

# Bones of the Skull

## Introduction

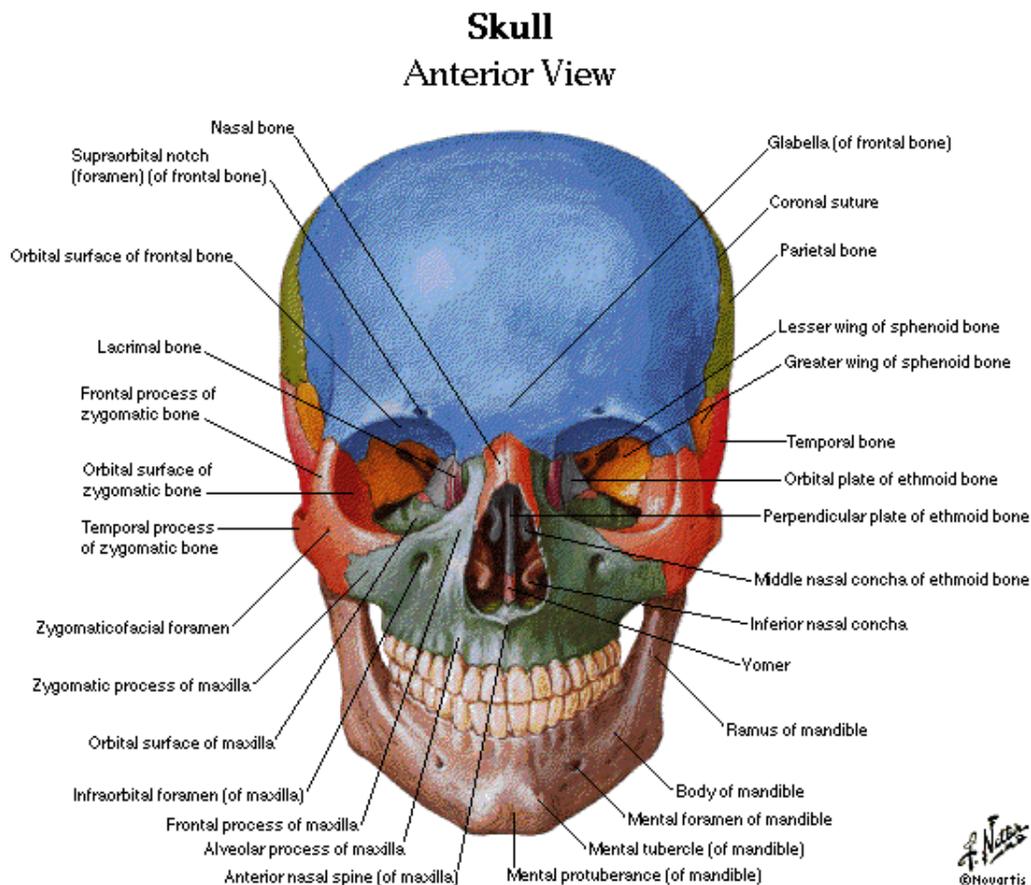
The skeleton of the head and neck includes the skull, middle ear ossicles, hyoid bone, and cervical vertebrae.

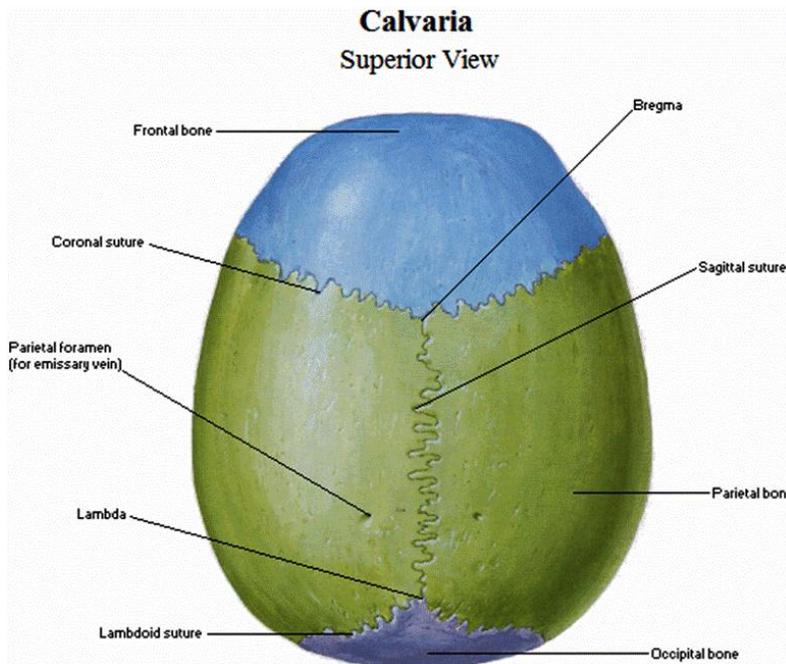
The skull is composed of several separate bones united at immobile joints called sutures. The mandible is an exception to this rule, as it is united to the skull by the mobile, synovial TemporoMandibular Joints (TMJ).

The bones of the skull are 22 bones, organized into a cranial skeleton (8 bones) that surrounds the brain and a facial skeleton (14 bones).

The cranial cavity is the space containing the brain. The skull vault (calvarium) is the upper part of the cranium and forms the roof and side walls of the cranial cavity.

The base of the skull is the lowest part of the cranium and forms the floor of the cranial cavity.





The relatively flat bones of the vault (frontal, parietals, and part of the occipital) are composed of external and internal tables of compact bone separated by a layer of spongy bone called the diploë.

**The cranium consist of the following bones:-**

- Frontal bone: one bone
- Ethmoid bone: one bone
- Sphenoid bone: one bone
- Occipital bone: one bone
- Parietal bones: paired (2 bones)
- Temporal bones: paired (2 bones)

**The facial skeleton consists of the following bones:**

- Zygomatic bones: paired (2 bones)
- Maxillae: paired (2 bones)
- Nasal bones: paired (2 bones)
- Lacrimal bones: paired (2 bones)
- Palatine bones: paired (2 bones)
- Inferior conchae: paired (2 bones)

- Mandible: one bone
- Vomer: one bone

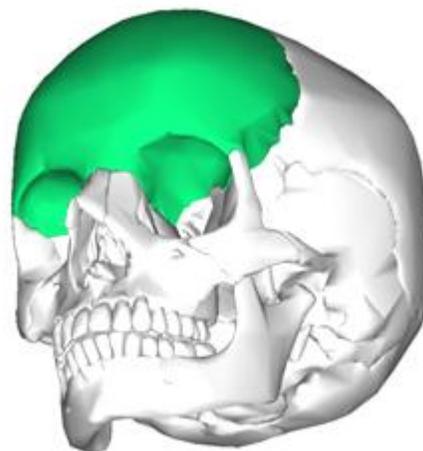
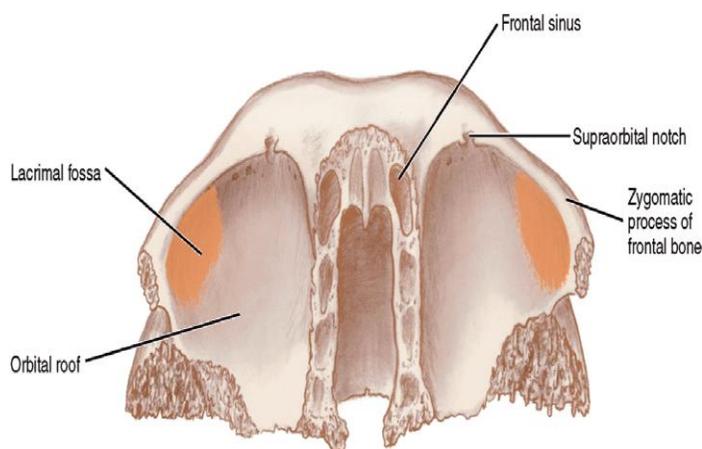
## The Cranial Bones:-

### 1- Frontal Bone

The frontal bone is a single cranial bone that forms the anterior portion of the calvaria and upper third of the face (forehead). The frontal bone articulates laterally with the zygoma at the frontozygomatic suture and medially with the (maxilla at the frontomaxillary suture and nasal bones at the frontonasal sutures). In the Base of the skull; inferiorly and deeply in anterior cranial fossa; it articulates with the ethmoid, posteriorly; it articulates with the wings of the sphenoid bone. In the vault; it articulates with the parietal bones at coronal suture.

The frontal bone forms a great portion of the roof of the orbit. The thickening of the frontal bone in the anterior region forms the superciliary arches (supraorbital ridges). These curved elevations give the prominence of eye brow region. The supraorbital notch or foramen crosses this rim and transmits the frontal vessels and nerves (supra orbital and supra trochlear nerves).

The frontal bone contains the frontal air sinuses (paranasal sinus), which are two hollow spaces lined with mucous membrane, they just above the orbital margins. The paranasal sinuses are mucous membrane lined air filled bone cavities, they are four in number: Maxillary (the largest), Frontal, sphenoid and ethmoid paranasal sinuses, they communicate with the nose and serve to lighten the facial skeleton and act as voice resonators.



## 2- Ethmoid Bone

The ethmoid bone is a single bone that lies in the mid area of the anterior cranial fossa. It constitutes part of the: nasal structure, medial orbital walls and anterior cranial fossa. In anterior cranial fossa; the (*crista galli*)- bony projection upward- gives attachment to Falx cerebri (meningeal layer of dura mater).

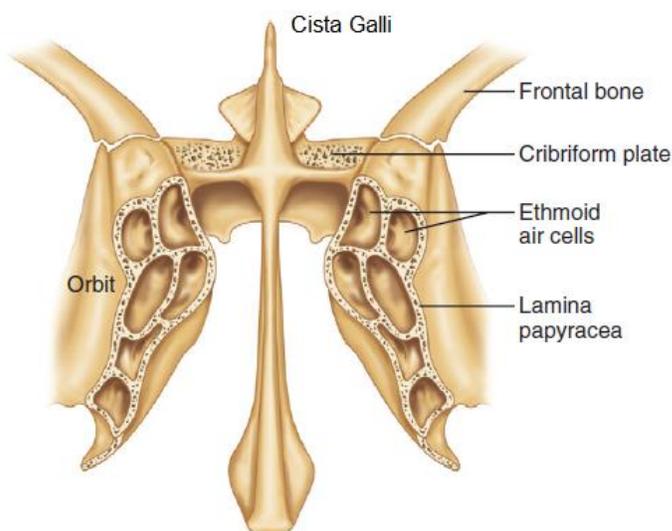
The perpendicular plate of ethmoid descends downward in the midline of nasal cavity to form the superior and anterior portions of the nasal septum. It articulates posteroinferiorly with the vomer and with septal cartilage to form the nasal septum.

The cribriform plate (perforated bony plates) of ethmoid articulates anteriorly and laterally with the frontal bone and posteriorly with the sphenoid bone, the filaments of olfactory nerve (cranial nerve I) pass through the cribriform plate.

Hanging bilaterally from the cribriform plate are the superior and middle nasal conchae which descend laterally in the nasal cavity.

lamina papyracea -paper like- is an extremely thin plate of ethmoid bone, constitutes most of the medial orbital wall.

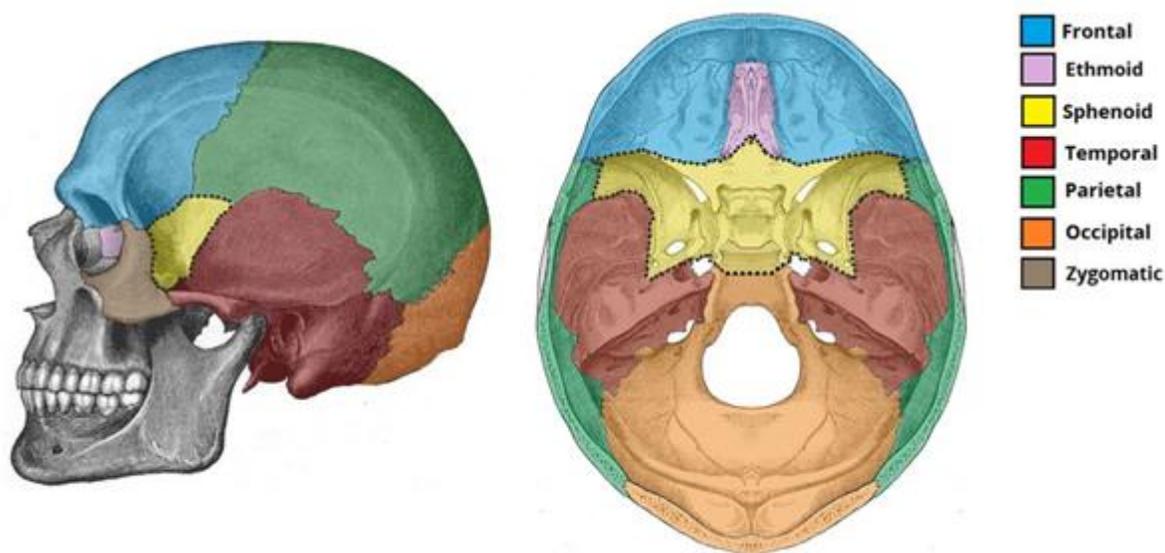
Ethmoid bone is a pneumatic bone; contain the ethmoid air cells (ethmoid paranasal sinus) which drain into superior and middle nasal meatus.



### 3- Sphenoid Bone

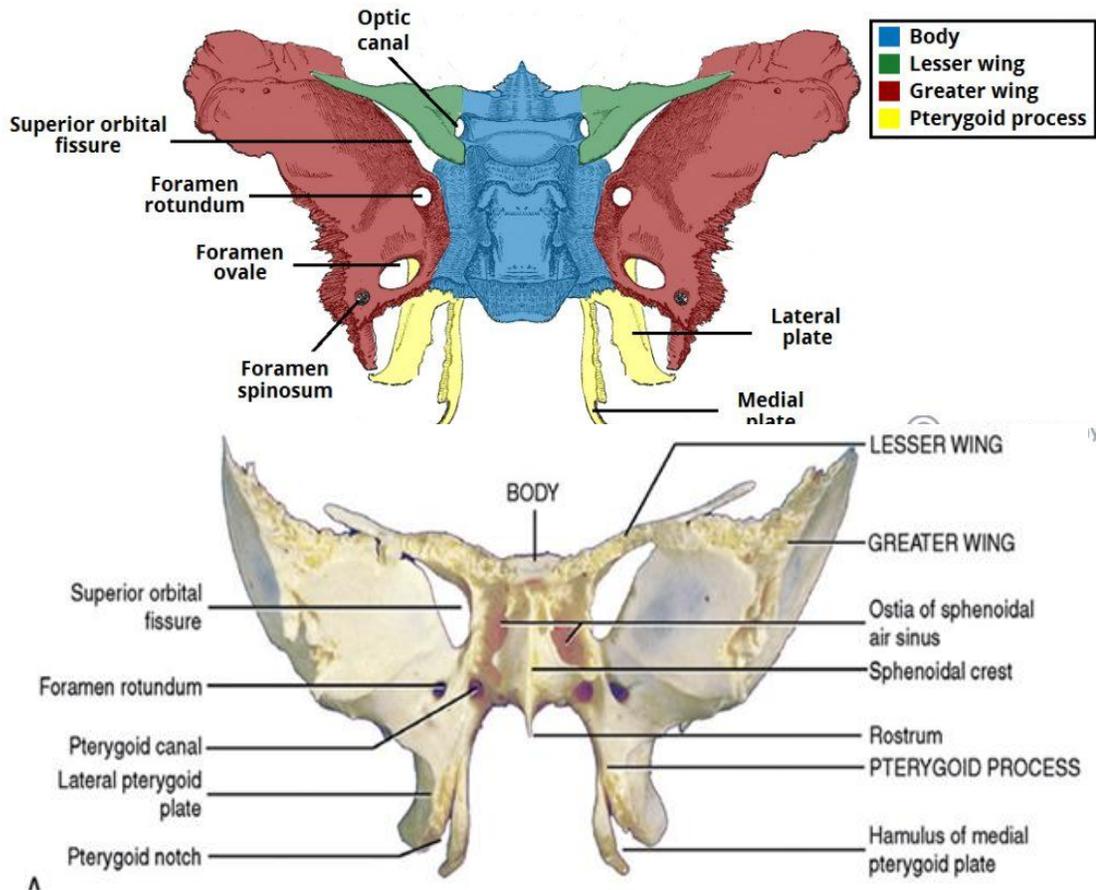
The sphenoid bone is a single bone situated at the middle of the skull base, it is a part of the anterior and middle cranial fossae. This complex bone has many processes that have delicate articulations with the adjacent cranial and facial bones.

The sphenoid bone articulates with the frontal, ethmoid, parietal, temporal, occipital, vomer, zygoma, palatine bones, and sometimes the tuberosity of the maxilla.

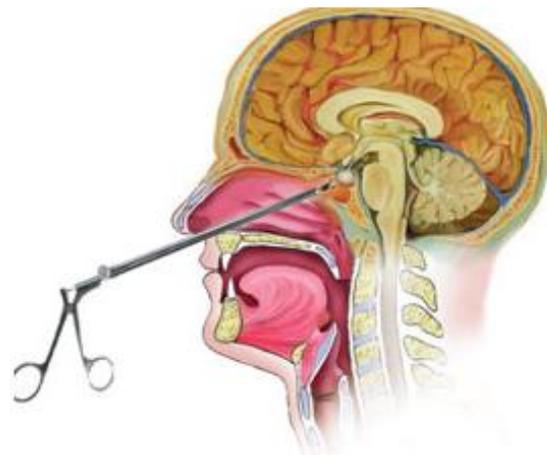


The sphenoid bone looks like a butterfly in shape; it has lesser wing, greater wing, body and pterygoid plates (2 medial and 2 lateral). Also it contains many foraminae and fissures; as the optic canal (Optic N. CNII), foramen rotundum (Maxillary N. CNV<sub>2</sub>), foramen ovale (Mandibular N. CNV<sub>3</sub>), foramen spinosum (middle meningeal artery) and superior orbital fissure (Oculomotor N. CNIII, Trochlear N. CNIV, Ophthalmic N. CNV<sub>1</sub>, Abducens N. CNVI and Ophthalmic Vein) .

The body of the sphenoid bone is hollow and forms two cavities separated by a thin bony septum. The hollow cavities are the sphenoidal air sinuses; these drain into the superior nasal meatus. On the superior surface of the body; there is depression for the pituitary gland (hypophysis) Known as hypophysial fossa or (*Sella turcica*). The body of the sphenoid lies on the roof of nasal cavity and that's why the pituitary gland surgery can be done by passing an endoscope through the nose (transnasal).



**Transnasal approach to pituitary gland**

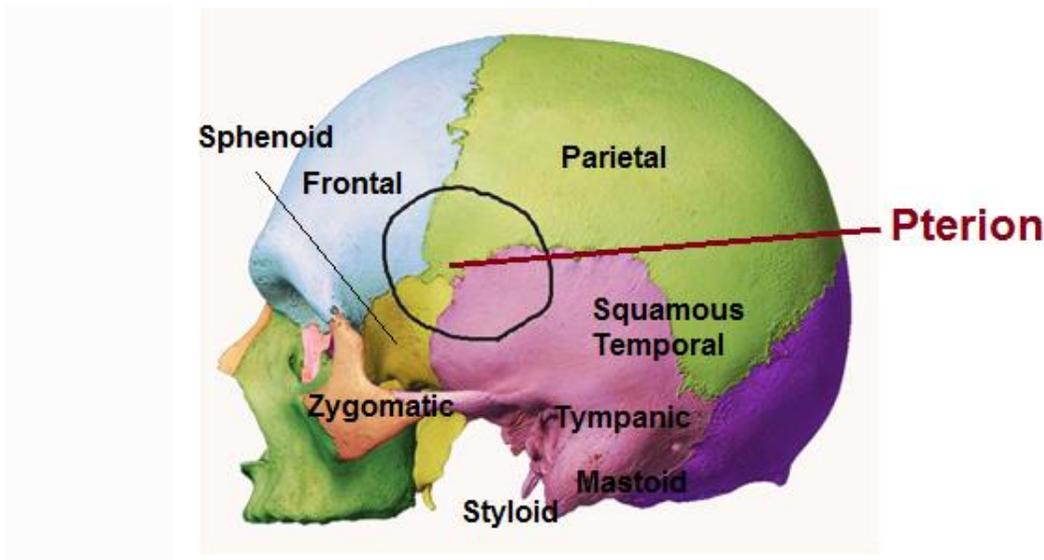


In children; the sphenoid occipital joint is cartilaginous (sphenoid occipital synchondrosis) and considered as growth center for the skull base then it will be transformed to suture at the completion of growth.

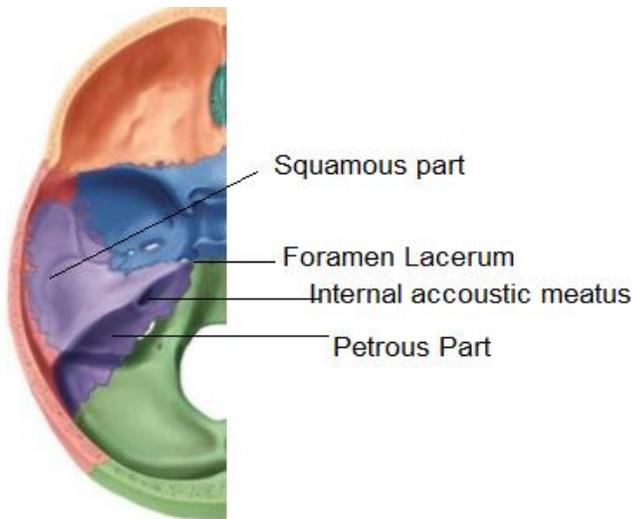
## 4- Temporal Bone

The temporal bone is a paired bone situated at the lateral side and base of the skull. Each temporal bone consists of the following parts and processes:

- Petrous part (also called the pyramid) It is located in the base of the skull, it houses the internal acoustic meatus and structures of the inner ear (internal auditory canal). Mastoid process (contain mastoid air cells that act as reservoir of air to equalize the pressure in middle ear) is considered as down growth from petrous part and both known as petromastoid.
- Tympanic part (contain the external auditory meatus),
- Squamous part: is the largest and most superiorly situated part of the temporal bone, it joint the parietal bone at the squamous suture and makes part of the pterion (which is the weakest part of the skull, composed of parts of the following bones: frontal, parietal, sphenoid and temporal. The middle meningeal artery runs behind the pterion within the cranium)

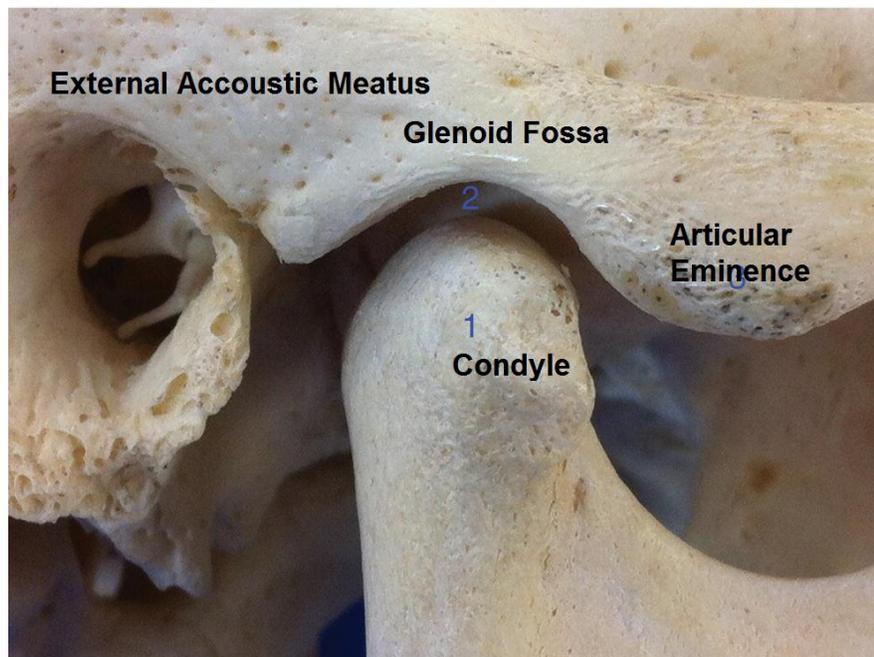


- Styloid process (gives attachment to muscle and ligaments)
- Zygomatic part process (form the zygomatic arch with the temporal process of the zygomatic bone).



The foraminae and canals in the temporal bone; are: foramen lacerum, carotid canal, internal acoustic meatus, external acoustic meatus, stylomastoid foramen and facial nerve canal (the inner opening is the internal acoustic and the outer opening is the stylomastoid foramen- between styloid and mastoid).

The temporal bone articulates with the mandibular bone through the TemporoMandibular Joint (TMJ), the glenoid fossa of the temporal bone (at the root of zygomatic arch) articulates with the condylar head of the mandible. The anterior boundary of the glenoid fossa is the articular eminence.

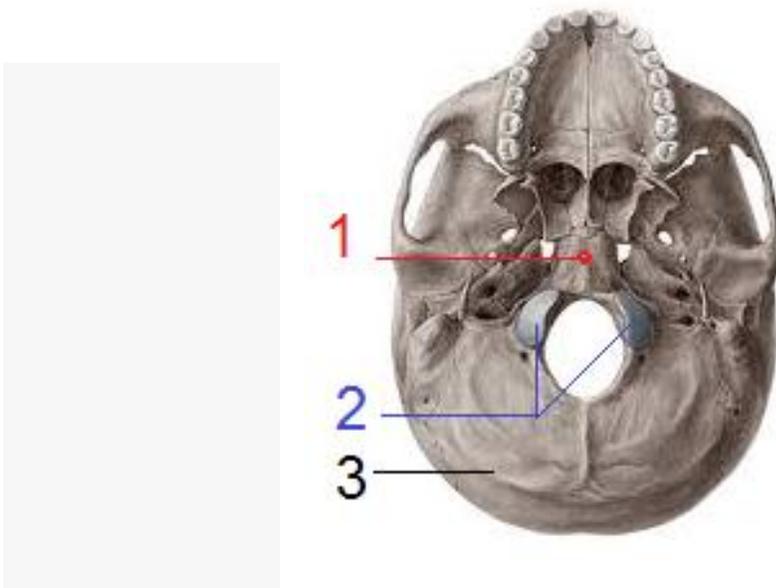


## 5- Occipital Bone

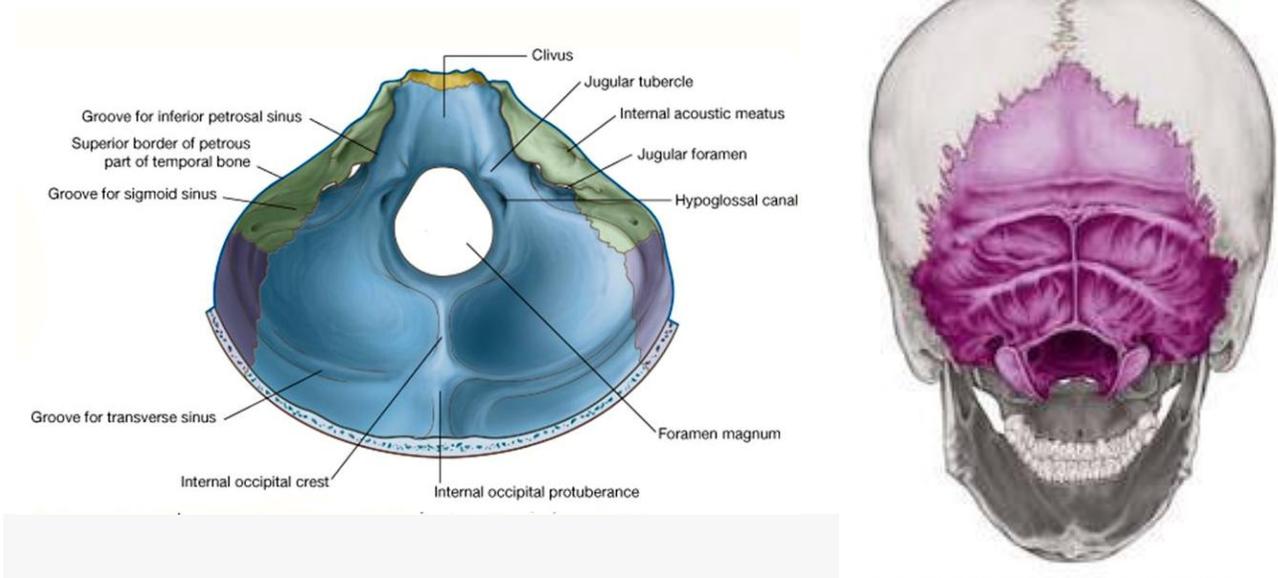
The occipital bone is an unpaired trapezoidal bone which is the main bone of back of the skull (occiput). It makes up a large portion of the basilar part of the neurocranium and entirely houses the cerebellum.

Superiorly the occipital bone articulates with the parietal bones at the lambdoid suture and constitutes a part of the vault of the skull. Inferiorly; it is the only cranial bone to articulate with the cervical spine. Anteriorly it articulates with the sphenoid at the skull base.

The occipital bone is composed of the following parts which are: basilar part (no.1 in the figure below), Condylar part (no.2), and the squamous part (no.3) which is placed laterally to the foramen magnum.



The squamous part is the largest of all four; it lies posterior to foramen magnum, it is curved from above downward (convex externally and concave internally). The external surface features external occipital protuberance (a palpable prominence lies on the midline of the external surface which serves as an attachment for the trapezius muscle), and three curved lines referred to as nuchal lines (provide attachments to muscles and ligaments): The highest nuchal line, the superior nuchal line runs slightly inferior and the inferior nuchal line runs further inferiorly. The internal surface of the squamous part is marked by grooves on its internal surface due to venous cranial sinuses: the superior sagittal sinus, the transverse sinuses and the sigmoid sinus.



The basilar part lies anterior to the foramen magnum and adjacent to the petrous part of the temporal bone. Anteriorly it articulates with the sphenoid bone.

The condylar parts (occipital condyle, *Condylus occipitalis*) are located lateral to the foramen magnum. They comprise two kidney-shaped prominences (occipital condyles) that articulate with the first cervical vertebra (atlanto-occipital joint). The hypoglossal nerve exits the neurocranium through the hypoglossal canal which pierces through the condylar part of the occipital bone.

The jugular foramen lies between the occipital bone and petrous part of the temporal bone (contents: internal jugular vein, Glossopharyngeal N., Vagus N. and Accessory N.)

## 6- Parietal Bones

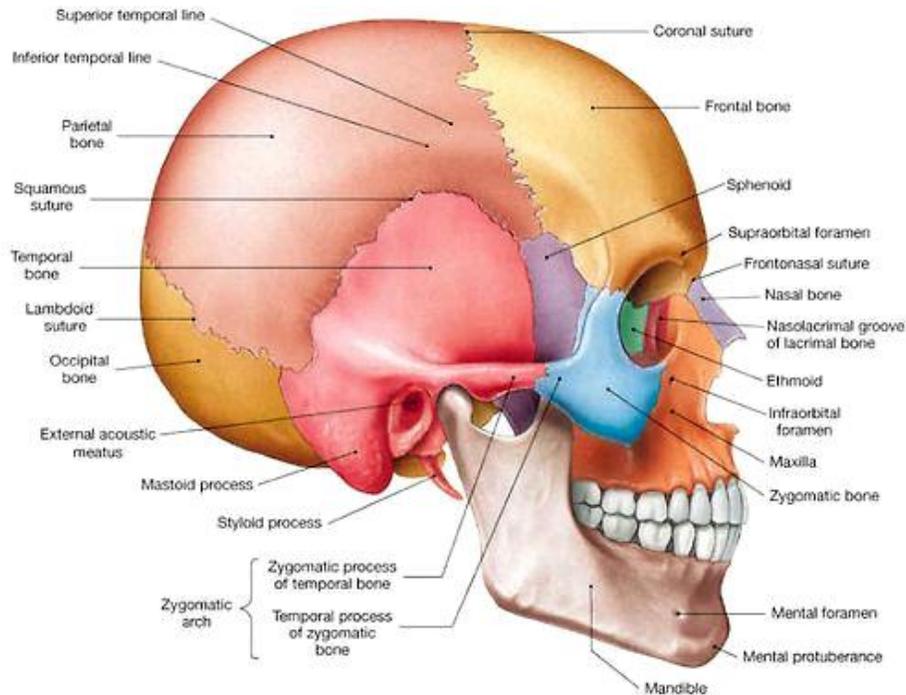
Parietal bones are two flat bones that form the majority of the vault of the skull (calvaria), it articulate with each other in the midline at the sagittal suture.

Anteriorly it articulates with the frontal bone at the coronal suture, the area of joint between the coronal suture and the sagittal suture known as Bregma.

Posteriorly the paired bones articulate with the occipital bone at the lambdoid suture, the area of joining the sagittal suture with the lambdoid suture is known as lambda.

Laterally the bones articulate with squamous temporal bone at the squamous suture.

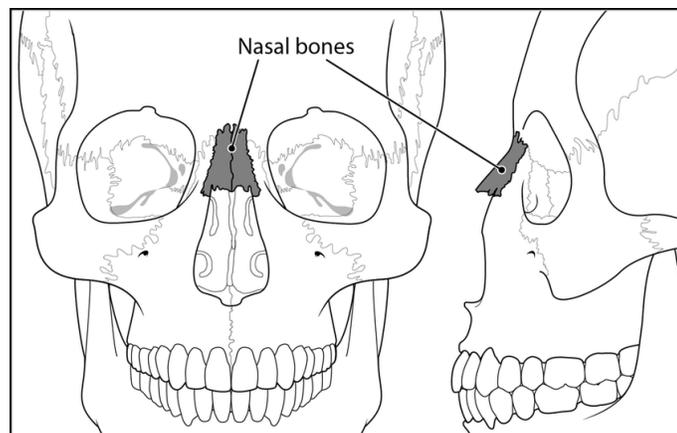
The bones have paired foraminae (one in each bone), known as parital foramen and contain an emissary vein.



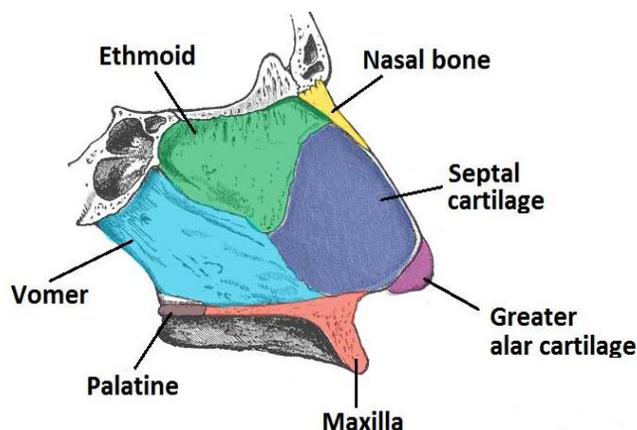
## The Facial Bones:-

### 1) The Nasal Bones

The nasal bones are rectangular bones, they form the bridge of the nose, they articulate with the frontal bone superiorly and with each other at the midline. At the superior articulation, they are relatively thick, but inferiorly, they are much thinner. It is in this area that most fractures occur. The nasal bones articulate posteriorly with the frontal process of the maxilla. The lower borders with the maxilla form the anterior nasal aperture.



The nasal cavity is divided into two cavities by the nasal septum, which is formed by the vomer, the perpendicular plate of the ethmoid and septal cartilage (the above figure on the right). The superior and middle conchae are shelves of bone that project into the nasal cavity from the ethmoid on each side. The inferior conchae are separate bones.



## 2) The Maxillary Bones

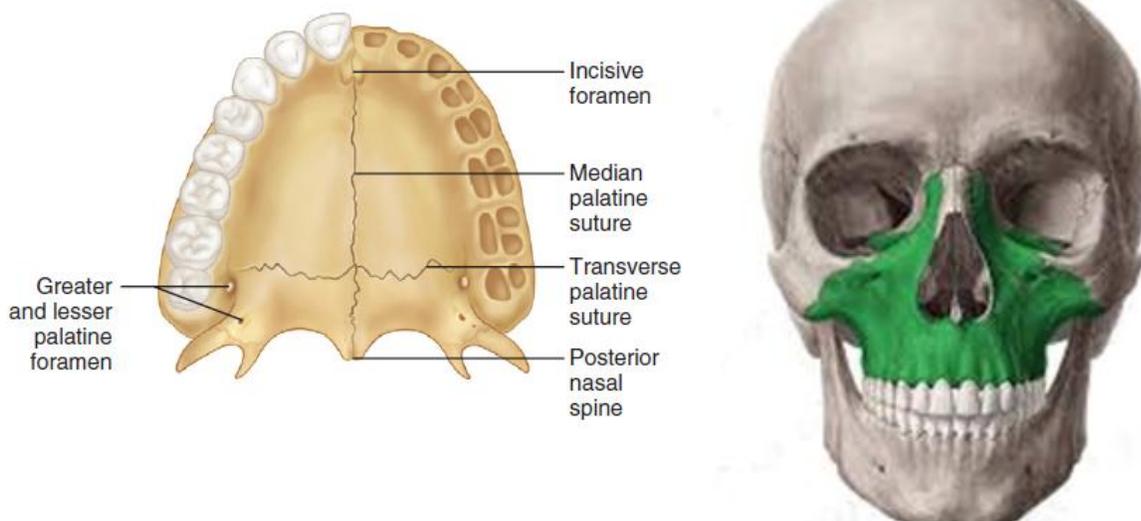
The two maxillae form the upper jaw, the anterior part of the hard palate, part of the lateral walls of the nasal cavities, and part of the floors of the orbital cavities. The two bones meet in the midline at the intermaxillary suture and form the lower margin of the nasal aperture.

The infraorbital foramen perforates the maxilla below the orbit. The alveolar process projects downward and, together with the fellow of the opposite side, forms the alveolar arch, which carries the upper teeth.

Each hemimaxilla contains a large pyramid-shaped body, the maxillary sinus (antrum of Highmore), and four prominent processes—the frontal, alveolar, zygomatic, and palatine processes.

The body of the maxilla is hollow and contains the maxillary sinus (pyramid shaped). The anterior wall of the sinus is the facial surface of the maxilla and is usually thin. The medial wall is the lateral nasal wall. The sinus opens superiorly and medially into the nasal cavity at the the middle meatus. The superior wall or roof of the sinus is the orbital floor, and the floor of the sinus is the palatine and alveolar processes of the maxilla.

Posteriorly, the maxilla articulates with the lacrimal bone to form the anterior portion of the medial orbital wall.



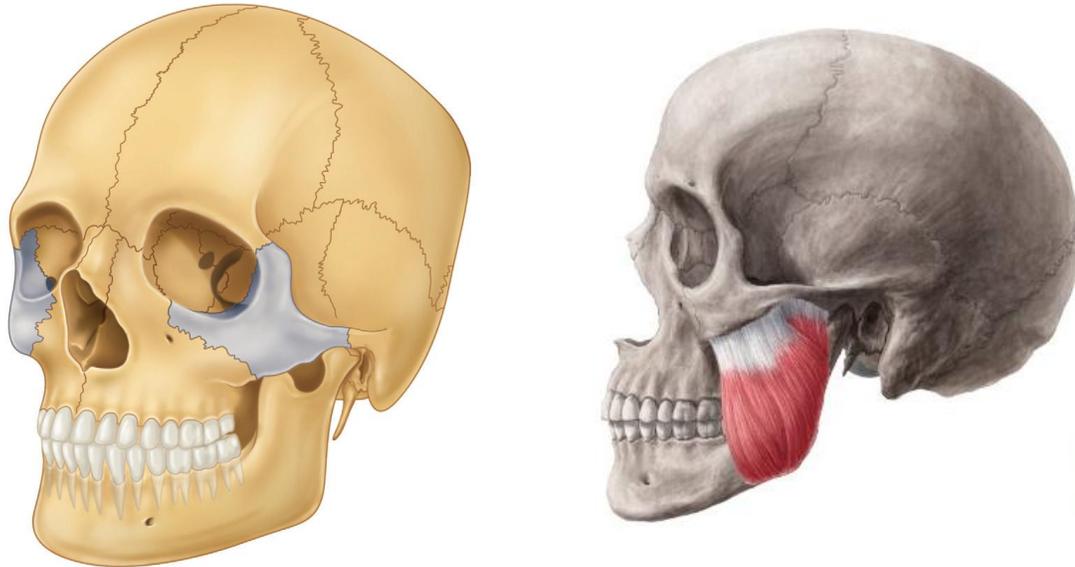
### 3) The Zygoma

The zygoma (zygomatic bone, malar bone) is a paired bone that makes up the essence of the cheek prominence. This thick, strong, diamond-shaped bone forms the lateral and anterior projections to the midface and is composed of four processes. The frontal process forms the lateral orbital wall and articulates with the frontal bone at the frontozygomatic suture. The temporal process forms the zygomatic arch and articulates with the temporal bone. The maxillary process articulates with the maxilla to form the infraorbital rim and part of the floor of the orbit. Finally, the fourth process joins the maxilla on the lateral wall, producing the zygomatic eminence. This is an area of thickened bone that is usually available for fixation in the treatment of zygomaticomaxillary complex (ZMC) fractures.

The zygoma articulates with the sphenoid bone on the posterior aspect of the frontal process. This articulation is with the greater wing of the sphenoid bone and forms the lateral wall of the orbit.

The only foramina of the zygomatic bone are the zygomaticofacial foramen, and the zygomaticotemporal. The zygomaticofacial and zygomaticotemporal branches of the second division of the trigeminal nerve pass from within the orbit to the surface and give sensory innervation to the associated structures.

On the inferior aspect, there is the insertion of the masseter muscle. The direction of force for this muscle is down and backward and its contraction contributes to displacement of the complex fracture of the zygoma



#### 4) Vomer

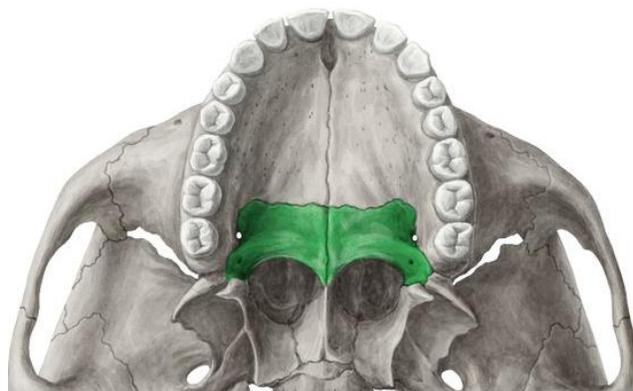
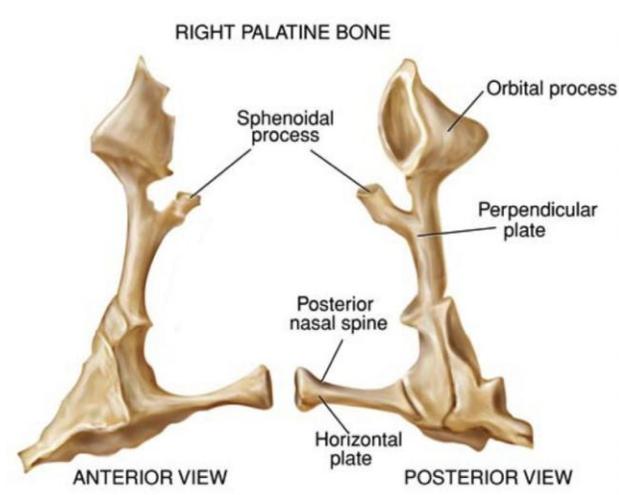
The vomer is a plow-shaped bone that is located in the midline of the nasal fossa and forms the posterior portion of the nasal septum. It articulates with the palatine, maxillary, and ethmoid bones.

#### 5) Palatine Bones

These are irregularly shaped paired bones; each is composed of a major horizontal portion and vertical perpendicular plates. The horizontal plate articulates anteriorly with the maxilla and with the palatine bone of the opposite side in the midline to form the posterior aspect of the hard palate.

The vertical plate passes superiorly behind the maxilla and articulates posteriorly with the lateral pterygoid plate of the sphenoid bone. The vertical plate terminates in a small contribution to the orbital floor at the posteromedial aspect.

The palatine bone has two foraminae; the greater and lesser palatine, which lie in the posterior part of the palate and transmit the greater and lesser palatine nerves (branches of maxillary nerve) and vessels.



## 6) Inferior Nasal Concha

The inferior nasal concha is a paired bone that forms the bony support of the inferior turbinate bilaterally. It is of surgical importance only when it obstructs the inferior meatus and the nasolacrimal duct.

## 7) Lacrimal Bones

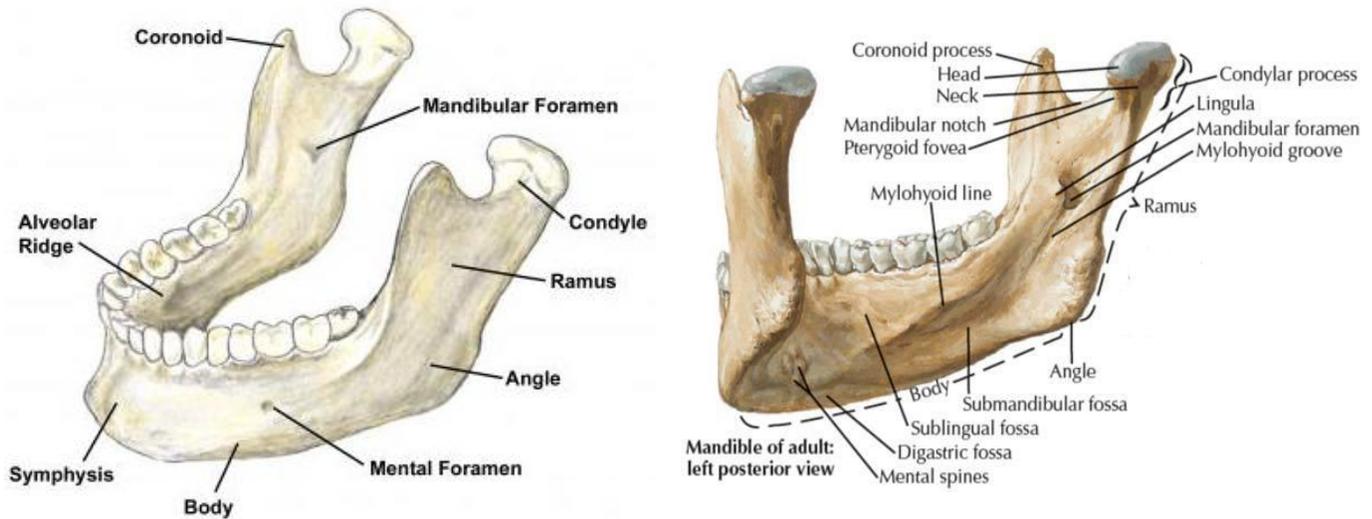
It is a paired bone, they are the smallest and most fragile bones of the face, and they are situated at the front part of the medial wall of the orbit.

Each lacrimal bone articulates anteriorly with the frontal process of the maxilla, posteriorly it articulates with the lamina papyracea of the ethmoid, superiorly it articulates with the frontal bone and inferiorly it articulates with the orbital plate of the maxilla.

Lacrima” is latin for “tear”, so the name of the bone corresponds with its relation to the nearby lacrimal structures. The lacrimal groove is a groove for the nasolacrimal duct, situated in the anterior part of the lateral surface of the lacrimal bone. The lacrimal groove fuses anteriorly with the posterior border of the frontal process of the maxilla to form the fossa that houses the lacrimal sac.

## 8) The Mandible

The mandible is the largest and strongest facial bone; it is composed of the body and two rami, with their junction at the angle. The body is U-shaped, it has mental foramen which is located on the external surface near the root apices of the first and second premolars, and the opening of the foramen is directed backward and laterally and transmits the mental nerve (terminal branch of inferior alveolar nerve) and vessels.

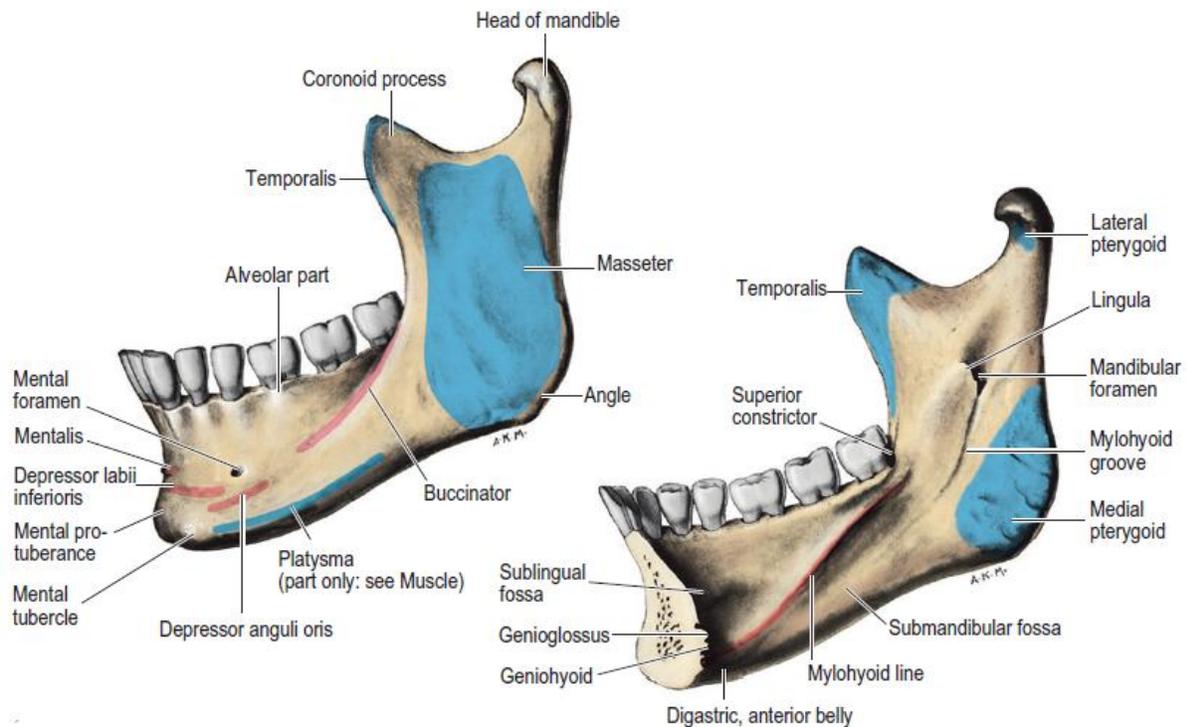


The symphysis menti is a shallow ridge on the external midline surface of the body of the mandible; this indicates the line of fusion of the two halves of the mandible during development. The mental spines (genial tubercles) are on the midline medial surface of the body of the mandible; these give origin to the genioglossus muscles above and the geniohyoid muscles below. The mylohyoid line is an oblique ridge that runs backward and laterally from the area of the mental spines to an area below and behind the third molar tooth and represents the attachment of the mylohyoid muscle (the floor of the mouth). The submandibular fossa, for the superficial part of the submandibular salivary gland, lies below the posterior part of the mylohyoid line. The sublingual fossa, for the sublingual gland, lies above the anterior part of the mylohyoid line.

The ramus of the mandible has an anterior coronoid process and a posterior condyloid process, or head. A short neck is inferior to the head.

The mandibular notch separates the coronoid and condyloid processes. The temporalis muscle attaches onto the anterior and medial aspects of the coronoid process. The mandibular foramen lies on the medial surface of the ramus. This transmits the inferior alveolar nerve and vessels. The lingula is a projection in front of the mandibular

foramen for the attachment of the sphenomandibular ligament. The foramen leads into the mandibular canal, which opens on the lateral surface of the body of the mandible at the mental foramen. The incisive canal is the forward continuation of the mandibular canal beyond the mental foramen and below the incisor teeth.



**This the End of the Lecture – Good Luck**