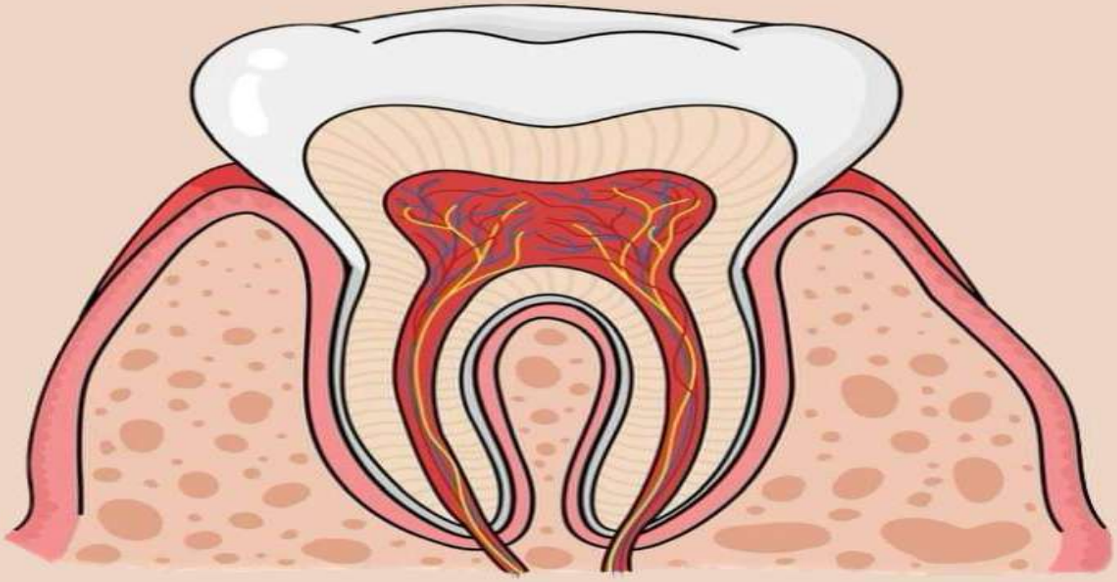
ANATOMY



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Anatomy & Embryology

Lecture 2: Axial Skeleton

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The Skeletal System

* **Divisions of the skeleton:**

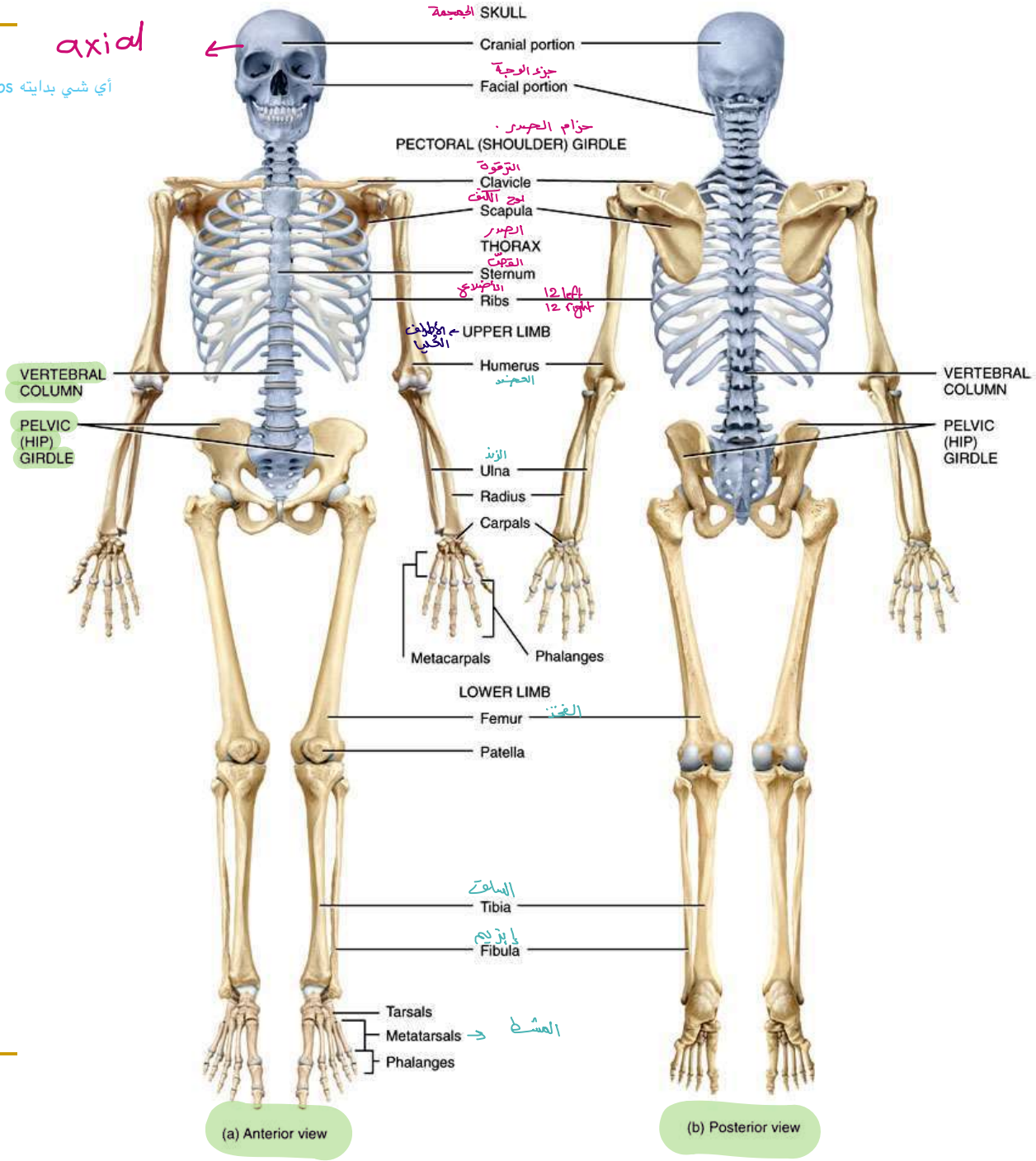
1. **Exoskeleton: rudimentary in man. It is represented by: nails & enamel of teeth .**
2. **Endoskeleton: about 206 bones & is formed of:**
   a. **The axial skeleton.**
   b. **The appendicular skeleton.**

Divisions of the Skeletal System

- The human skeleton consists of ***206 named bones***
- Bones of the skeleton are grouped into two principal divisions:
  - **Axial skeleton** → support the body
    - Consists of the bones that lie around the longitudinal axis of the human body: Skull bones, auditory ossicles (ear bones), hyoid bone, ribs, sternum (breastbone), and bones of the vertebral column.
    - The primary function is protection of vital organs.
  - **Appendicular skeleton** → movement
    - Consists of the bones of the **upper** and **lower limbs (extremities),** plus the bones forming the **girdles** that connect the limbs to the axial skeleton. The primary function of this division is movement.

axial

related to the bone أي شي بدايته os ف هو



Bones of the Human Body

TABLE 7.1

The Bones of the Adult Skeletal System

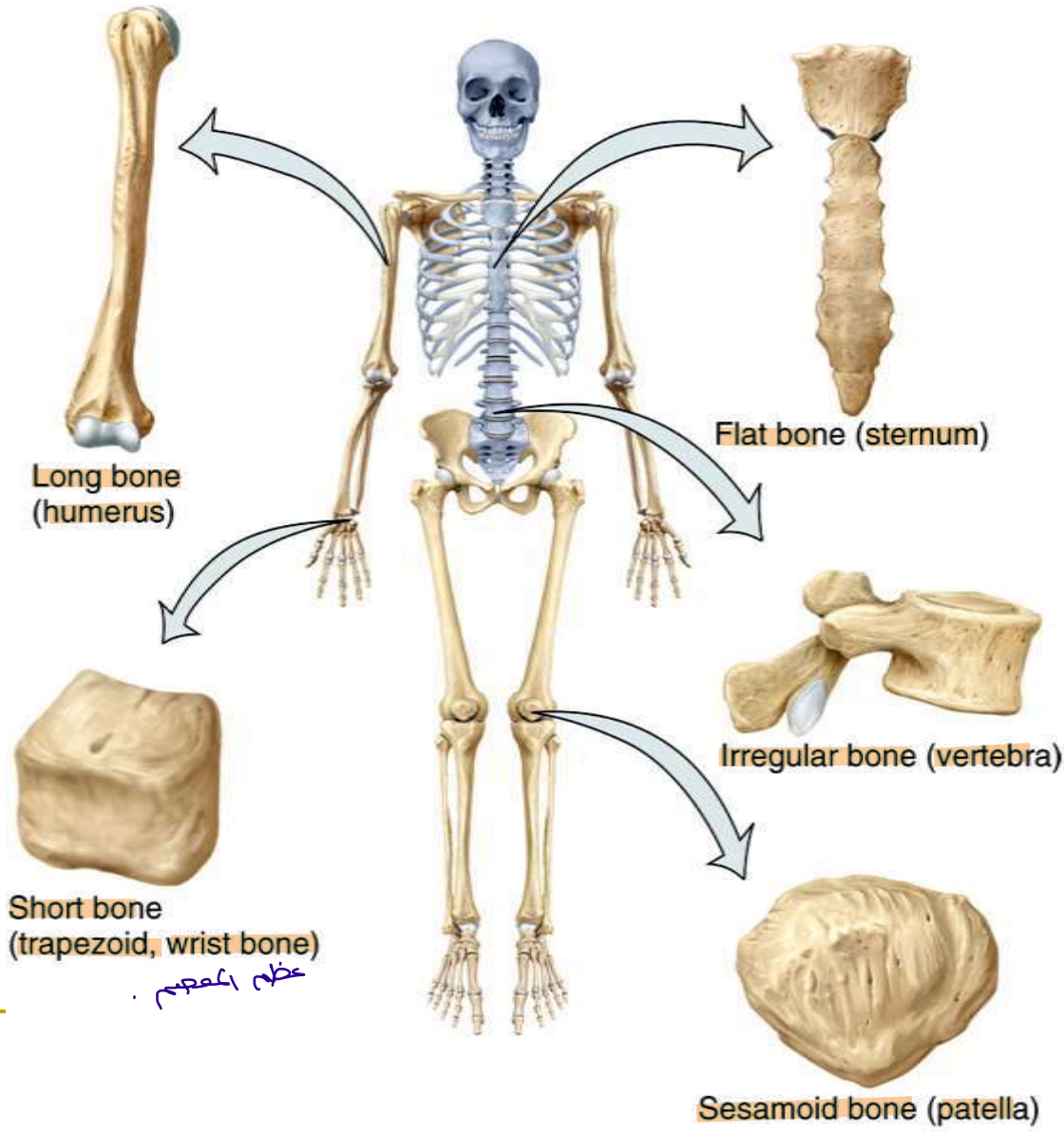
DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES
Axial Skeleton		
		
	Skull	
	Cranium	8
	Face	14
	Hyoid → on the neck	1
	Auditory ossicles	6
	Vertebral column فقرية	26
	Thorax	
	Sternum	1
	Ribs	24
		Subtotal = 80

DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES
Appendicular Skeleton		
		
	Pectoral (shoulder) girdles	
	Clavicle الترقوة	2
	Scapula لوح الكتف	2
	Upper limbs	
	Humerus	2
	Ulna	2
	Radius	2
	Carpals	16
	Metacarpals	10
	Phalanges	28
	Pelvic (hip) girdle	
	Hip, pelvic, or coxal bone	2
	Lower limbs	
	Femur	2
	Patella	2
	Fibula	2
	Tibia	2
	Tarsals	14
	Metatarsals	10
	Phalanges	28
		Subtotal = 126
		Total in an adult skeleton = 206

Classification of Bones According to Shape:

- Bones can be classified into five types based on shape:

1) Long — length > width
2) Short — length ≈ width
3) Flat — squamus
4) Irregular — غير منتظمة
5) Sesamoid — زي كلوة الركبة



- **Long Bones**
  - Greater length than width and are slightly curved for strength
  - **Femur, tibia, fibula, humerus, ulna, radius, phalanges**
- **Short bones**
  - Cube-shaped and are nearly equal in length and width
  - **Carpal, tarsal**

- **Flat bones**
  - Thin and composed of two nearly parallel plates of compact bone tissue enclosing a layer of spongy bone tissue
  - **Cranial, sternum, ribs, scapulae**
- **Irregular bones**
  - Complex shapes and cannot be grouped into any of the previous categories
  - **Vertebrae, hip bones, some facial bones, calcaneus**
- **Sesamoid bones**
  - Protect tendons from excessive wear and tear
  - **Patellae, in foot, in hand**

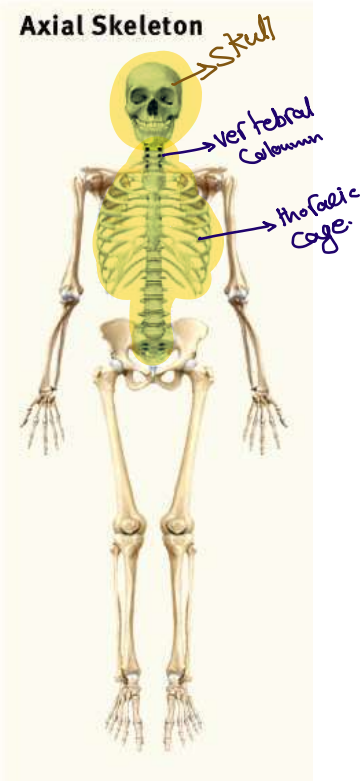
The 14 bones that are found in the fingers of each hand and also in the toes of each foot

normally at tendons of the muscles.

your kneecap, the bone at the front of your knee joint

The Axial Skeleton

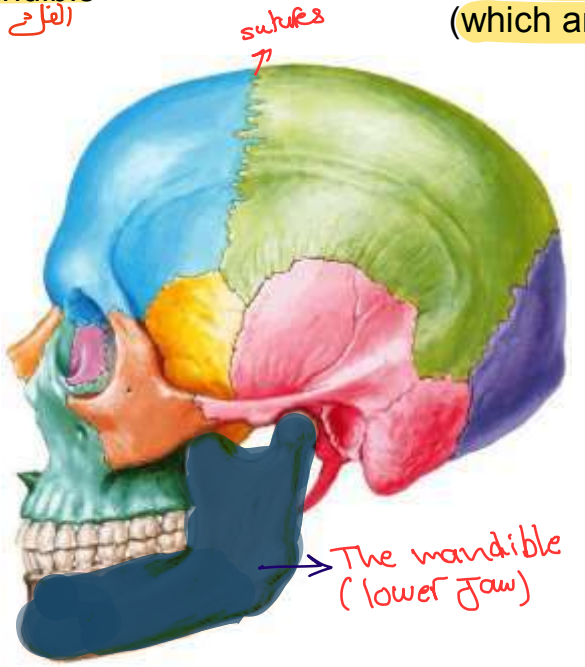
Skull, vertebral column, thoracic cage



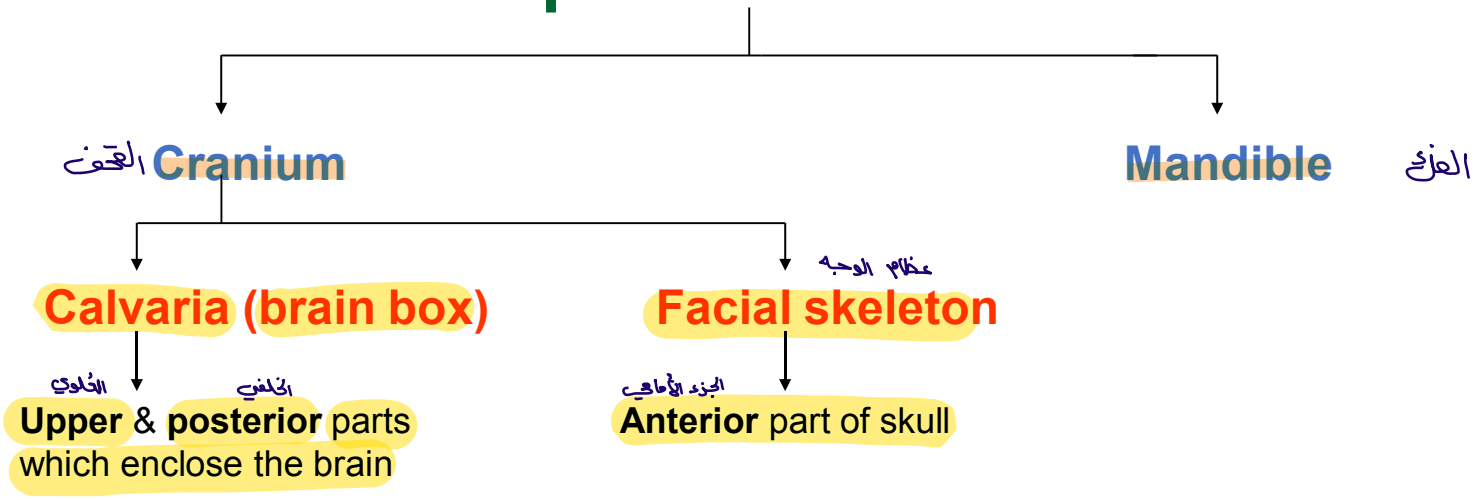
The skull

Is formed of 22 separate bones

- **One movable** bone (قابلة للحركة)
  - The mandible (الفك)
- **21 immovable** bones (غير قابلة للحركة)
  - Articulating together by **sutures** (يشبه خياطة)
    (which are fibrous joints)



The parts of the skull

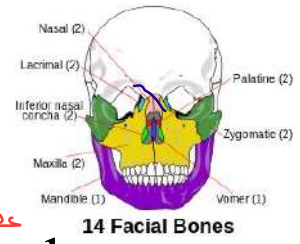


The Skull

- The skull (Cranium) Consists of 22 bones
- Bones of the skull are grouped into two categories:

1. **Cranial bones**
   - 8 Eight cranial bones form the cranial cavity
     - Frontal bone, **two parietal bones**, **two temporal bones**, the occipital bone, the sphenoid bone, ethmoid bone

2. **Facial bones**
   - 14 Fourteen facial bones form the face
     - Two nasal bones, two maxillae, two zygomatic bones, the **mandible**, two lacrimal bones, two palatine bones, two inferior nasal conchae, **vomer**



14 Facial Bones

Features of the Skull

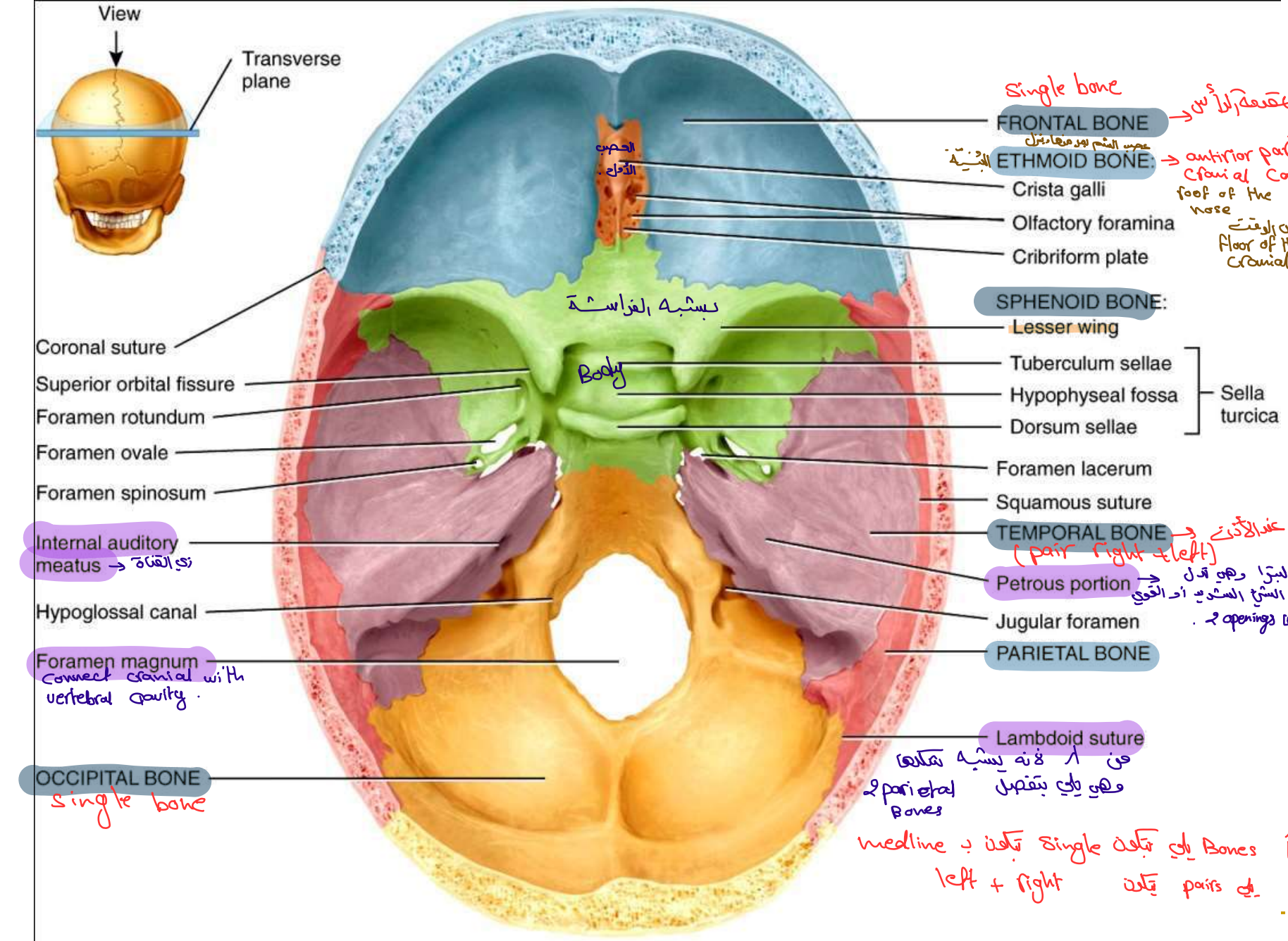
- The cranial and facial bones protect and support special sense organs and the brain
- Besides forming the large cranial cavity, the skull also forms several smaller cavities
  - **Nasal cavity**
  - **Orbits (eye sockets)** محاجر العين
  - **Paranasal sinuses** الجيوب الأنفية
  - **Small cavities which house organs involved in hearing and equilibrium** مسؤولة عن السمع والتوازن

- Immovable joints called **sutures** fuse most of the skull bones together
- The skull provides large areas of **attachment for muscles** that move various parts of the head
- Skull and facial bones provide **attachment** for muscles that produce **facial expressions**
- The facial bones form the framework of the face and provide support for the entrances to the **digestive** and **respiratory** systems

Cranial Bones: → 8 Bones

1. **Frontal Bone** (singel bone)
   - Forms the forehead
2. **Parietal Bones**
   - Form the sides and roof of the cranial cavity
3. **Temporal Bones (Zygomatic process and Mandibular fossa of TMJ**
   - Form the lateral aspects and floor of the cranium
   - Consists of 5 parts: squamous part, petrous part, tympanic part, mastoid part and the styloid process

- **Occipital Bone (foramen magnum?)** single bone
  - Forms the posterior part and most of the base of the cranium
  - The perceptible protrusion on the back of the head is the external occipital protuberance



(a) Superior view of sphenoid bone in floor of cranium

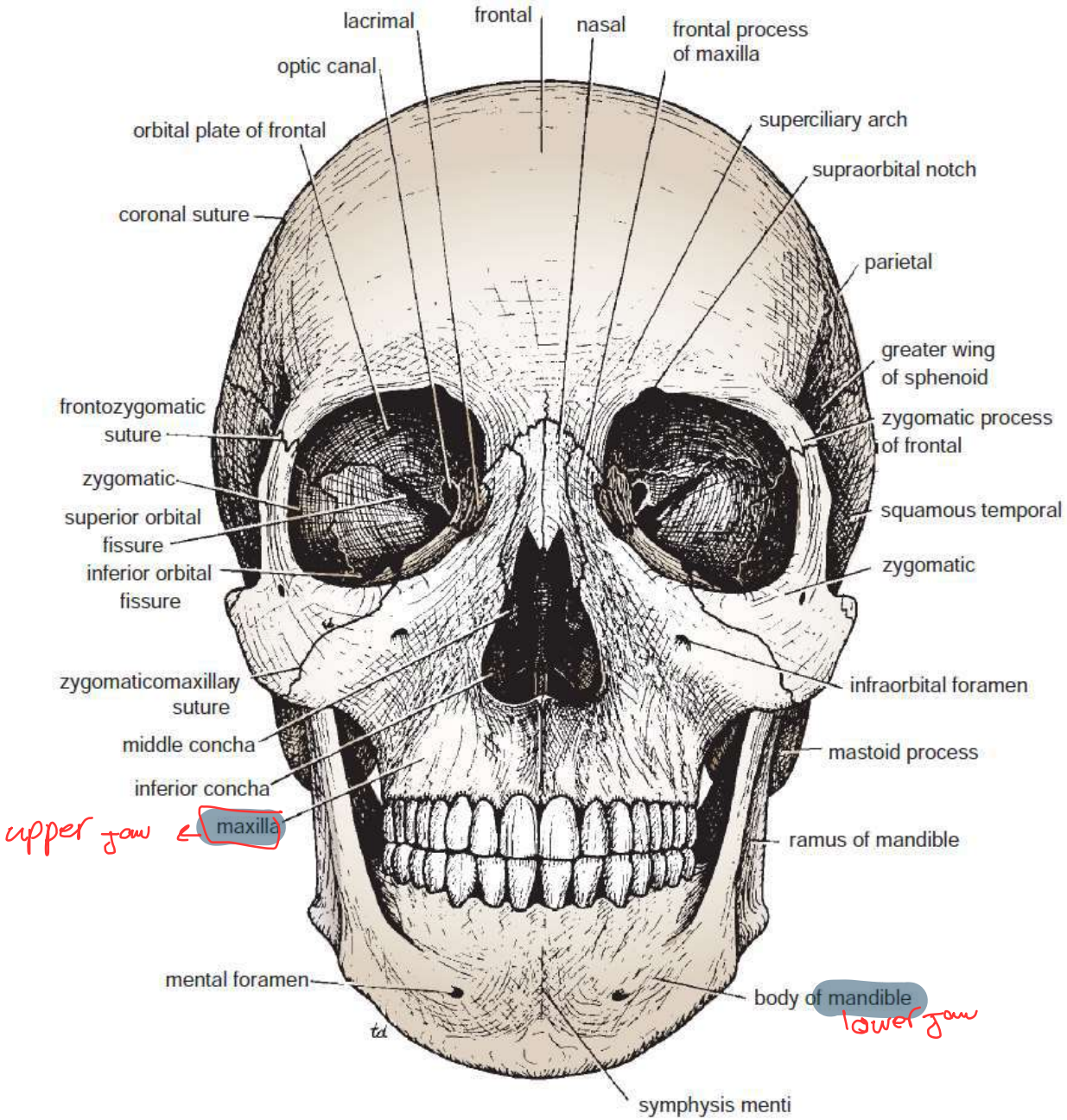
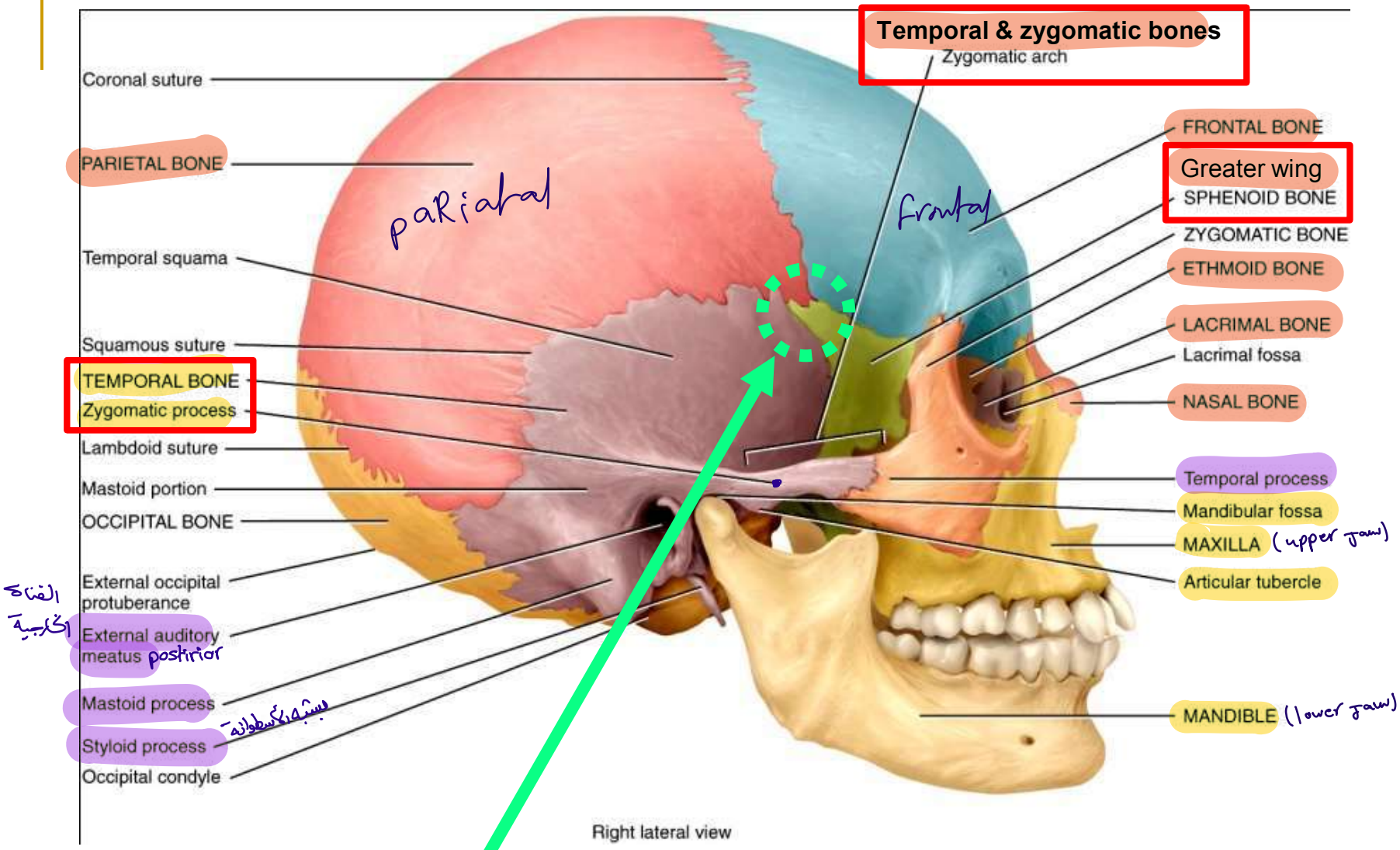
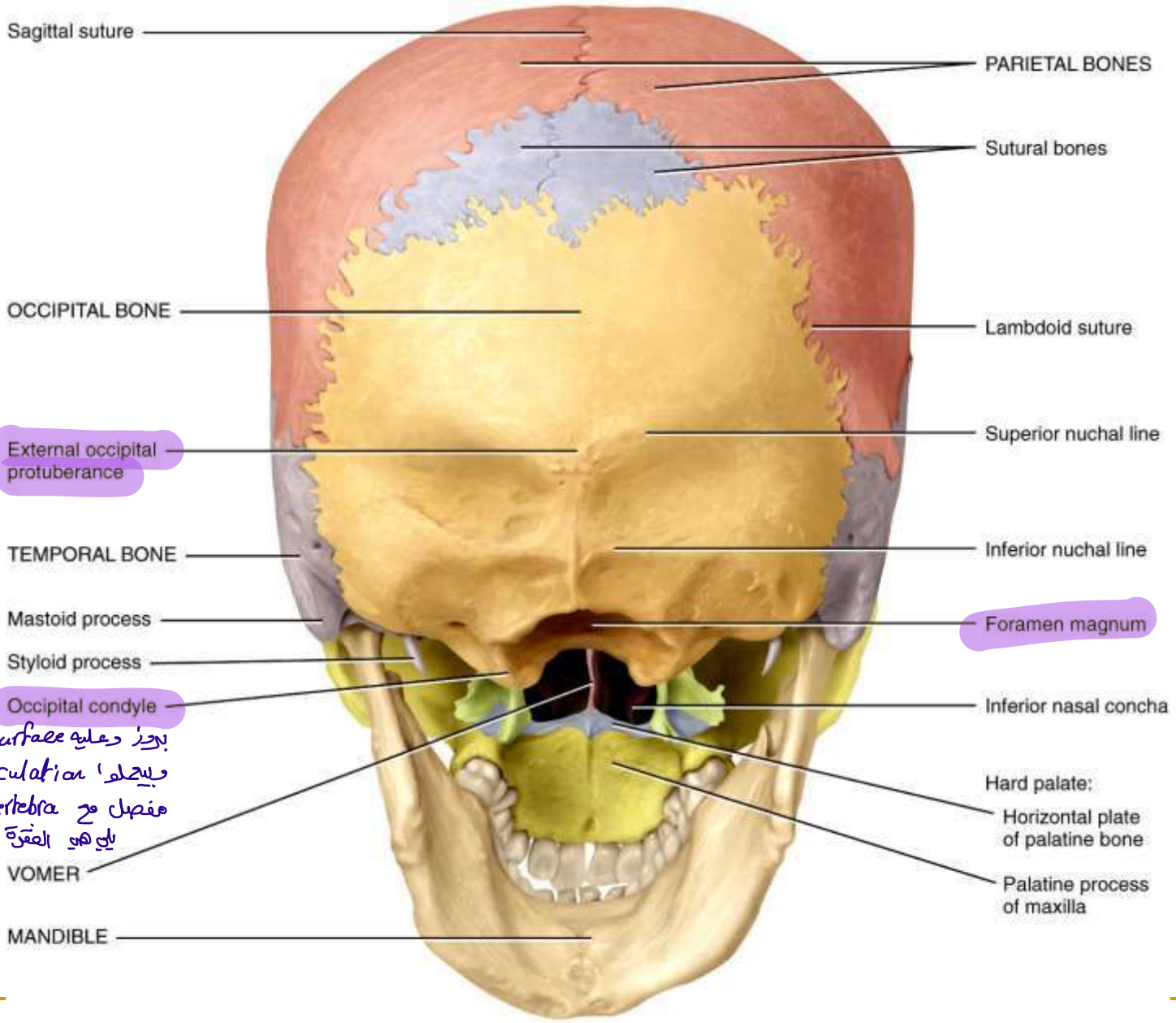


FIGURE 11.1 Bones of the anterior aspect of the skull.



Pterion: middle meningeal artery.



Posteroinferior view

Sphenoid Bone (optic nerve)

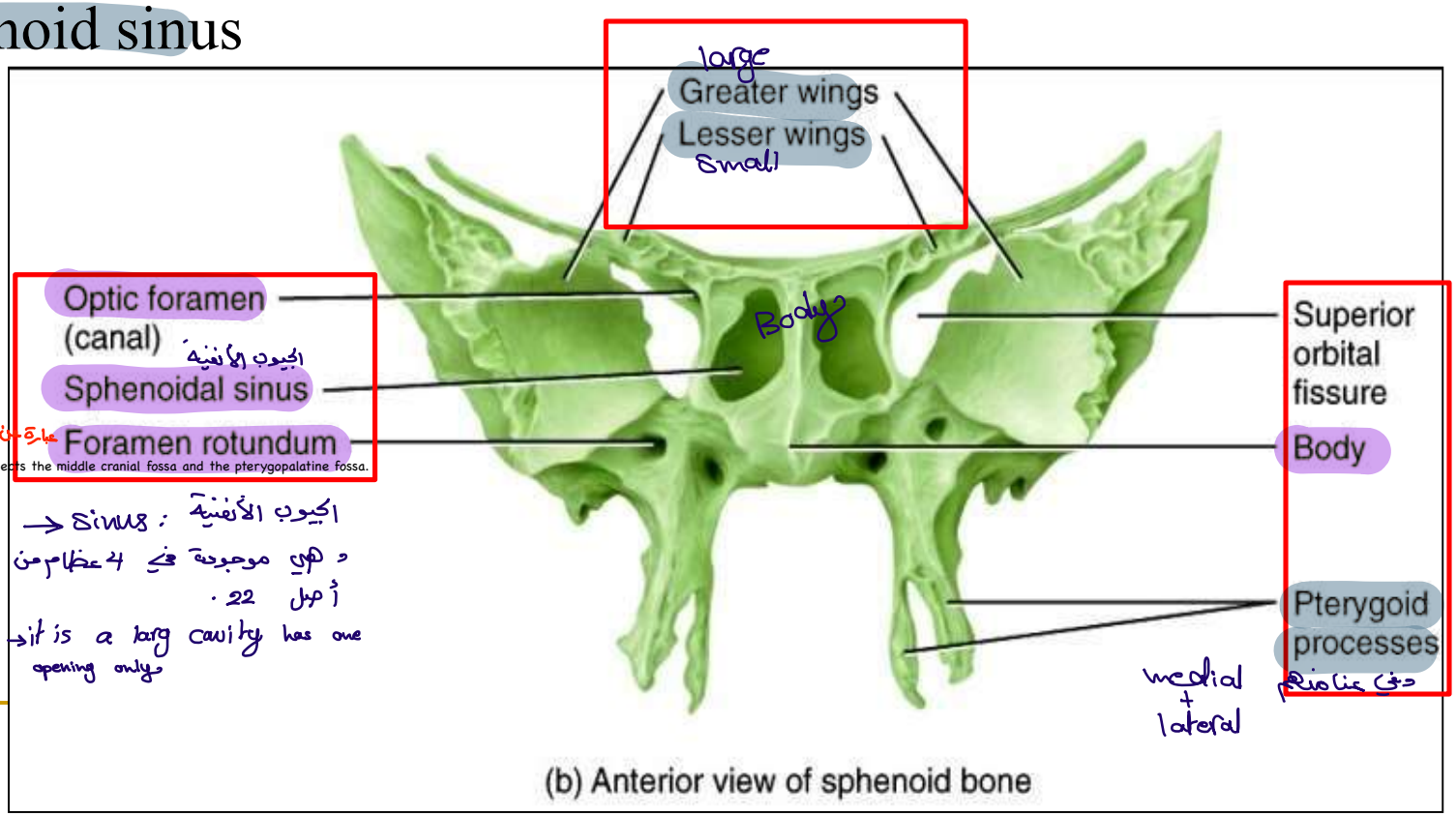
عجيب الجسر الحجب الثاني single bone

- Lies at the middle part of the base of the skull
- It's formed of:

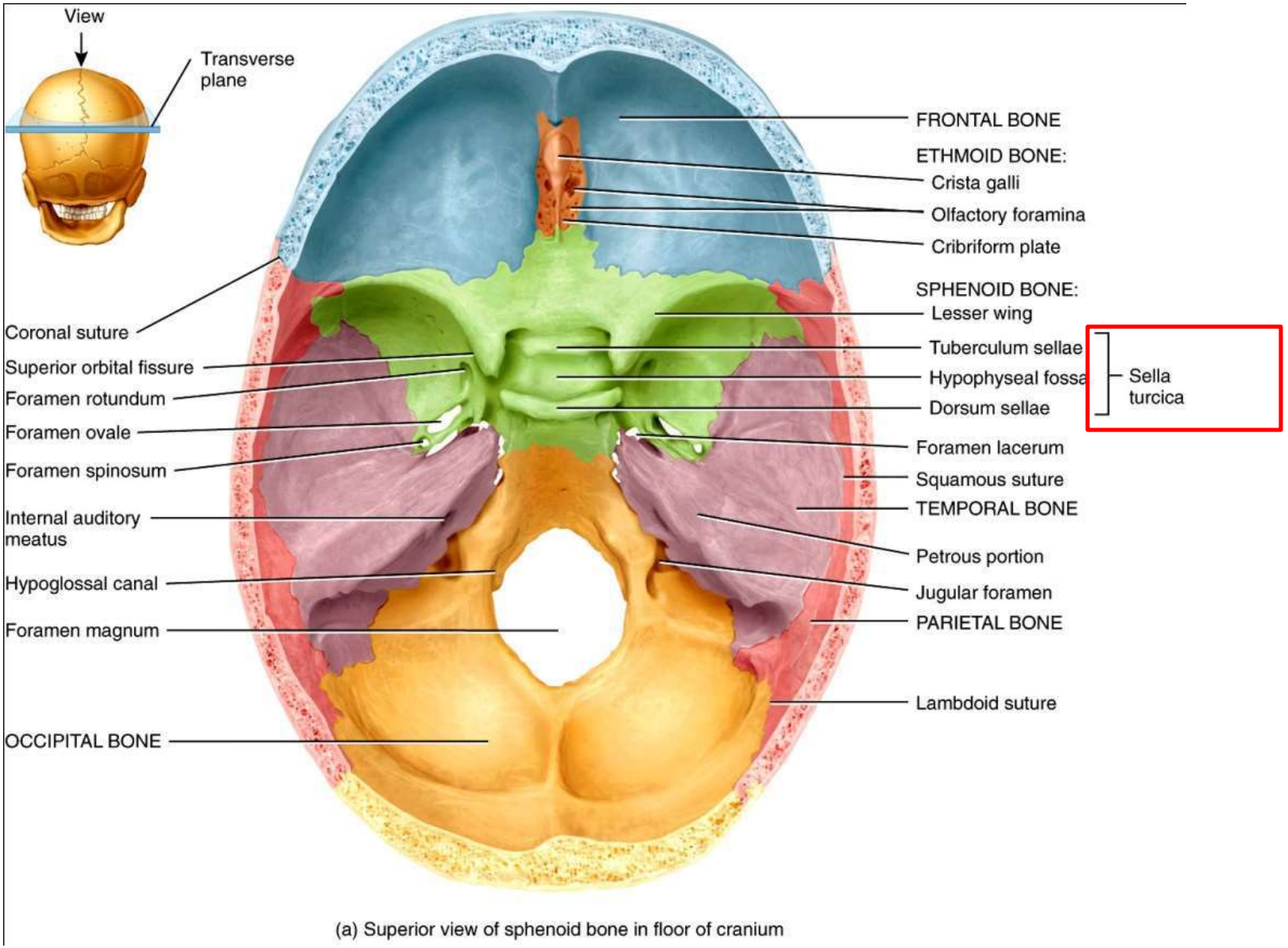
هتل سرج الحصان

1. **Body (Sella turcica): contain the pituitary gland**
2. Lesser wings
3. Greater wings
4. Pterygoid processes
5. Sphenoid sinus

الغدة النخامية وهي غدة مهمة جداً. بنسميها الغدة الرئيسية.



→ Sinus: الجيوب الأنفية
وهي موجودة في 4 عظام من أصل 22.
→ it is a larg cavity has one opening only



(a) Superior view of sphenoid bone in floor of cranium

- **Ethmoid Bone (olfactory nerve)**

  عصب الشم

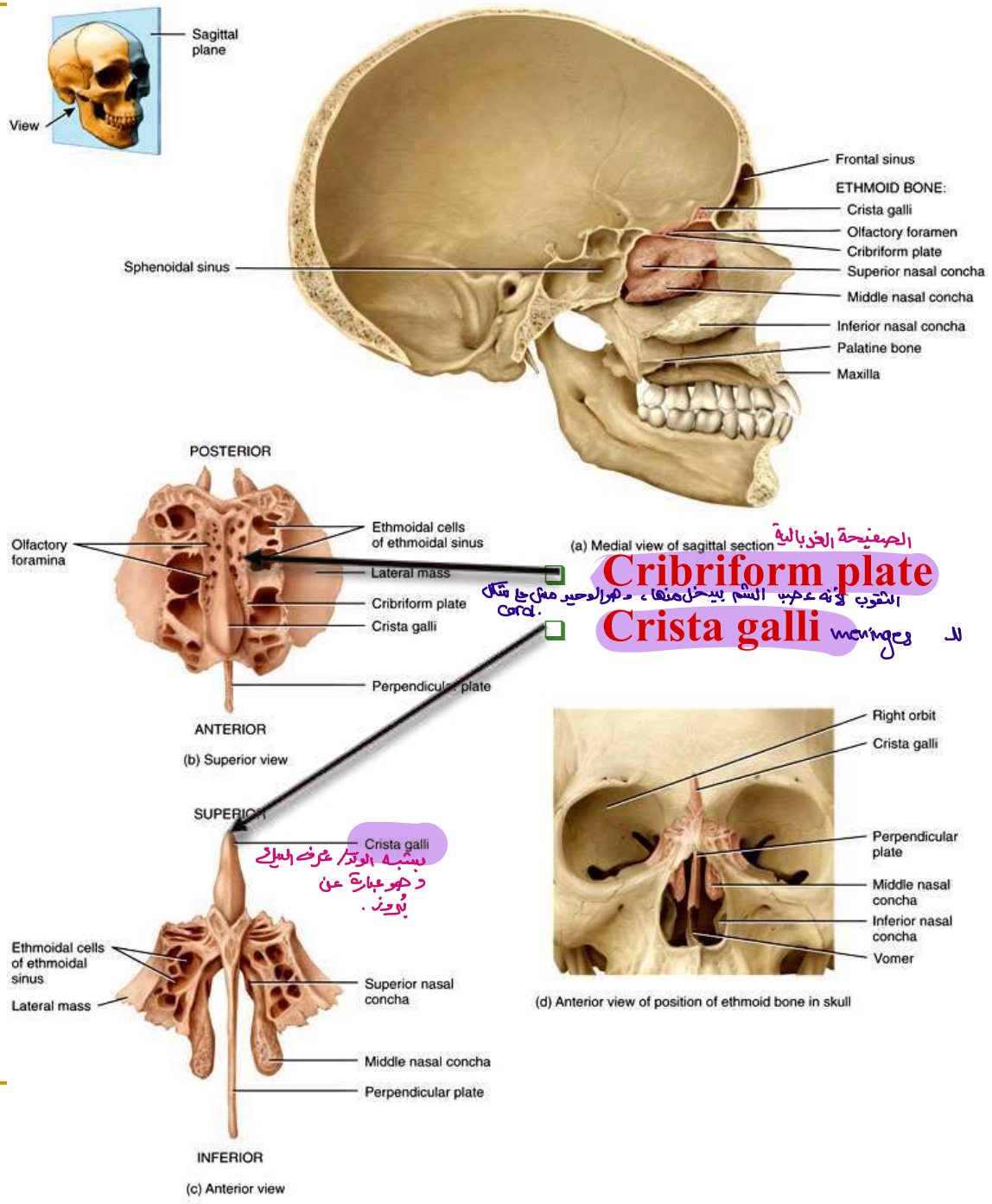
  Single bone

- Located in the midline in the anterior part of the cranial floor and forms the roof of the nasal cavity

  يمرّ منها عصب الشم olfactory nerve العصب الأول

Parts:

1. **Superior and middle conchae: thin bony projections (nose)**
2. **Transverse plate**
3. **Perpendicular plate**
4. **Crista galli**
5. **Cribriform plate**
6. **Ethmoid sinuses**



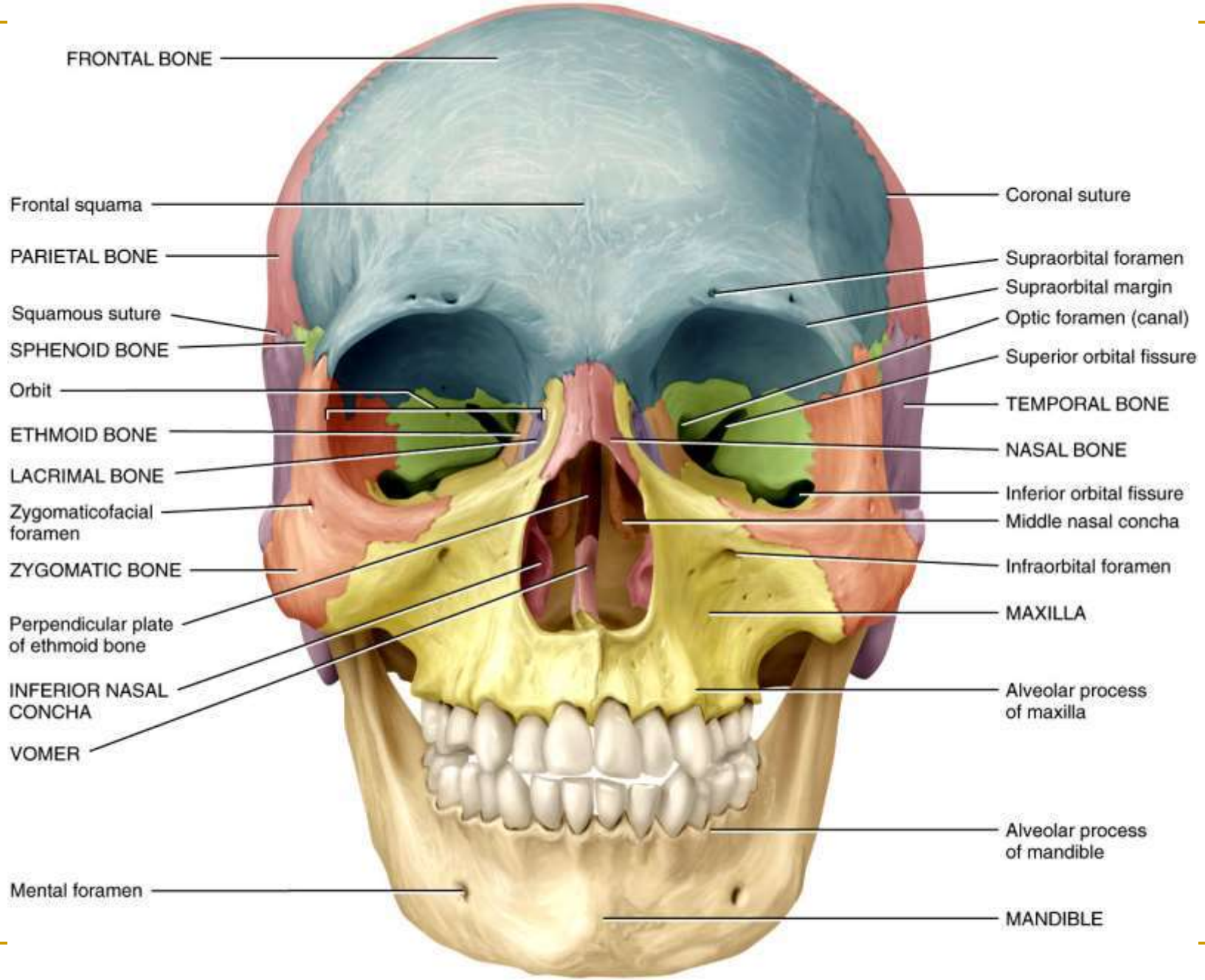
Facial Bones:

Maxillae bone articulates with every bone of the face except the mandible

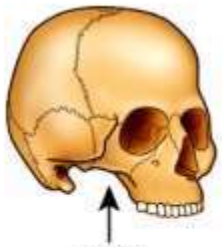
- **Nasal Bones**
  - Form the bridge of the nose
- **Maxillae**
  - Form the upper jawbone
  - Has the following processes:
    1. Frontal process superiorly
    2. Zygomatic process laterally
    3. Palatine process posteriorly
    4. Alveolar process inferiorly. This one contains sockets for the teeth.
  - The palatine process form most of the hard palate
    - Separates the nasal cavity from the oral cavity
- **Zygomatic Bones**
  - Commonly called cheekbones, form the prominences of the cheeks
  - The **temporal** process of this bone unite with the **zygomatic** process of the temporal bone to form the **zygomatic arch**.

- **Lacrimal Bones**
  - Form a part of the medial wall of each orbit
- **Palatine Bones**
  - Form the posterior portion of the hard palate
- **Inferior Nasal Conchae**
  - Form a part of the inferior lateral wall of the nasal cavity
- **Vomer**
  - Forms the inferior portion of the nasal septum
- **Mandible**
  - Lower jawbone
  - The largest, strongest facial bone
  - The only movable skull bone

Temporomandibular joint (TMJ)
Temporal bone and the mandible



Anterior view



Incisor teeth

MAXILLA:
Incisive foramen
Palatine process

ZYGOMATIC BONE

Zygomatic arch

PALATINE BONE
(horizontal plate)

Inferior nasal concha

VOMER

Pterygoid processes

SPHENOID BONE

Articular tubercle

Foramen ovale

Foramen lacerum

Foramen spinosum

TMJ

Mandibular fossa

Styloid process

Carotid foramen

External auditory meatus

Jugular foramen

Stylomastoid foramen

Occipital condyle

Mastoid process

TEMPORAL BONE

Foramen magnum

Mastoid foramen

OCCIPITAL BONE

PARIETAL BONE

Inferior nuchal line

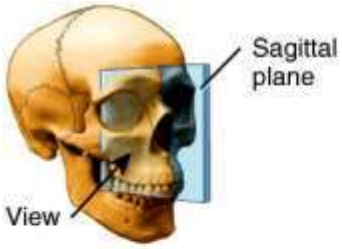
Lambdoid suture

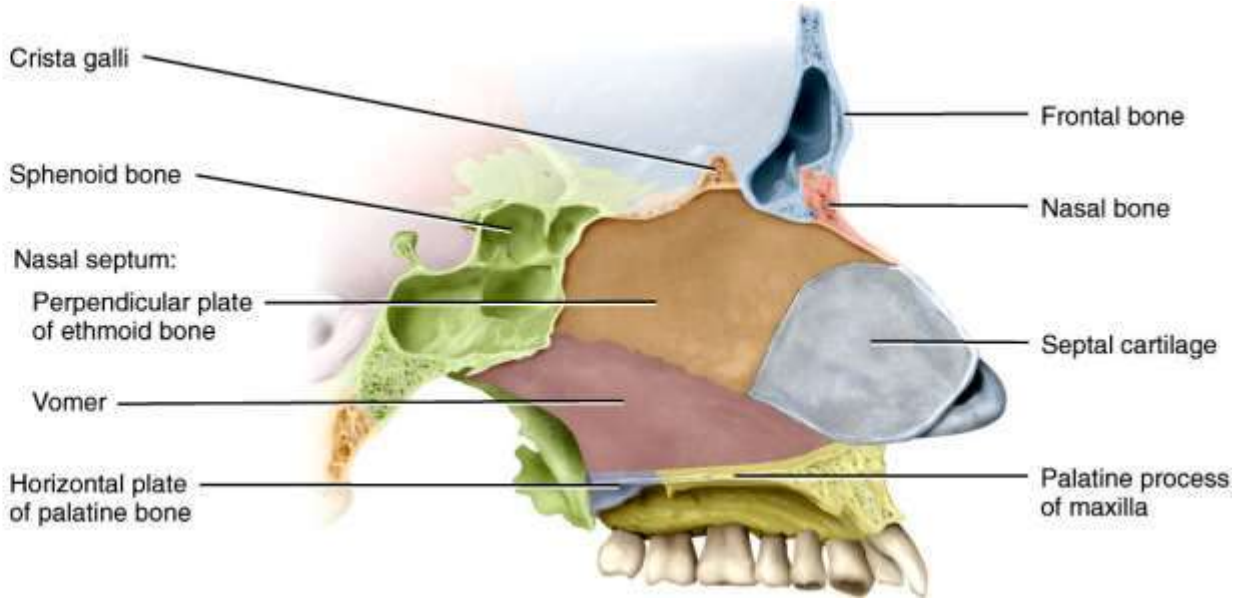
Superior nuchal line

External occipital protuberance

Inferior view

The Nasal Septum:

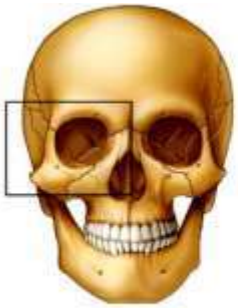


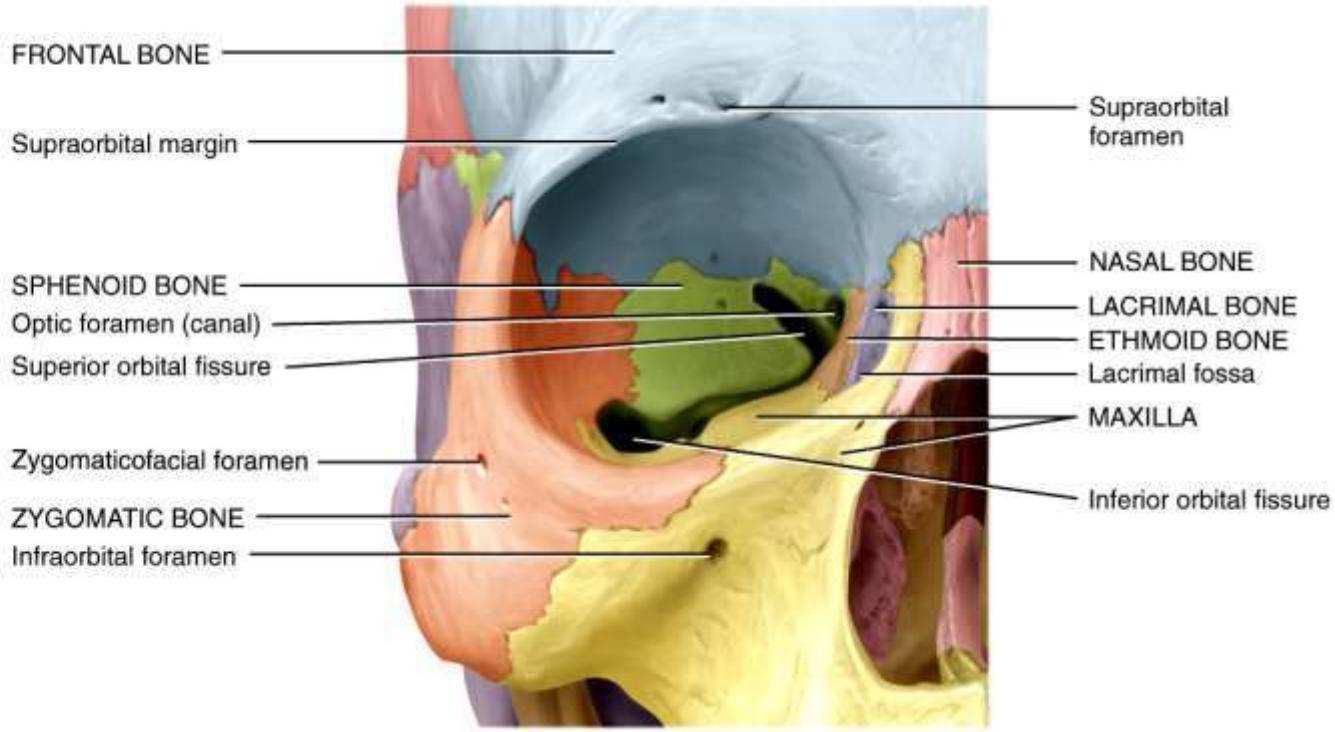


A partition that divides the nasal cavity into right and left halves. It's formed of **2 bony part** and **1 cartilaginous part**:

1. **The perpendicular plate of the ethmoid bone posterior and superior**
2. **The vomer bone posterior and inferior.**
3. **Septal cartilage (hyaline cartilage) anteriorly.**

The Orbital Cavity:





- The bones that participate in the formation of the orbital cavity are:

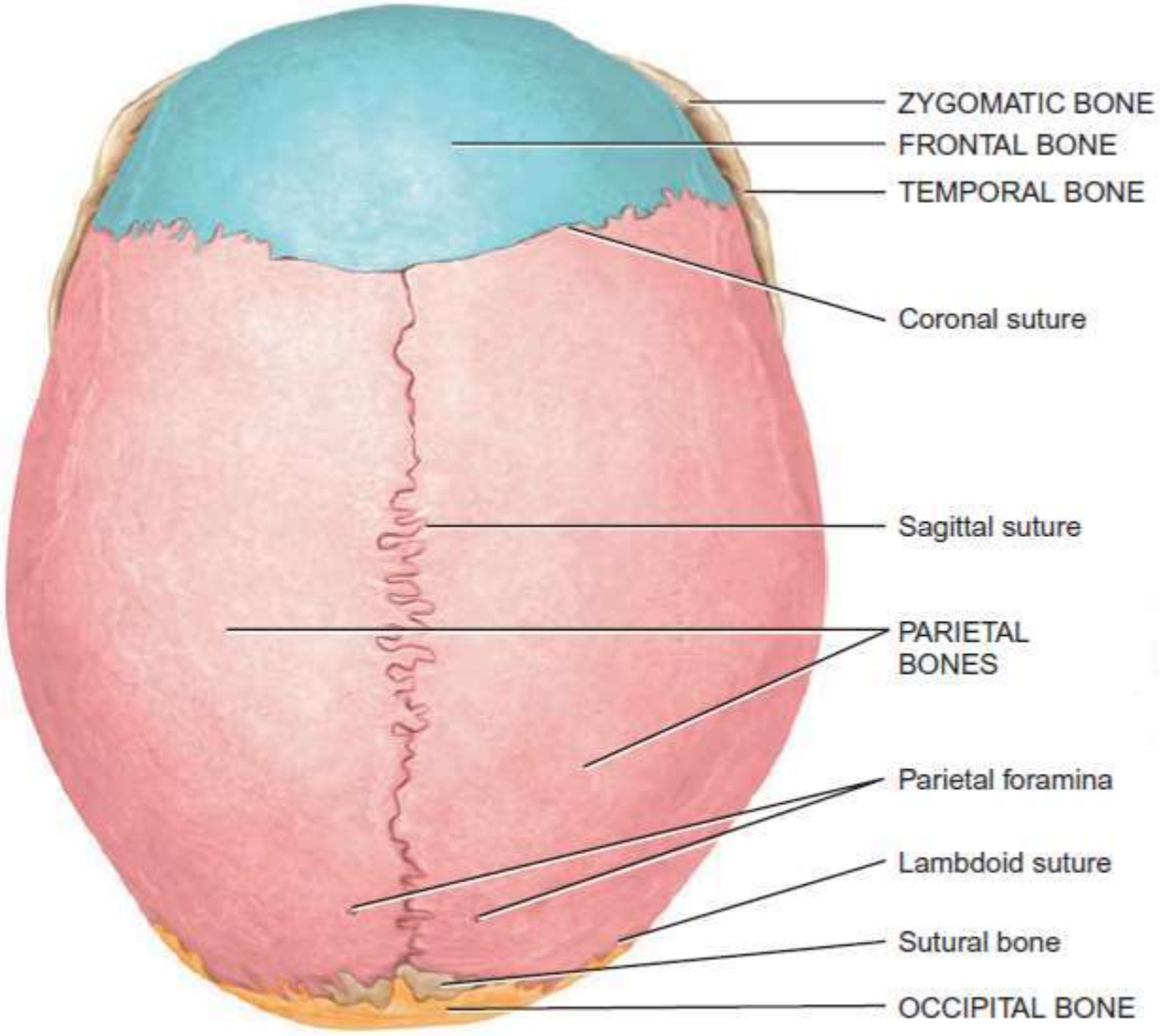
1-Frontal 2-Lacrimal

3-Ethmoid 4-Maxillary

5-Zygomatic 6-Sphenoid

Main Sutures:

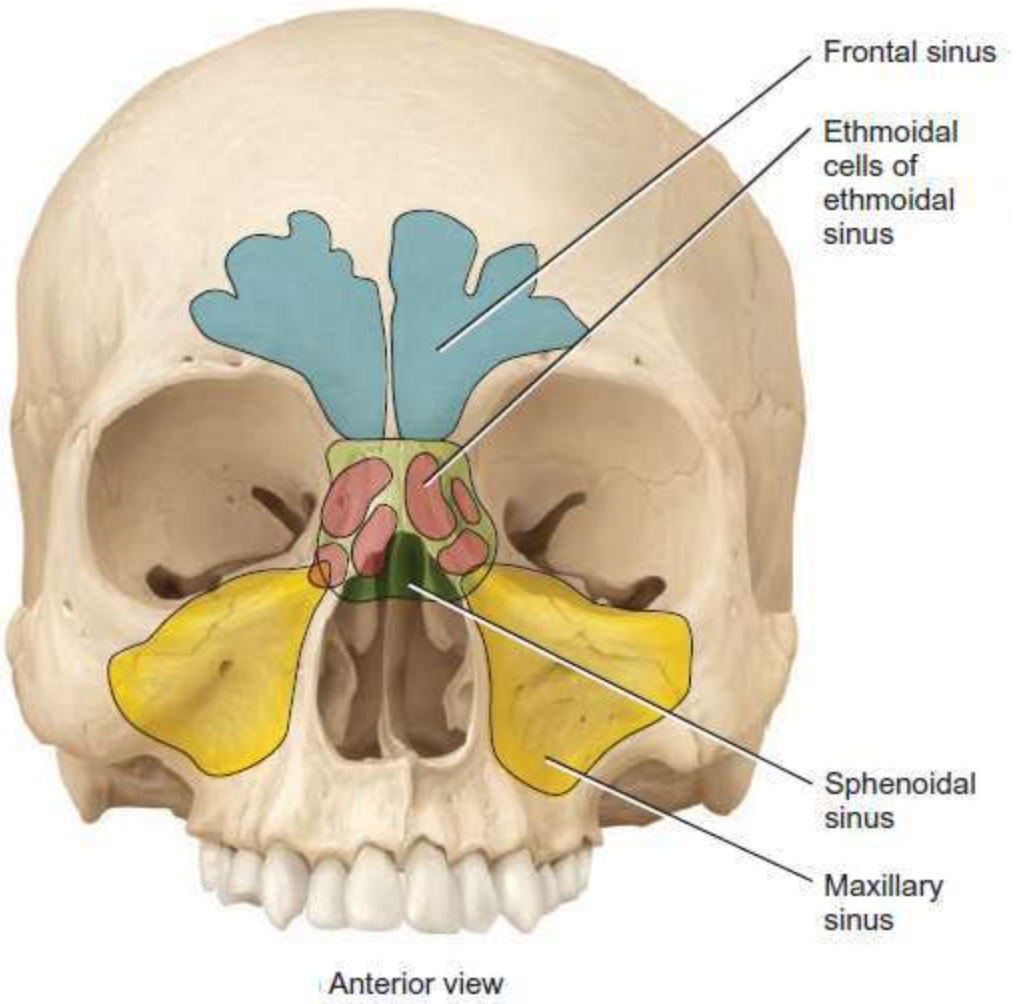
1) **Coronal Suture:** between the frontal and the two parietal bones.
2) **Sagittal Suture:** between the two parietal bones.
3) **Lambdoid Suture:** between the two parietal and the occipital bones.
4) **Squamous suture:** Temporal and parietal



(a) Superior view

Paranasal Sinuses:

- ❖ Cavities within cranial and facial bones near the nasal cavity
- ❖ Secretions produced by the mucous membranes which line the sinuses, drain into the nasal cavity
- ❖ Serve as resonating chambers that intensify and prolong sounds



❖ Found in the following bones

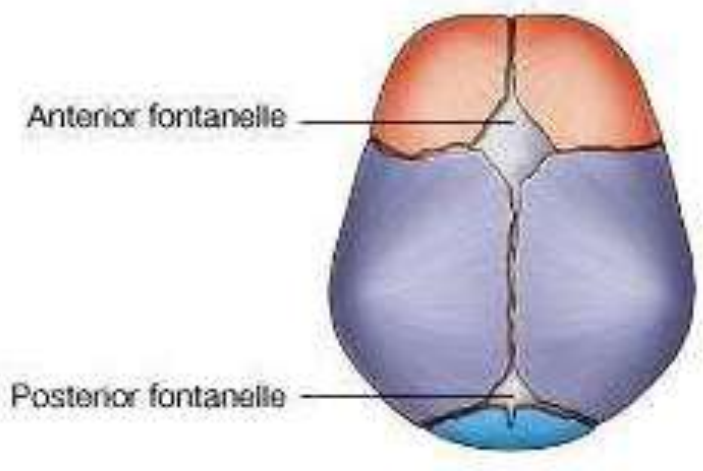
1-Frontal **2-Ethmoid**

3-Sphenoid **4-Maxillary** **: Largest**

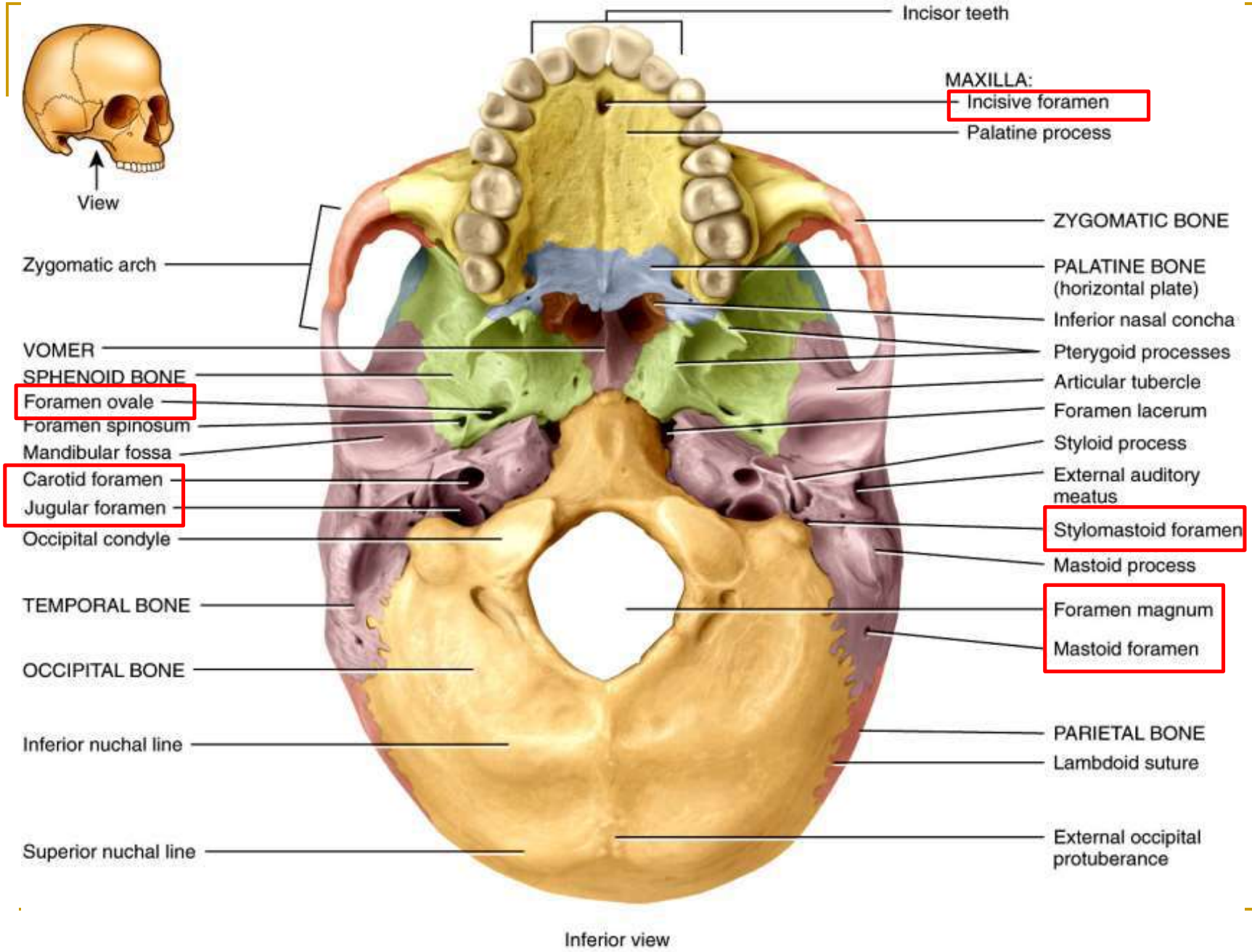
Sinusitis is an inflammation of the mucous membrane.

Fontanels:

- ❑ Areas of unossified tissue that link the cranial bones at birth
- ❑ Eventually, they are replaced with bone to become sutures
- ❑ Provide flexibility to the fetal skull, allowing the skull to change shape as it passes through the birth canal



	Anterior Fontanel	Posterior Fontanel
Location	Between the frontal and parietal bones	Between the parietal and occipital bones
Shape	Diamond ♦	Triangular ▲
Size	Larger than the posterior	Smaller than the anterior
Closes	Later than the posterior (1.5 - 2 years)	Before the anterior (2 months)


Incisor teeth
MAXILLA:
Incisive foramen
Palatine process
View
ZYGOMATIC BONE
Zygomatic arch
PALATINE BONE (horizontal plate)
Inferior nasal concha
VOMER
Pterygoid processes
SPHENOID BONE
Articular tubercle
Foramen ovale
Foramen lacerum
Foramen spinosum
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Mandibular fossa
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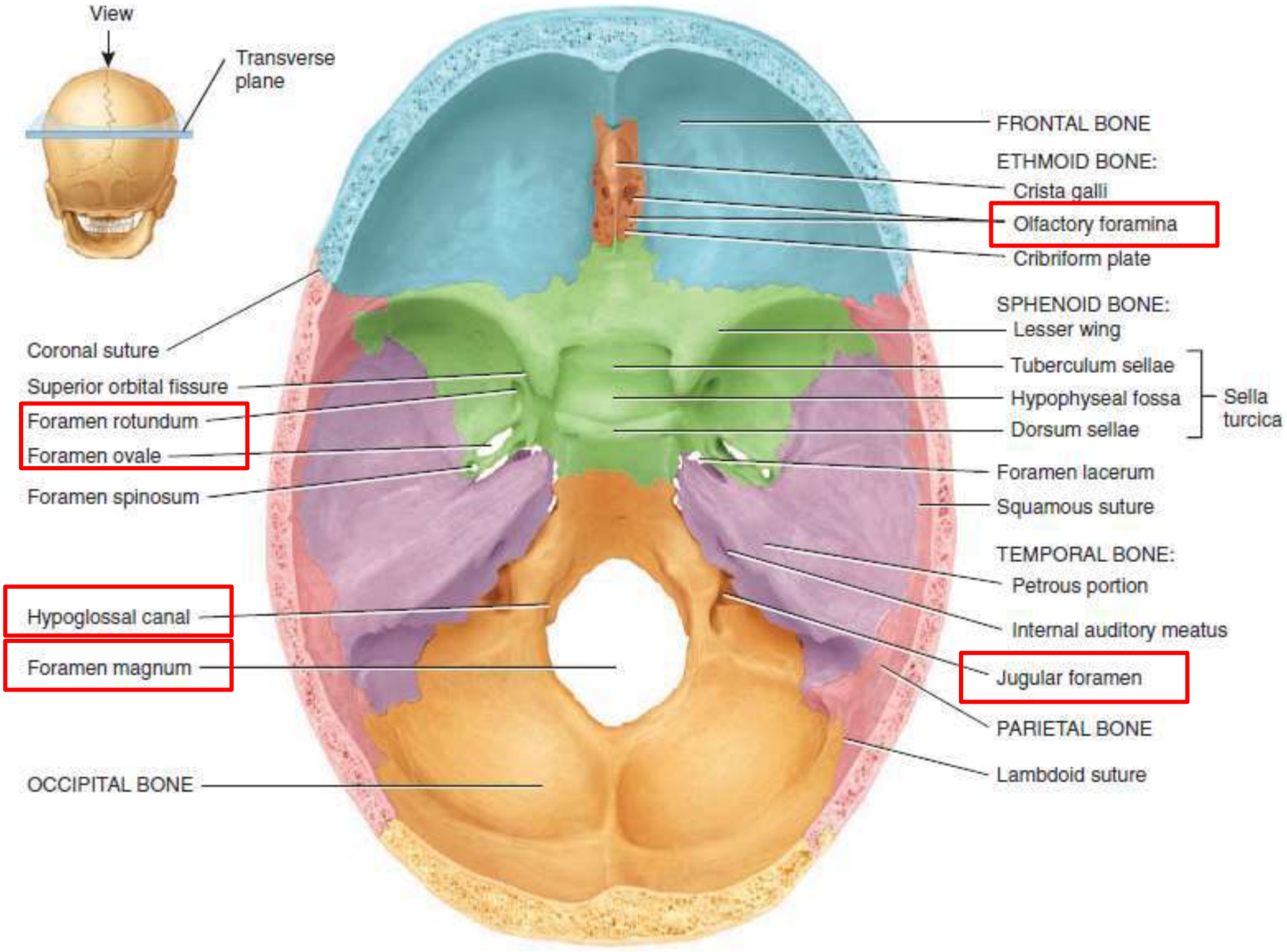
Jugular foramen
Stylomastoid foramen
Occipital condyle
Mastoid process
TEMPORAL BONE
Foramen magnum
Mastoid foramen
OCCIPITAL BONE
PARIETAL BONE
Inferior nuchal line
Lambdoid suture
Superior nuchal line
External occipital protuberance
Inferior view



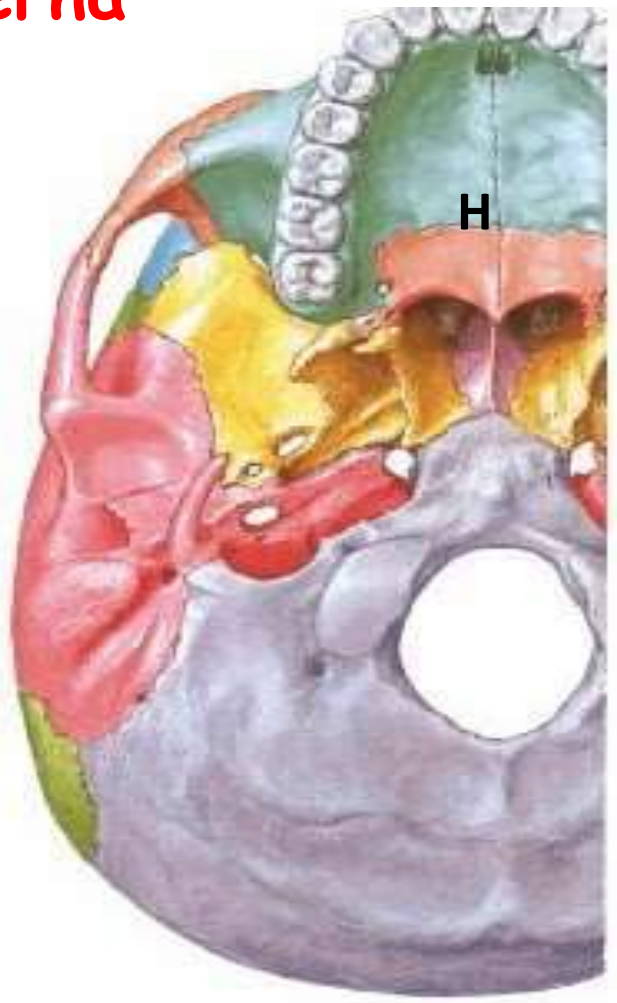
(a) Superior view of sphenoid bone in floor of cranium

Norma Basalis Externa

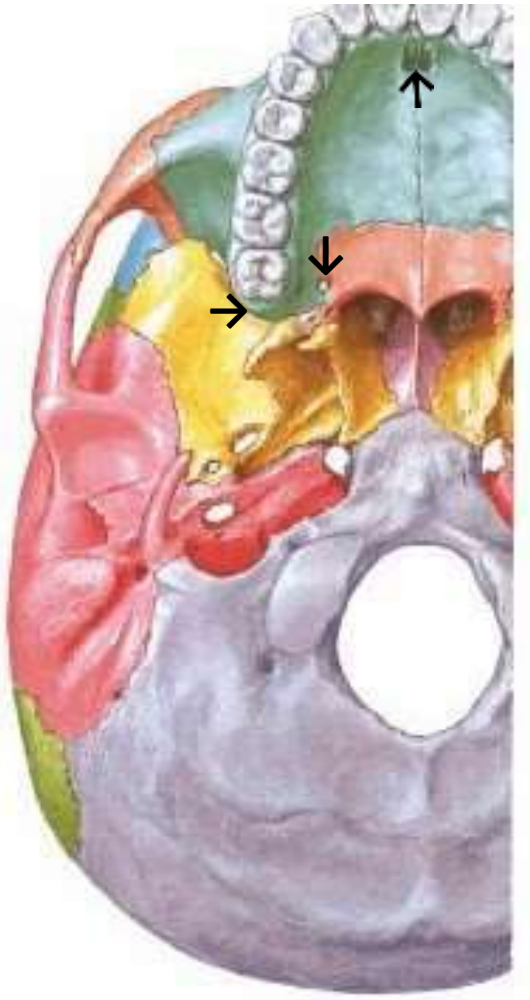
A. Anterior part:

*It is formed by the hard palate (H).

*The hard palate is bounded anteriorly by the alveolar arch, which has 16 sockets for the roots of the upper teeth.



* **The greater palatine foramen (↓) lies in the posterior part of the hard palate. It gives passage to greater palatine nerve & vessels.**
* **The lesser palatine foramina, usually two, lie behind the greater palatine foramen. They give passage to lesser palatine nerve & vessels.**
* **The maxillary tuberosity (→) is present at the posterior end of the alveolar arch.**
* **The incisive fossa (↑) lies posterior to the central incisor teeth. It contains foramina which serve as a connection between palate & nose.**



B. Middle part:

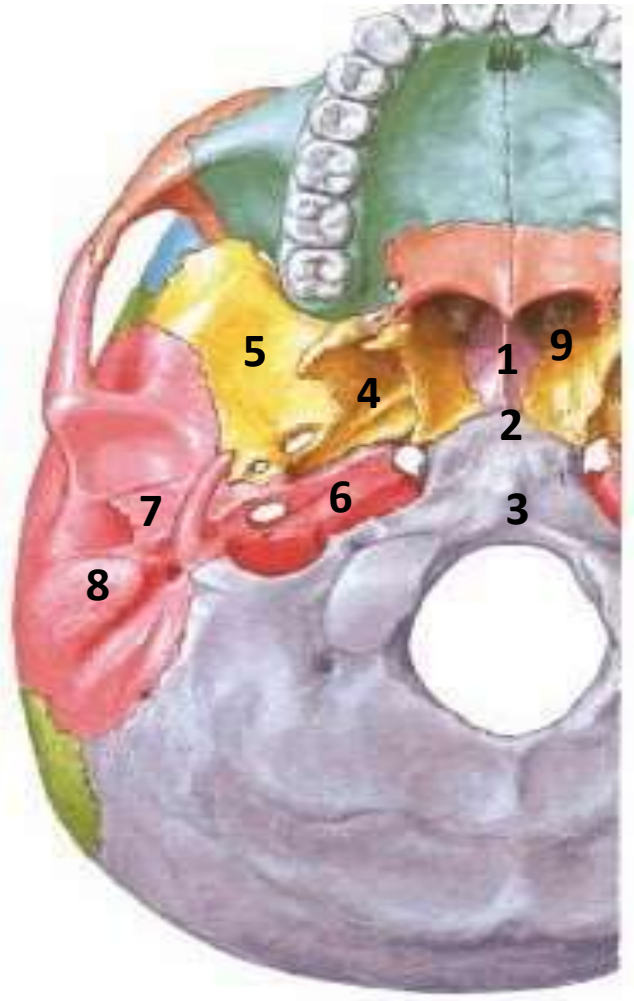
*** In the middle, it shows:**

1. **Vomer.**
2. **Body of sphenoid.**
3. **Basilar part of occipital bone.**

*** Laterally, it shows:**

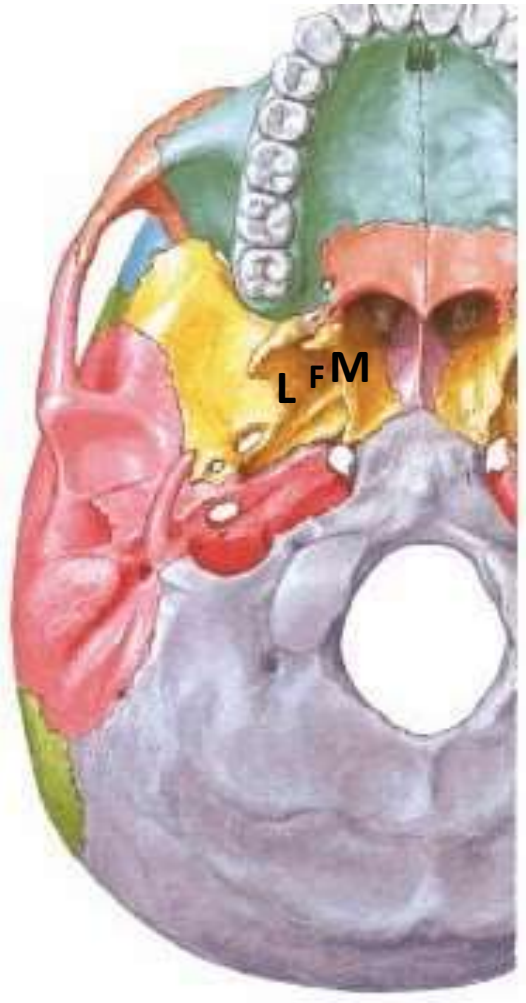
4. **Pterygoid process.**
5. **Greater wing of sphenoid.**
6. **Petrous part of temporal bone.**
7. **tympanic parts of temporal bone.**
8. **Mastoid process.**

*** It contains: Posterior nasal openings (9) (choanae) which are separated by vomer (part of nasal septum).**



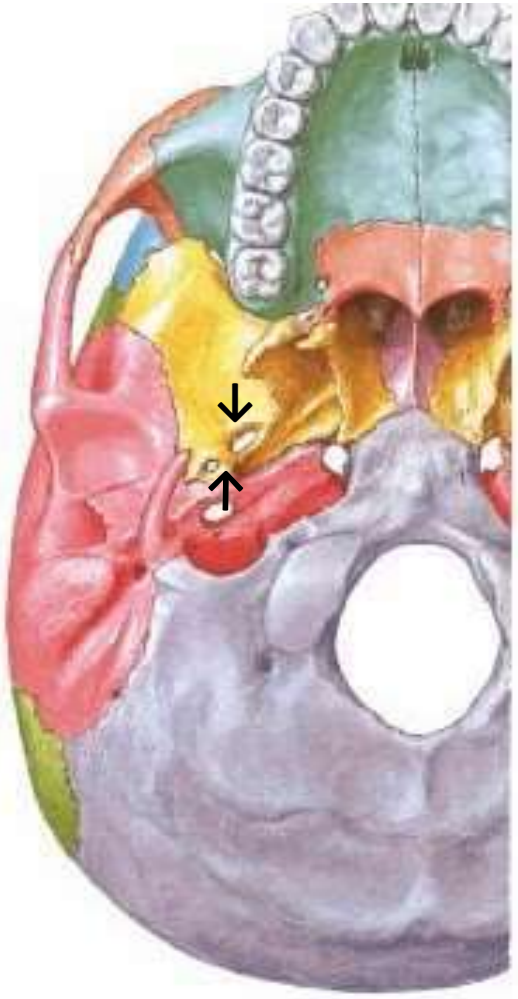
** The pterygoid process of the sphenoid bone:

* It is formed of lateral pterygoid plate (L) and medial pterygoid plate (M) with the pterygoid fossa (F) in between.



** **The greater wing of sphenoid bone shows:**

1. **Foramen ovale (↓):**
   * **Gives passage to:**
     - **a. Mandibular nerve.**
     - **b. Lesser petrosal nerve.**
     - **c. Accessory meningeal artery.**
2. **Foramen spinosum (↑):**
   * **Gives passage to:**
     - **a. Nervus spinosus.**
     - **b. Middle meningeal artery.**

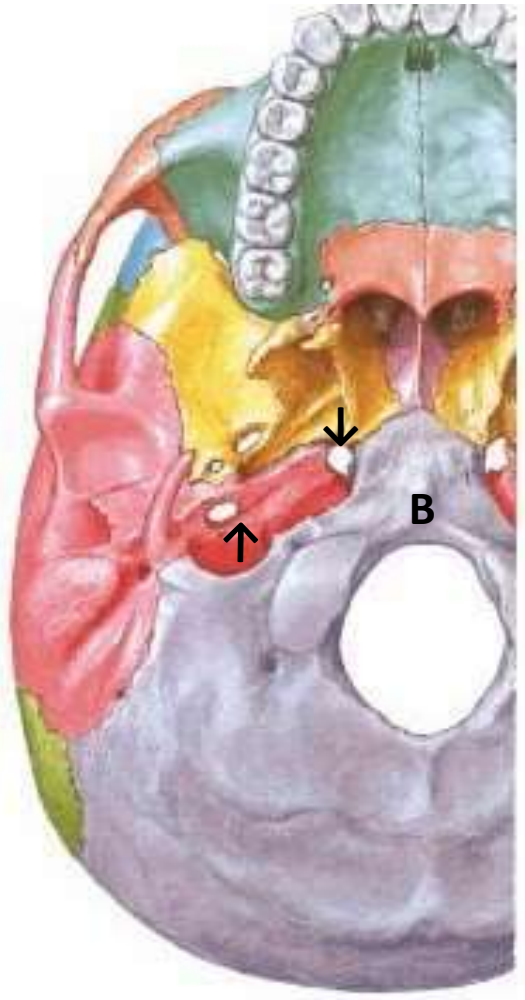


C. Posterior part:

** The basilar part of occipital bone (B) articulates anteriorly with the body of the sphenoid bone.

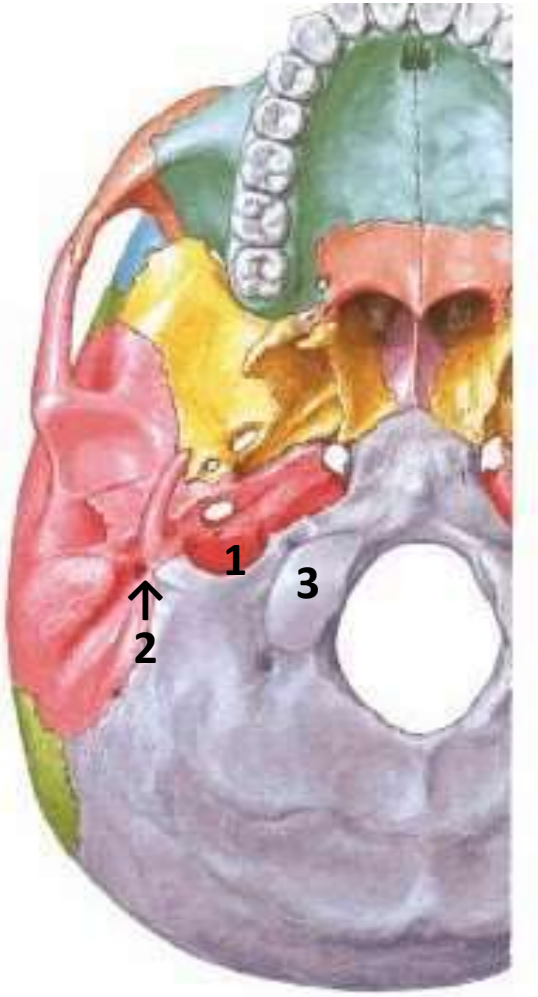
** Foramen lacerum (↓) lies between petrous part of temporal bone, basilar part of occipital and the pterygoid process. In life it is closed by cartilage plate.

** The carotid canal (↑): lies posterolateral to foramen lacerum. Gives passage to internal carotid artery.



** **Notice the following**:

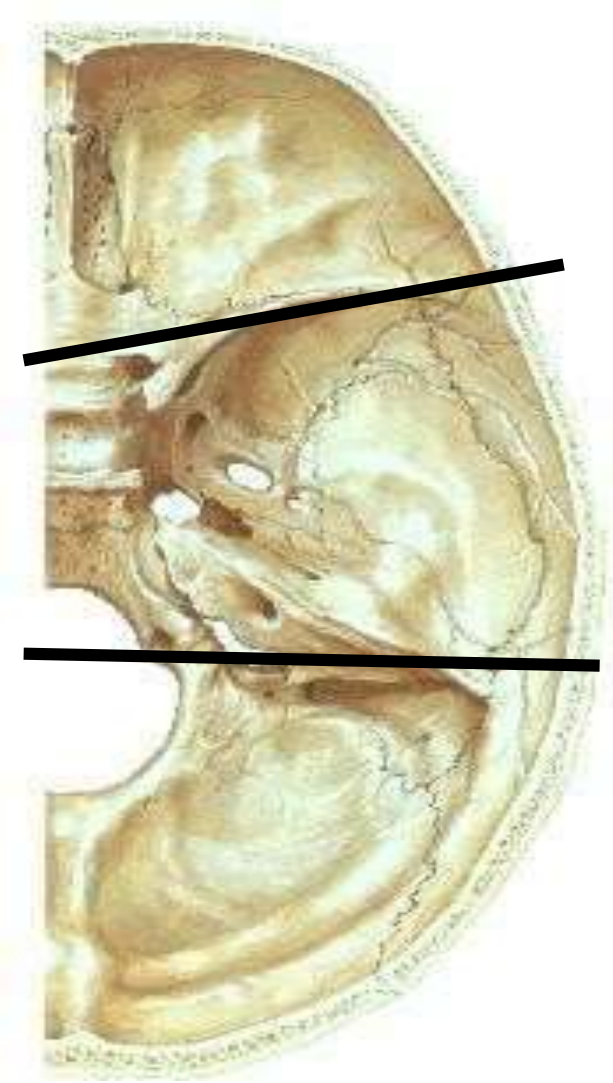
1. **The jugular foramen:** lies lateral to the occipital condyle. Gives passage to internal jugular vein.
2. **The stylomastoid foramen:** lies between styloid and mastoid processes. Gives passage to facial nerve.
3. **The occipital condyles:** articulate with the atlas to form atlanto-occipital joint.
4. **The anterior condylar (hypoglossal) foramen.** Gives passage to hypoglossal nerve.
5. **The posterior condylar foramen.**
6. **The foramen magnum:** communicates the cranial cavity with the vertebral canal. Gives passage to brain stem which continues as spinal cord.



Cranial Cavity

* **It is divided into:**

1. Anterior cranial fossa.
2. Middle cranial fossa.
3. Posterior cranial fossa.



Ant. Cranial Fossa

* **It is formed by the following bones:**

*In the midline:

1- Frontal bone.

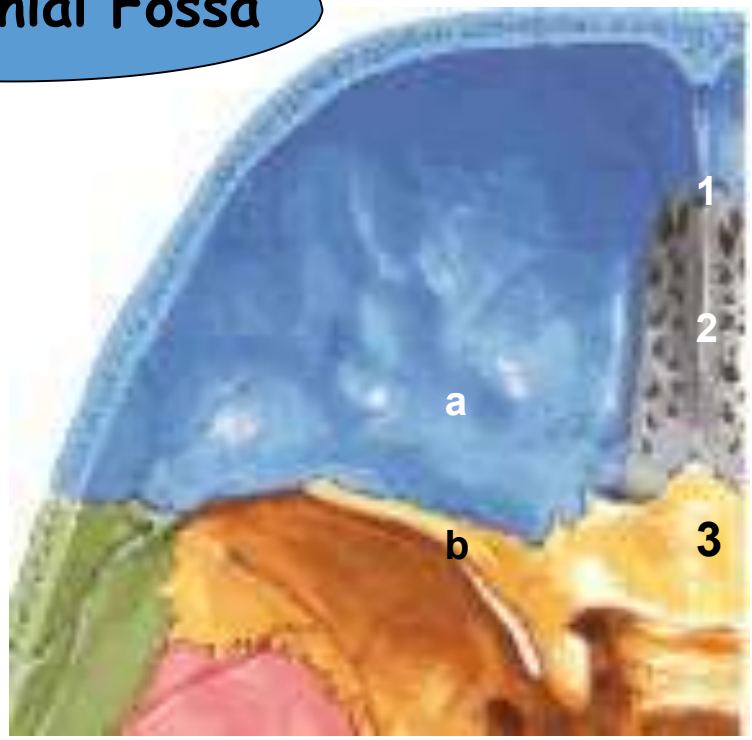
2 Ethmoid.

3 Sphenoid.

* On each side:

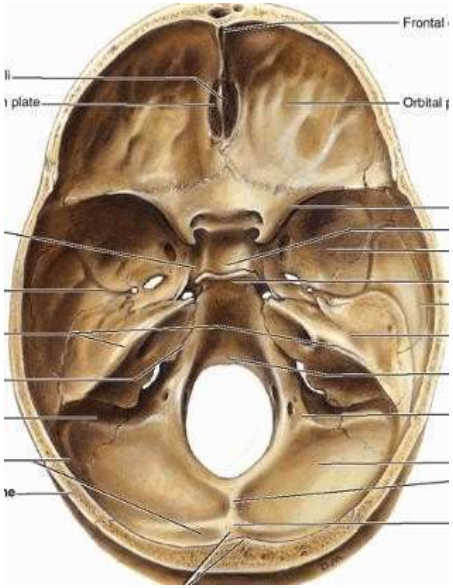
a. Frontal bone.

b. Sphenoid (lesser wing).



* Midline structures of the anterior cranial fossa:

1. Frontal crest.
2. Foramen caecum.
3. Crista galli.
4. Cribriform plate of ethmoid (gives passage to olfactory nerve).



Middle Cranial Fossa

*Formed by the following bones:

*In the midline:

Sphenoid (body).

* On each side:

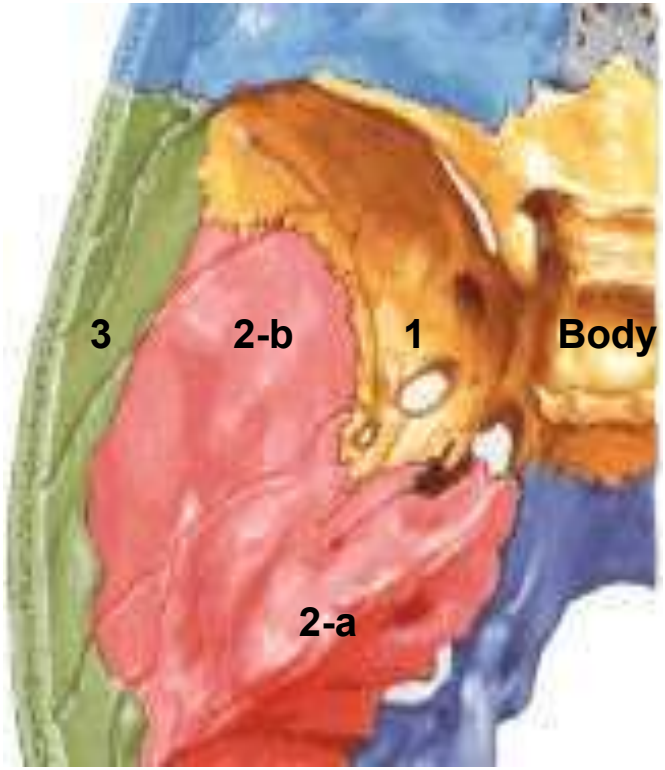
1Sphenoid (greater wing).

2- Temporal bone:

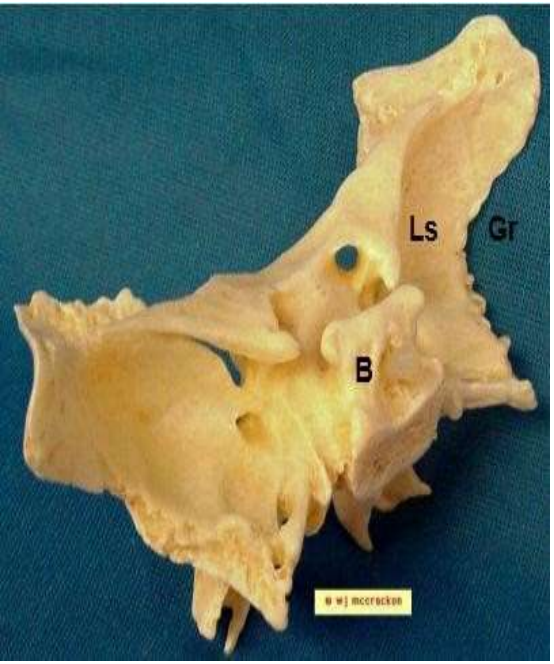
a. Petrous part.

b. Squamous part.

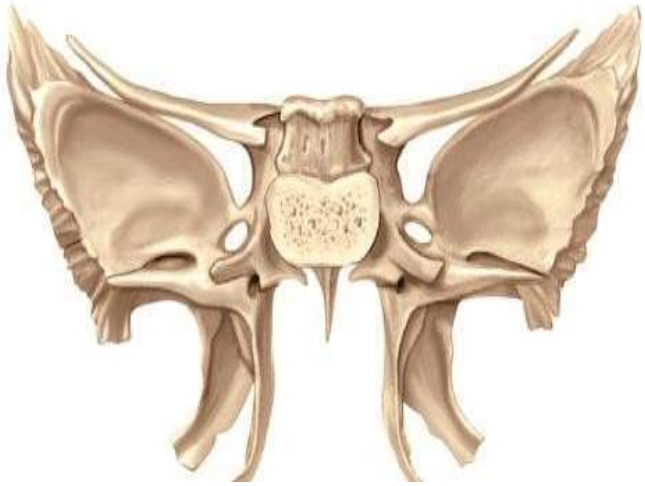
3- Parietal bone.



sphenoid bone is like a butterfly



(a) Superior view



* **Middle cranial fossa shows:**

Greater wing of sphenoid which contains:

1. **Sup. Orbital Fissure** → gives passage to nerves & vessels of orbit.
2. F. **R**otundum → gives passage to maxillary nerve
3. F. **O**vale.
4. F. **S**pinosum.

Post. Cranial Fossa

* **Formed by the following bones:**

*In the midline:

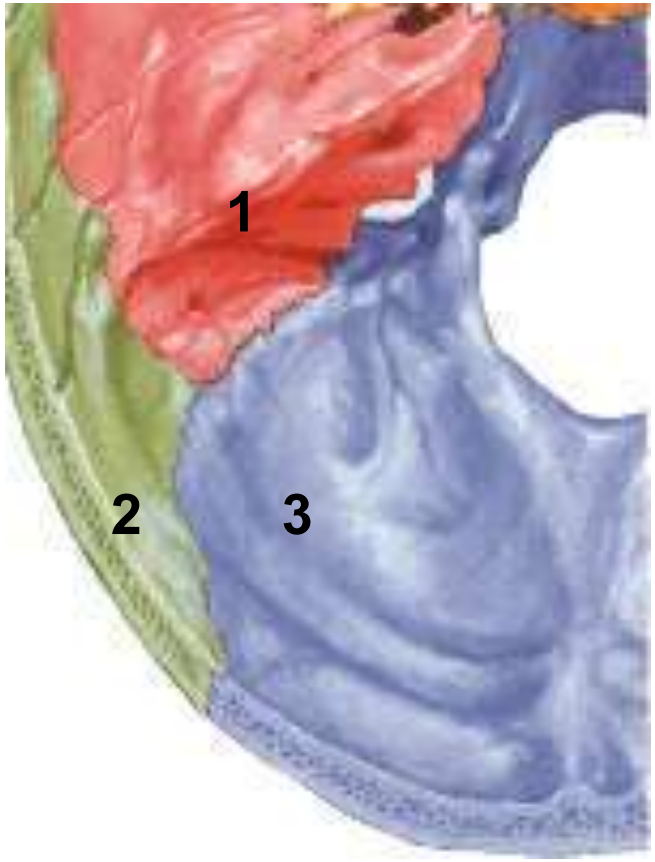
Occipital bone.

* **Laterally-placed:**

1Petrous part of temporal bone.

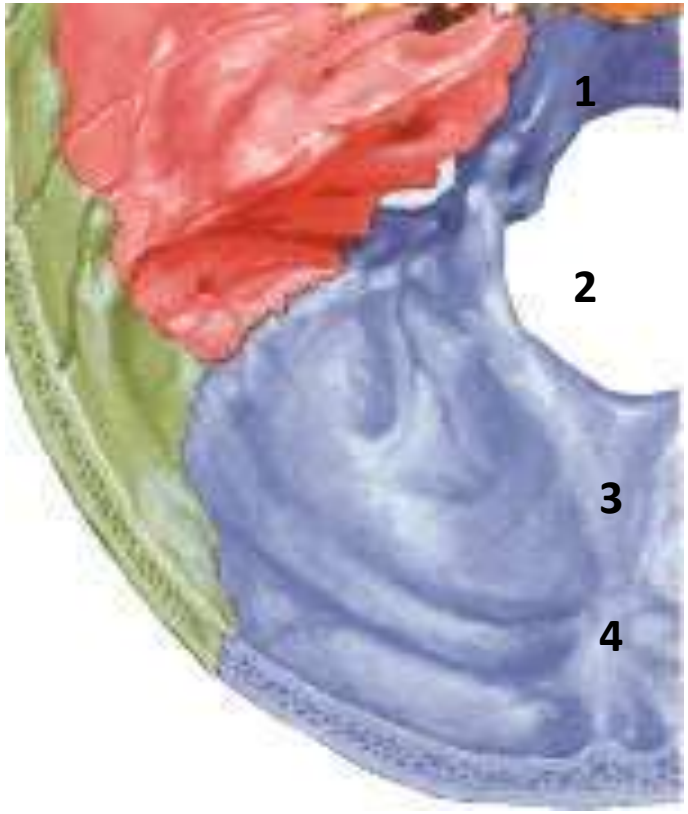
2 Parietal bone.

3 Occipital bone.



* **Midline structures in the posterior cranial fossa :**

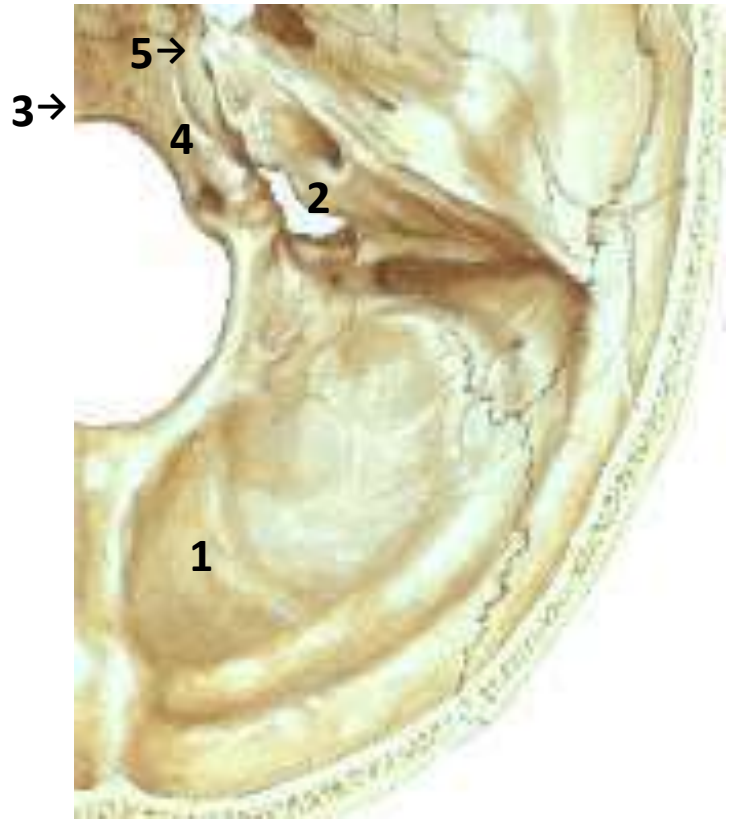
1. Clivus (formed by: body of sphenoid + basilar part of occipital bone).
2. Foramen magnum.
3. Internal occipital crest.
4. Internal occipital protuberance.



* <u>Laterally-placed structures in the post. cranial fossa:</u>

* <u>Two sulci & 3 foramina</u>:

1. Transverse sulcus (contains transverse sinus).
2. Sigmoid sulcus (contains sigmoid sinus).
3. Hypoglossal canal (gives passage to hypoglossal nerve).
4. Jugular foramen (gives passage to internal jugular vein).
5. internal auditory meatus → gives passage to 7th & 8th cranial nerves).



Anatomy & Embryology

Lecture 1: Introduction to Human Anatomy

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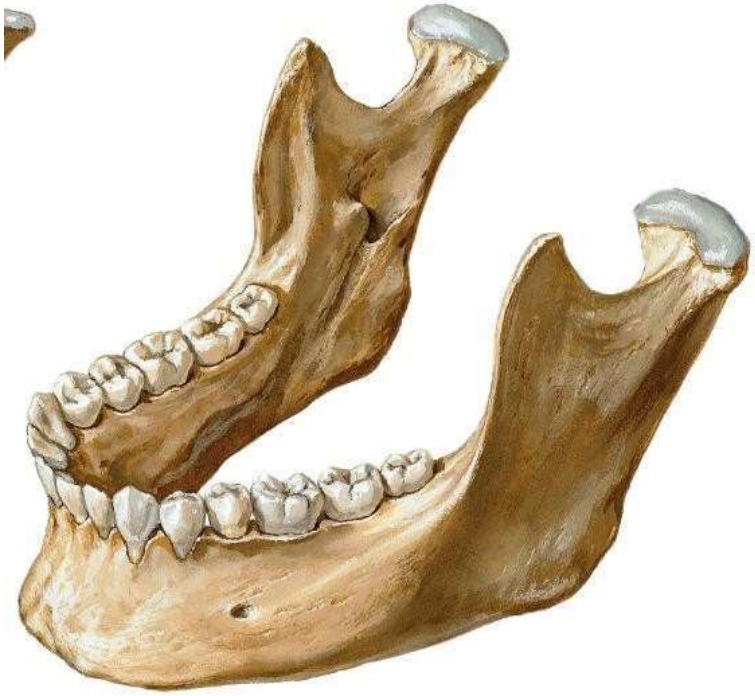
Mandible

** Is formed of two bones, (right and left) which unite at the symphysis menti after the frist year.

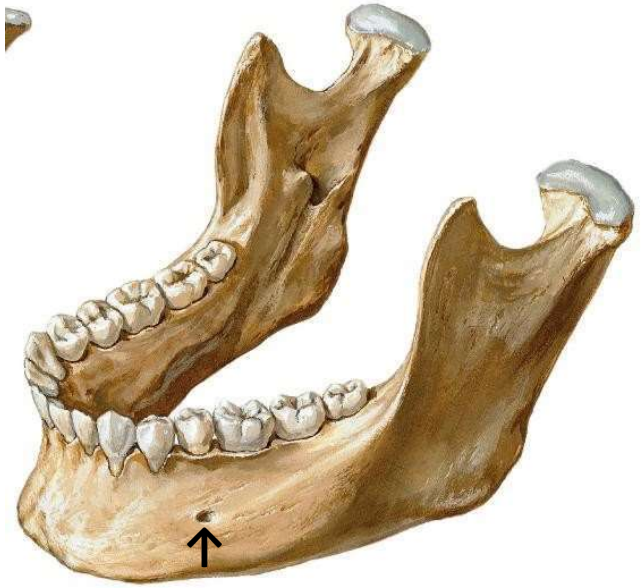
** The mandible is formed of a body and two rami.



A. The body

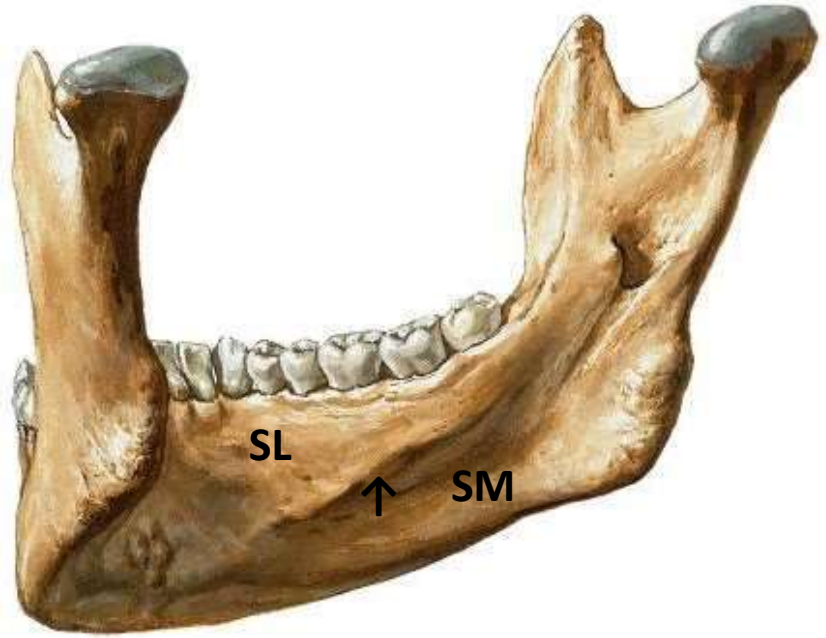
* **External surface:**

* **The mental foramen** lies midway between upper & lower borders, below 2nd premolar tooth.



* Internal surface :

- It shows the mylohyoid line (↑).
- Below this line is the submandibular fossa (SM), while above this line is the sublingual fossa (SL).



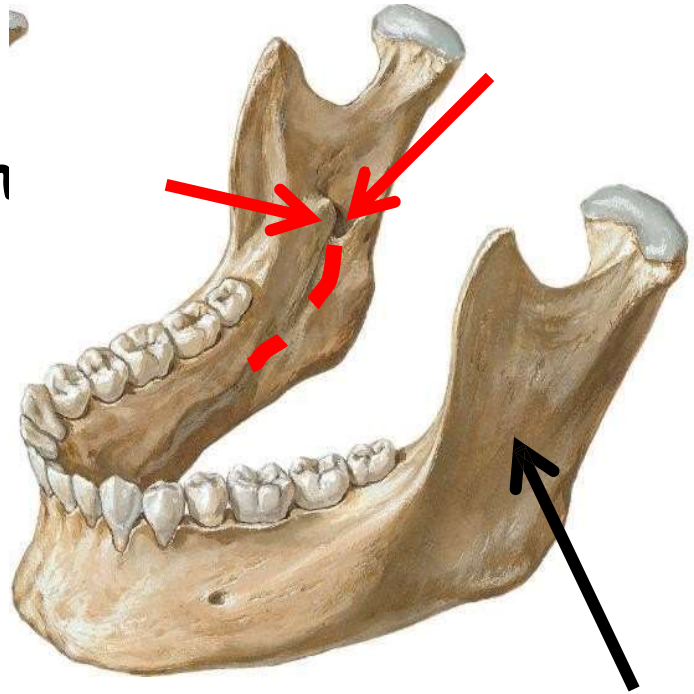
B. Ramus of mandible

* It has two surfaces.

1. The medial surface: shows the mandibular foramen which leads to mandibular canal.

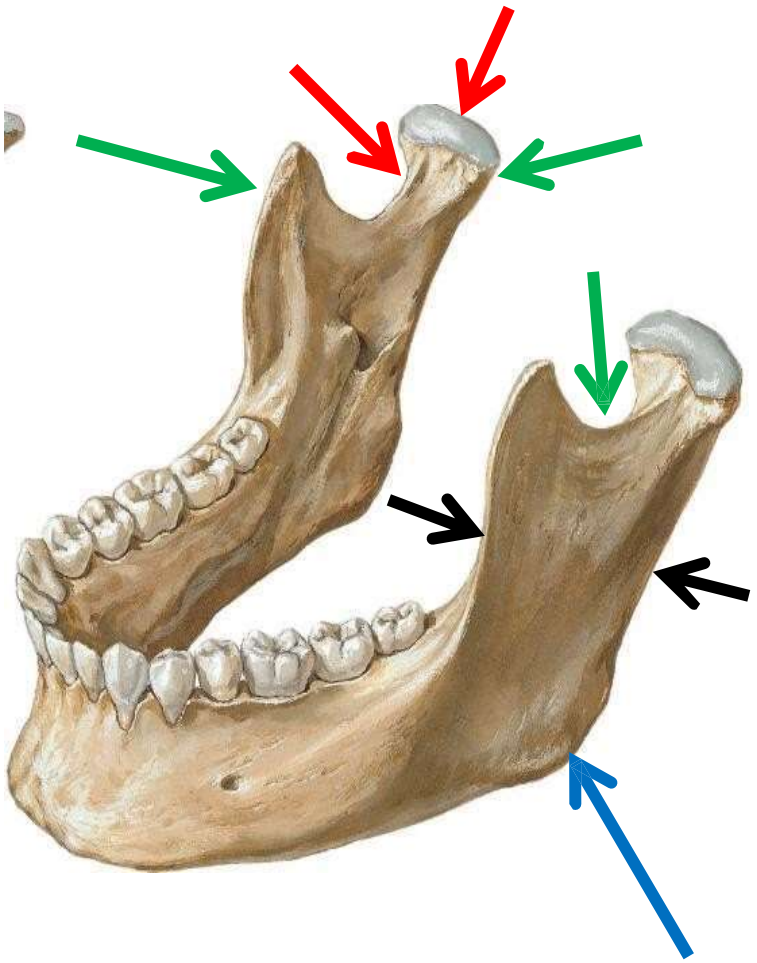
- Projecting over the foramen is the lingula .
- The mylohyoid groove starts at the lower border of the foramen.

2. The lateral surface: is flat

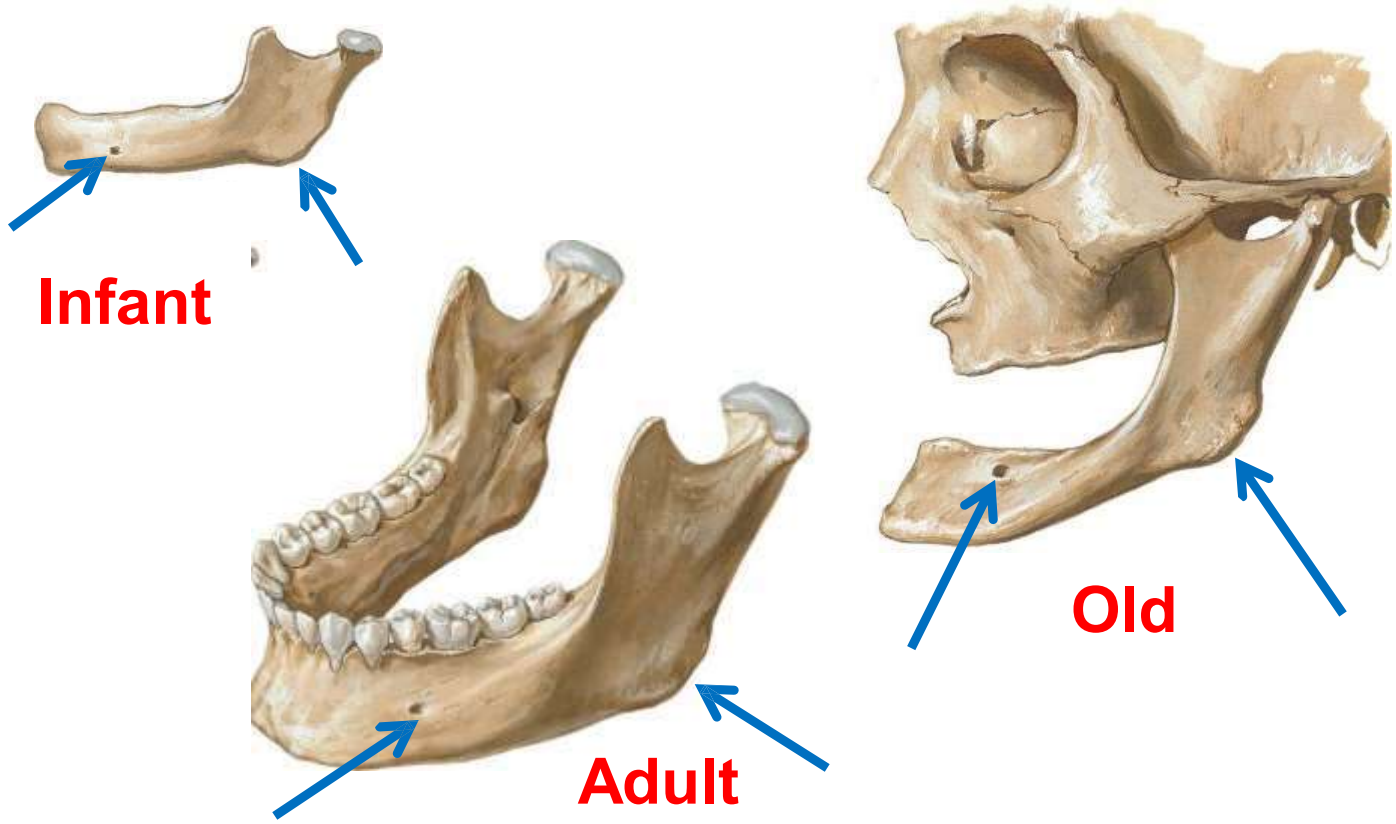


** **Upper border:**

- Shows two process coronoid anteriorly and condylar process posteriorly and in between the mandibular notch.
- The condylar process is expanded to form the head of the mandible.
- The constricted area below the head is the neck.
- Angle of the mandible is the area of meeting of body and the ramus .

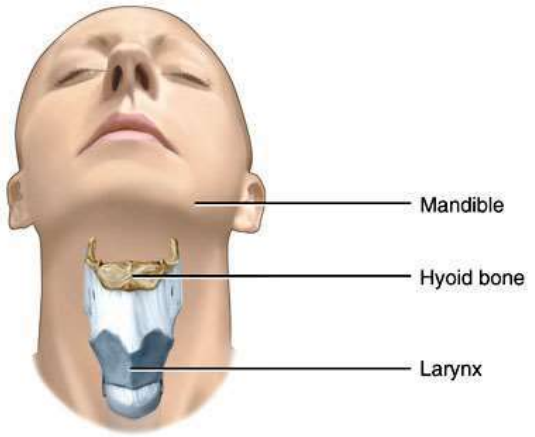


Age changes of the mandible

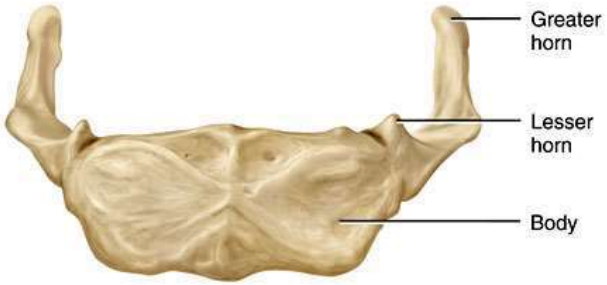


The Hyoid Bone

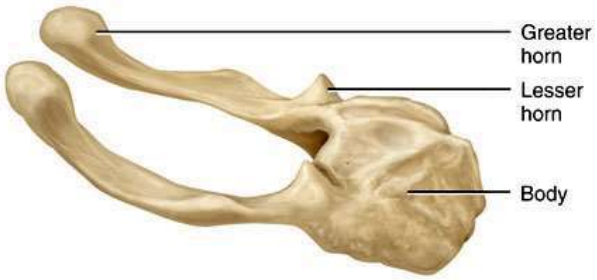
- Located in the upper part of the neck
- The only bone in the body that does not articulate with any other bone
- Supports the tongue, providing attachment sites for some tongue muscles and for muscles of the neck and pharynx and some ligaments
- Formed of body, greater horns and lesser horns



(a) Position of hyoid



(b) Anterior view



(c) Right lateral view

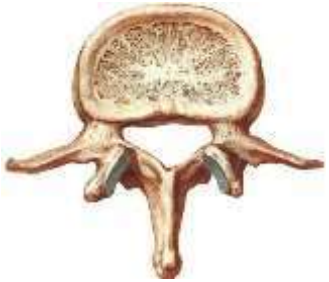
The Vertebral Column

- Also called the spine, backbone, or spinal column
- Functions to:
  - Protect the spinal cord
  - Support the head
  - Serve as a point of attachment for the ribs, pelvic girdle, and muscles
- Composed of a series of bones called **vertebrae (**Adult=26)
  - 7 **cervical** are in the neck region
  - 12 **thoracic** are posterior to the thoracic cavity
  - 5 **lumbar** support the lower back
  - 1 **sacrum** consists of five fused sacral vertebrae
  - 1 **coccyx** consists of four fused coccygeal vertebrae

* **The vertebral column:** is formed of a series of bones called vertebrae (which are 33 vertebrae).
* The vertebrae articulate together by cartilagenous intervertebral discs.

* **The column is divided into 5 regions:**
  7 cervical - 12 thoracic - 5 lumbar - 5 sacral (fused to form the sacrum) - 4 coccygeal (fused to form the coccyx).
* **The vertebral column:**

1. Forms the axial skeleton of the body.
2. Supports the weight of the body.
3. Protects & surrounds the spinal cord.



** **Curves of vertebral column**:

***Primary curve**: The vertebral column is concave anteriorly at birth.

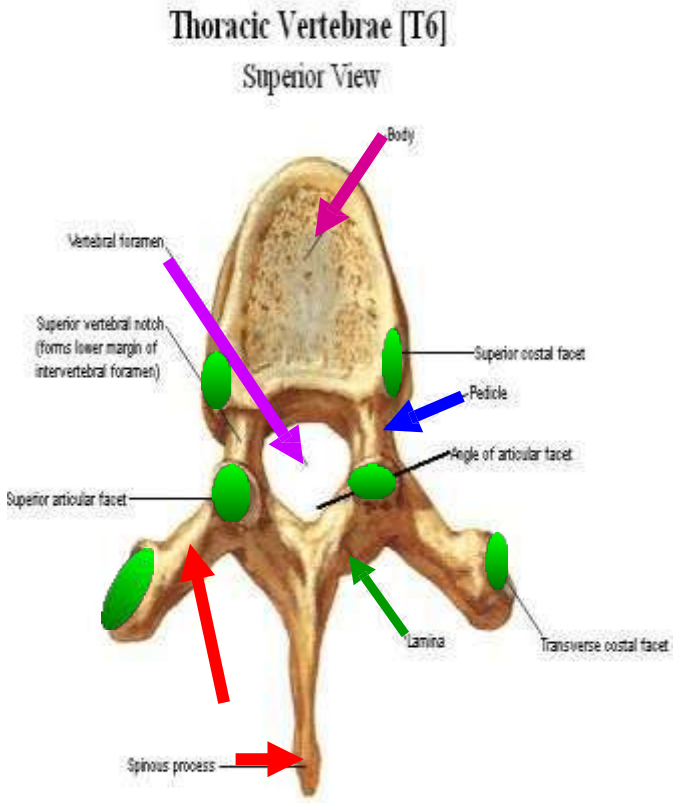
* **Secondary curves**:

(a) The cervical curve: becomes convex anteriorly when the child extends his head at the 3rd - 4th month.

(b) The lumbar curve: becomes convex anteriorly when the child begins to walk between 12-18 months due to strengthening of the muscles of the back.

The Thoracic Vertebrae

* 12 in number
* Each is formed of :
- Body
- Pedicle
- Transverse process
- Lamina
- Spine
- Vertebral foramen
- Articular facets



Cervical Vertebrae

Atlas = 1st Cervical Vertebra

*Articulates with skull above & axis below.

*Formed of 2 lateral masses connected by anterior & posterior arches.

*Its transverse process shows a foramen transversarium.

Axis = 2nd Cervical Vertebra

*Articulates with atlas above & 3rd cervical vertebra below.

*It has a well-defined process called dens.

*Its transverse process shows a foramen transversarium.

Typical Cervical Vertebra (3-6)

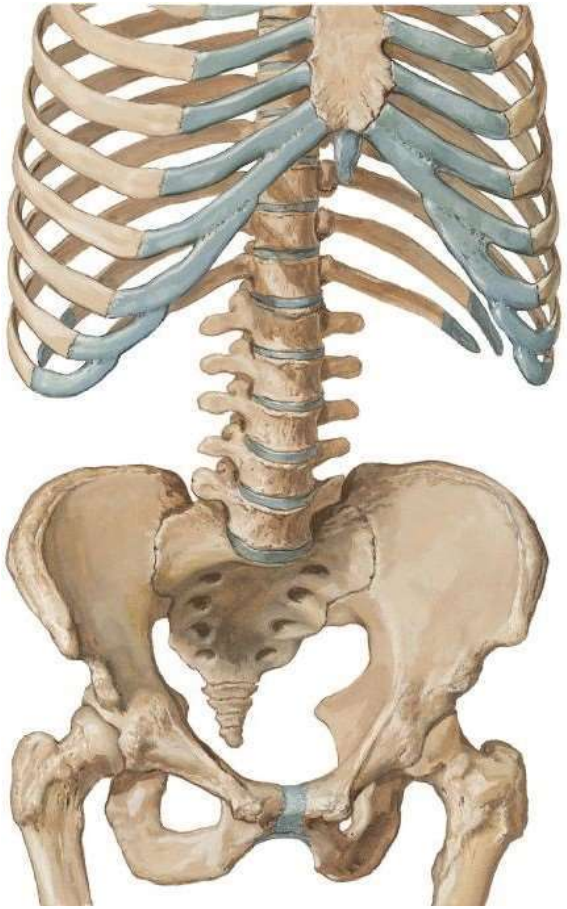
* Its spine is bifid.
*Its transverse process shows a foramen transversarium.

7th Cervical Vertebra

*Its spine is long & not bifid.

*Its transverse process shows a foramen transversarium.

- **The lumbar vertebrae** are the largest vertebrae in the body.
- No foramina transverseria in transverse processes & no bifid spines.
- **The sacrum** is a single triangular bone that is formed by fused 5 sacral vertebrae.
- The sacrum articulates with the 5th lumbar vertebra above & with the hip bones on each side.



Sacrum

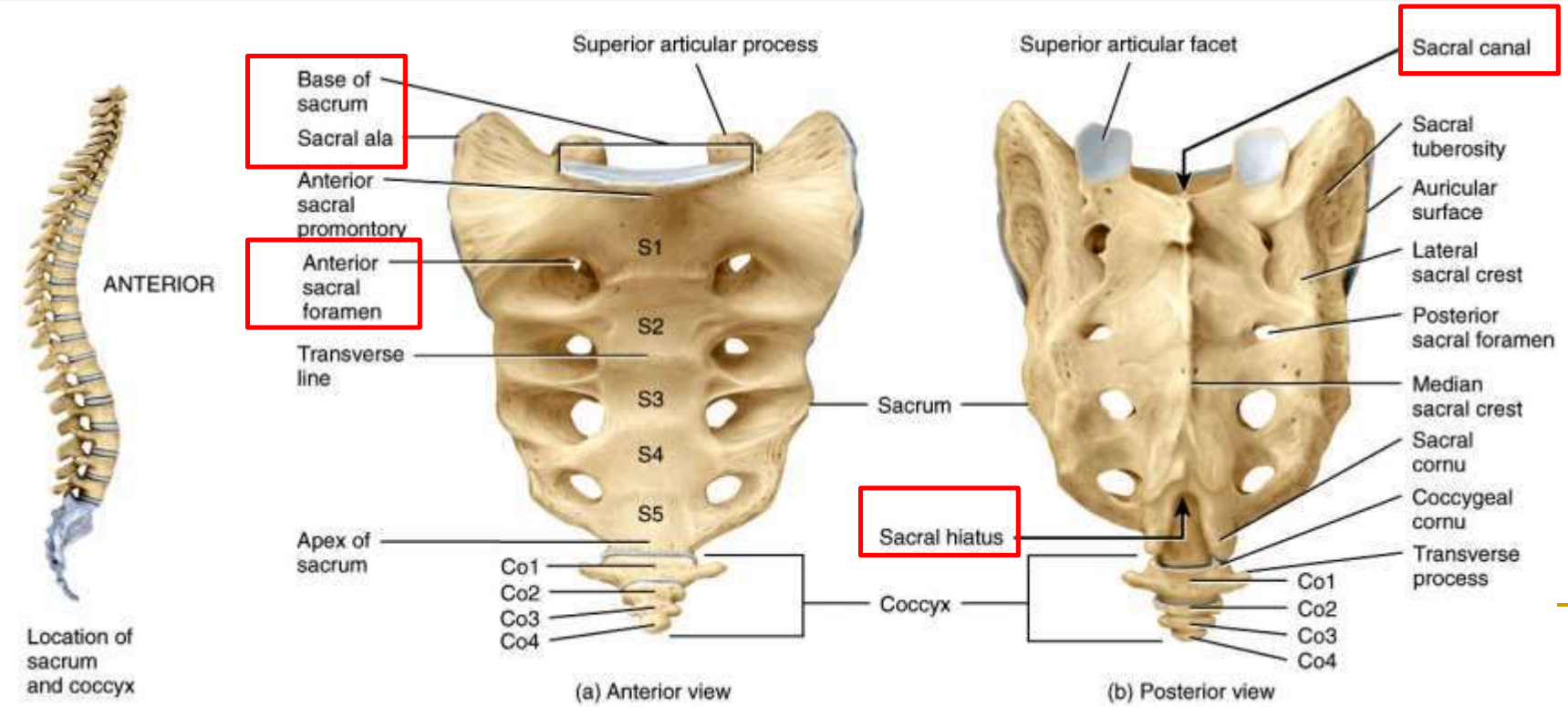
The sacrum is a triangular bone formed by the union of five sacral vertebrae (S1–S5)

Serves as a strong foundation for the pelvic girdle

Coccyx

The coccyx, like the sacrum, is triangular in shape

It is formed by the fusion of usually four coccygeal vertebrae



Differences between the typical vertebrae in the different regions:			
	Cervical	**Thoracic**	**Lumbar**
Body	Small and rectangular	Large and heart-shaped	Large and kidney-shaped
Vertebral Foramen	Large triangular	Small round	Triangular
Transverse Process	Small with foramina	Large with no foramina	Large with no foramina
Spinous Process	Short and bifid (7^{th})	Long and directed inferiorly	Broad and directed posteriorly
Facets for the ribs	Not present	Present	Not present

Intervertebral Disc

*Each 2 vertebrae are separated from each other by an intervertebral (IV) disc.

* The IV disc is considered as a 2ry cartilaginous joint.

*It is formed of white fibrocartilage (which is the hardest type of cartilage).

* It is formed of 2 parts:

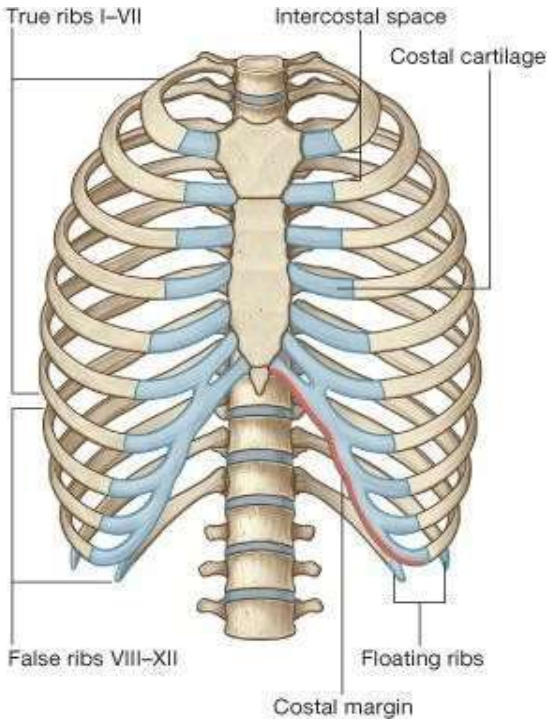
a. An inner part called nucleus pulposus.

b. An outer peripheral part called annulus fibrosus.

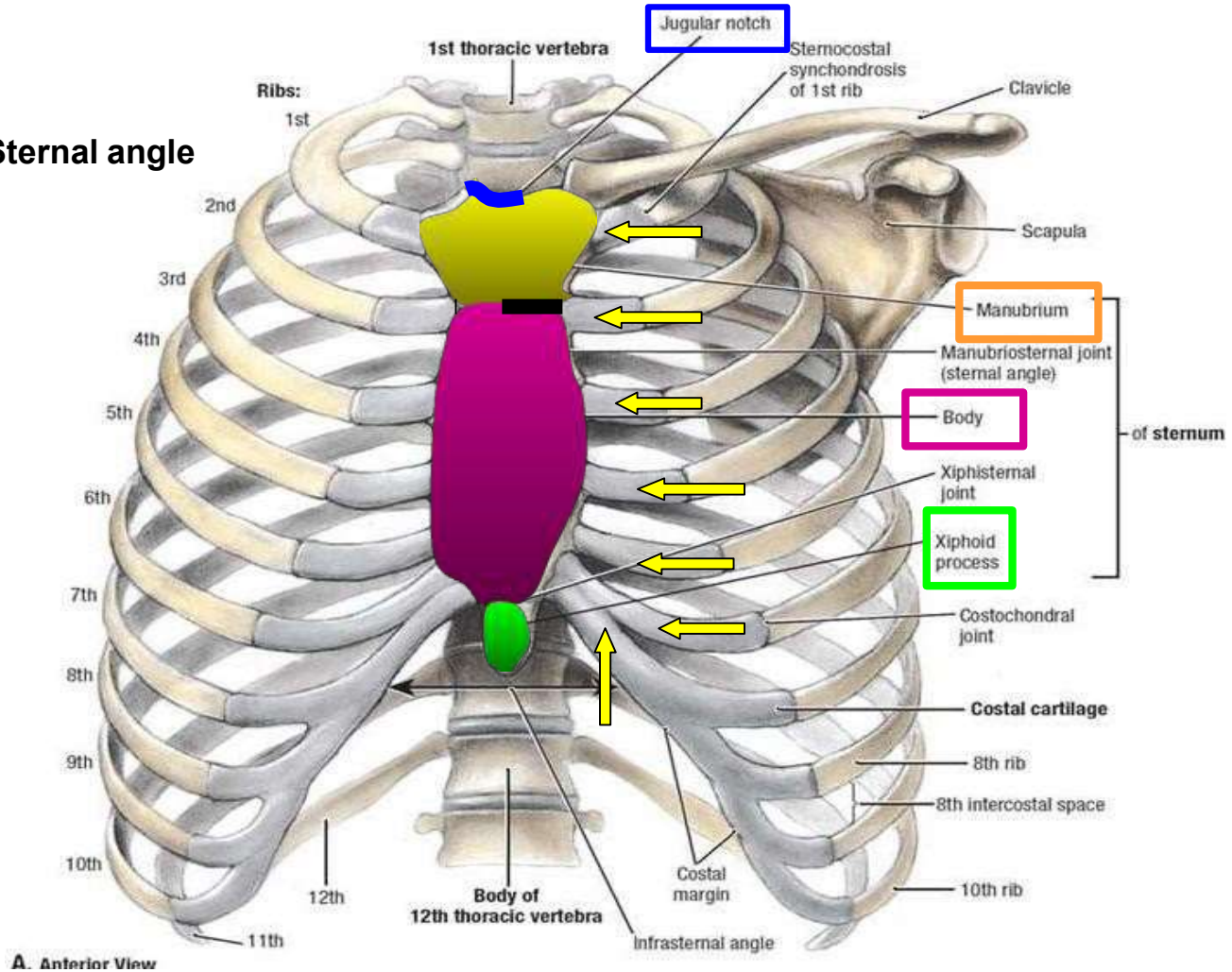
*Its dislocation (called disc prolapse) causes a compression of one of the adjacent spinal nerves leading to severe pain.

Thoracic cage

- **Formed of:**
- **Anteriorly→** sternum (manubrium, body & xiphoid process). It is joined to the upper 7 costal cartilages.
- **On each side→** 12 pairs of ribs separated by **intercostal spaces.**
- **Posteriorly→** 12 thoracic vertebrae.

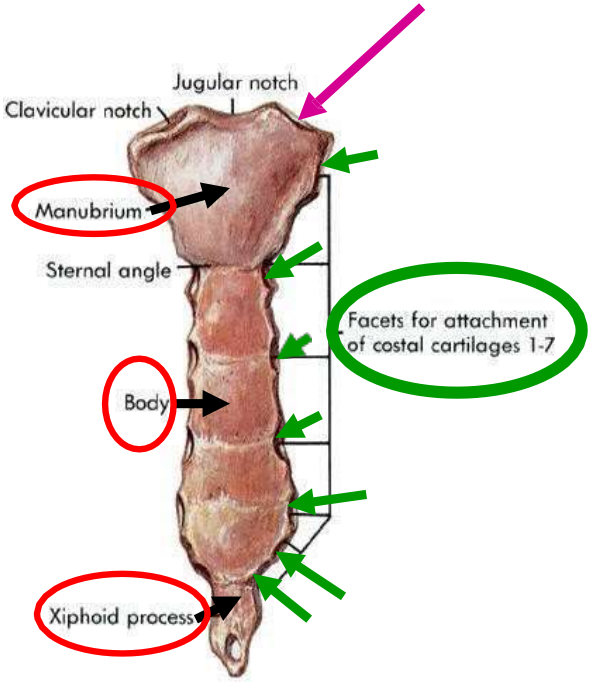


Sternal angle



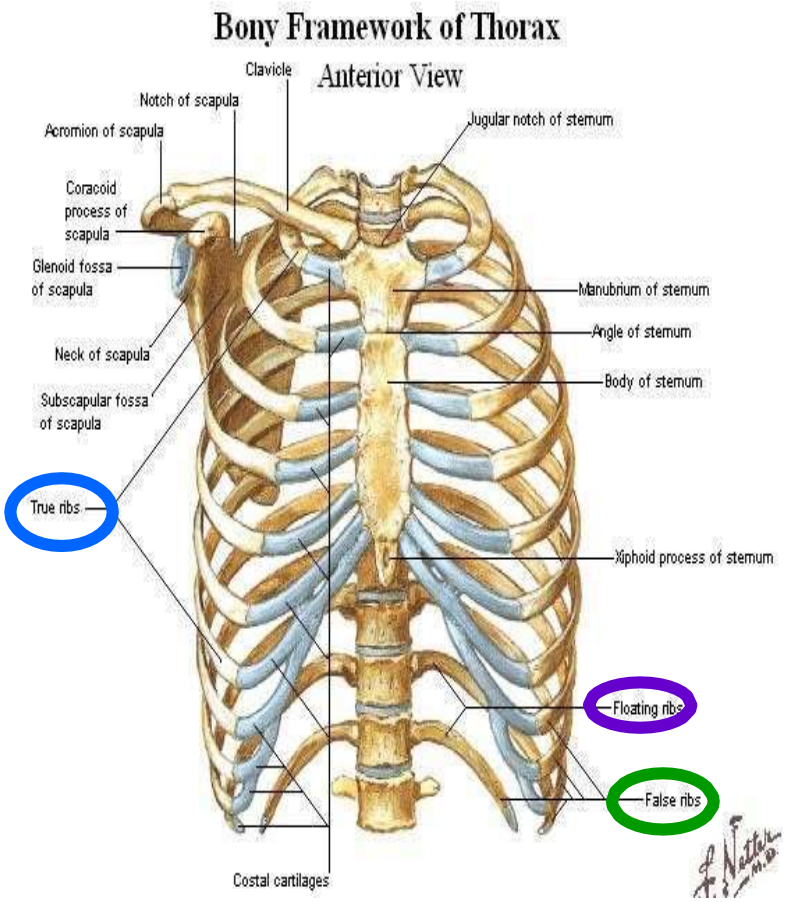
The Sternum

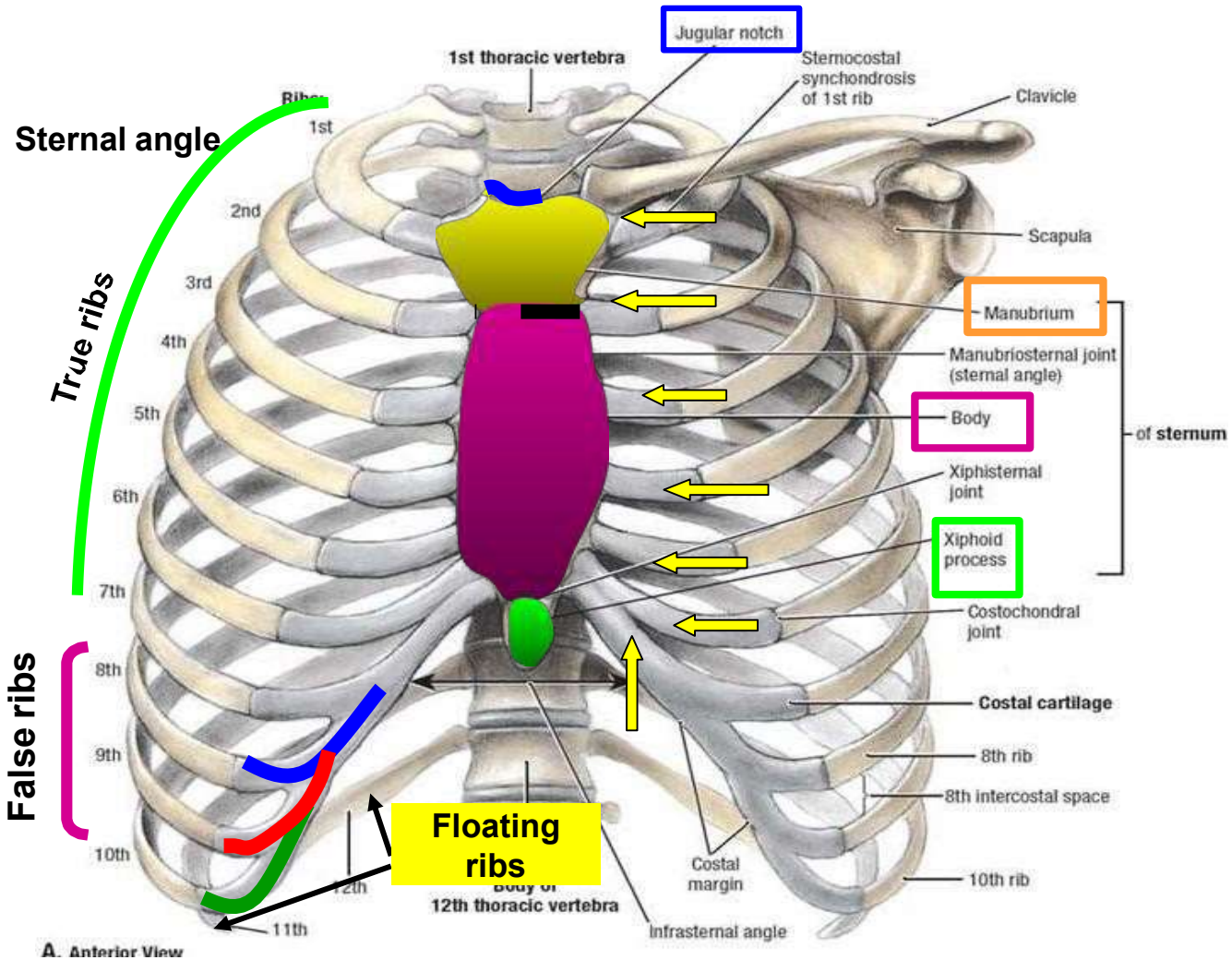
- **Formed of** 3 parts → manubrium, body & xiphoid process.
- **Articulates with** → clavicles & upper 7 costal cartilages.



The Ribs

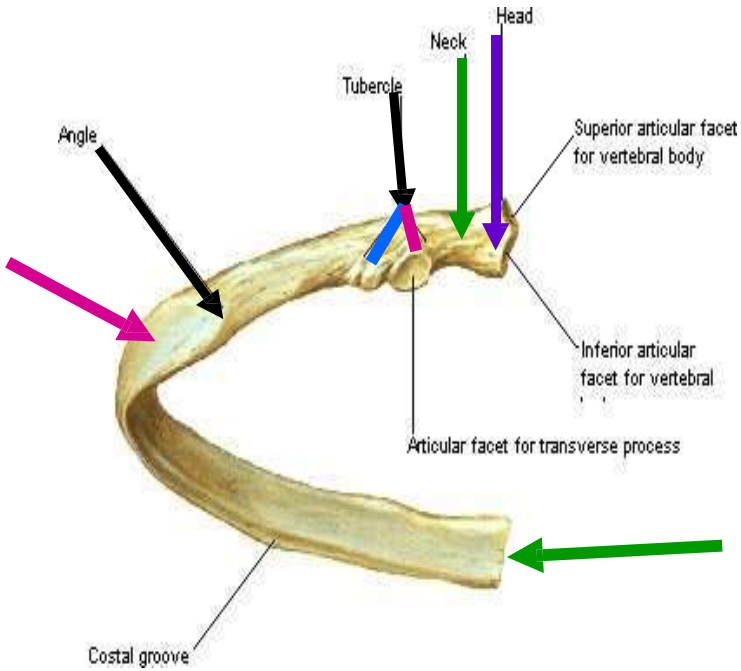
- 12 pairs of ribs articulate with the thoracic vertebrae.
- Upper seven are true ribs as each articulates by its costal cartilage to the sternum.
- Lower five are false ribs as their costal cartilages fail to reach the sternum.
- Last two are called floating ribs as their costal cartilages are free.




Jugular notch
1st thoracic vertebra
Sternocostal synchondrosis of 1st rib
Clavicle
Sternal angle
1st
2nd
3rd
4th
5th
6th
7th
True ribs
Scapula
Manubrium
Manubriosternal joint (sternal angle)
Body
of sternum
Xiphisternal joint
Xiphoid process
Costochondral joint
Costal cartilage
8th rib
8th intercostal space
10th rib
False ribs
8th
9th
10th
11th
Floating ribs
12th thoracic vertebra
Costal margin
Infrasternal angle
A. Anterior View

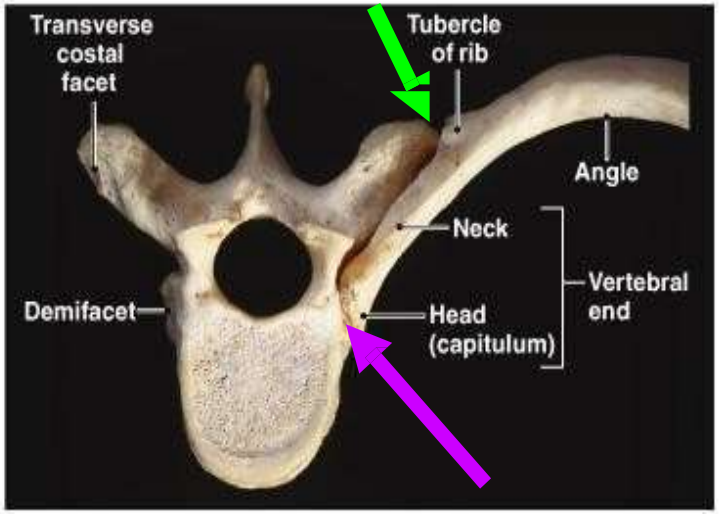
Parts of a typical rib

- **Vertebral end →** head, neck & tubercle
- **Shaft**
- **Sternal end →** groove for attachment of costal cartilage.

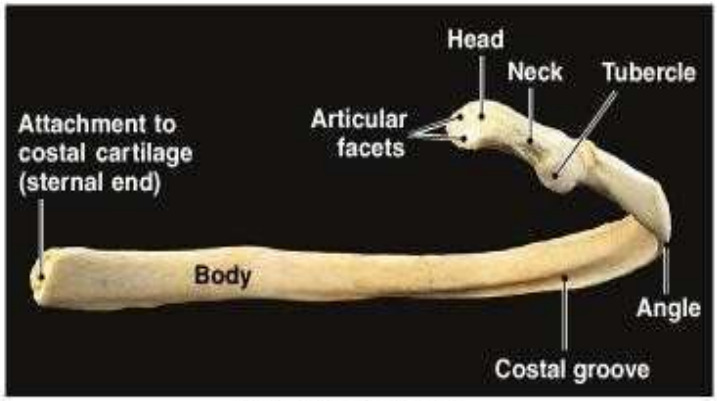


Articulation of vertebra to rib

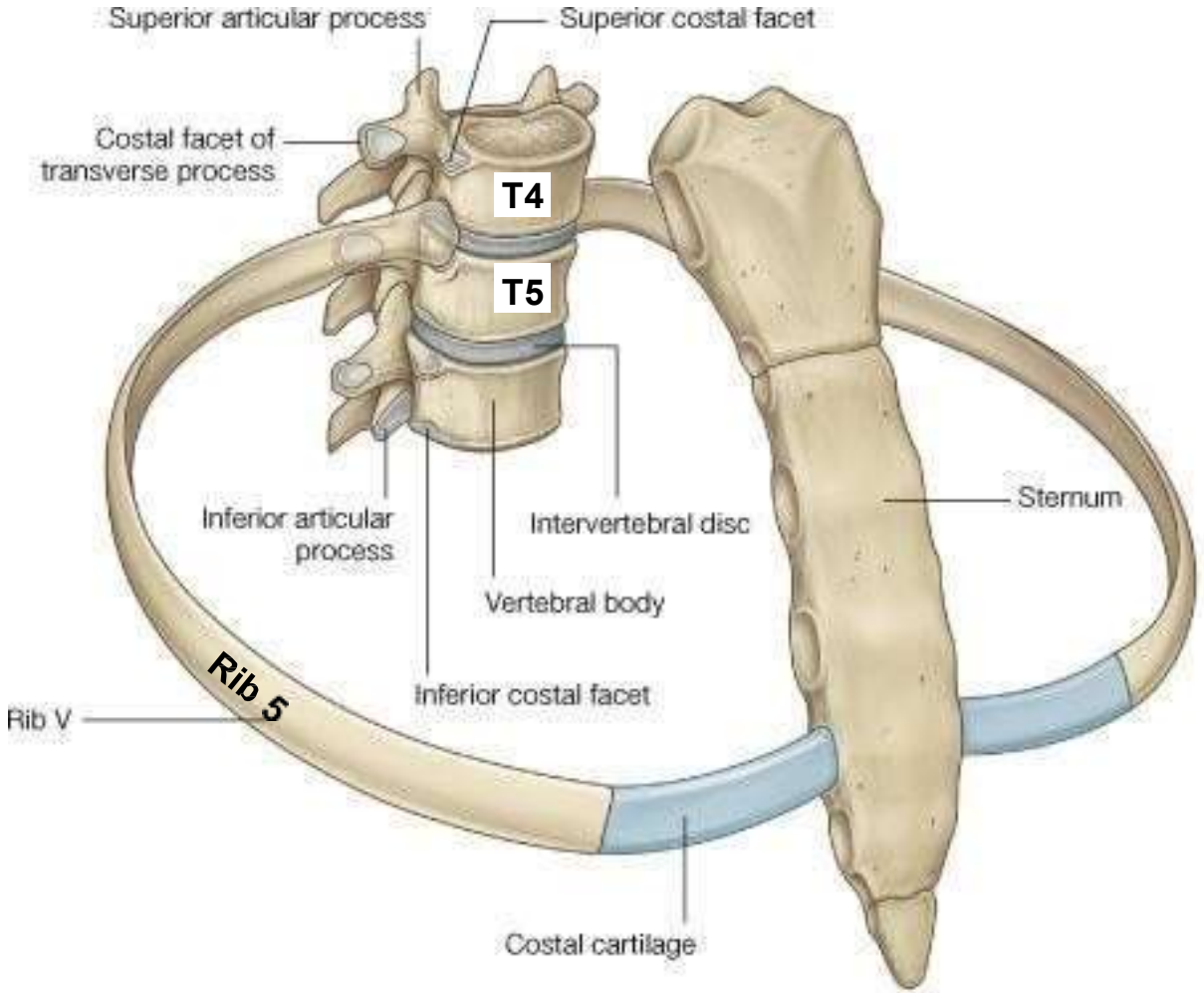
- Head of rib articulates with Body of vertebra
- Tubercle of rib articulates with Transverse process of vertebra



(a) Superior view



(b) Posterior view


Superior articular process
Superior costal facet
Costal facet of transverse process
T4
T5
Inferior articular process
Intervertebral disc
Sternum
Vertebral body
Rib 5
Inferior costal facet
Rib V
Costal cartilage

Thank You
Thank You
Thank You!!!!