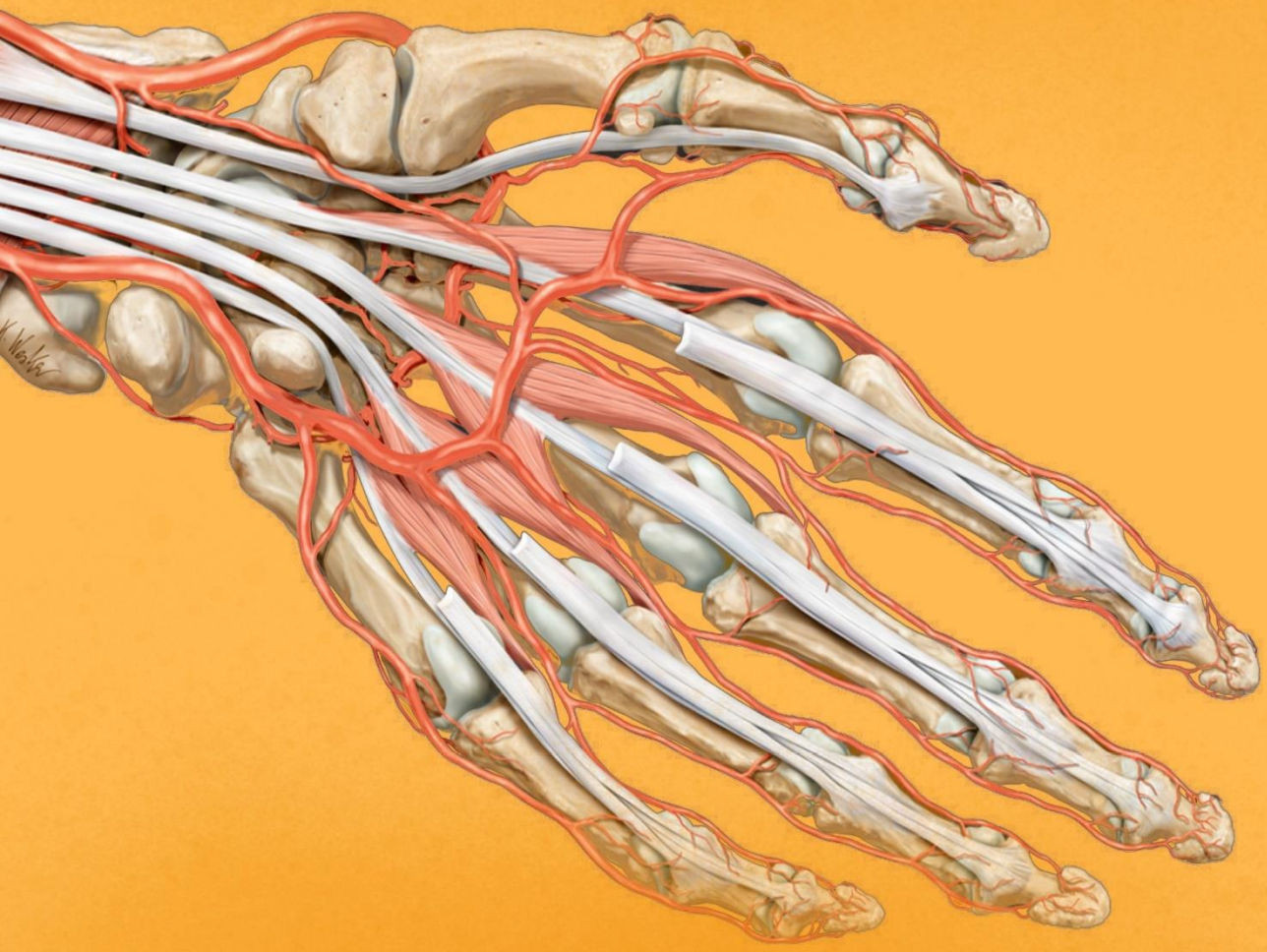
HATAHET ANATOMY



Axial Skeleton: Skull

Lecture: 4

Pages: 10

Lecture 4: Axial Skeleton: Skull

Introduction to the Skull

Main divisions of skull

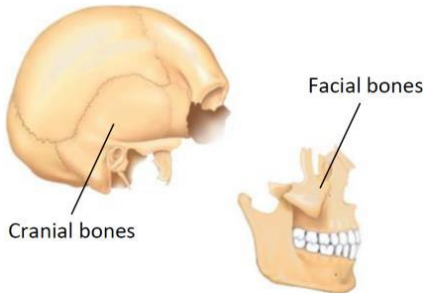
The bones of the skull are immovable bones and have a special type of joints between them called (Sutures). The skull bones make up to 33% of all axial skeleton bones, classified into 2 types of bones:

❶ Facial bones (Viscerocranium)

- the bones of the skull that have no relation with covering the brain
- considered irregular bones
- we have 14 bones in the skull

❷ Cranial bones (Brain box) (Neurocranium)

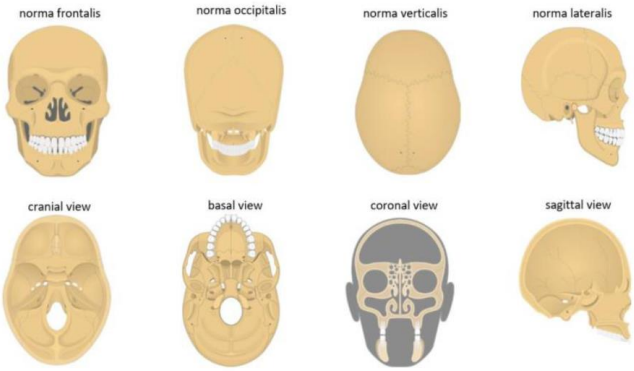
- the bones of the skull that houses the brain & the special senses
- most of them are considered flat bones
- we have 8 cranial bones in the skull



Views of skull

It is important to be familiar with every view of the skull; because some bones are hidden within. The 8 views are:

❶ Anterior view
❷ Posterior view
❸ Superior view
❹ Lateral view, divides the skull into cranial and facial bones
❺ Cranial view
❻ Basal view
❼ Coronal view
❽ Sagittal view



Bones of The Skull

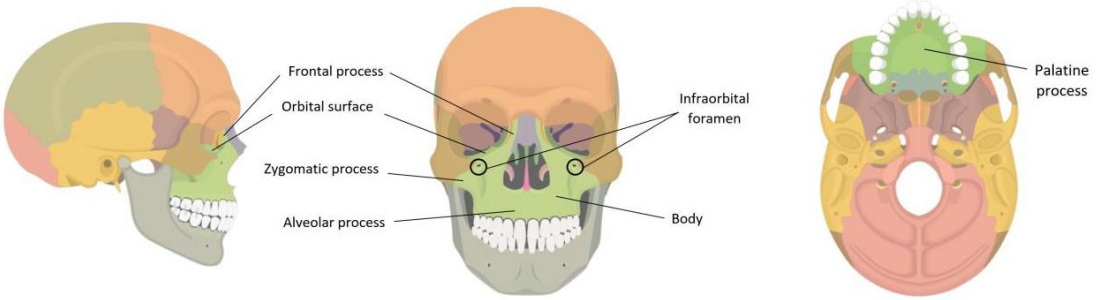
Facial bones

Maxillary bone (Maxilla) [X2]

- **the major facial bone**; because it articulate with most of the facial bones
- the right & left maxillary bones form the upper jaw (الفك العلوي)

  - **Body**, thick and has an air sinus
  - **Alveolar process (Upper jaw)**, the part that holds sockets (alveoli) for upper teeth to sit in
  - **Zygomatic process**, articulates with zygomatic bone
  - **Frontal process**, articulates with frontal bone and nasal bones
  - **Infraorbital foramen**, a small foramen below the orbit
  - **Orbital surface**, the part of maxilla that makes up the floor of the orbit
  - **Palatine process**, the process that makes the $^{3}/_{4}$ anterior of the hard palate

- **Hard palate**: the bony part of the roof of the oral cavity



Mandible [X1]

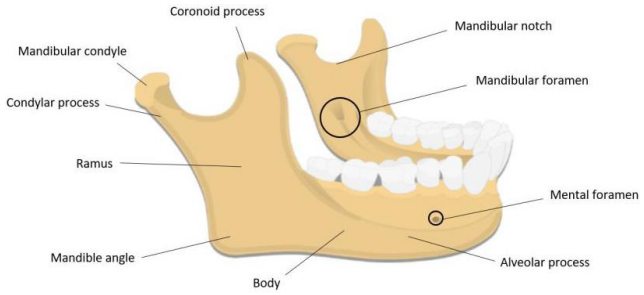
- the largest and the strongest bone of the face
- the only skull bone that doesn't articulate with other skull bones by sutures
- **it is the only movable bone in the skull**

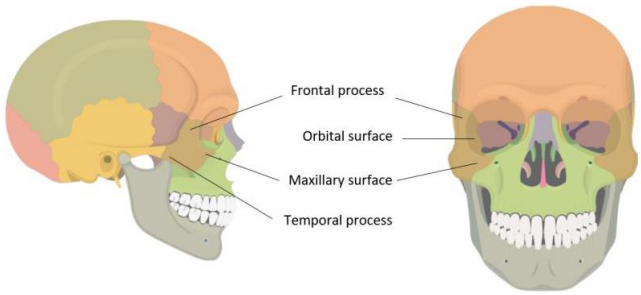
  - **Body**, the thick part of the mandible
  - **Alveolar process**, the part of the body that holds the sockets for lower teeth to sit in
  - **Ramus**, the part of the mandible that goes up and articulate with the skull, one on each side
  - **Mandibular angle**, the curved point where each ramus of the mandible meet with the body
  - **Coronoid process**, the anterior protrusion of the ramus, serves as an attachment point for the muscles of mastication
  - **Condylar process**, the posterior protrusion of the ramus that forms the **(TemporoMandibular Joint - TMJ)** with the temporal bone
  - **Mandibular notch**, a notch between the 2 processes of the ramus of the mandible

Zygomatic bone [X2]

- the bone that makes the sides of the face
- also called the **(Cheek bone)**

  - **Temporal process**, the process that articulates with temporal bone
  - **Orbital process**, the part that contributes in forming the orbits
  - **Maxillary process**, articulates with maxillary bone
  - **Frontal process**, articulates with frontal bone

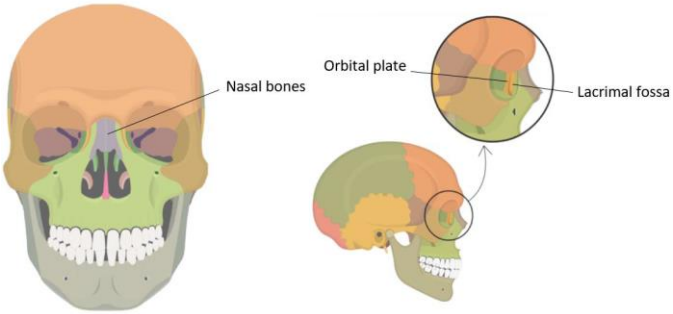




Nasal bones [X2]

- 2 bones joined together at the midline by a suture
- they articulate:

  ① **medially** → together
  ② **superiorly** → with the frontal bone
  ③ **laterally** → with the maxilla



Lacrimal bone [X2]

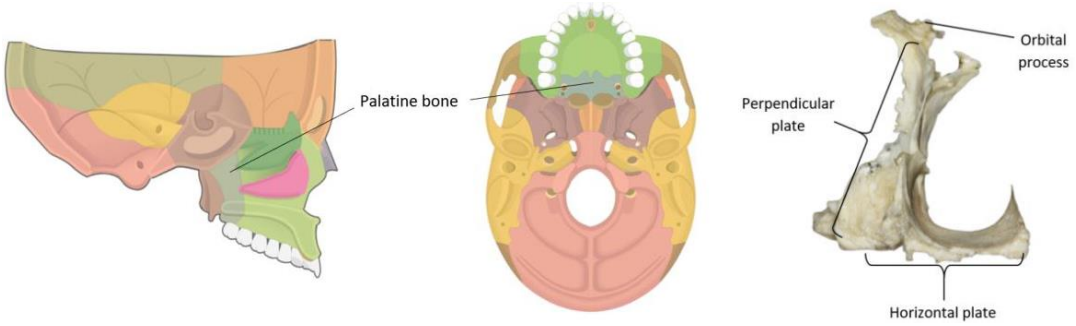
- the smallest facial bone (and the whole skull)
- found in the medial wall of the orbit

  - **Orbital plate**, posterior to lacrimal fossa, it forms a portion of the medial wall of the orbit
  - **Lacrimal fossa**, a depression in the junction between lacrimal and maxillary bones, it houses the **(Lacrimal sac)** where tears are transmitted into the nasal cavity

Palatine bones [X2]

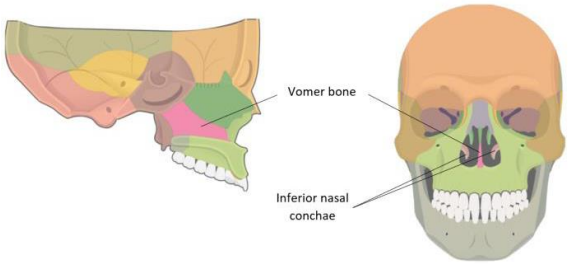
- L-shaped bones joined together at the midline
- they form the posterior $^1/_4$ of the hard palate

  - **Horizontal plate**, contributes in forming the $^1/_4$ posterior part of the hard palate
  - **Perpendicular plate**, contributes in forming the walls of the nasal cavity
  - **Orbital process**, contributes in forming a very very very small portion of the orbit



Vomer bone [X1]

- a singular bone in the midline
- contributes in forming the lower part of the nasal septum



Inferior nasal concha [X2]

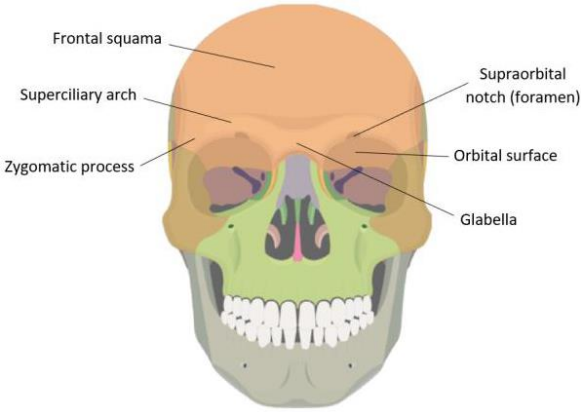
- 2 separate bones that for a part of the nasal cavity wall

Cranial bones

Frontal bone [X1]

- the bone that forms the forehead (الجبهة)
- it starts as 2 bones but they fuse together very early in life into 1 bone

  - **Frontal squama**, the thick flat part of the bone, forms the forehead
  - **Superciliary arch** (**Supraorbital arch**), an elevation above each orbit
  - **Supraorbital foramen**, a foramen in the superciliary arch through which the supraorbital nerve and supraorbital vessels pass. Sometimes it is incomplete and is called **Supraorbital notch**
  - **Orbital surface**, contributes to a part of the orbit
  - **Zygomatic process**, articulates with zygomatic bone
  - **Glabella**, a smooth elevation between the two superciliary arches



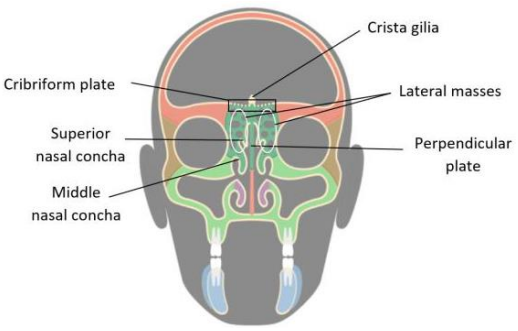
Parietal bone [X2]

- paired bone that forms the greater portions of the side of the cranial roof

Ethmoid bone [X1]

- the bone that makes up the largest portion of the nasal cavity
- this bone is hidden inside the skull and can only be seen in **Coronal view**

  - **Cribriform plate**, appear in the anterior cranial fossa and forms the roof of the nasal cavity, it consists of numerous small holes to pass the **Olfactory nerve** (العصب الشمي) to the nasal cavity
  - **Crista galli**, a superior projection from the cribriform plate that serves as an attachment point for the membrane that separates the 2 brain hemispheres
  - **Orbital plate**, the part that contributes in forming the orbits
  - **Perpendicular plate**, the plate that forms the upper part of the nasal septum
  - **Lateral masses**, 2 bony masses lateral to the perpendicular line

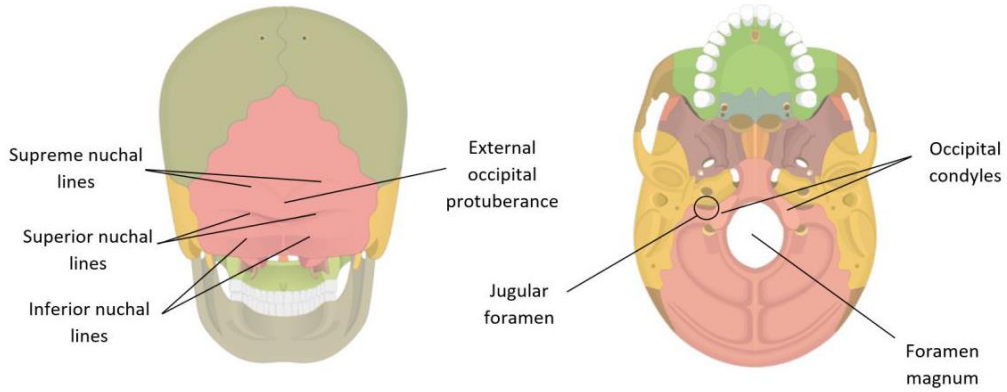


Occipital bone [X1]

- the largest cranial bone
- makes up most of the base of skull

  - **External occipital protuberance**, a subcutaneous elevation, it is the most prominent structure in the posterior surface of the skull, it is the attachment point for the **Nuchal ligament**
  - **Internal occipital crest**, the inner elevation that forms an attachment point for **Falx cerebelli** (غشاء يفصل المخيخ الأيمن عن الأيسر)
  - **Clivus**, wide depression anterior to foramen magnum
  - **Occipital condyles**, 2 oval-shaped processes in both sides of the foramen magnum, they articulate with the vertebral column
  - **Foramen magnum**, the largest foramen of the skull where the spinal cord exits the skull to the vertebral canal
  - **Nuchal lines**, located at the posterior wall of the occipital bone and serve as attachment points for muscles, those are:

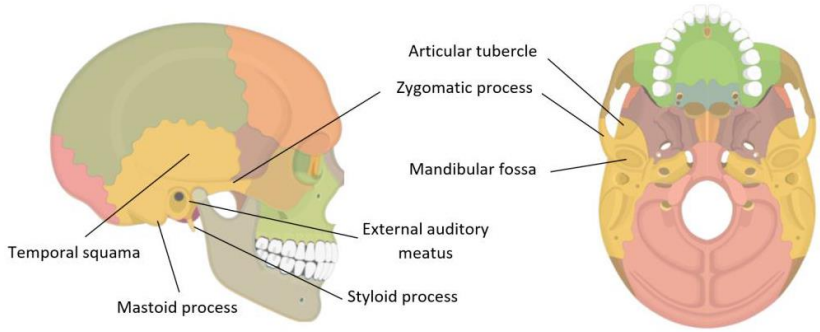
    ① Supreme nuchal lines **② Superior nuchal lines** **③ Inferior nuchal lines**



Temporal bone [X2]

- each temporal bone is inferior to the parietal bone of the same side
- it contains the auditory ossicles and supports the ear structure

  - **Temporal squama**, the thick flat part of the bone
  - **Zygomatic process**, the process that makes the posterior half of the (Zygomatic arch)
  - **Mastoid process**, a subcutaneous process posterior to the ear that makes an attachment point for neck muscles
  - **Styloid process**, a projection in the inferior surface of the temporal bone that makes an attachment point for some muscles
  - **Petrous Portion**, the inner surface of temporal bone, contains the **Internal auditory (acoustic) meatus**
  - **Mandibular fossa**, an infero-posterior fossa where the mandible articulates with the temporal bone to form the TMJ
  - **Articular tubercle**, rounded elevation anterior to the mandibular fossa where the mandible articulates
  - **External auditory (acoustic) meatus**, contains the 3 ossicle bones.



Sphenoid bone [X1]

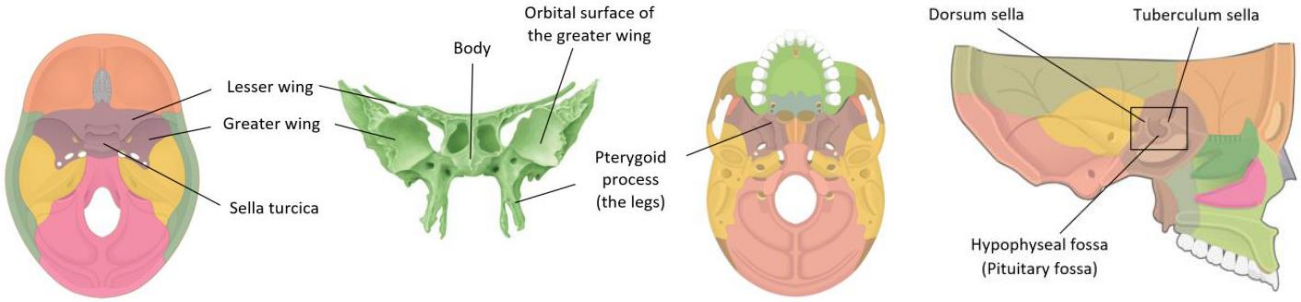
- **the key bone (keystone) of the cranium**; because it articulates with all of the cranial bones, holding them together
- this bone **looks like a butterfly** with a body, 2 wings, 4 legs

  - **Body**, the central part of the sphenoid bone
  - **Greater wings**, make a portion of the **middle cranial fossa**, and contain an orbital surface
  - **Lesser wings**, make a portion of the **anterior cranial fossa**
  - **Pterygoid processes**, attachment points for some of the muscles that move the mandible, each one has 2 pterygoid plates:

    ① Medial pterygoid plate **② Lateral pterygoid plate**

◆ **Sella turcica**, a bony saddle-shaped structure in the middle cranial fossa, it consists of:

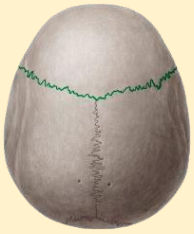
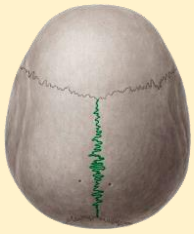
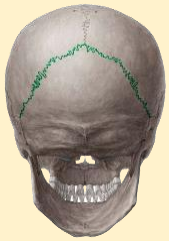
- **Tuberculum sellae**, the anterior ridge of the saddle
- **Dorsum sellae**, the posterior ridge of the saddle, has 2 extensions called **Clinoid processes**
- **Pituitary fossa**, the depression between both ridges, contains the **Pituitary gland (الغدة النخامية)**



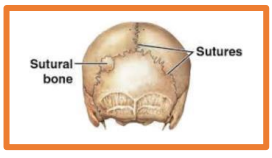
Bones of The Skull

Sutures

▪ **Sutures**: immovable fibrous joints made of dense fibrous connective tissue that connect the bones of the skull in adults together and make them immobile. We have 4 main sutures in the skull:

Sutures / Differences	Coronal suture	Squamous suture	Sagittal suture	Lambdoidal suture
Located between	**Frontal & 2 Parietals**	**Temporal & Parietal**	**2 Parietals**	**Occipital & 2 Parietals**
Illustration				

▪ **Sutural bones (Wormian bones)**: small and several bones between sutures, found in the area where a periphery of a bone meets the periphery of another bone during the ossification process



Cranial junctions

➢ **Bregma** → the intersection between both **Sagittal & Coronal sutures**

➢ **Vertex** → the most superior point in the **calvaria**

➢ **Lambda** → the intersection between both **Sagittal & Lambdoidal sutures**

➢ **Pterion** → H-shaped junction between the thin parts of (Frontal / Parietal / Temporal / Sphenoid) bones. An artery called **(Middle meningeal artery)** goes underneath this point and any injury in this area will cause it to bleed, resulting in collection of blood that exert pressure on the brain **(Epidural Hemorrhage)**

➢ **Nasion** → the intersection between the **Frontal & 2 Nasal bones**

Pterion labelled in a test dummy

Paranasal sinuses (Air sinuses)

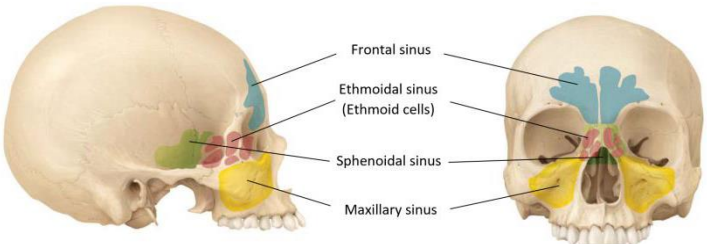
- **Paranasal sinuses**: extensions of the nasal cavity into the thick parts of the skull bones

➢ Functions of air sinuses:

① decrease the weight of the skull
② enhance the quality of the voice

➢ We have 4 main air sinuses:

❶ Maxillary sinuses (x2), the largest
❷ Frontal sinuses (x2)
❸ Sphenoidal sinuses (x2)
❹ Ethmoidal sinuses (x18 ethmoidal cells)

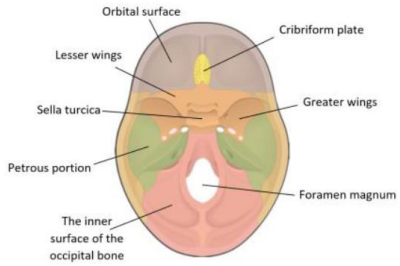


***Note**: Sinuses are absent or under-developed at birth and increase in size during face development (Teeth eruption)

Cranial fossae

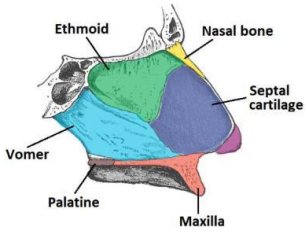
- **Cranial fossae**: levels in the cranial floor that contain depressions for brain lobes, grooves for blood vessels, and number of foramina
- **Calvaria**: the outer bony cover of the brain

➢ The floor of the skull consists of 3 cranial fossae:

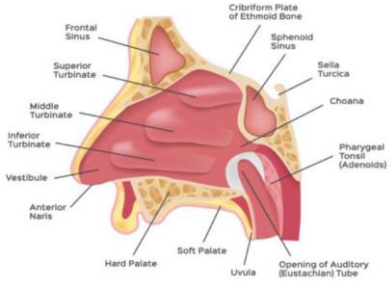
Cranial fossa	Bones forming the fossa	Cranial View
Anterior cranial fossa (Cerebrum: **Frontal lobe**)	◆ **Frontal bone** → Orbital plate ◆ **Ethmoid bone** → Cribriform plate ◆ **Sphenoid bone** → Lesser wing	
Middle cranial fossa (Cerebrum: **Temporal lobe**)	◆ **Sphenoid bone** → Greater wing & Sella turcica ◆ **Temporal bone** → Petrous portion	
Posterior cranial fossa (Cerebrum & Brainstem)	◆ **Occipital bone** → ① Foramen magnum ② Int. occipital protuberance ③ Clivus	

Nasal cavity

- **Nasal septum**: the septum that divides the nasal cavity into 2 (right & left) halves, it is rarely medial and usually deviated to one side, it consists of 2 parts:
  - ◆ **the bony part** → superior is **Ethmoid bone** and inferior is **Vomer bone**
  - ◆ **the cartilage part** → the **Septal cartilage**



➢ Bones that make up the nasal cavity

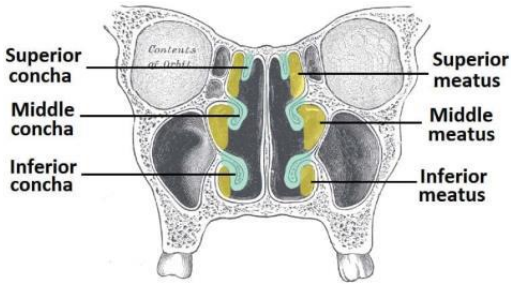
Parts of the Nasal cavity	Bones of the Nasal cavity	Sagittal View
Roof	◆ **Ethmoid bone** → Cribriform ◆ **Nasal bones**	
Floor	◆ **Palatine bone** → Horizontal plate ◆ **Maxillary bone** → Palatine process	
Medial wall	◆ **Nasal septum**	
Lateral wall	◆ **Palatine bone** → Perpendicular plate ◆ **Maxillary bone** ◆ **Ethmoid bone** → Sup & Mid nasal conchae ◆ **Inferior nasal conchae**	

➢ Conchae of the nasal cavity are:

❶ **Superior nasal concha**, two protrusions of the ethmoid bone but can't be seen from the anterior view **(only from the coronal view)**

❷ **Middle nasal concha**, two protrusions of the ethmoid bone into the nasal cavity

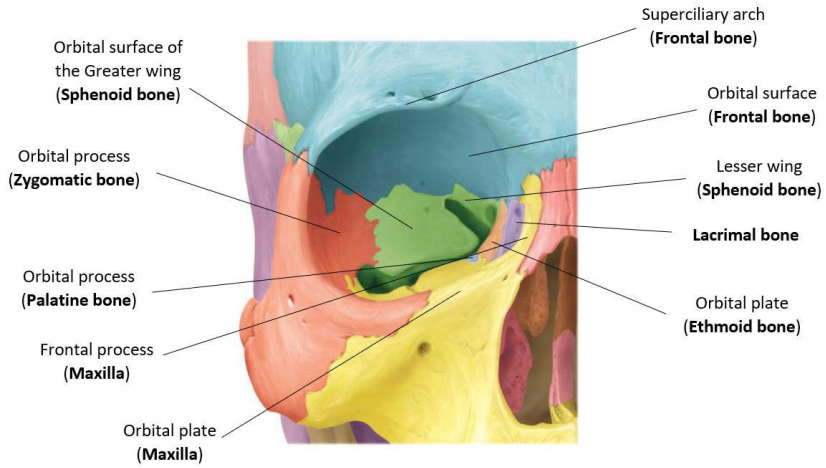
❸ **Inferior nasal concha**, two separated facial bones attached to the maxilla that give rise to two protrusions into the nasal cavity



The Orbit (Eye socket)

The skull has 2 orbits (Eye sockets) that house the eyes and the lacrimal accessories (gland & duct), each orbit is formed by 7 cranial & facial bones:

Skull bones	Parts that form the orbit
Facial bones	◆ **Maxillary bone** → Frontal process & Orbital surface ◆ **Zygomatic bone** → Orbital process ◆ **Lacrimal bone** → The entire bone ◆ **Palatine bone** → Orbital process
Cranial bones	◆ **Frontal bone** → Superciliary arch + Orbital surface ◆ **Sphenoid bone** → Greater wing & Lesser wing ◆ **Ethmoid bone** → Orbital plate



Brain Box (Cranium)

The brain box is divided into 2 parts:

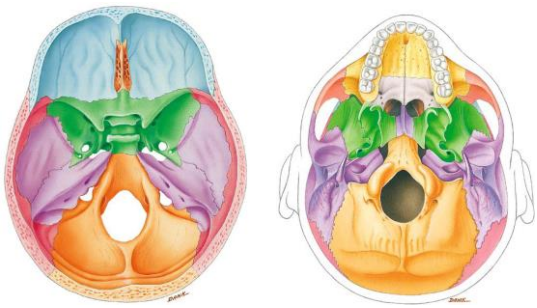
❶ **Cranial vault (Calvaria)**

- forms the roof and sides of the brain box
- made by the: **(Frontal bone, Parietal bone, Occipital squama, Temporal squama, Greater wing or sphenoid bone)**

❷ **Cranial base**

- forms the floor of the brain box
- made by the:

Internal surface **External surface**



A. Internal surface, which includes the: **(Anterior, Middle, Posterior) cranial fossae**
B. External surface, which includes the inferior aspect of the skull which is divided into 2 sets of bones:

① Facial bones: **(Hard palate, Vomer bone, Alveolar process of maxilla)**
② Cranial bones: **(Greater wing & Pterygoid plates of sphenoid, Mastoid & Styloid process of temporal bone, Occipital bone)**

Multiple Choice Questions

1) All of the following are TRUE regarding the human skeleton, EXCEPT:

A. It is composed of axial skeleton located in the midline & appendicular skeleton located in the periphery
B. Both upper limb & lower limbs are composed of 30 bones each
C. A set of bones that attach the appendicular skeleton to the axial skeleton is the definition of Girdles
D. Pectoral girdle is made up of the two hip bones (Coxal bones)

Answer: D

2) The last fontanel to ossify in a normal child is the:

A. Anterior fontanel
B. Posterior fontanel
C. Sphenoid fontanel
D. Mastoid fontanel

Answer: A

3) All of the following are considered facial bones, EXCEPT:

A. Maxillary bone
B. Vomer bone
C. Inferior nasal concha
D. Ethmoid bone

Answer: D

4) The Olfactory nerve (Cranial nerve I) exits the skull to the upper part of nasal cavity through the:

A. Foramen spinosum
B. Optic canal
C. Cribriform plate
D. Jugular foramen

Answer: C

5) The correct combination of bones that make up the associated structure of the following is:

A. Zygomatic arch is made up of 1 facial bone and 1 cranial bone
B. Nasal septum is made up of 2 bones: Vomer bone superiorly & ethmoid bone inferiorly
C. The 3/4 anterior of the hard palate is made up of the horizontal palatine bone
D. All of the above are correct

Answer: A

6) The hyoid bone does NOT articulate with ay bones in the skeleton, another true statement about it is:

A. It is a part of the axial skeleton
B. All of the choices are correct
C. It is mainly composed of a central body, greater horns, lesser wings
D. forms attachments points for several muscles of the tongue and neck

Answer: B

7) One of the following is mismatched regarding the anatomy of the nasal cavity:

A. Medial wall → Nasal septum
B. Lateral wall → Superior, Middle, and Inferior nasal conchae
C. Floor → Hard palate
D. All of the above are correctly matched

Answer: D

8) A 42-year-old patient presents with difficulty speaking and swallowing. On physical examination, you notice tongue deviation to the left side due to the 12th cranial nerve (CN XII) abnormality. Which anatomical structure is likely implicated in this patient's symptoms? **Very tricky Q**

A. Jugular foramen
B. Foramen ovale
C. Hypoglossal foramen
D. Foramen magnum

Answer: C

9) The bone that is considered the Keystone of the cranium (and the correct reason) is:

A. Maxilla; because it articulate with most of the facial bones
B. Sphenoid bone; because it articulates with all of the cranial bones, holding them together
C. Mandible; because it is the only movable bone in the whole skull
D. Maxilla; because it doesn't articulate with the mandible

Answer: B

10) The largest paranasal sinus in the skull is known to be the:

A. Maxillary sinus
B. Frontal sinus
C. Ethmoidal cells
D. Sphenoidal sinus

Answer: A

11) All of the following are TRUE according to the skull sutures, EXCEPT:

A. Lambdoidal suture is located between 3 bones: 2 parietals & 1 frontal
B. Squamous suture is located in both sides of the skull: right & left
C. Squamous suture is best seen and observed from the lateral view of the skull
D. All of the listed statements are false

Answer: A

12) The part that makes up a part of the middle cranial fossa is:

A. Foramen magnum of the occipital bone
B. Lesser wing of the sphenoid bone
C. Cribriform plate of the ethmoid bone
D. Petrous portion of the temporal bone

Answer: D

13) One of the following parts does NOT contribute to the eye socket:

A. Zygomatic bone
B. Frontal bone
C. Ethmoid bone
D. Temporal bone

Answer: D

14) Which of the following best explains why trauma to the pterion region is life-threatening?

A. It is the weakest part of the skull and fractures easily.
B. It overlies the middle meningeal artery, and injury can cause an epidural hemorrhage.
C. It is located near the optic canal, potentially leading to blindness.
D. It contains many small foramina, allowing infection to spread rapidly.

Answer: B

15) A patient presents with difficulty in mastication and complains of pain near the (TMJ). Which structure is most likely affected?

A. Coronoid process of the mandible
B. Condylar process of the mandible
C. Zygomatic process of the maxilla
D. Perpendicular plate of the palatine bone

Answer: B

16) If the cribriform plate of the ethmoid bone were damaged, which function would be most affected?

A. Vision
B. Smell
C. Hearing
D. Taste

Answer: B

17) A forensic scientist examines a skull and identifies the intersection of the sagittal and lambdoidal sutures. This landmark is known as:

A. Bregma
B. Lambda
C. Pterion
D. Nasion

Answer: B

18) Which of the following bones contributes to the formation of the orbit, the nasal cavity, and the cranial floor?

A. Maxilla
B. Sphenoid
C. Zygomatic
D. Occipital

Answer: B

19) Why is the foramen magnum a critical anatomical structure?

A. It allows passage of the jugular vein.
B. It provides an attachment point for the spinal cord and brainstem.
C. It connects the paranasal sinuses with the nasal cavity.
D. It houses the pituitary gland.

Answer: B

20) Which feature of the temporal bone contributes to hearing and balance?

A. Zygomatic process
B. Styloid process
C. Petrous portion
D. Mastoid process

Answer: C

21) If an individual has a fracture in the sphenoid bone affecting the sella turcica, which structure is at greatest risk?

A. Optic nerve
B. Pituitary gland
C. Middle meningeal artery
D. Cerebellum

Answer: B

22) A surgeon operating on the nasal septum must be careful not to damage which two bones that primarily form its structure?

A. Ethmoid and vomer
B. Frontal and nasal
C. Maxilla and palatine
D. Zygomatic and lacrimal

Answer: A