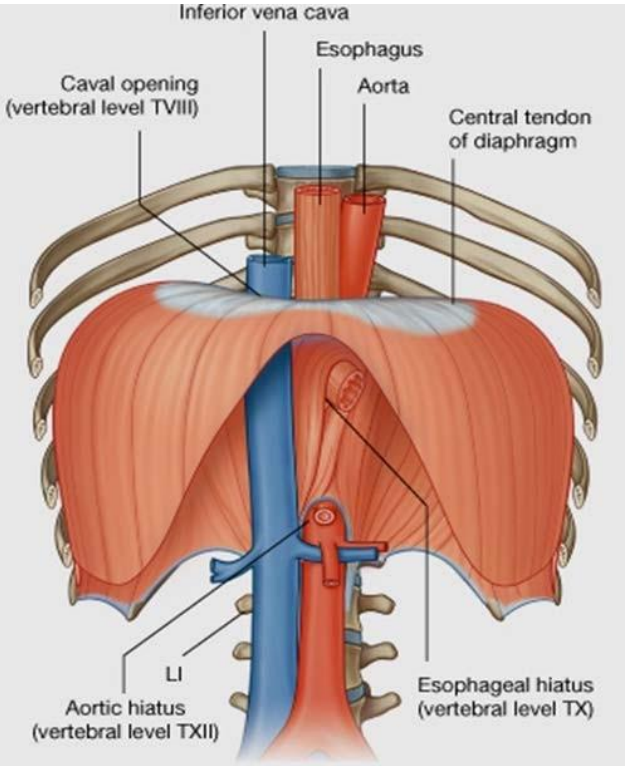
Action of the Diaphragm

On contraction, the diaphragm pulls down its central tendon and increases the vertical diameter of the thorax.

Openings in the Diaphragm

The diaphragm has three main openings:

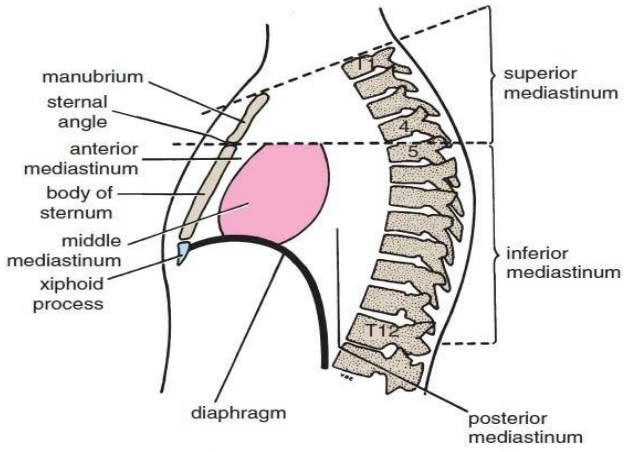
1) **The aortic opening** lies anterior to the body of the 12th thoracic vertebra. It transmits the aorta, the thoracic duct, and the azygos vein.
2) **The esophageal opening** lies at the level of the 10th thoracic vertebra. It transmits the esophagus, the right and left vagus nerves.
3) **The caval opening** lies at the level of the 8th thoracic vertebra in the central tendon. It transmits the inferior vena cava and terminal branches of the right phrenic nerve.



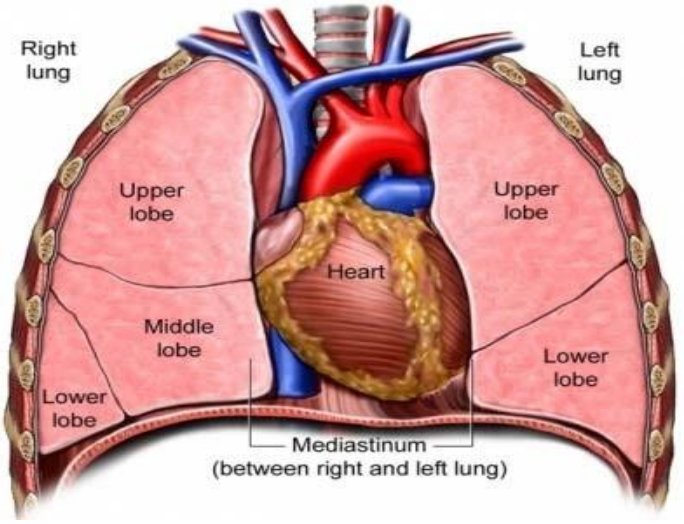
Mediastinum

The mediastinum, though thick, is a movable partition that extends superiorly to the thoracic outlet and the root of the neck and inferiorly to the diaphragm. It extends anteriorly to the sternum and posteriorly to the vertebral column. It contains the remains of the thymus, the heart and large blood vessels, the trachea and esophagus, the thoracic duct and lymph nodes, the vagus and phrenic nerves, and the sympathetic trunks.

The mediastinum is divided into **superior** and **inferior mediastina** by an imaginary plane passing from the sternal angle anteriorly to the lower border of the body of the 4th thoracic vertebra posteriorly. The inferior mediastinum is further subdivided into the **middle mediastinum,** which consists of the pericardium and heart; the **anterior mediastinum,** which is a space between the pericardium and the sternum; and the **posterior mediastinum,** which lies between the pericardium and the vertebral column.



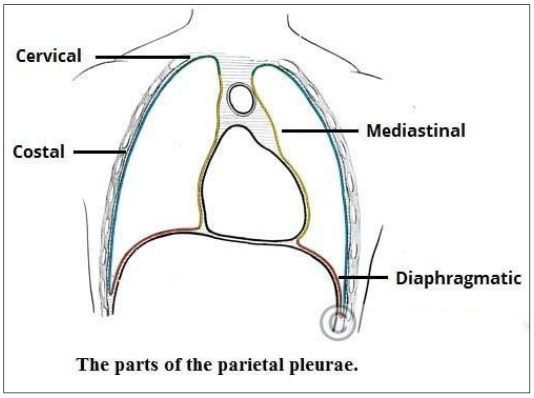
Subdivisions of the mediastinum.



▪ Pleurae

The pleurae and lungs lie on either side of the mediastinum within the chest cavity. Each pleura has two parts: a **parietal layer** and a **visceral layer.**

- **<u>Parietal layer</u>** which lines the thoracic wall, divided according to the region in which it lies or the surface that it covers:
  1. **Cervical pleura** extends up into the neck, lining the undersurface of the suprapleural membrane.
  2. **Costal pleura** lines the inner surfaces of the ribs, the costal cartilages, the intercostal spaces, the sides of the vertebral bodies, and the back of the sternum.
  3. **Diaphragmatic pleura** covers the thoracic surface of the diaphragm.
  4. **Mediastinal pleura** covers and forms the lateral boundary of the mediastinum.



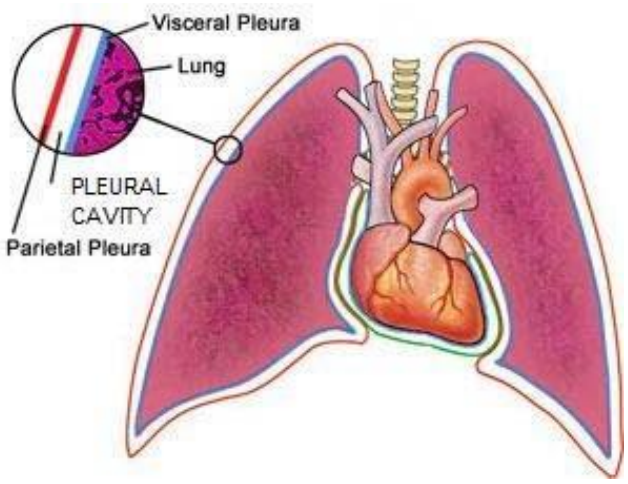
The parts of the parietal pleurae.

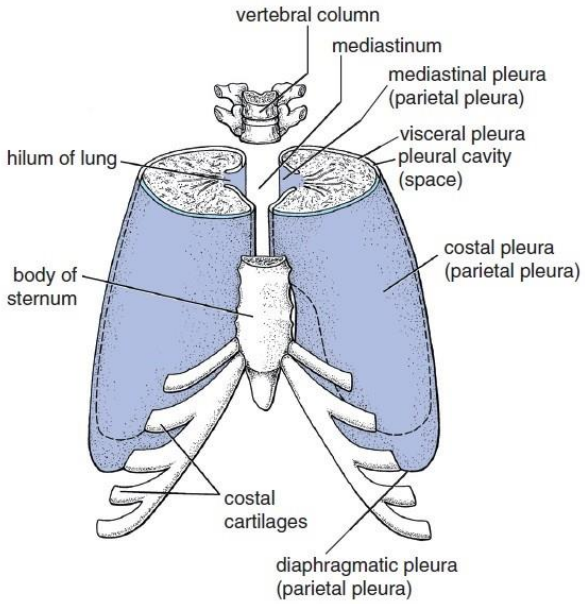
- **<u>Visceral layer</u>** which completely covers the outer surfaces of the lungs and extends into the depths of the interlobar fissures.

The two layers become continuous with one another by means of a cuff of pleura that surrounds the structures entering and leaving the lung at the hilum of each lung.

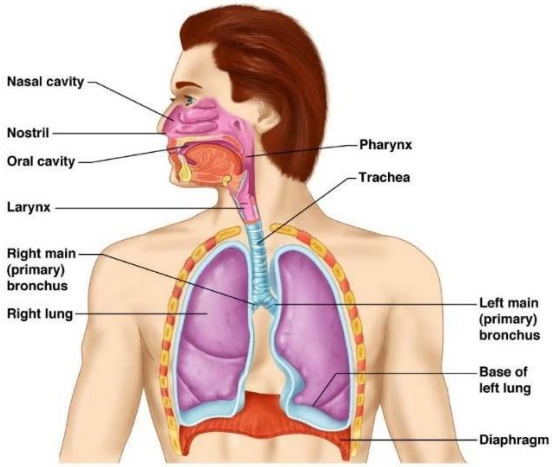
The parietal and visceral layers of pleura are separated from one another by a slitlike space, the **pleural cavity or pleural space**.

The pleural cavity normally contains a small amount of tissue fluid, the **pleural fluid,** which covers the surfaces of the pleura as a thin film and permits the two layers to move on each other with the minimum of friction.



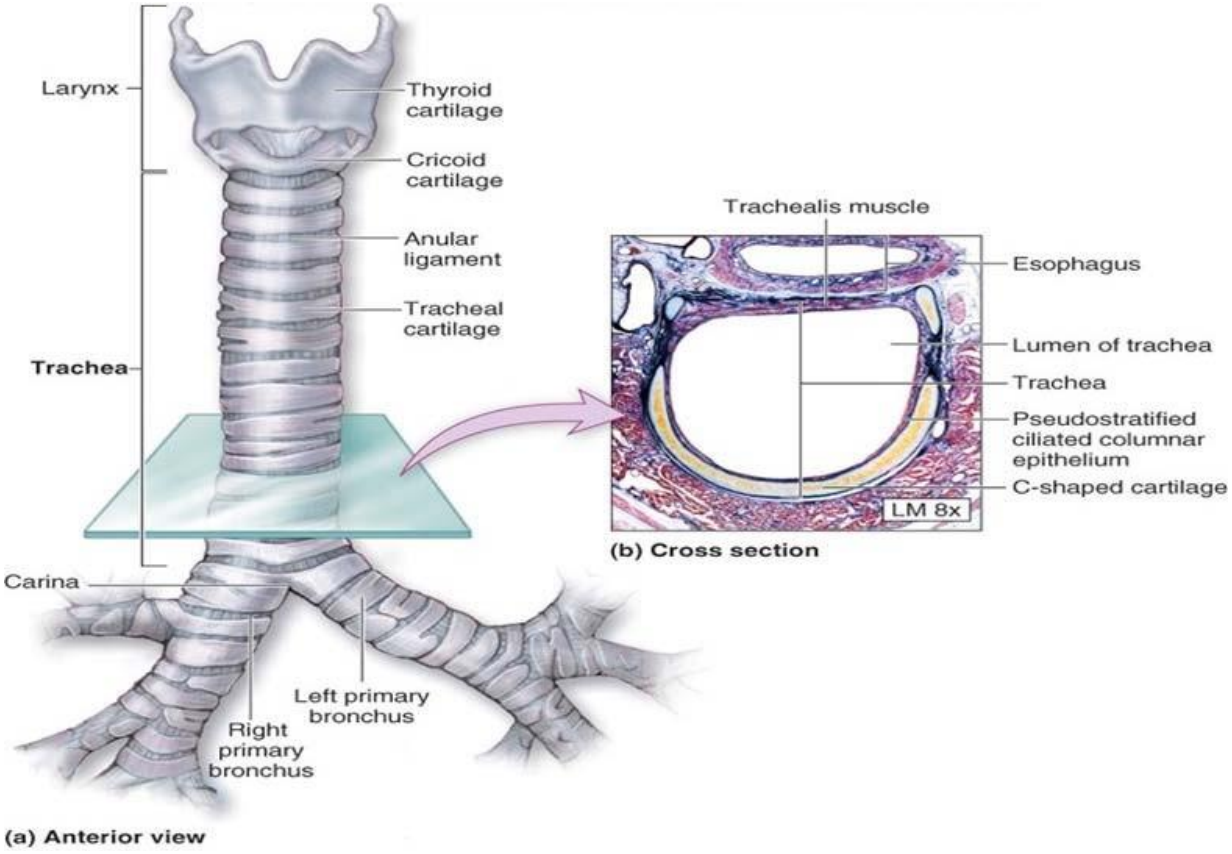


▪ Trachea



The trachea is a mobile cartilaginous and membranous tube. It begins in the neck as a continuation of the larynx at the level of the 6th cervical vertebra. It descends in the midline of the neck. In the thorax, the trachea ends below at the **carina** by dividing into right and left principal (main) bronchi at the level of the sternal angle (opposite the disc between the 4th and 5th thoracic vertebrae).

In adults, the trachea is about (11.25 cm) long and (2.5 cm) in diameter. The fibroelastic tube is kept patent by the presence of U-shaped bars (rings) of hyaline cartilage embedded in its wall. The posterior free ends of the cartilage are connected by smooth muscle, the **trachealis muscle.**



Blood Supply of the Trachea

- Upper two thirds → the inferior thyroid arteries
- Lower third →the bronchial arteries.

Nerve Supply of the Trachea

Sensory nerve supply → from the vagi and the recurrent laryngeal nerves. Sympathetic nerves → supply the trachealis muscle.

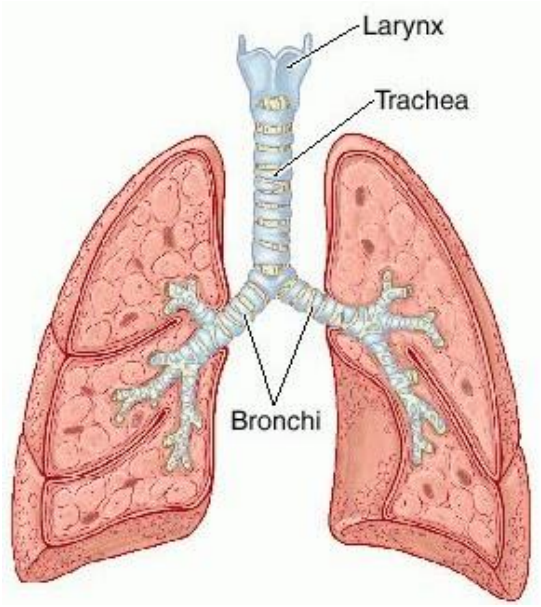
- **The Bronchi**

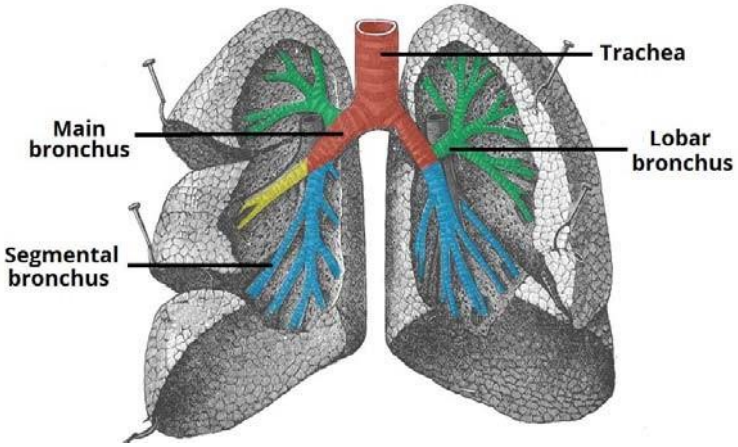
The trachea bifurcates behind the arch of the aorta into the **right and left principal (primary or main) bronchi**. The bronchi divide dichotomously, giving rise to several million terminal bronchioles that terminate in one or more respiratory bronchioles.

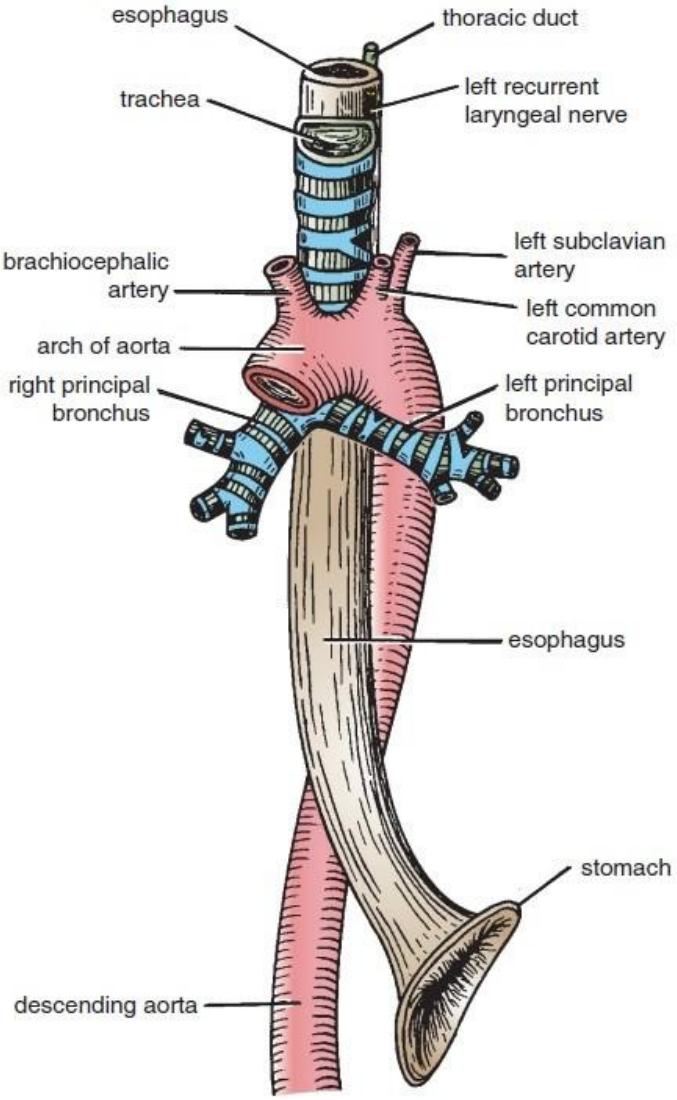
Principal Bronchi

- The ***right principal (main) bronchus*** is wider, shorter, and more vertical than the left and is about (2.5 cm) long. The right principal bronchus gives off the **superior lobar bronchus, middle** and an **inferior lobar bronchus**.
- The ***left principal (main) bronchus*** is narrower, longer, and more horizontal than the right and is about (5 cm) long.

The left principal bronchus <u>divides into</u> a **superior** and an **inferior lobar bronchus.**







The Orbital Region

The orbits are a pair of bony cavities that contain the eyeballs; their associated muscles, nerves, vessels, and fat; and most of the lacrimal apparatus. The orbital opening is guarded by two thin, movable folds, the eyelids.

The Orbit

The orbit is a pyramidal cavity with its base anterior and its apex posteriorly. The **orbital margin** is formed above by the frontal bone, the lateral margin is formed by the processes of the frontal and zygomatic bones, the inferior margin is formed by the zygomatic bone and the maxilla, and the medial margin is formed by the processes of the maxilla and the frontal bone.

Roof: Formed by the orbital plate of the frontal bone, which separates the orbital cavity from the anterior cranial fossa.

Lateral wall: Formed by the zygomatic bone and the greater wing of the sphenoid

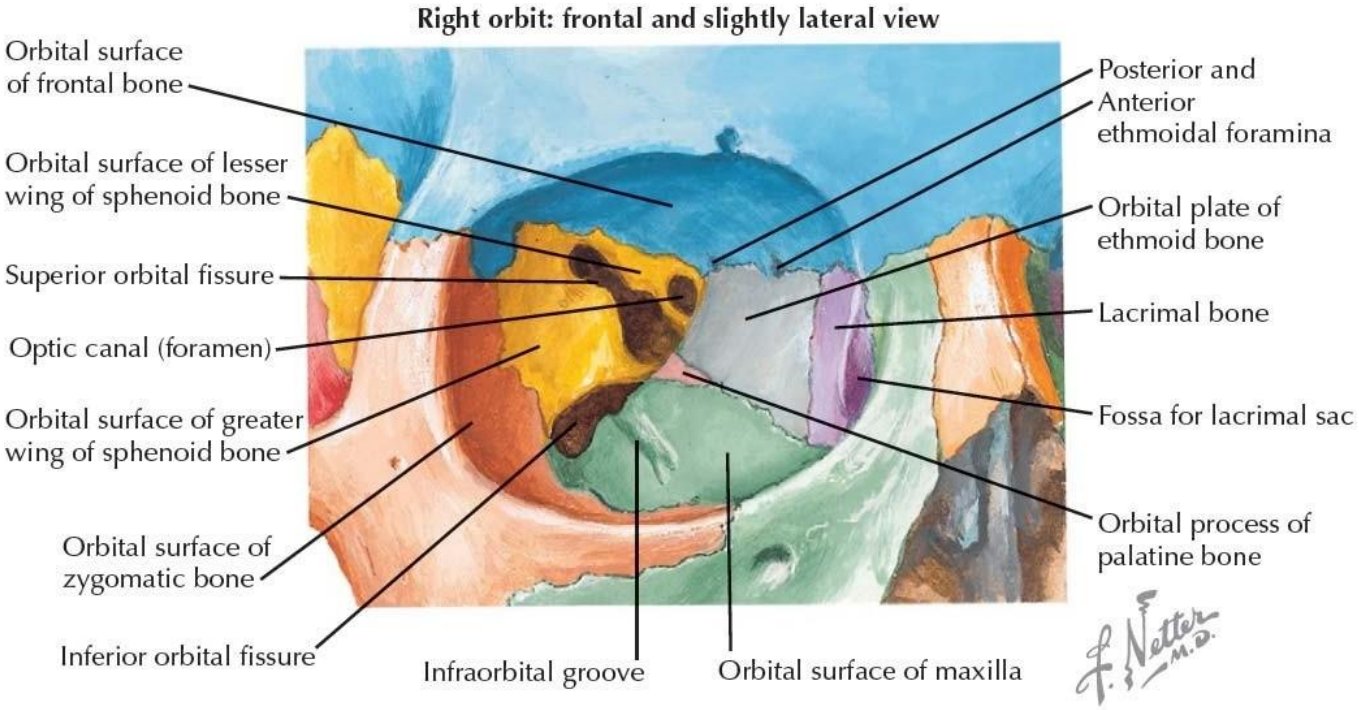
Floor: Formed by the orbital plate of the maxilla, which separates the orbital cavity from the maxillary sinus

Medial wall: Formed from before backward by the frontal process of the maxilla, the lacrimal bone, the orbital plate of the ethmoid (which separates the orbital cavity from the ethmoid sinuses), and the body of the sphenoid

Openings into the Orbital Cavity

1. **Supraorbital notch (Foramen):** situated on the superior orbital margin. It transmits the supraorbital nerve and blood vessels.
2. **Infraorbital groove and canal:** Situated on the floor of the orbit in the orbital plate of the maxilla; they transmit the infraorbital nerve and blood vessels.
3. **Nasolacrimal canal:** Located anteriorly on the medial wall; it communicates with the inferior meatus of the nose. It transmits the nasolacrimal duct.

4. **Inferior orbital fissure:** Located posteriorly between the maxilla and the greater wing of the sphenoid; it communicates with the pterygopalatine fossa. It transmits the maxillary nerve and its Zygomatic branch, the inferior ophthalmic vein, and sympathetic nerves.
5. **Superior orbital fissure:** Located posteriorly between the greater and lesser wings of the sphenoid; it communicates with the middle cranial fossa. It transmits the lacrimal, frontal, and nasociliary branches of ophthalmic division of the trigeminal n., trochlear, oculomotor (upper and lower divisions), and abducent nerves, together with the superior ophthalmic vein.
6. **Optic canal:** Located posteriorly in the body of the sphenoid; it communicates with the middle cranial fossa. It transmits the optic nerve and the ophthalmic artery.
7. **Anterior ethmoidal foramen:** located between the frontal and ethmoidal bone and transmit the anterior ethmoidal nerve and vessels.
8. **Posterior ethmoidal foramen:** located between the frontal and ethmoidal bone and transmit the posterior ethmoidal nerve and vessels.
9. **Zygomatic foramen (1 or 2 openings):** located in the zygomatic bone and transmit the zygomatic branches.



Nasal Cavity

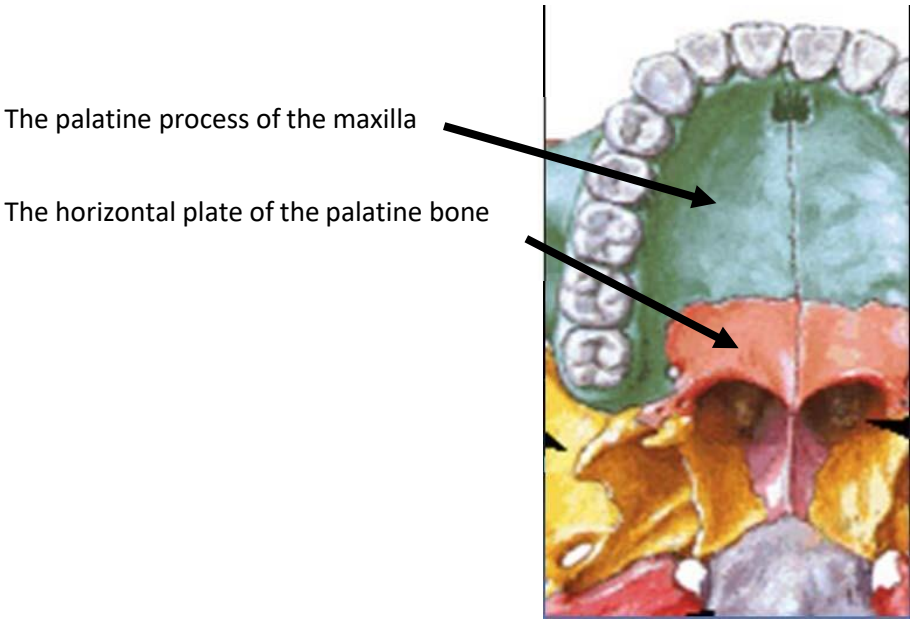
The nasal cavity extends from the nostrils in front to the **posterior nasal apertures** or **choanae** behind, where the nose opens into the nasopharynx. The **nasal vestibule** is the area of the nasal cavity lying just inside the nostril. The nasal cavity is divided into right and left halves by the **nasal septum**. The septum is made up of the **septal cartilage,** the **vertical plate of the ethmoid,** and the **vomer.**

Walls of the Nasal Cavity

Each half of the nasal cavity has a floor, a roof, a lateral wall, and a medial or septal wall.

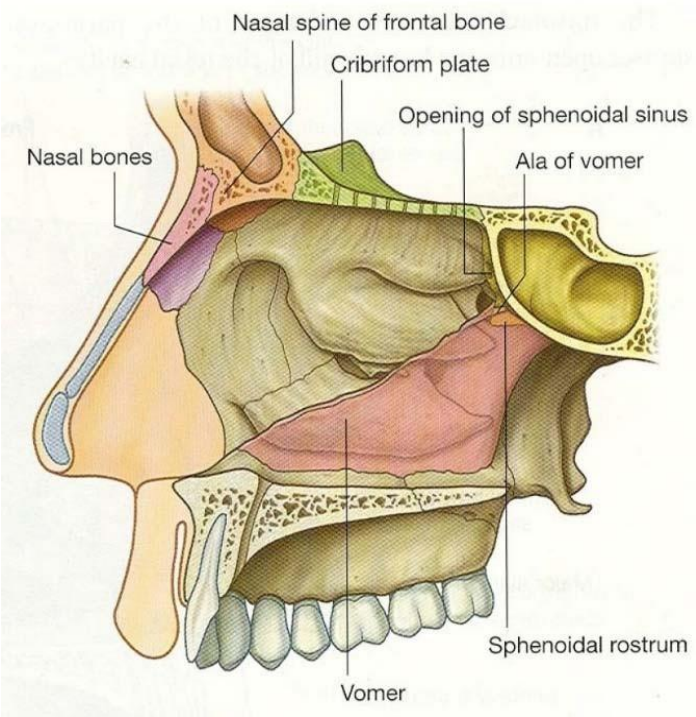
Floor

The palatine process of the maxilla and the horizontal plate of the palatine bone



Roof

The roof is narrow and is formed anteriorly beneath the bridge of the nose by the nasal and frontal bones, in the middle by the cribriform plate of the ethmoid, located beneath the anterior cranial fossa, and posteriorly by the downward sloping body of the sphenoid.



Lateral Wall

The lateral wall of each nasal cavity mainly consists of the

1-maxilla

2- palatine bone,

3- medial pterygoid plate

4- labyrinth of ethmoid

5- inferior concha

6- lacrimal bone

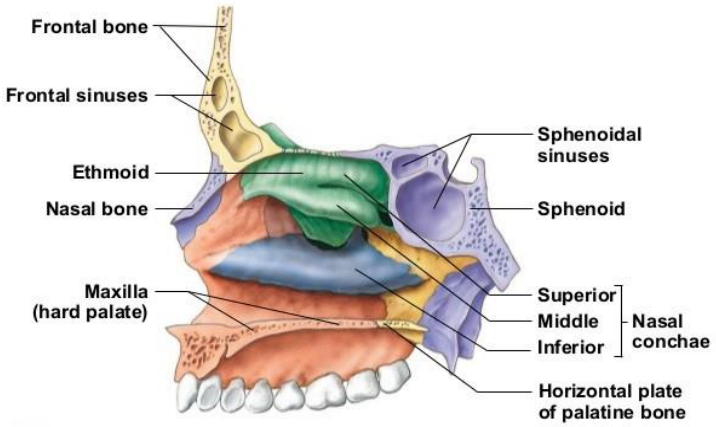
The paranasal sinuses are connected to the nasal cavity through small orifices called ostia

The lateral wall has three projections of bone called the **superior, middle,** and **inferior nasal conchae**. The space below each concha is called a **meatus.**

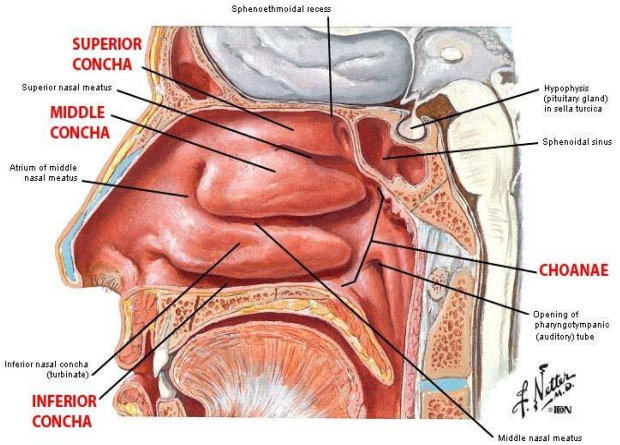
- **Sphenoethmoidal Recess:** The sphenoethmoidal recess is a small area above the superior concha. It receives the opening of the **sphenoid air sinus**.

- **Superior Meatus:** The superior meatus lies below the superior concha. It receives the openings of the **posterior ethmoid sinuses.**
- **Middle Meatus:** The middle meatus lies below the middle concha. It has a rounded swelling called the **bulla ethmoidalis** that is formed by the **middle ethmoidal air sinuses,** which open on its upper border. A curved opening, the **hiatus semilunaris,** lies just below the bulla. The anterior end of the hiatus leads into a funnel-shaped channel called the **infundibulum,** which is continuous with the **frontal sinus.** The **anterior ethmoidal sinuses** are also open into the **infundibulum.** The **maxillary sinus** opens into the middle meatus through the **hiatus semilunaris.**
- **Inferior Meatus:** The inferior meatus lies below the inferior concha and receives the opening of the lower end of the **nasolacrimal duct,** which is guarded by a fold of mucous membrane.

Figure 6.16b The Nasal Complex, Part I



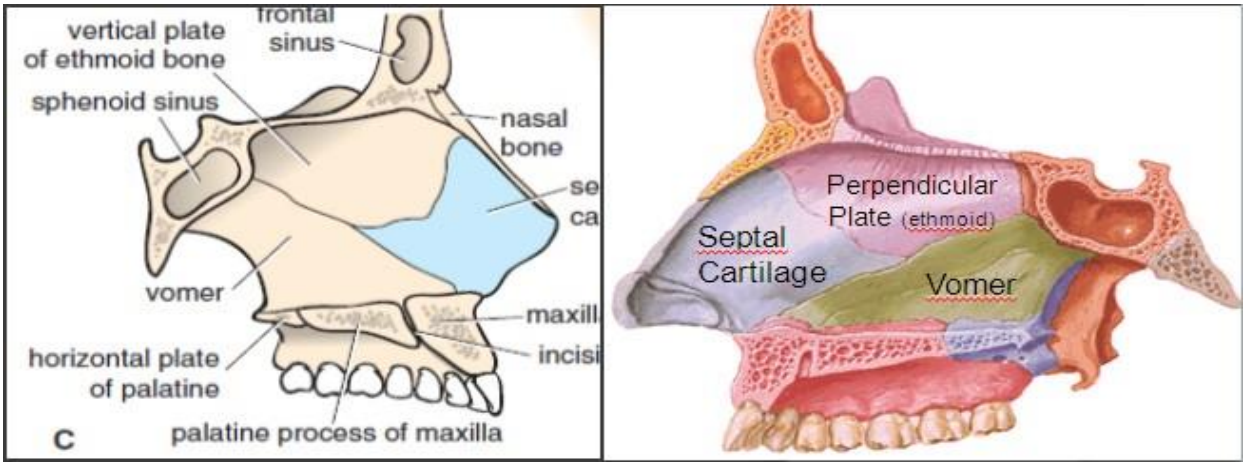
b Diagrammatic sagittal section with the nasal septum removed to show major features of the wall of the right nasal cavity



Medial Wall

The medial wall is formed by the nasal septum. The upper part is formed by the vertical plate of the ethmoid and the vomer. The anterior part is formed by the

septal cartilage. The septum rarely lies in the midline, thus increasing the size of one half of the nasal cavity and decreasing the size of the other.



Paranasal Sinuses and Their Site of Drainage into the Nose

Sinus	Site of Drainage
Maxillary sinus	Middle meatus through hiatus semi-lunaris
Frontal sinuses	Middle meatus via infundibulum
Sphenoidal sinuses	Sphenoethmoidal recess
Ethmoidal sinuses	
Anterior group	Infundibulum and into middle meatus
Middle group	Middle meatus on or above bulla ethmoidalis
Posterior group	Superior meatus

☒ **Auditory ossicles** consist of three paired ossicles are the malleus, incus, and stapes.

- The **malleus** is the largest ossicle and possesses a head, a neck, a long process or handle, an anterior process, and a lateral process.

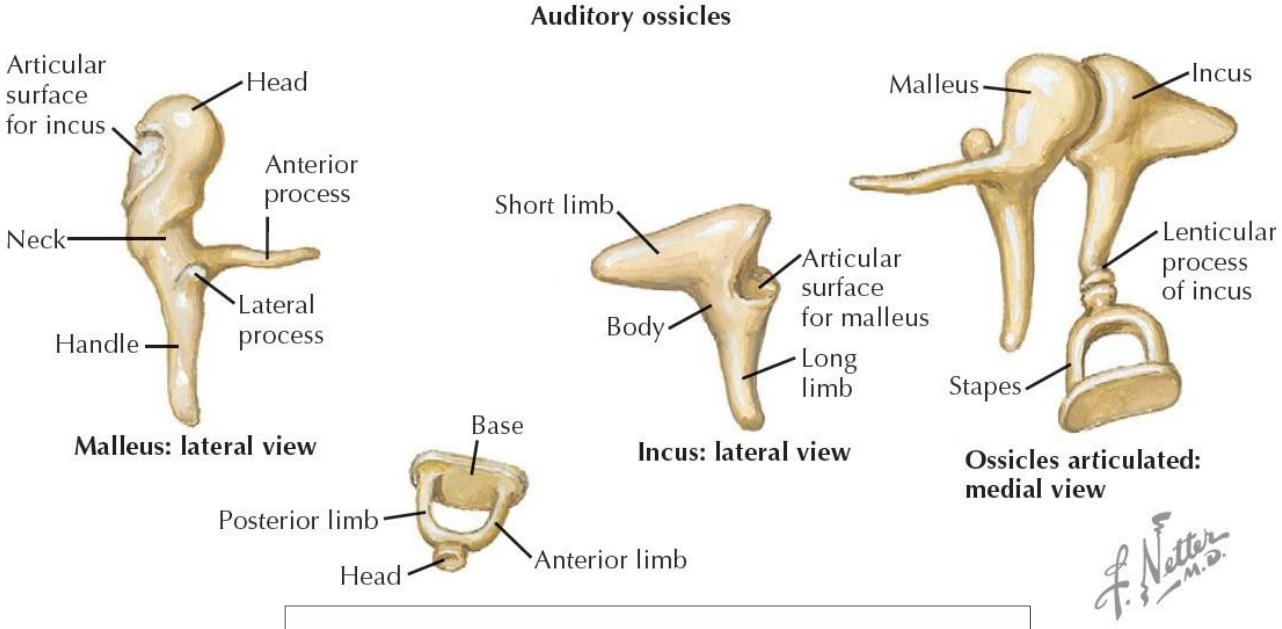
The head is rounded and articulates posteriorly with the incus. The neck is the constricted part below the head.

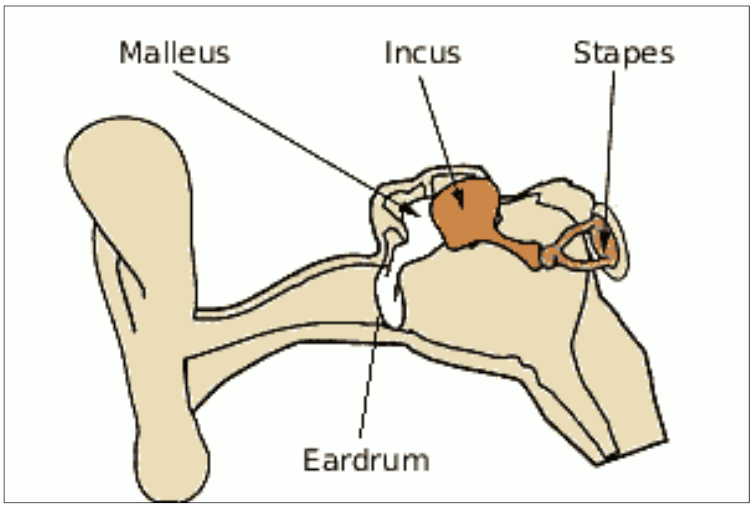
- The **incus** possesses a large body and two processes.

The body is rounded and articulates anteriorly with the head of the malleus.
The long process descends behind and parallel to the handle of the malleus. Its lower end bends medially and articulates with the head of the stapes.
The short process is attached to the posterior wall of the tympanic cavity by a ligament.

- The **stapes** has a head, a neck, two limbs, and a base.

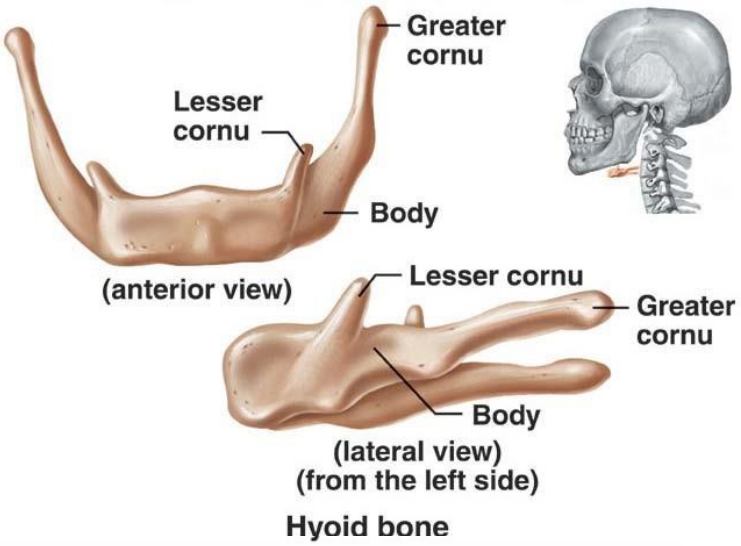
The head is small and articulates with the long process of the incus. The two limbs diverge from the neck and are attached to the oval base.





Hyoid bone

The hyoid bone is a mobile single bone found in the midline of the neck below the mandible and abides the larynx. It does not articulate with any other bones. The hyoid bone is U shaped and consists of a body and two greater and two lesser cornua. It is attached to the skull by the stylohyoid ligament and to the thyroid cartilage by the thyrohyoid membrane. The hyoid bone forms a base for the tongue and is suspended in position by muscles that connect it to the mandible (by digastric, geniohyoid and mylohyoid muscles), to the styloid process of the temporal bone (by stylohyoid muscle), to the thyroid cartilage (by thyrohyoid muscle), to the sternum (by sternohyoid muscle), and to the scapula (by omohyoid muscle).



Hyoid bone