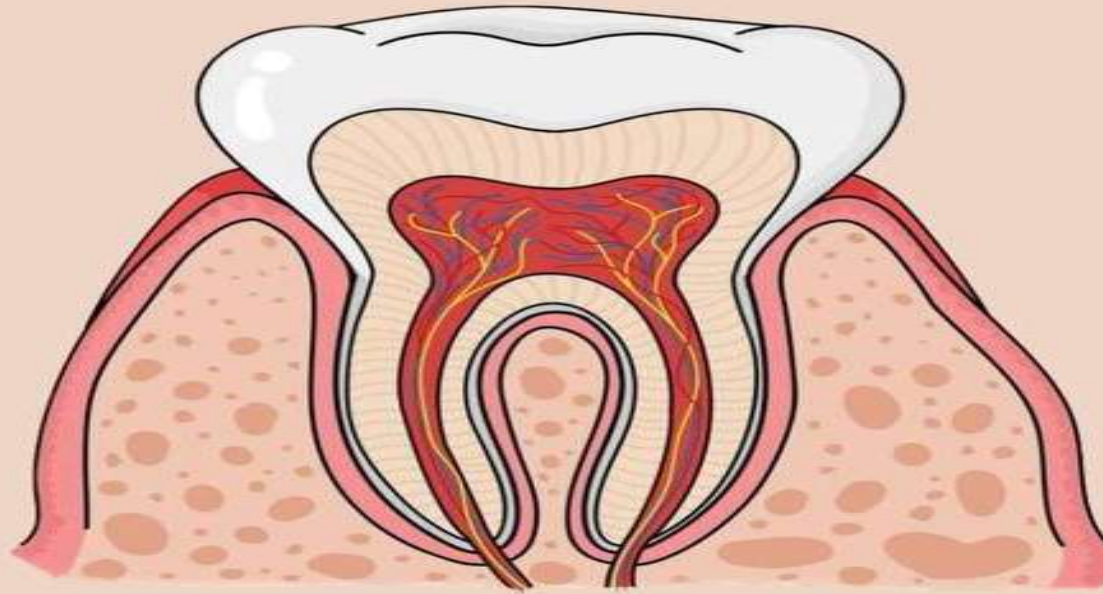




ANATOMY



LEC NO. : L-2

DONE BY : Malak al-hmeed

وَقُلْ رَبِّ زِدْنِي عِلْمًا



Anatomy & Embryology

Lecture 2: Axial Skeleton

Dr. Jihad Alzyoud
Associate Professor of Anatomy &
Histology

Jihada@hu.edu.jo
Jihada@staff.hu.edu.jo

بترتبط العظام مع (Bones)
بعض عن طريق الغضاريف
(cartilages)
وبس تتجمع بتكون مفاصل
(joints)
ويتم تثبيتها عن طريق ربطها



The Skeletal System

THE SKELETON

- * It comprises cartilages, bones, ligaments & joints.
- * The bones are rigid and heavier than cartilages.
- * Cartilages are more flexible and lighter.
- * The younger the age, the greater is the contribution of cartilage to the skeleton.

صلابة

مرونة

بنلاحظ دائما انه الكبار بالعمر يعانون من احتكاك او خشونة بالفاصل وهاد الاشياء سبب تراجع اداء الغضاريف وكميتها

علاقة عكسية بين العمر

* **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.

العظام المتصلة بالعمود

b. The appendicular skeleton.

العظام الموجودة في الاطراف

Divisions of the Skeletal System

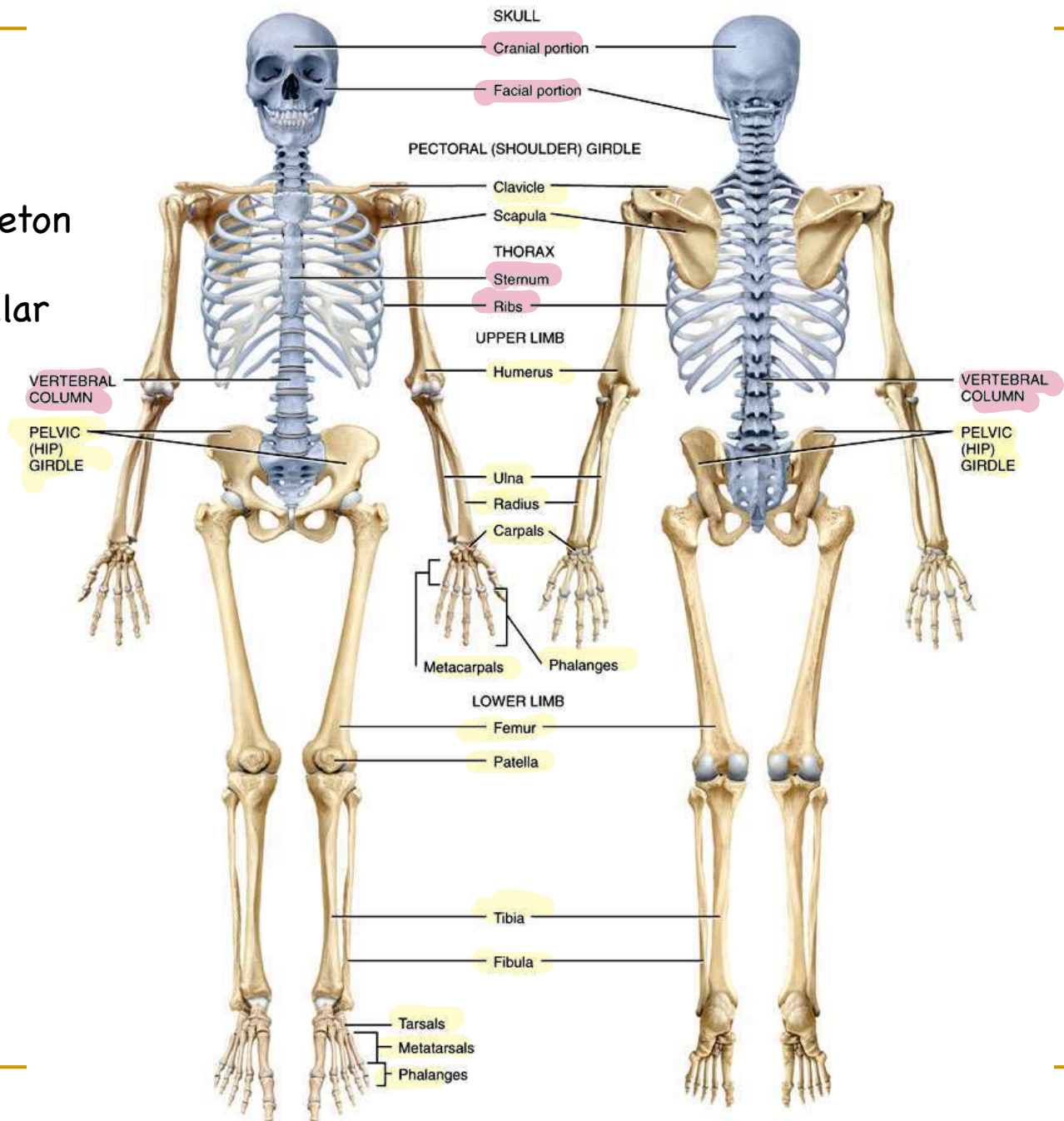
- The human skeleton consists of **206 named bones**
- Bones of the skeleton are grouped into two principal divisions:
 - **Axial skeleton**
 - Consists of the bones that lie around the longitudinal axis of the human body: Skull bones, auditory ossicles (ear bones), hyoid bone, ribs, sternum (breastbone), and bones of the vertebral column.
 - The primary function is protection of vital organs.
 - **Appendicular skeleton**
 - 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.

الوظيفة الأساسية لحماية الأعضاء الحيوية

الوظيفة الأساسية هي الحركة

● Axial skeleton

● Appendicular skeleton



(a) Anterior view



(b) Posterior view

Bones of the Human Body

الارقام مطلوبة

TABLE 7.1

The Bones of the Adult Skeletal System

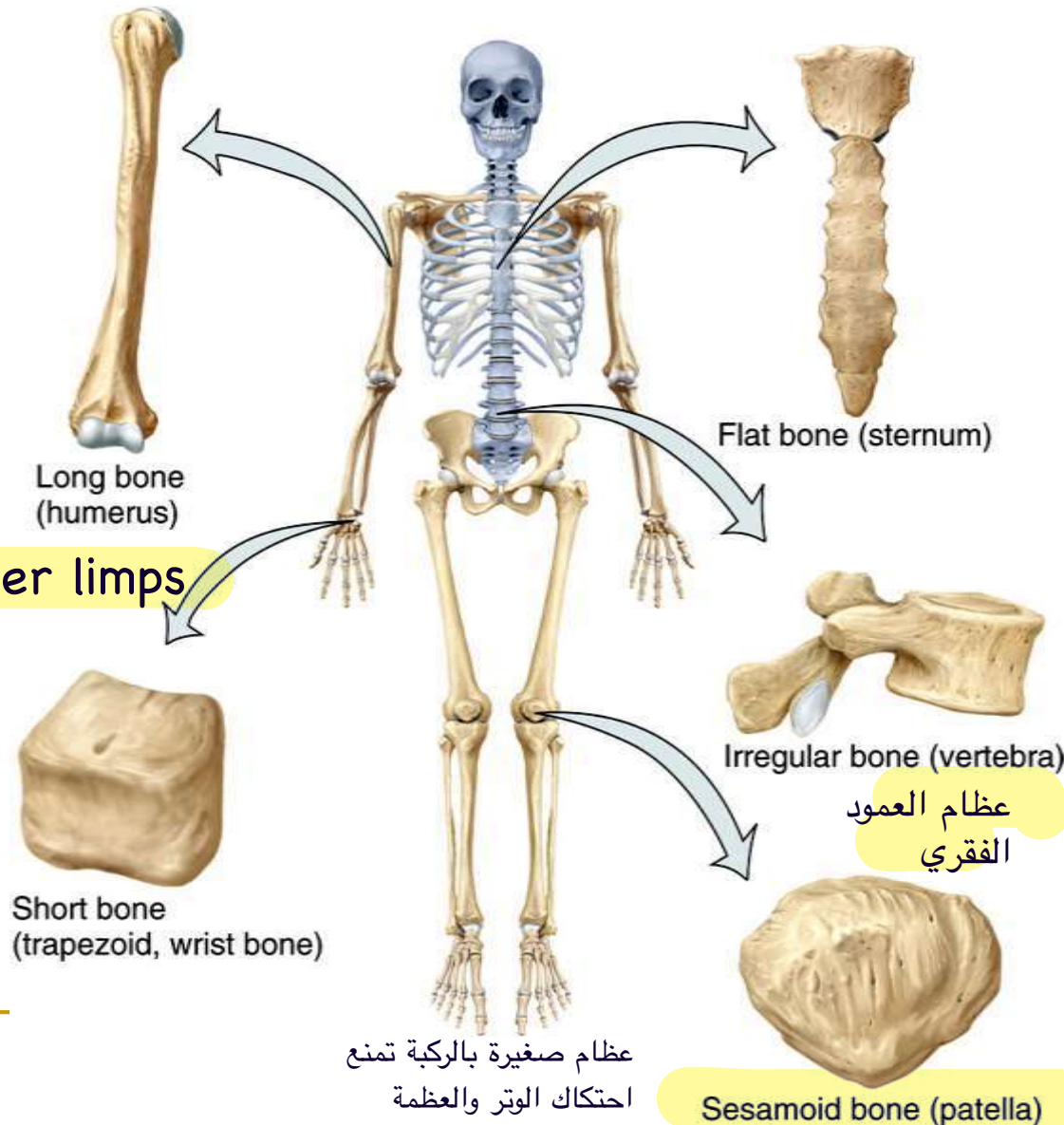
DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES	DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES
Axial Skeleton 	Skull		Appendicular Skeleton 	Pectoral (shoulder) girdles	
	Cranium	8		Clavicle	2
	Face	14		Scapula	2
	Hyoid	1		Upper limbs	
	Auditory ossicles	6		Humerus	2
	Vertebral column	26		Ulna	2
	Thorax			Radius	2
	Sternum	1		Carpals	16
	Ribs	<u>24</u>		Metacarpals	10
	Subtotal = 80			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	<u>28</u>	
			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
- 2) Short
- 3) Flat
- 4) Irregular
- 5) Sesamoid

Lower & upper limbs



Sesamoid bone (patella)

❑ 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 Axial Skeleton

Axial Skeleton



The skull

Is formed of 22 separate bones

One movable bone

The mandible

21 immovable bones

Articulating together by **sutures**
(which are fibrous joints)

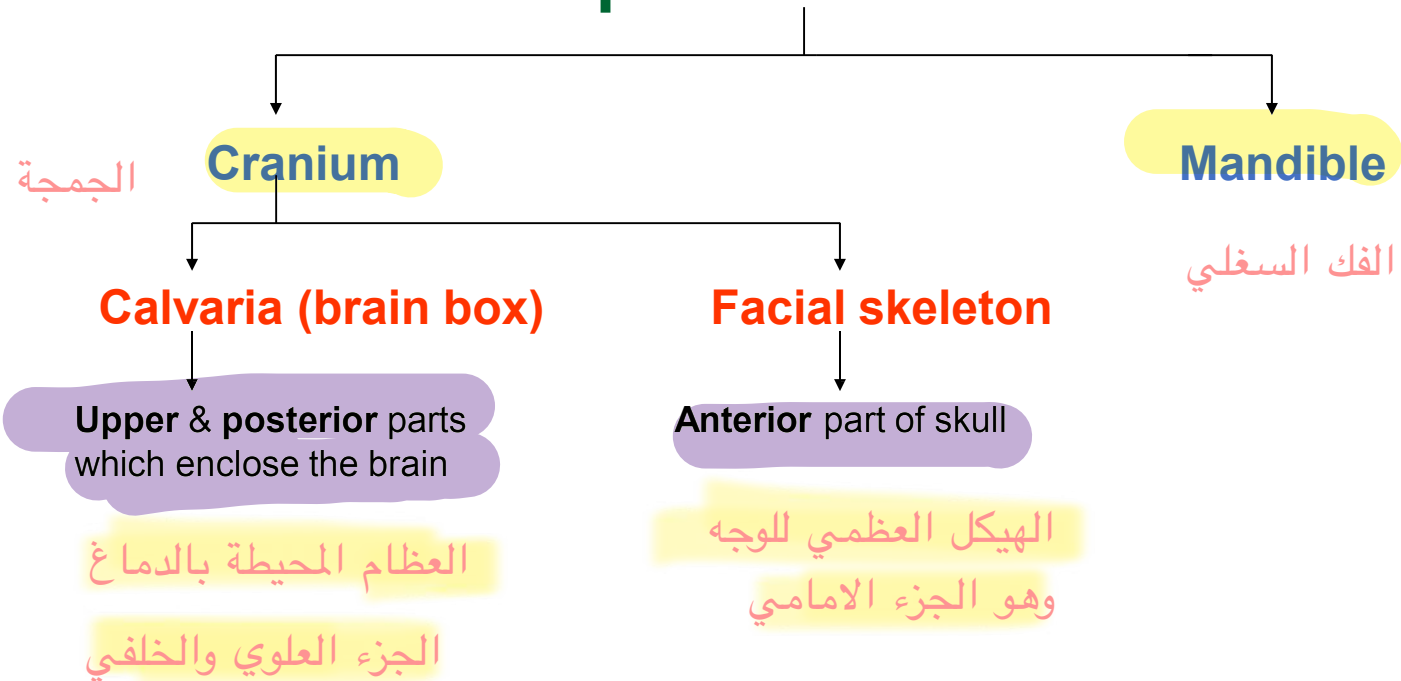
غير متحرك ترتبط مع بعضها
ب joints وهي ايضا غير متحركة



ال joints الغير
متحركة
بنسُميها
sutures

عضمة الفك
الوحيدة التي تتحرك

The parts of the skull



The Skull

اجزاء الجمجمة رح نبليش
نتعرف عليها بالتدريج فكل
جزء مذكور لازم نحدده على الرسم

- The skull (Cranium) Consists of 22 bones
- Bones of the skull are grouped into two categories:
 1. Cranial bones عظام الجمجمة
 - 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 عظام الوجه
 - 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**

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**
تجويف الانف
 - **Orbits (eye sockets)**
تجويف خاص بالعين
 - **Paranasal sinuses**
الجيوب الانفية
 - **Small cavities which house organs involved in hearing and equilibrium**
جيوب تحوي على الاعضاء المساهمة في عملية السمع
- الجمجمة عبارة عن تجويف كبير يحتوي بداخله على اربع تجاويف اصغر



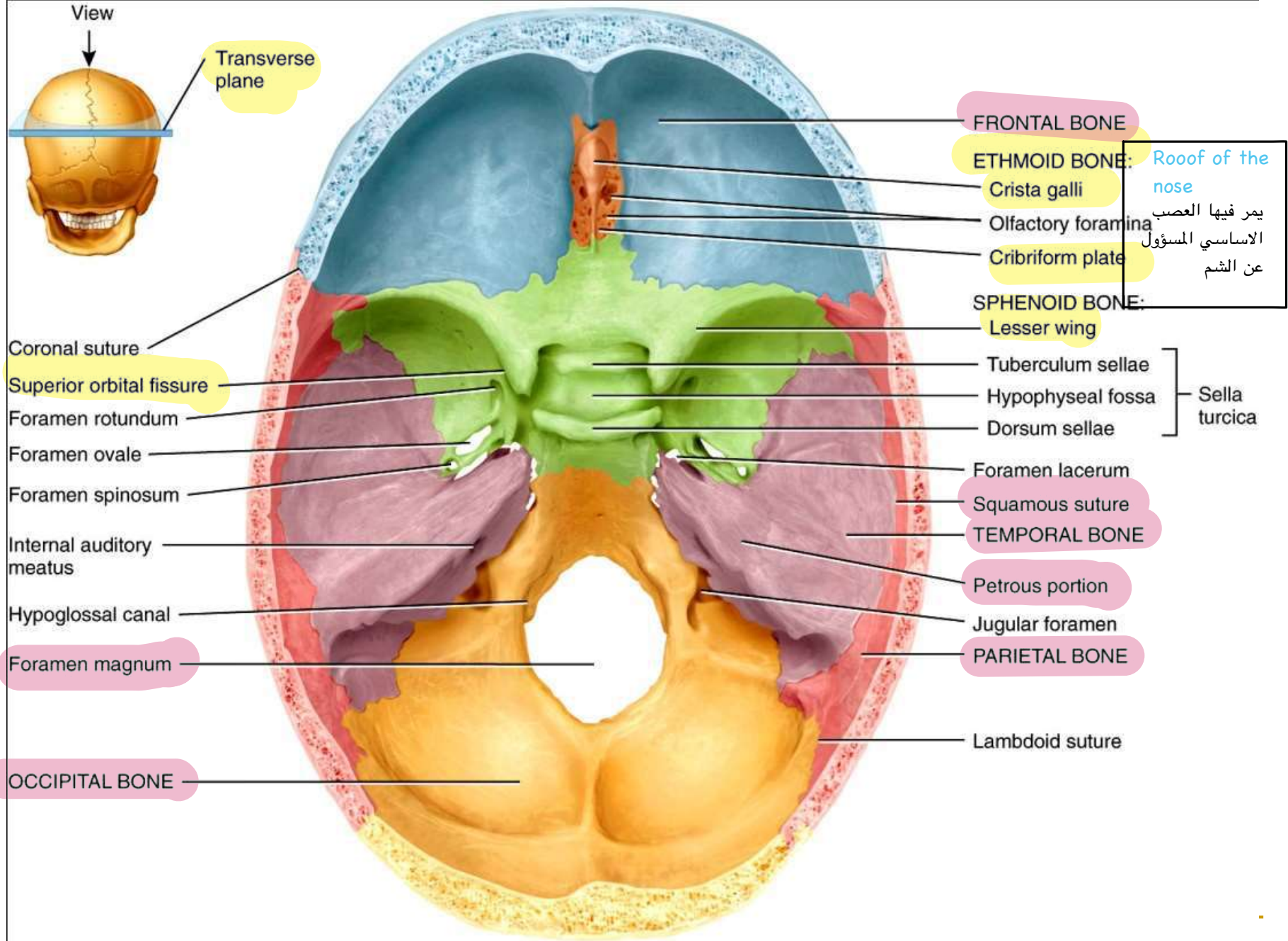
الغرز الى بتربط العظام مع بعض

- 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** الارتباط بالعضلات
المسؤولة عن تعابير الوجه
- The facial bones form the framework of the face and provide support for the entrances to the **digestive** and **respiratory** systems

Type your text

Cranial Bones:

- **Frontal Bone** عظام الجبهة
 - Forms the forehead
- **Parietal Bones** جوانب وسقف تجويف الجمجمة
 - Form the sides and roof of the cranial cavity
- **Temporal Bones** (**Zygomatic process** and **Mandibular fossa of TMJ**) تشكيل الجوانب وارضية الجمجمة
 - 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?**)
 - Forms the posterior part and most of the base of the cranium الجزء الخلفي وقاعدة الجمجمة
 - The perceptible protrusion on the back of the head is the external occipital protuberance الاشي البارز بمؤخرة الرأس



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

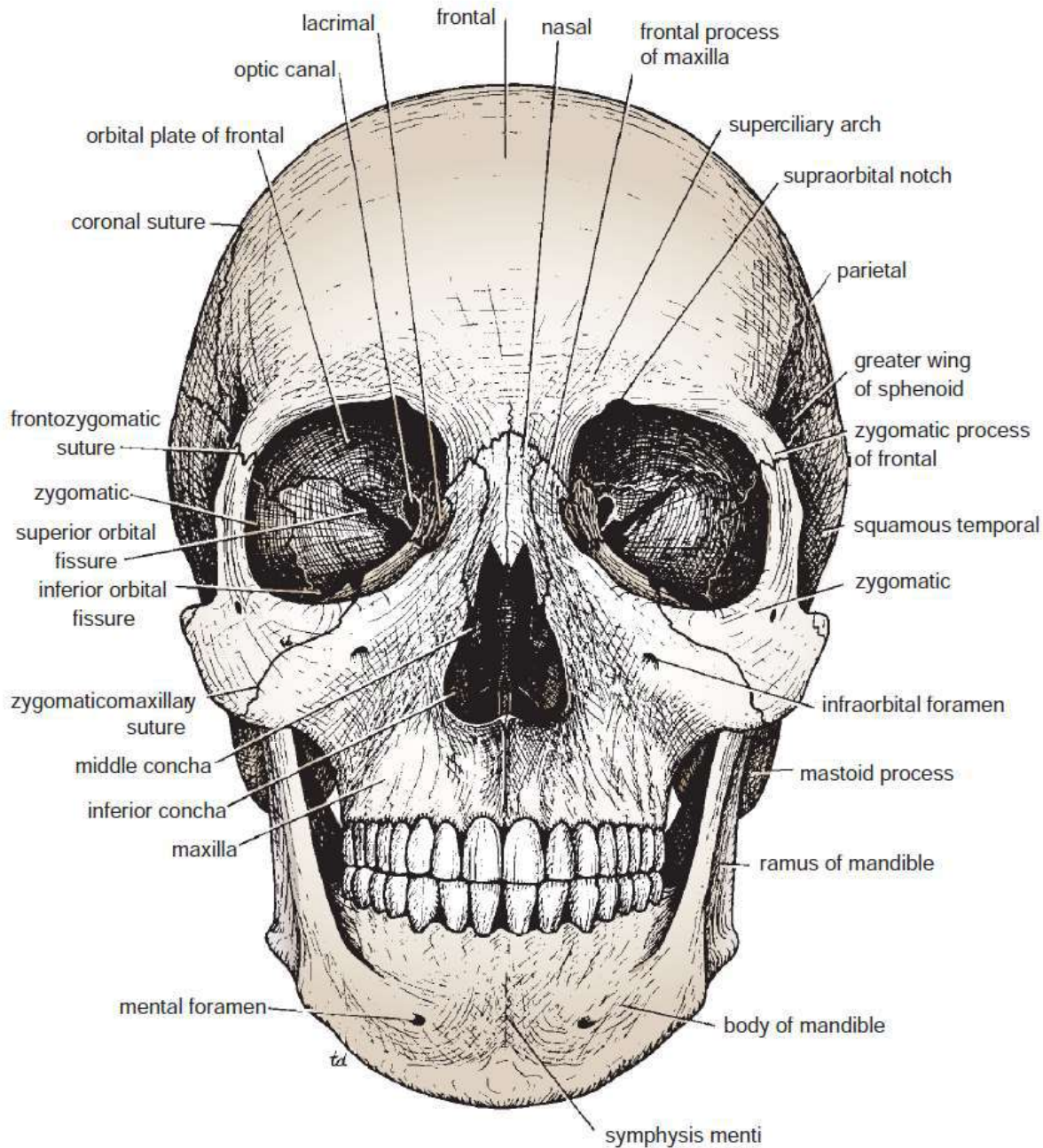
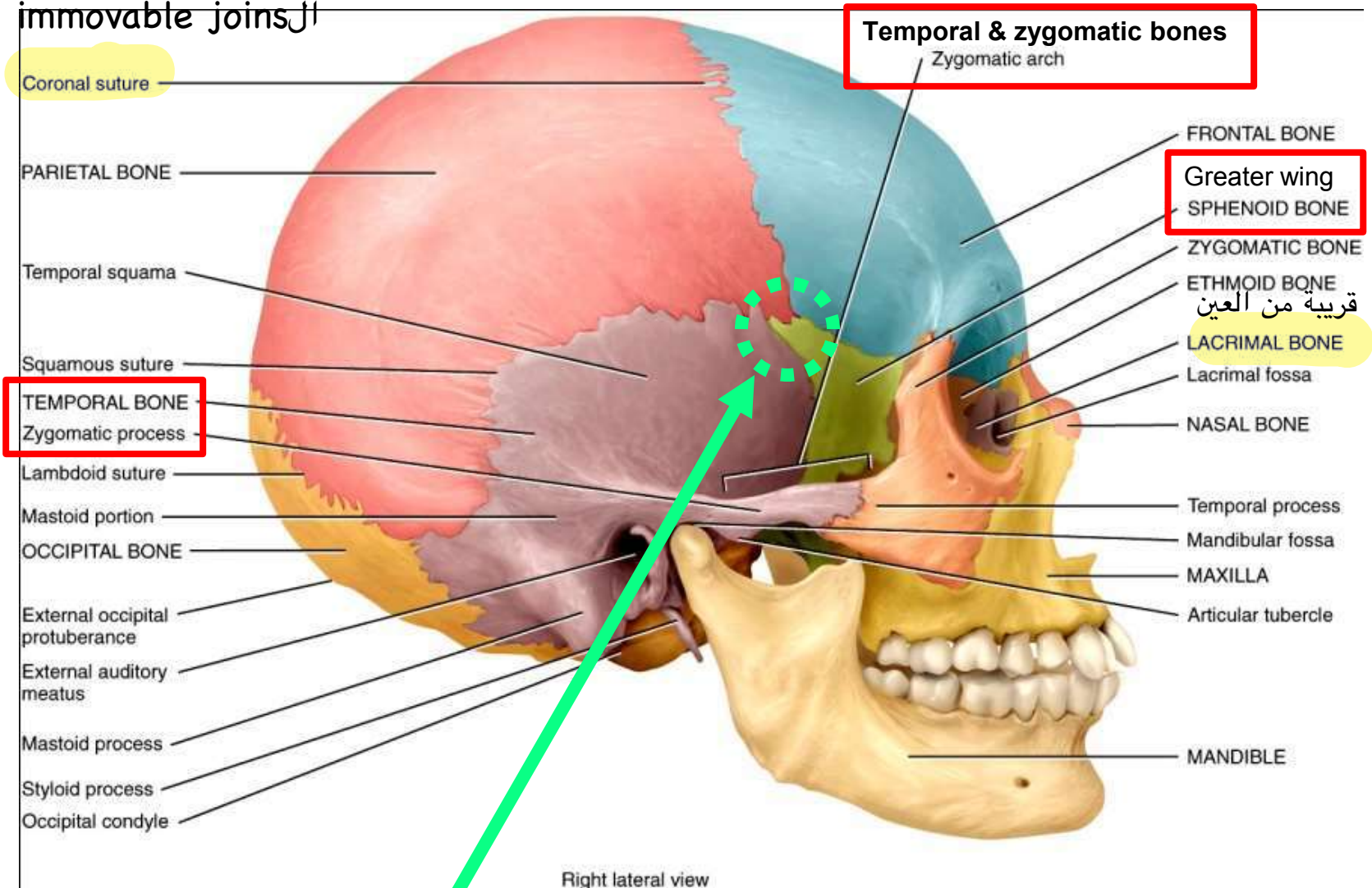


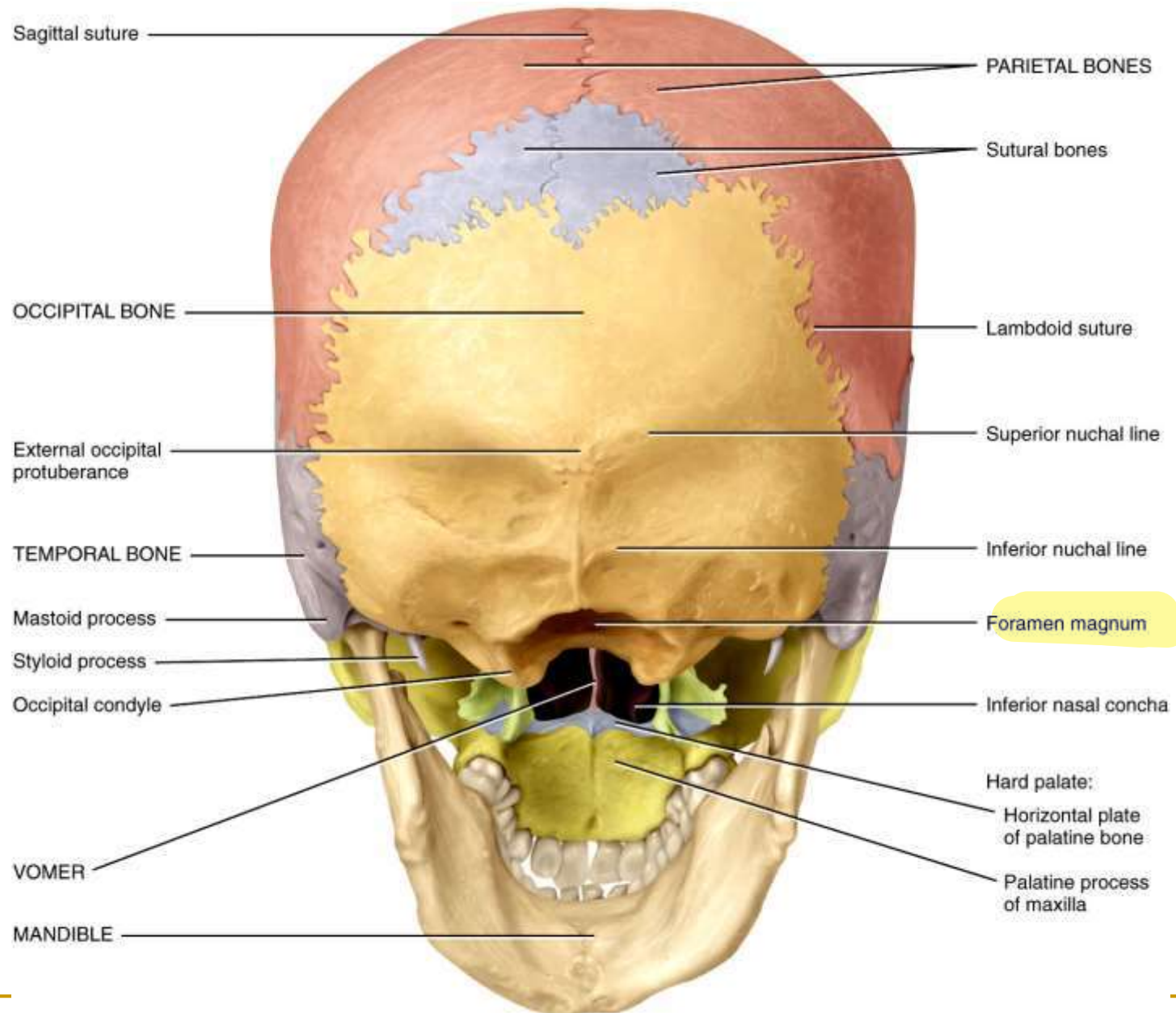
FIGURE 11.1 Bones of the anterior aspect of the skull.

غرز الي هي نفسها

ال joints immovable



Pterion: middle meningeal artery.



Posteroinferior view

Sphenoid Bone (optic nerve)

❑ Lies at the middle part of the base of the skull

❑ It's formed of:

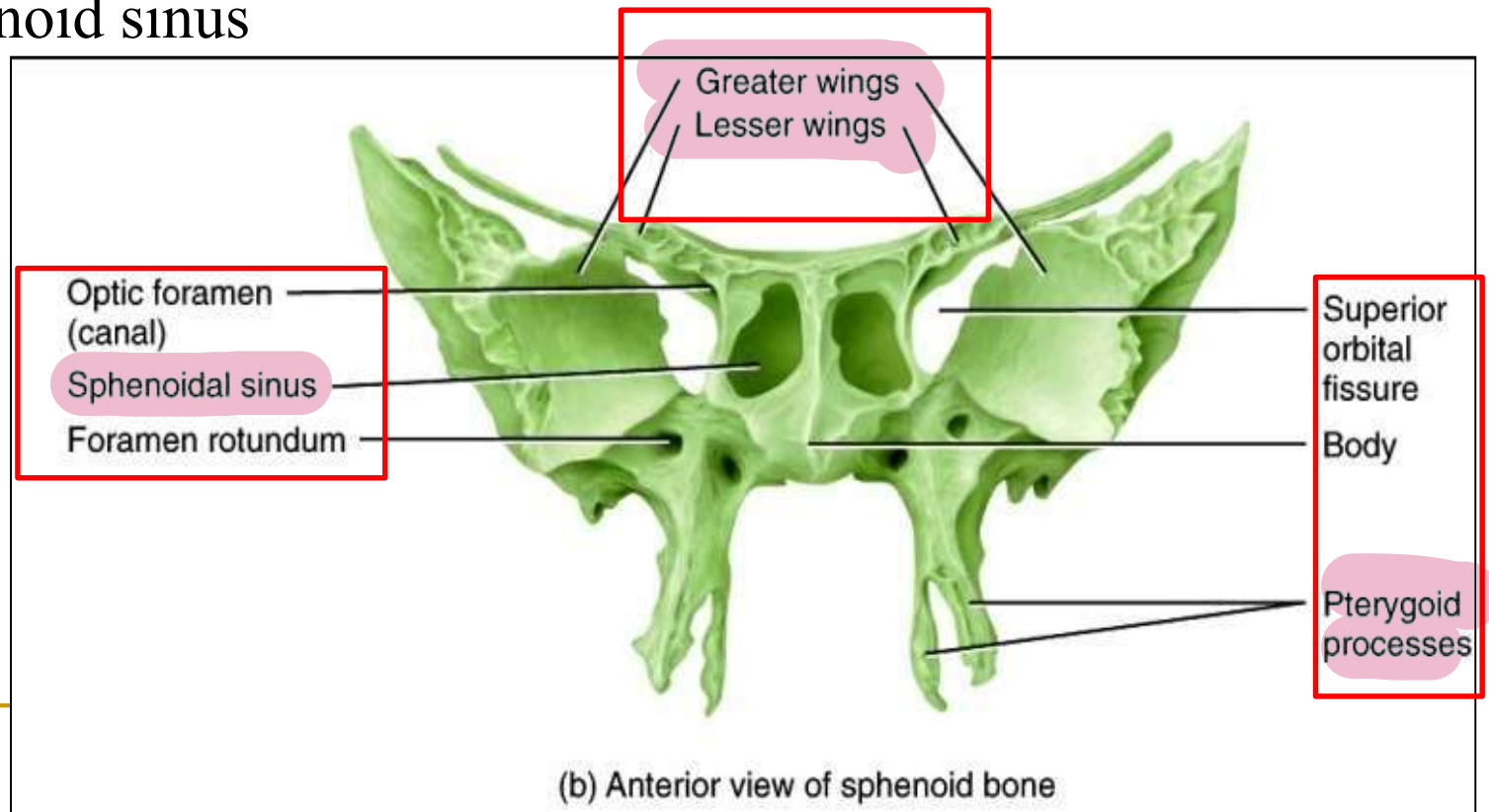
1. **Body (Sella turcica): contain the pituitary gland**

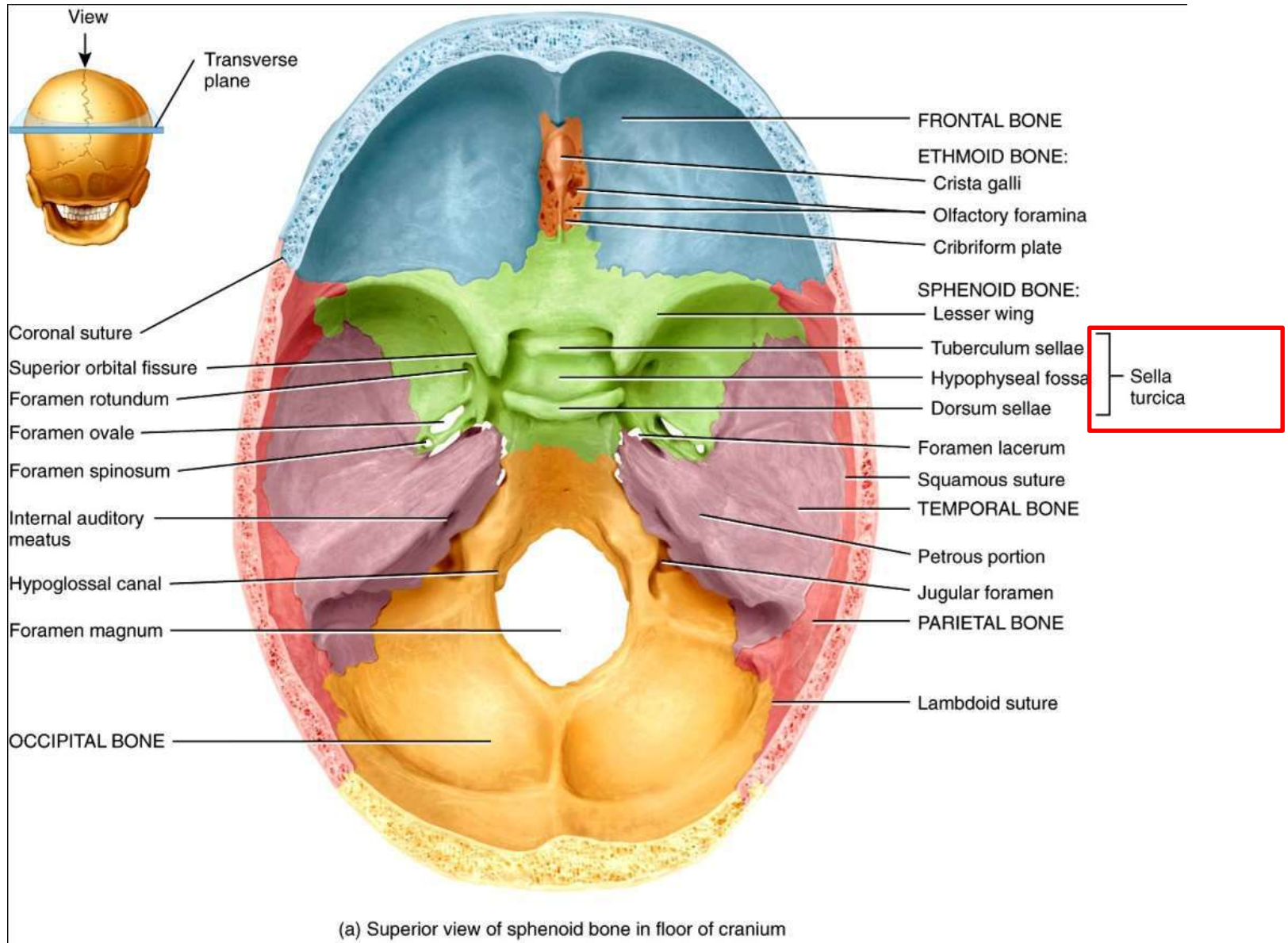
2. Lesser wings

3. Greater wings

4. Pterygoid processes

5. Sphenoid sinus



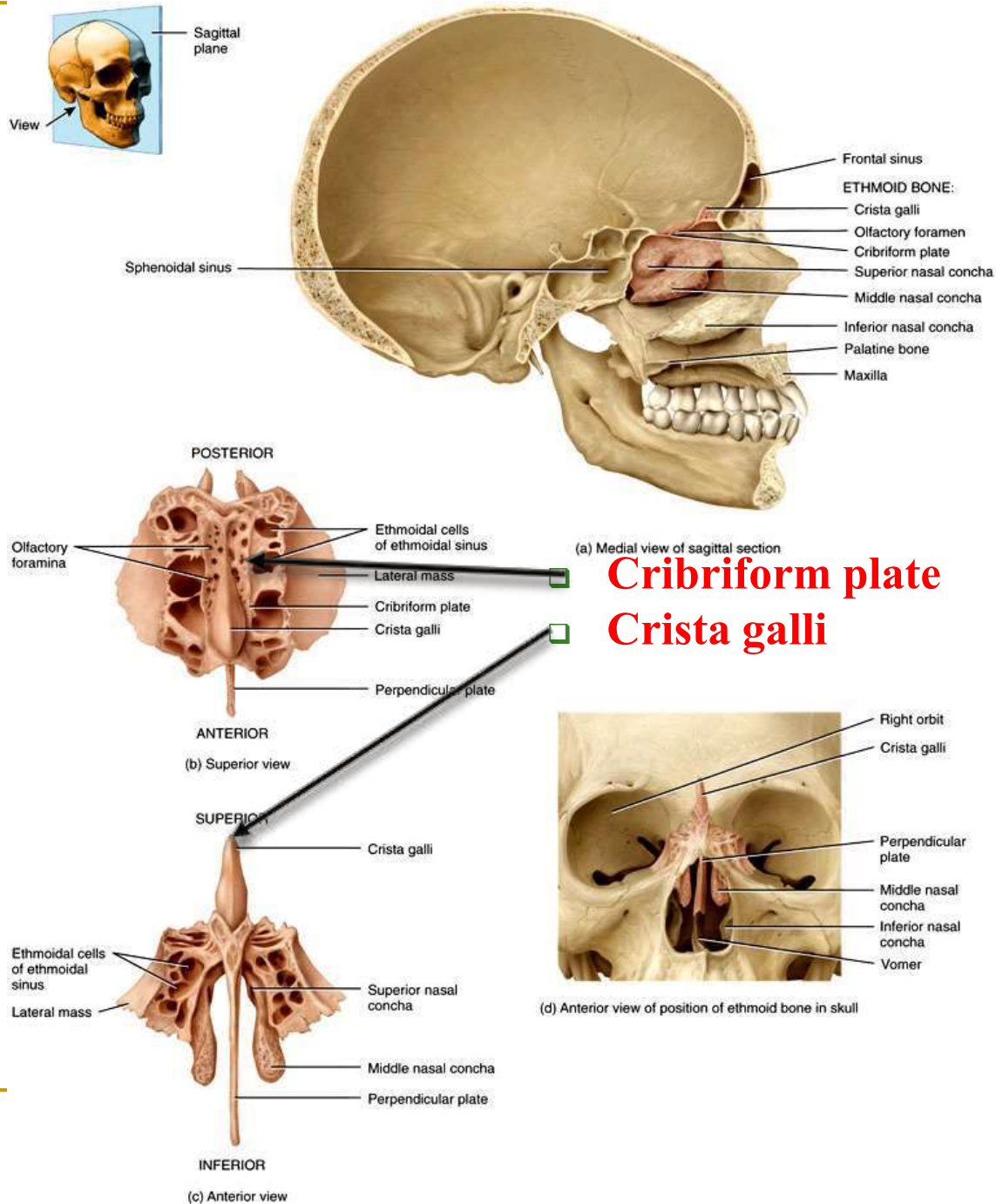


Ethmoid Bone (olfactory nerve)

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

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

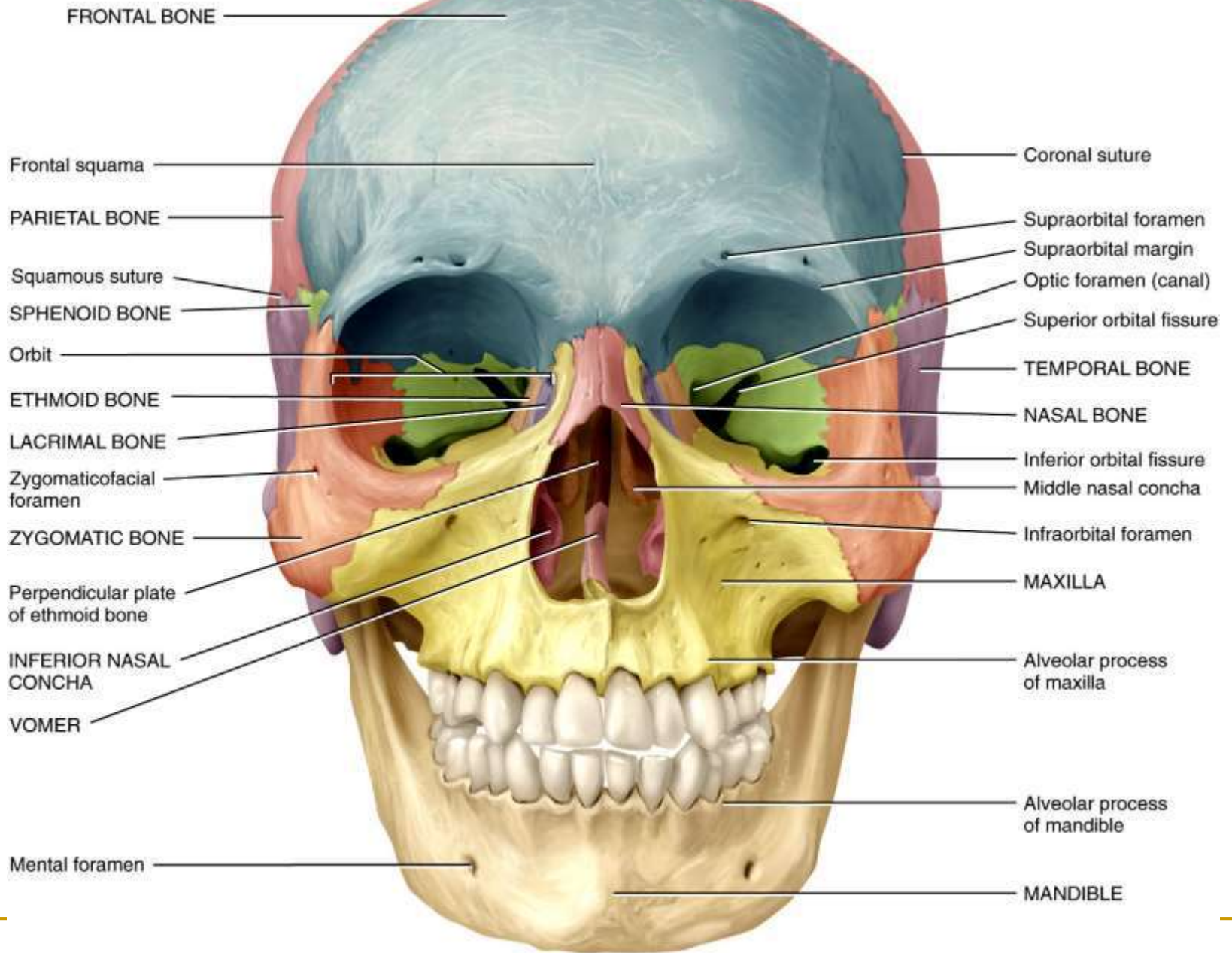
- **Vomer**

- Forms the inferior portion of the nasal septum

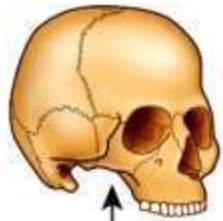
- **Mandible**

- Lower jawbone
- The largest, strongest facial bone
- The only movable skull bone

Temporomandibular joint (TMJ)
Temporal bone and the mandible



Anterior view



View

Incisor teeth

MAXILLA:

Incisive foramen

Palatine process

Zygomatic arch

ZYGOMATIC BONE

VOMER

SPHENOID BONE

Foramen ovale

Foramen spinosum

Mandibular fossa

Carotid foramen

Jugular foramen

Occipital condyle

TEMPORAL BONE

OCCIPITAL BONE

Inferior nuchal line

Superior nuchal line

PALATINE BONE
(horizontal plate)

Inferior nasal concha

Pterygoid processes

Articular tubercle

Foramen lacerum

Styloid process

External auditory
meatus

Stylomastoid foramen

Mastoid process

Foramen magnum

Mastoid foramen

PARIETAL BONE

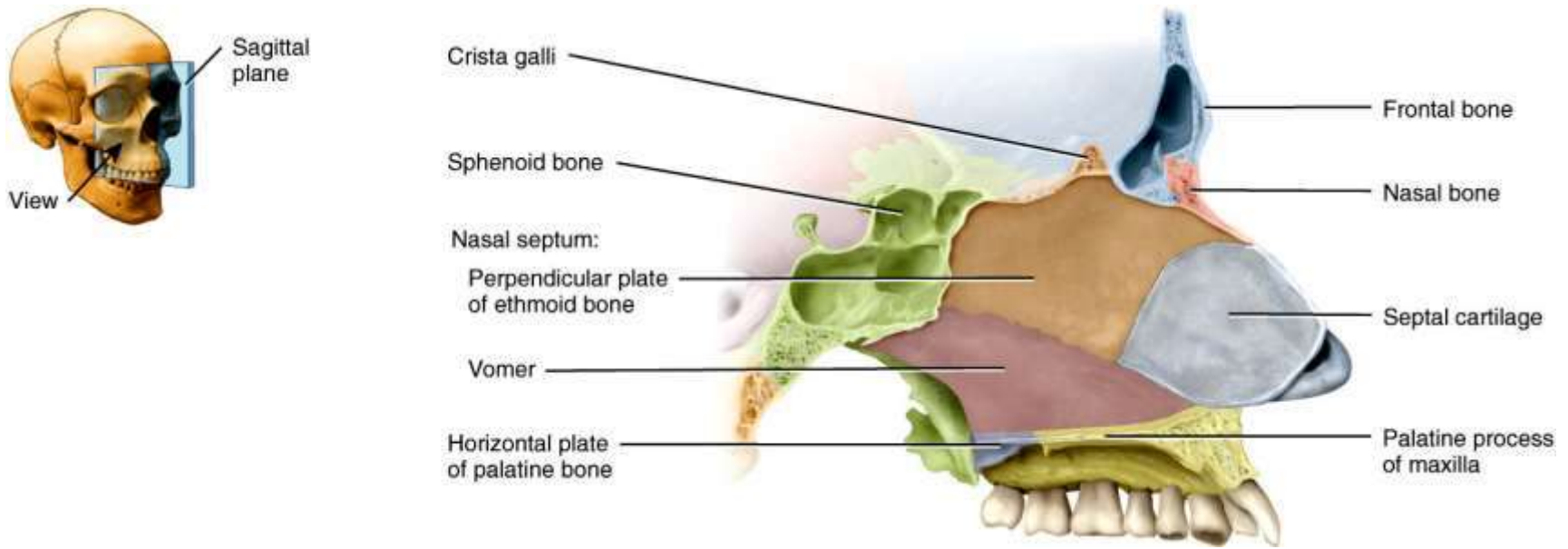
Lambdoid suture

External occipital
protuberance

Inferior view

TMJ

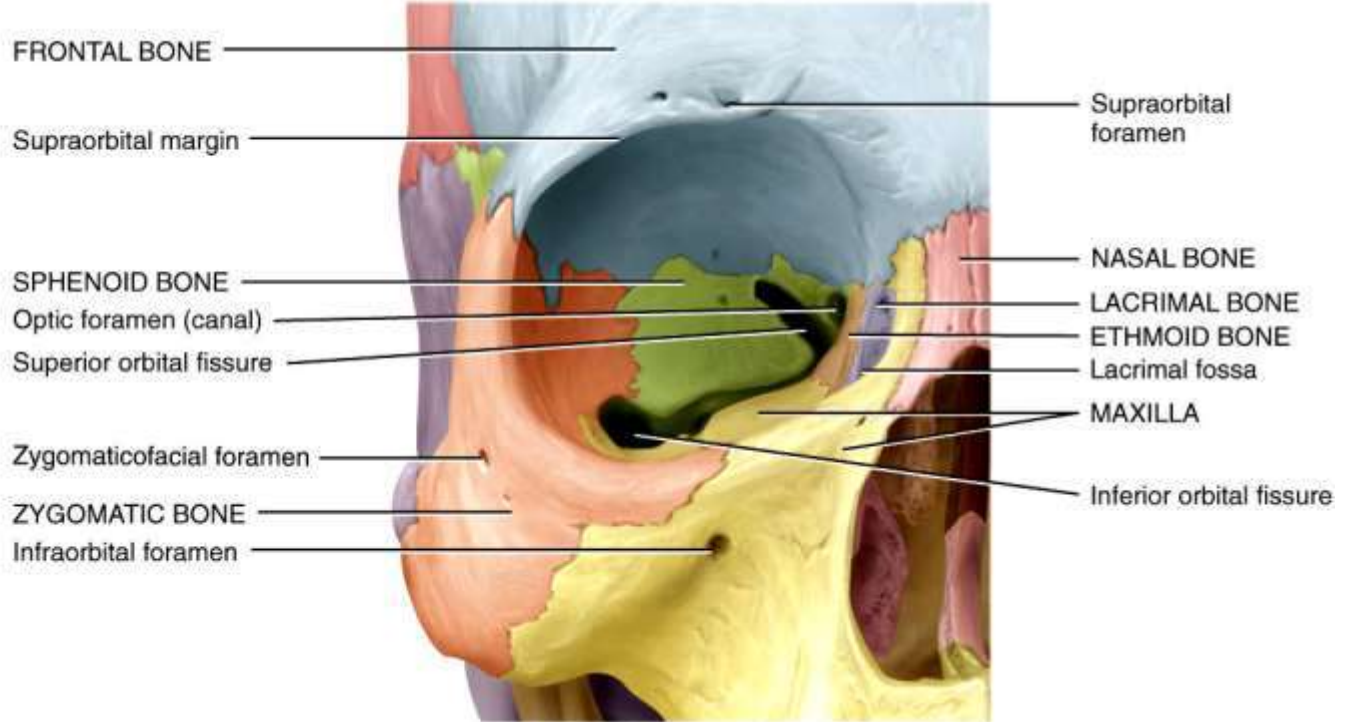
The Nasal Septum:



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:

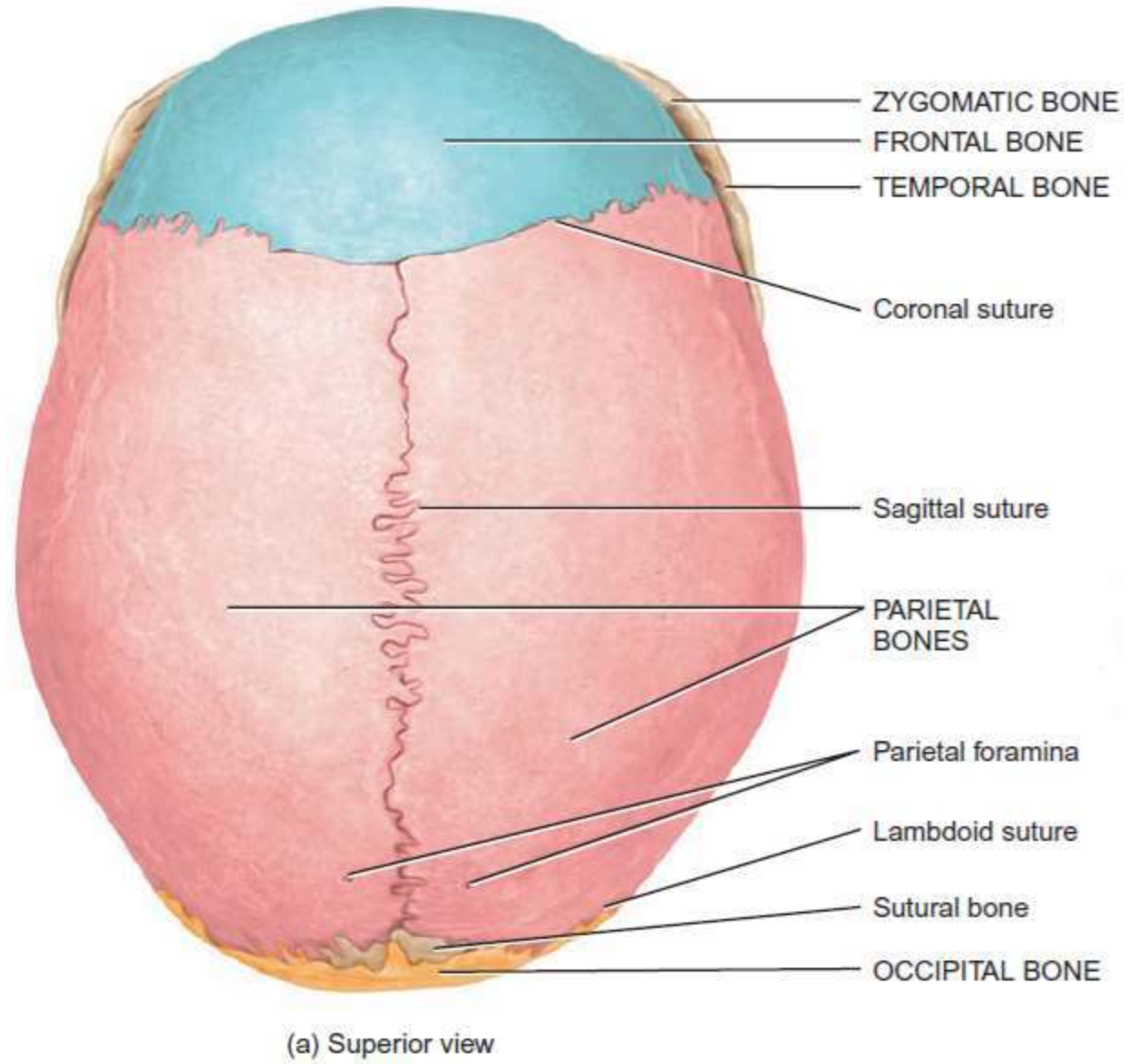


- The bones that participate in the formation of the orbital cavity are:

1-Frontal **2-Lacrimal**
3-Ethmoid **4-Maxillary**
5-Zygomatic **6-Sphenoid**

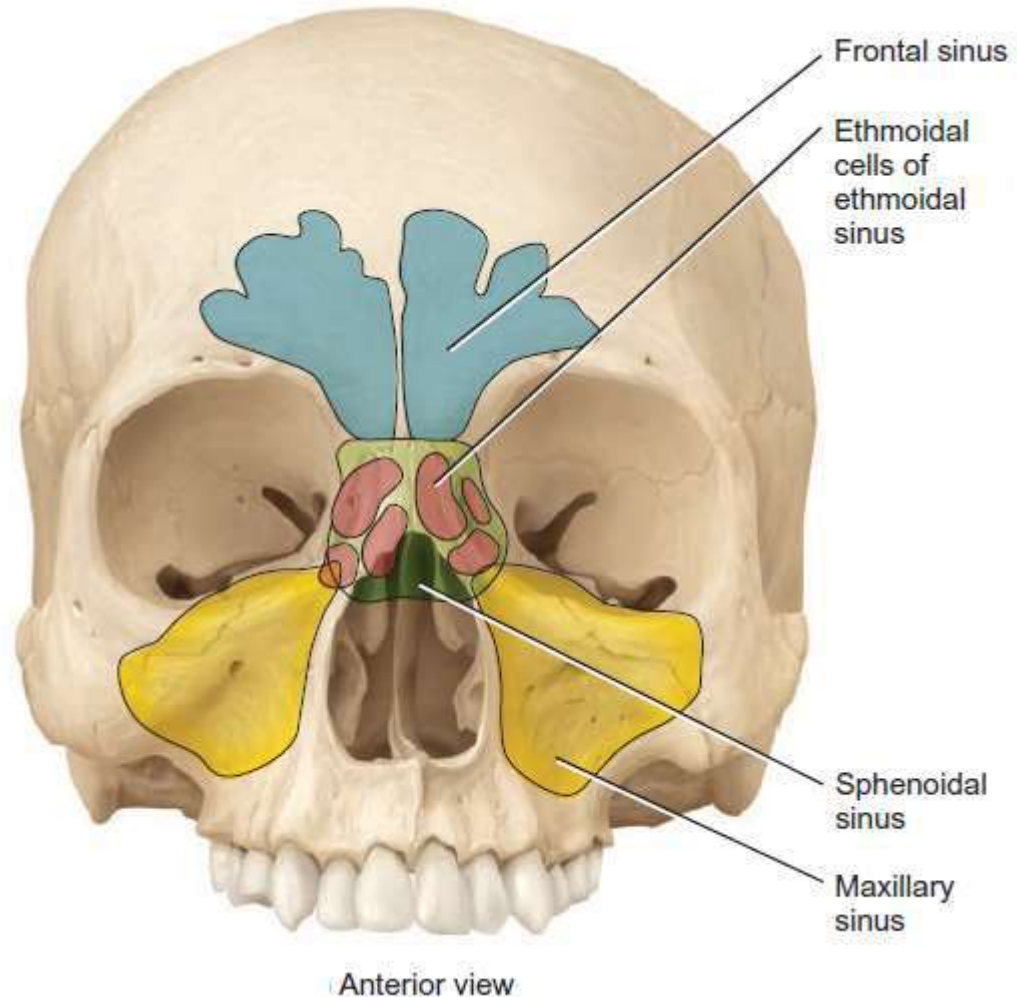
Main Sutures:

- 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



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



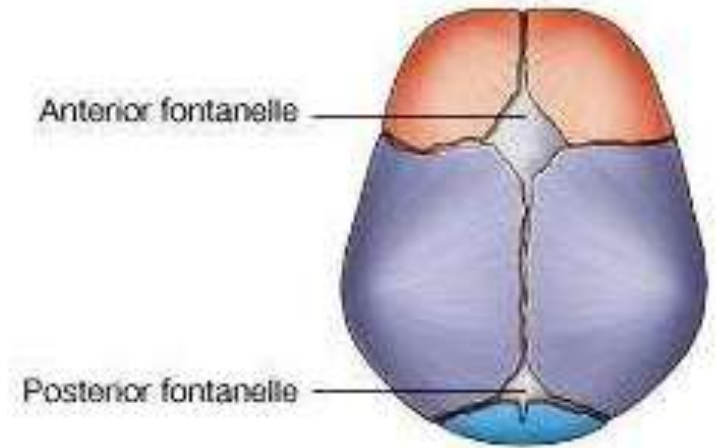
- ❖ Found in the following bones

1-Frontal **2-Ethmoid**
3-Sphenoid **4-Maxillary : Largest**

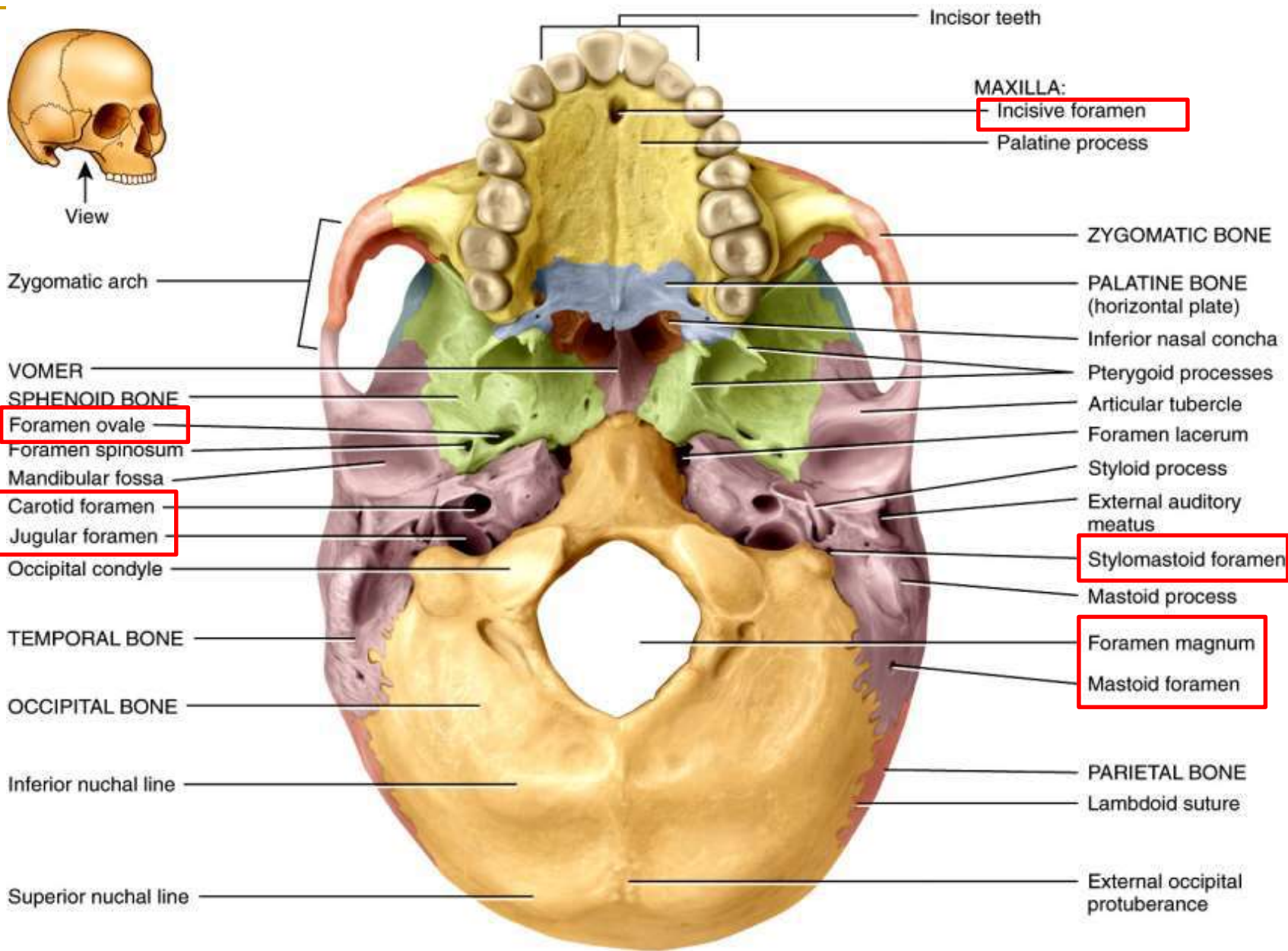
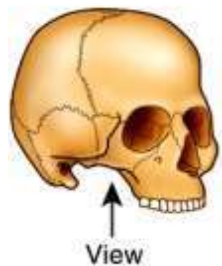
Sinusitis is an inflammation of the mucous membrane.

Fontanelles:

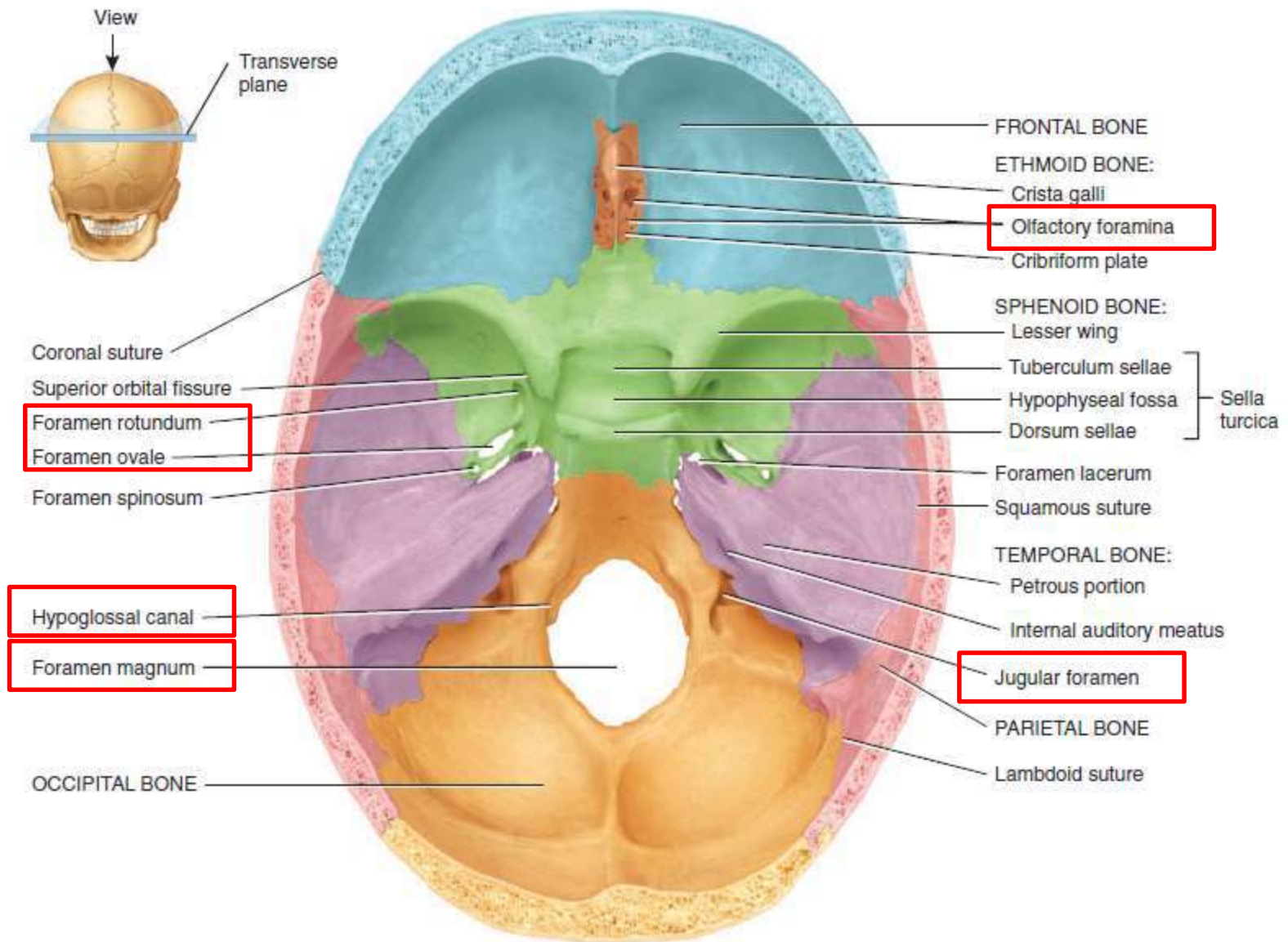
- ❑ Areas of unossified tissue that link the cranial bones at birth
- ❑ Eventually, they are replaced with bone to become sutures
- ❑ Provide flexibility to the fetal skull, allowing the skull to change shape as it passes through the birth canal



	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)



Inferior view

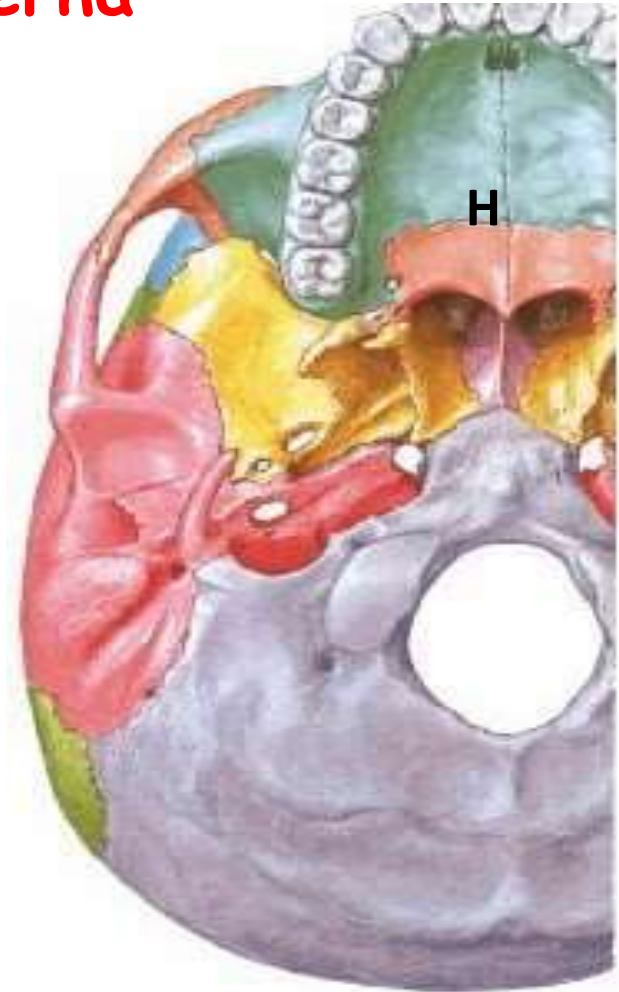


(a) Superior view of sphenoid bone in floor of cranium

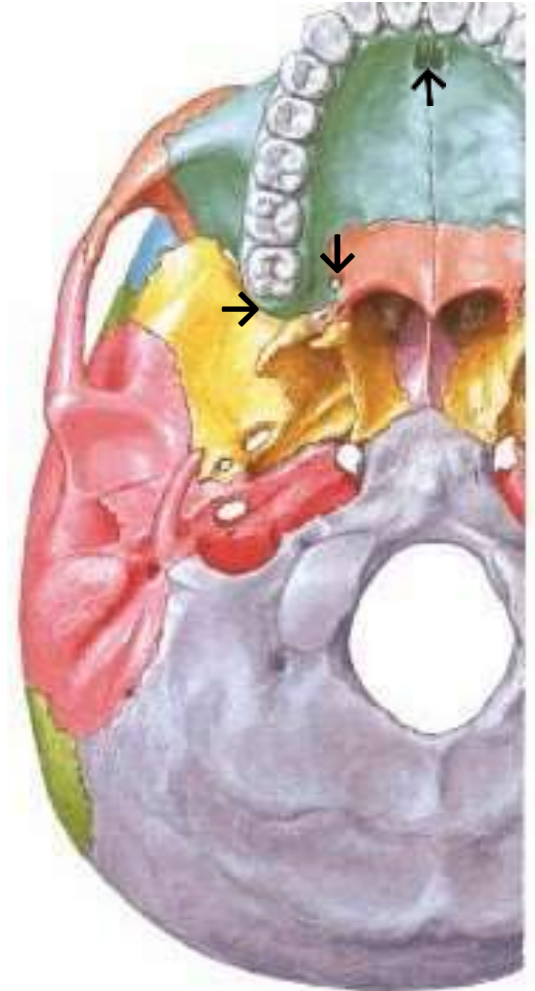
Norma Basalis Externa

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:

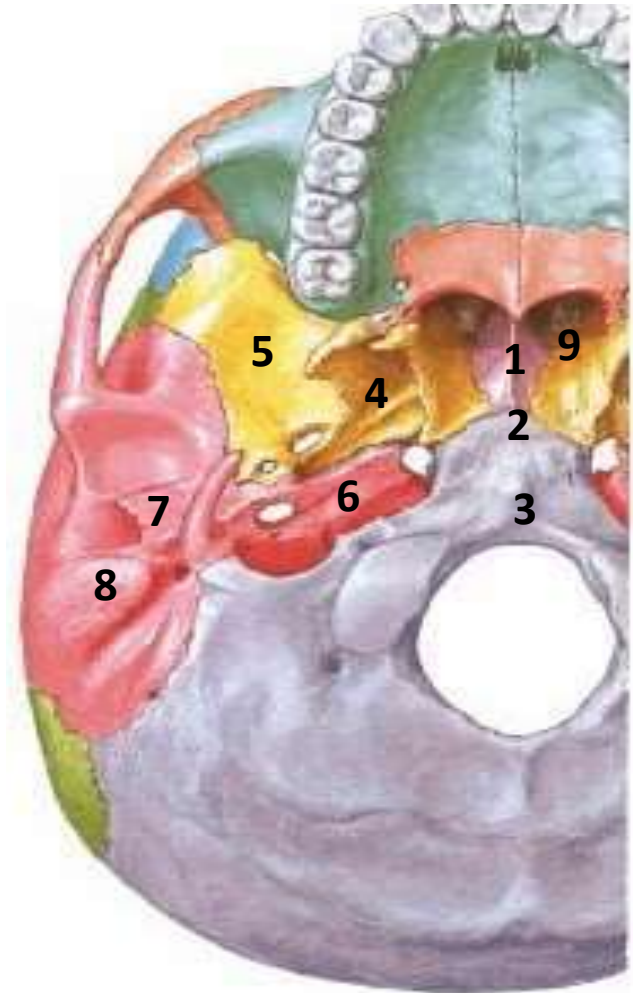
* In the middle, it shows:

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

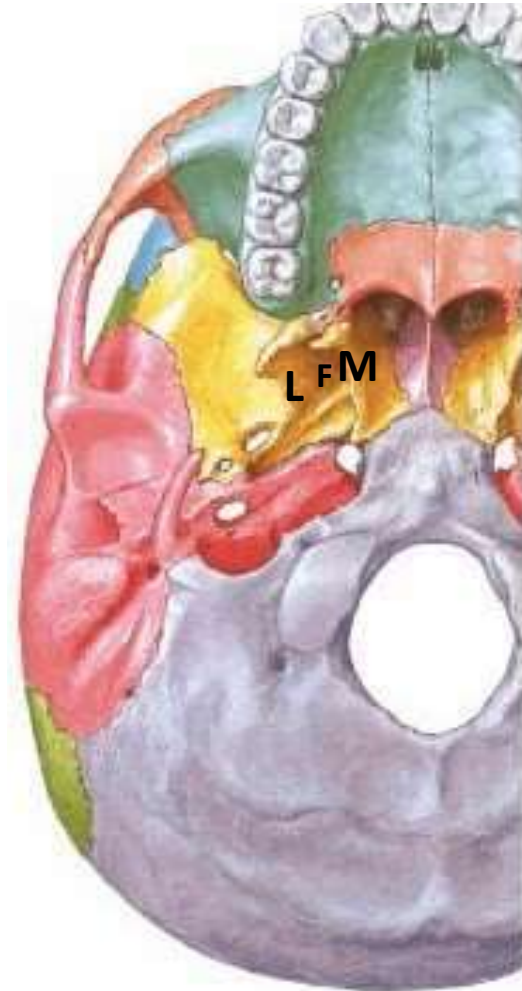
* Laterally, it shows:

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 (↓):

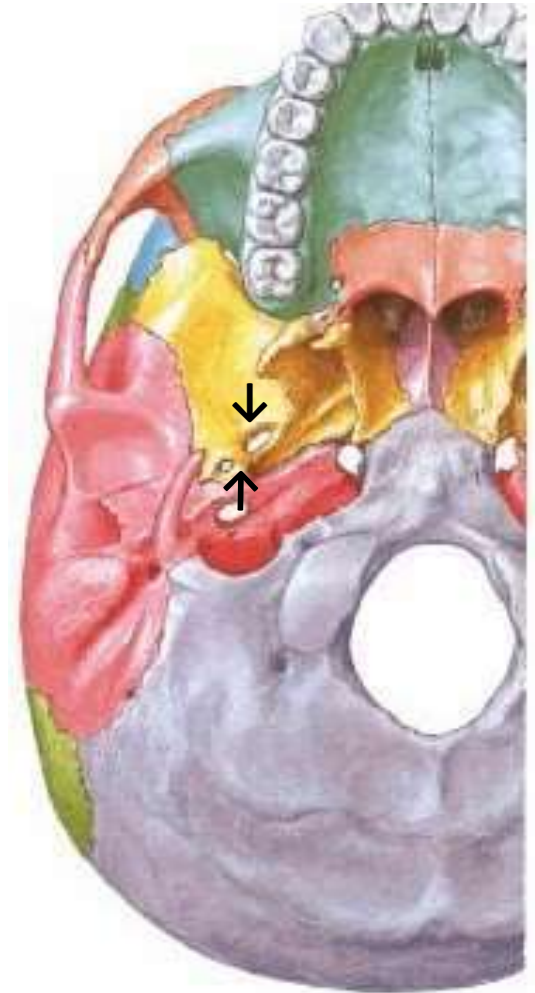
*** Gives passage to:**

- a. Mandibular nerve.
- b. Lesser petrosal nerve.
- c. Accessory meningeal artery.

2. Foramen spinosum (↑):

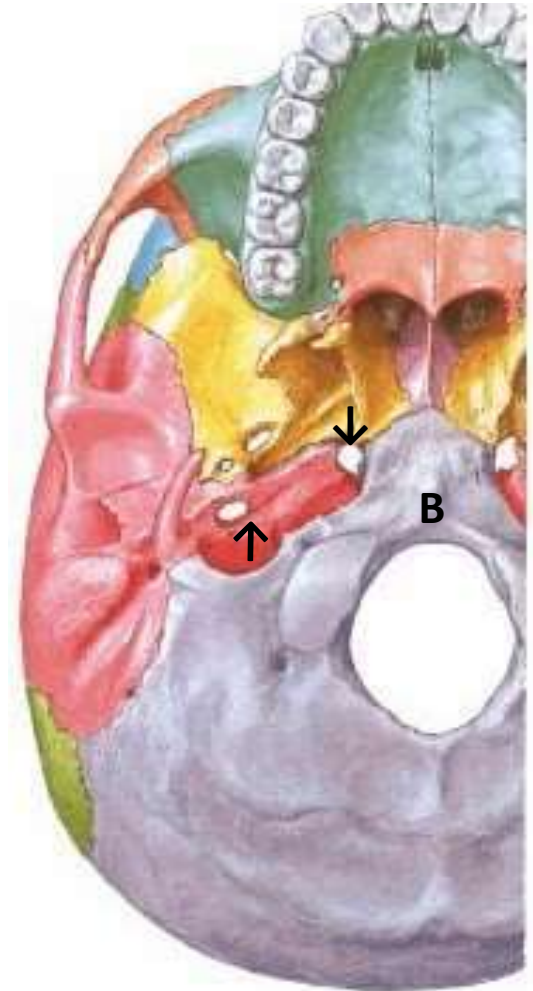
*** Gives passage to:**

- a. Nervus spinosus.
- b. Middle meningeal artery.



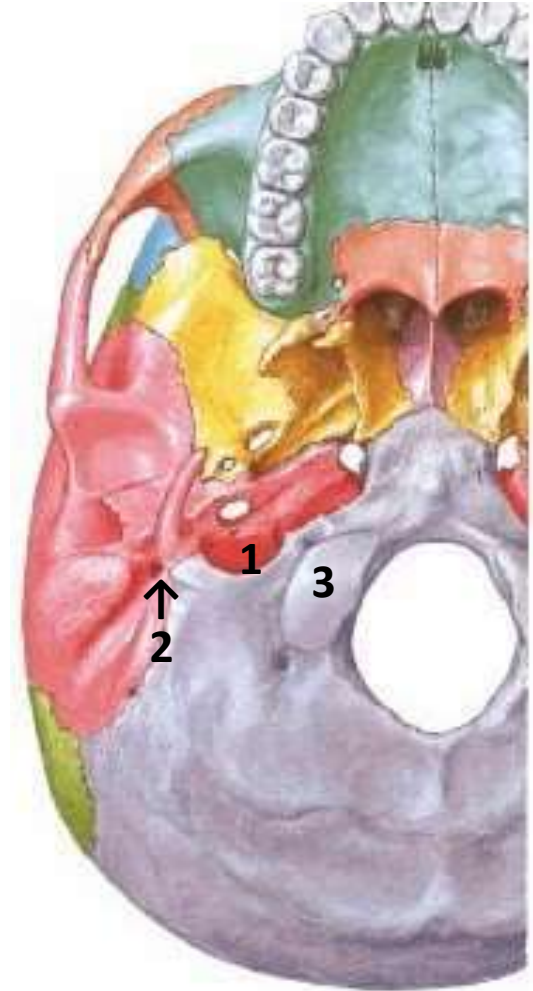
C. Posterior part:

- ** **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.

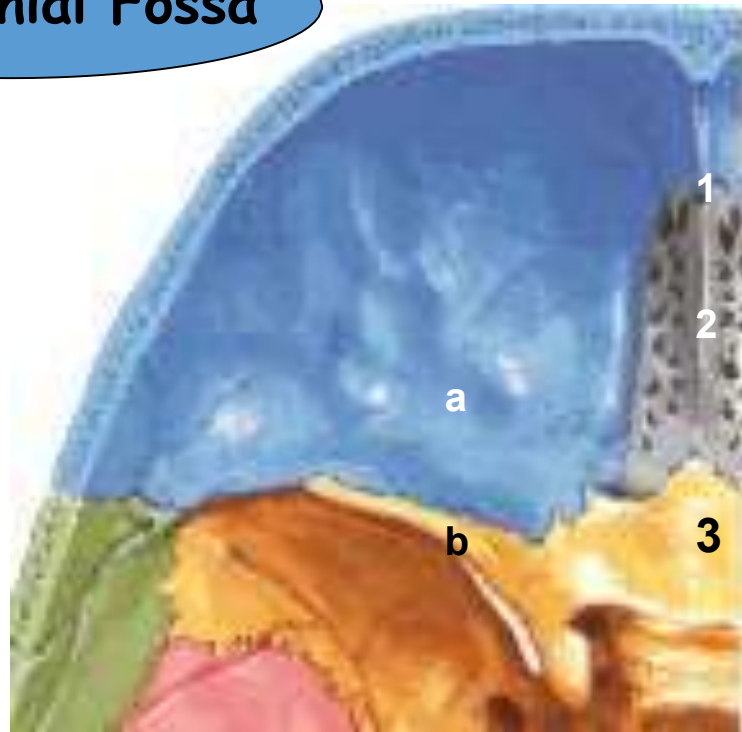
2 Ethmoid.

3 Sphenoid.

* On each side:

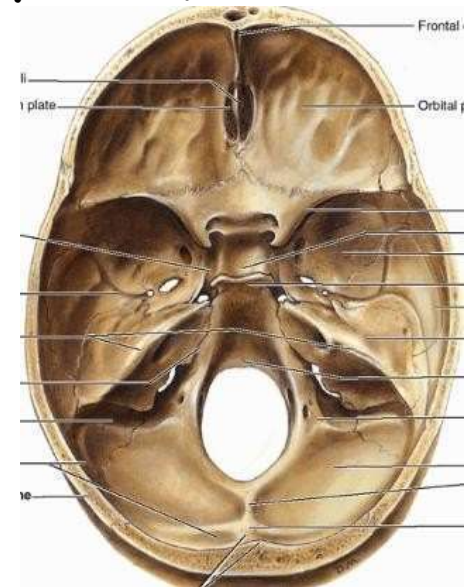
a. Frontal bone.

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:**

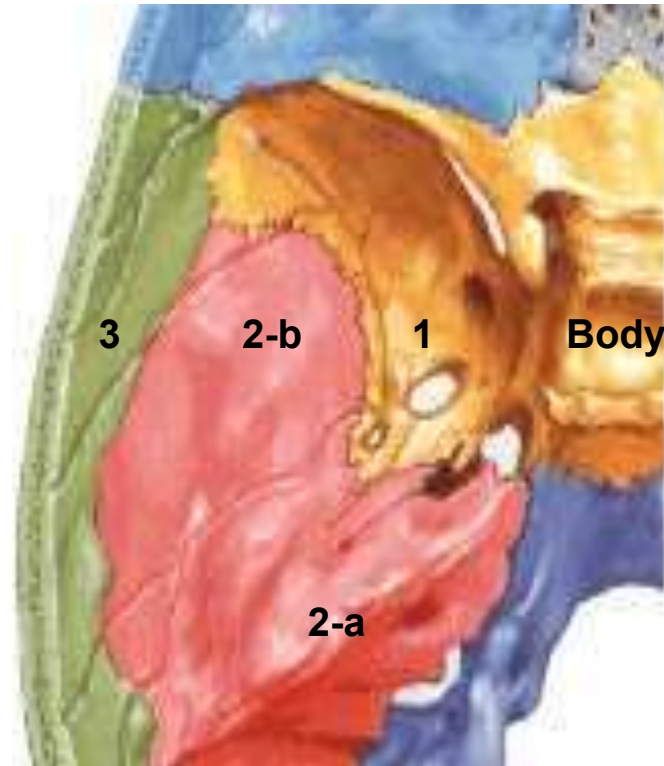
1 Sphenoid (greater wing).

2- Temporal bone:

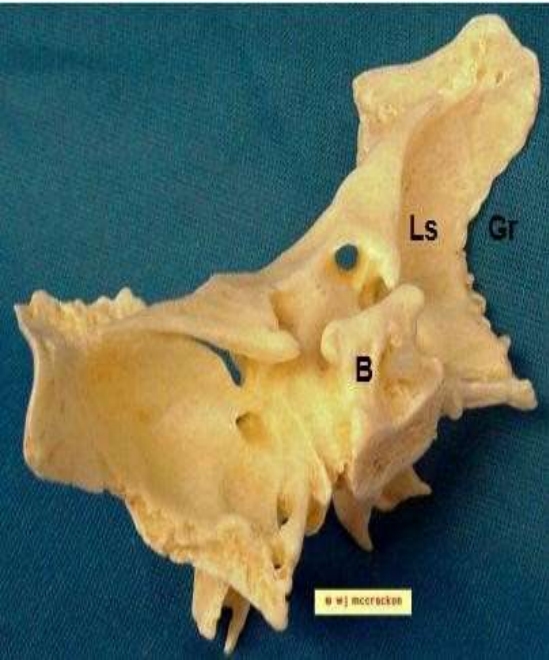
a. Petrous part.

b. Squamous part.

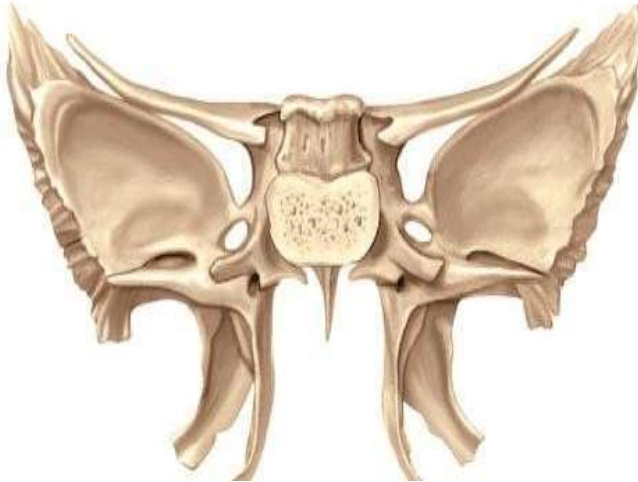
3- Parietal bone.



sphenoid bone is like a butterfly



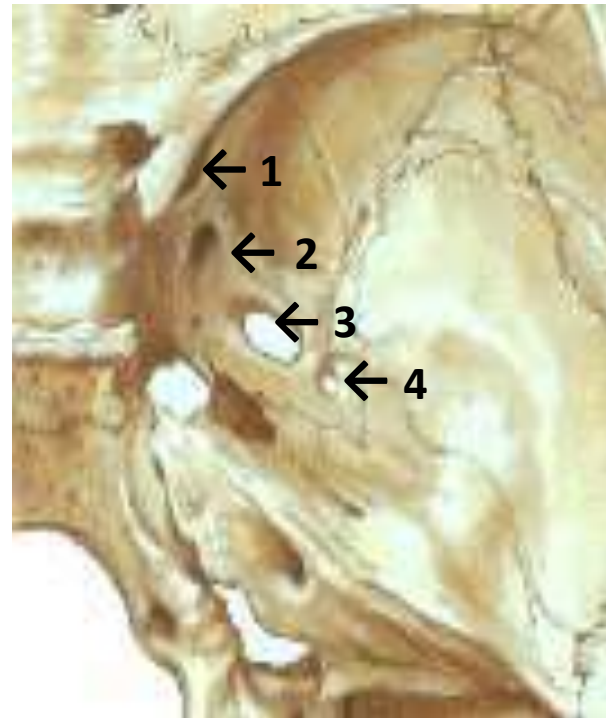
(a) Superior view



* 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:

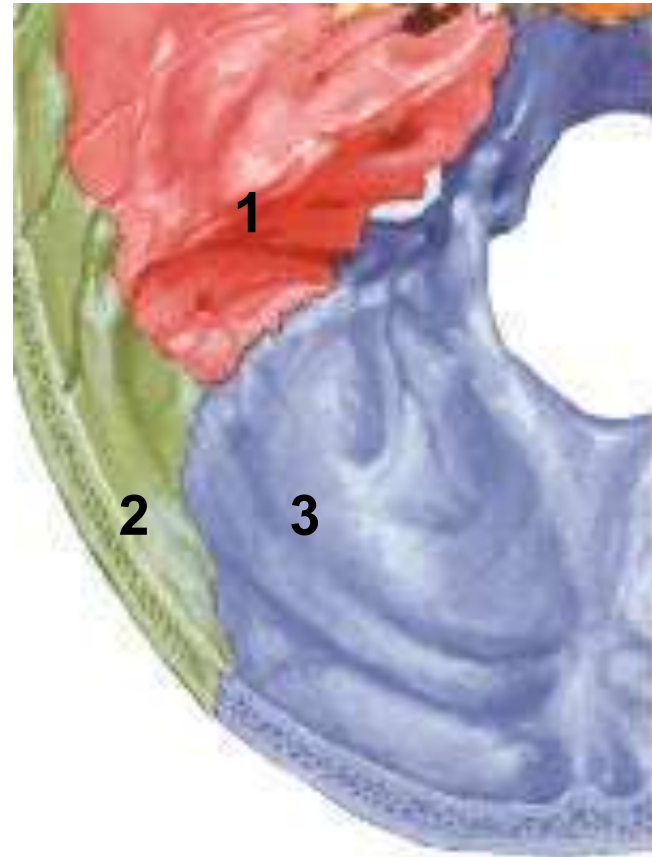
Occipital bone.

* Laterally-placed:

1 Petrous part of temporal bone.

2 Parietal bone.

3 Occipital bone.



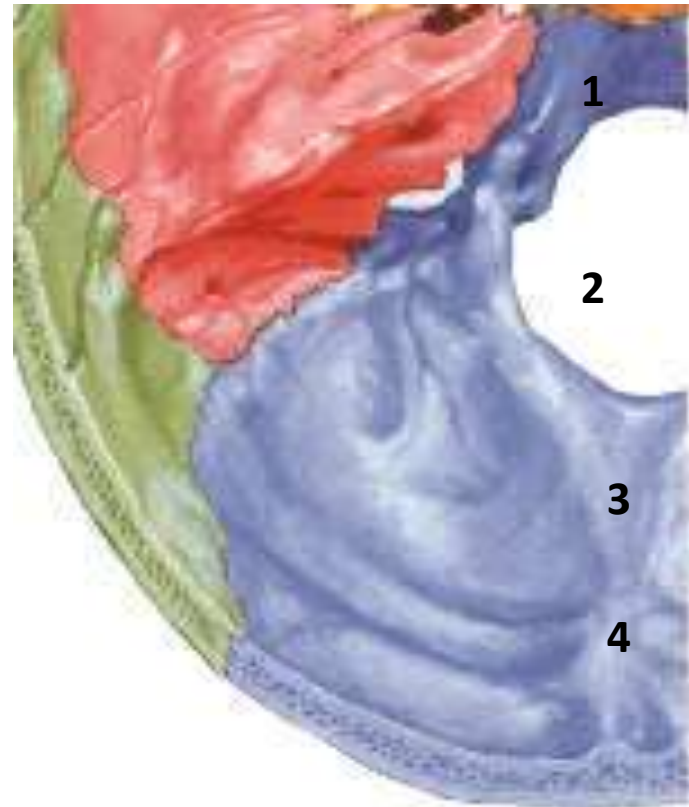
* Midline structures in the posterior cranial fossa :

1. Clivus (formed by: body of sphenoid + basilar part of occipital bone).

2. Foramen magnum.

3. Internal occipital crest.

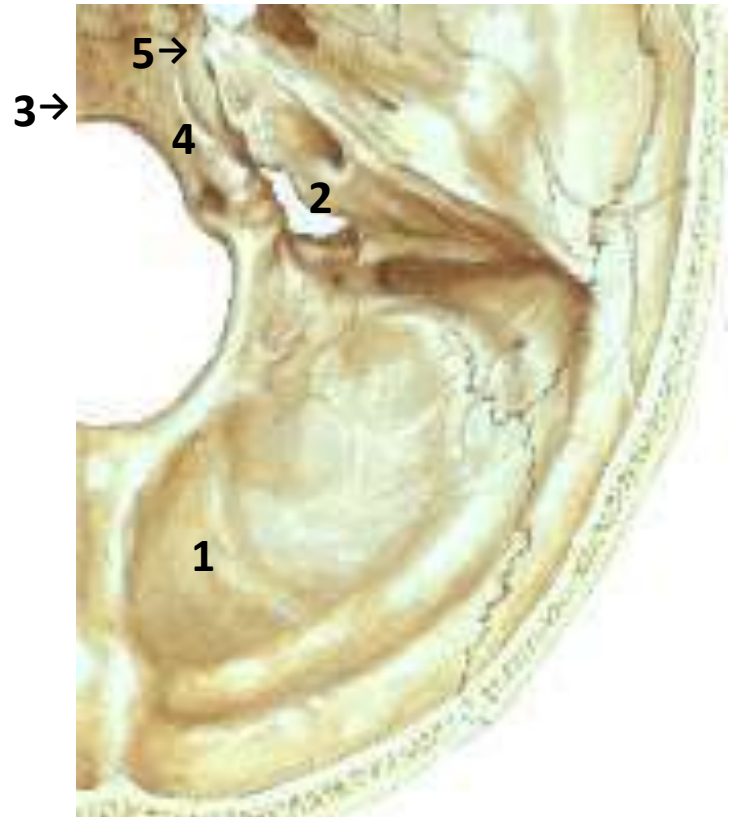
4. Internal occipital protuberance.



* Laterally-placed structures in the post. cranial fossa:

* Two sulci & 3 foramina:

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

Dr. Jihad Alzyoud

Associate Professor of Anatomy & Histology

Jihada@hu.edu.jo
Jihada@staff.hu.edu.jo

Mandible

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

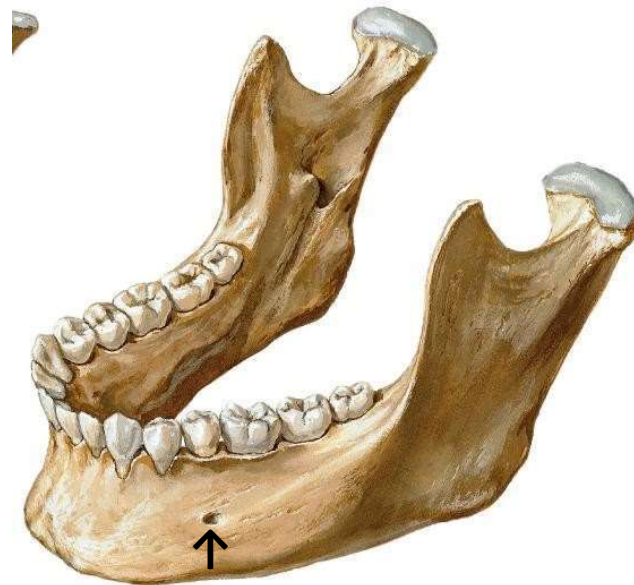
** The mandible is formed of a **body** and **two rami**.



A. The body

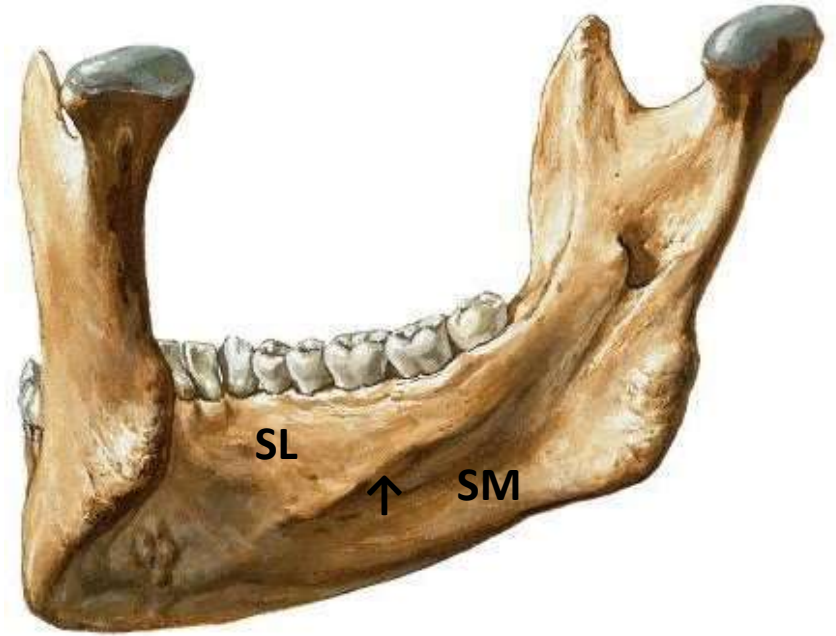
* External surface:

* 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

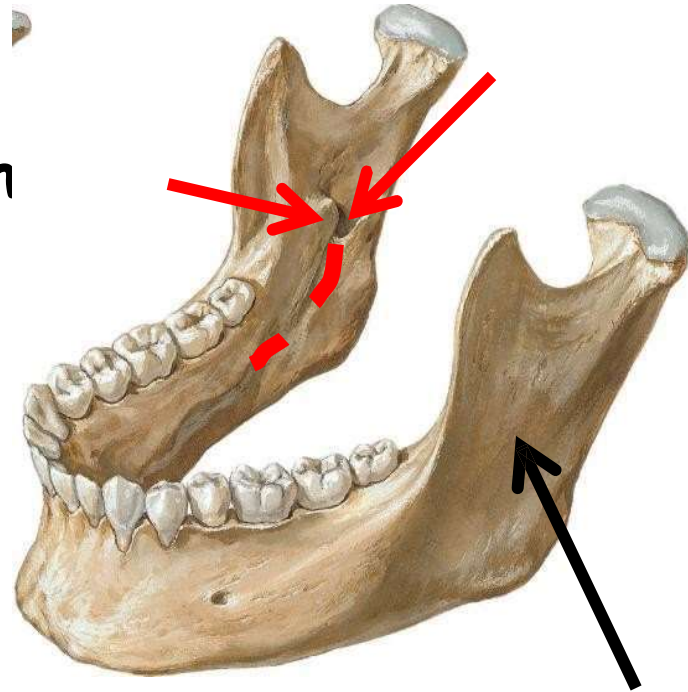
* It has two surfaces.

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

• Projecting over the foramen is the **lingula**.

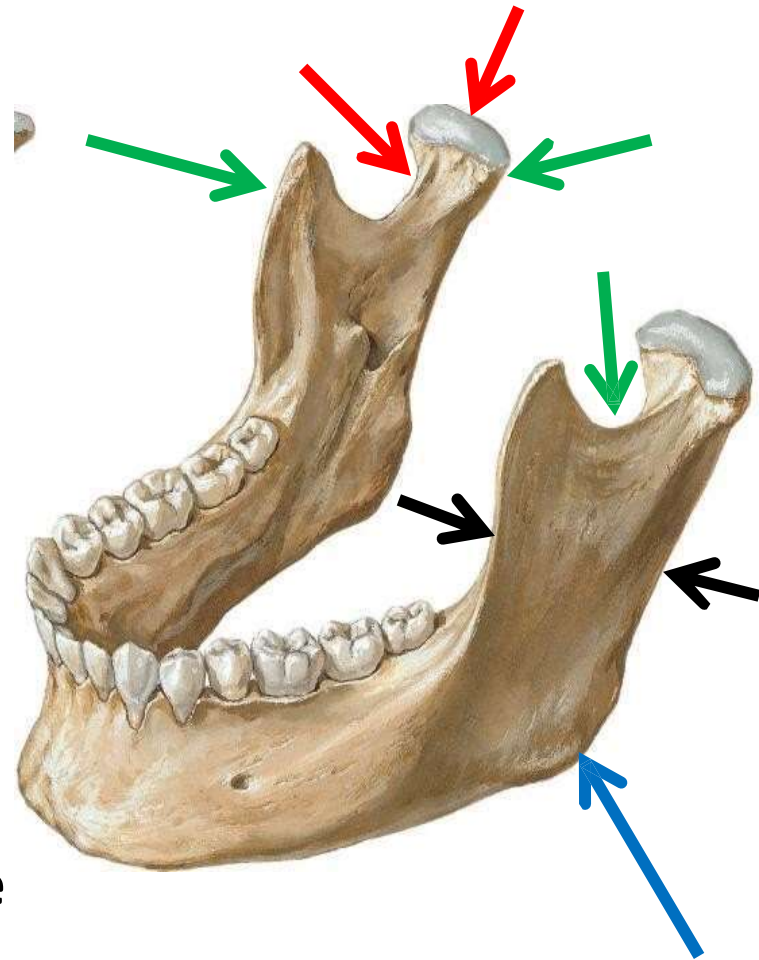
• The **mylohyoid groove** starts at the lower border of the foramen.

2. The lateral surface: is flat

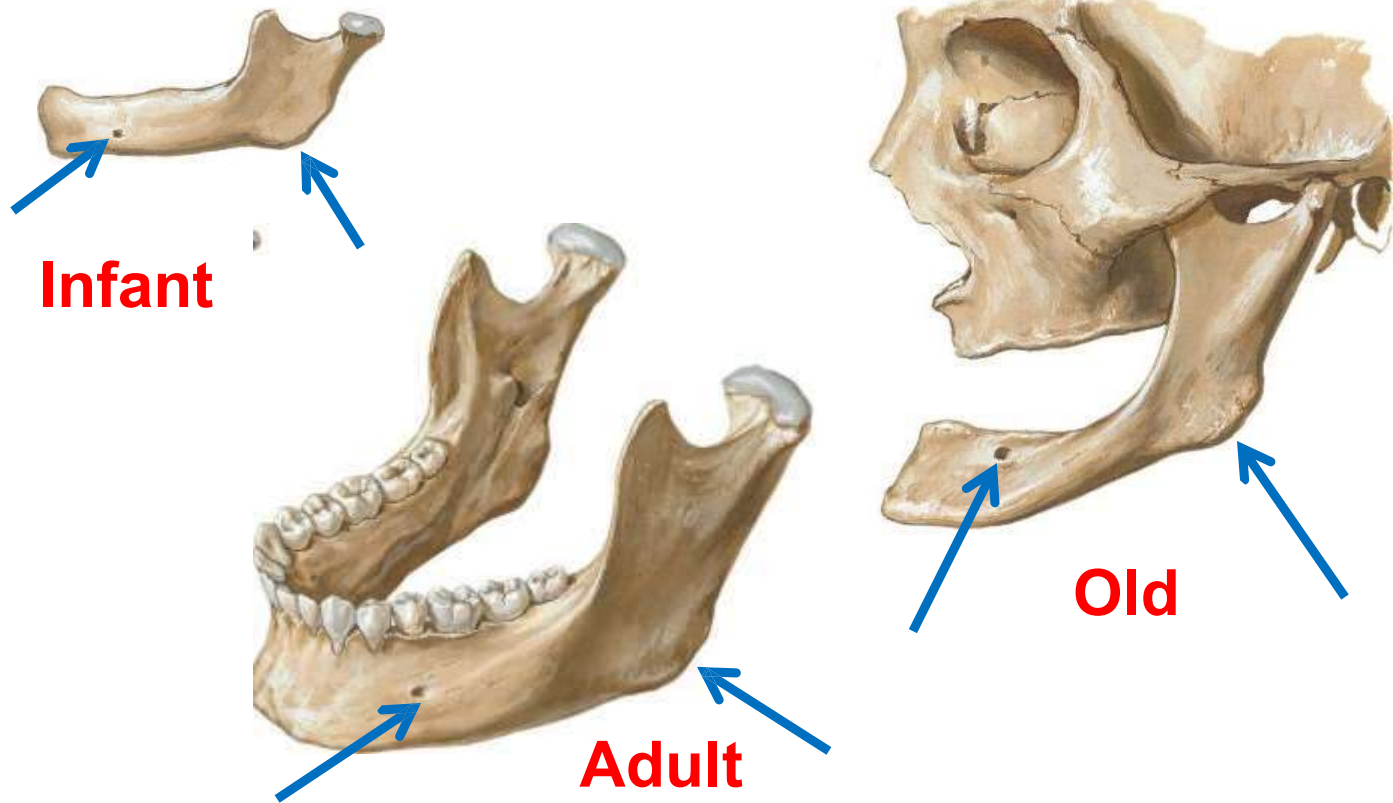


**** Upper border:**

- 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 .

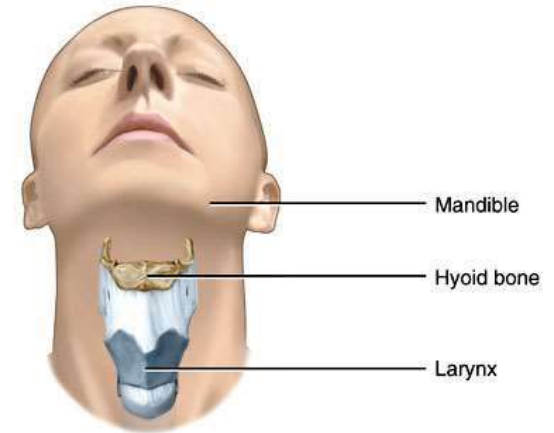


Age changes of the mandible

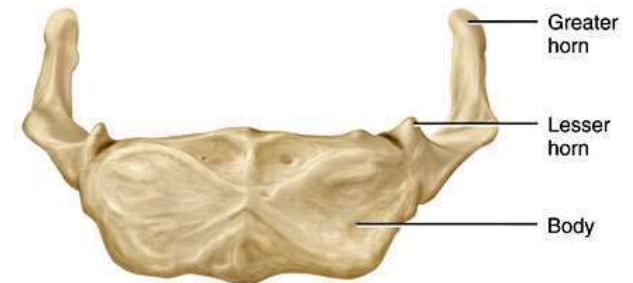


The Hyoid Bone

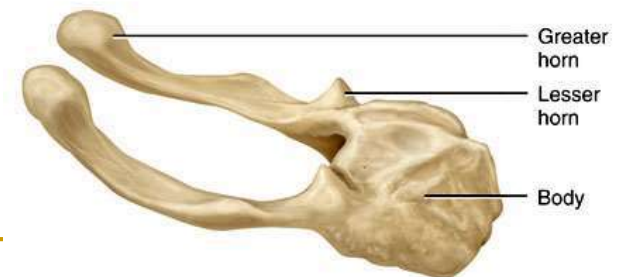
- Located in the upper part of the neck
- The only bone in the body that does not articulate with any other bone
- Supports the tongue, providing attachment sites for some tongue muscles and for muscles of the neck and pharynx and some ligaments
- Formed of body, greater horns and lesser horns



(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.

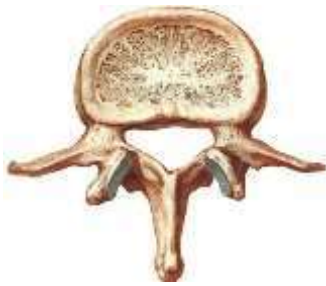


* **The column is divided into 5 regions:**

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:

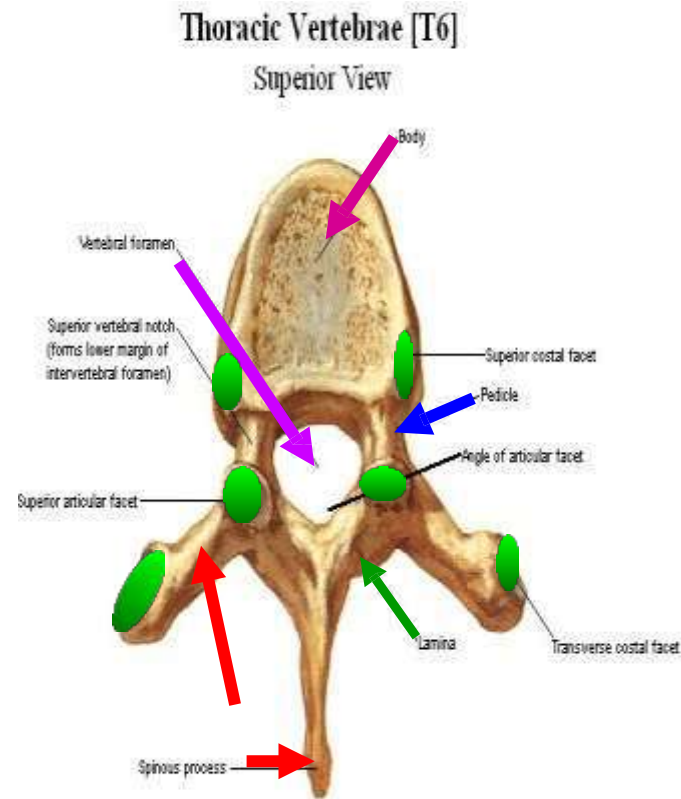
(a) **The cervical curve**: becomes convex anteriorly when the child extends his head at the 3rd - 4th month.

(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.



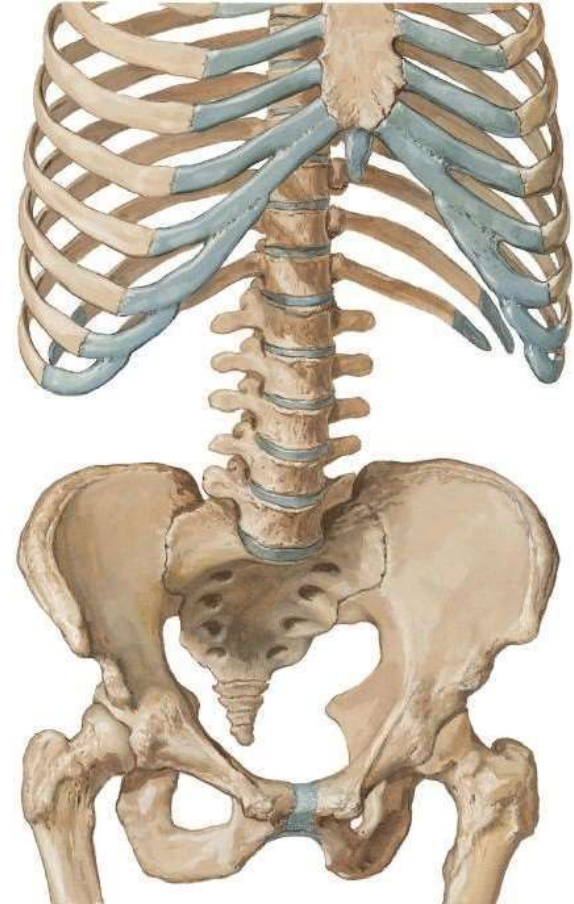
7th Cervical Vertebra

*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 transversaria 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

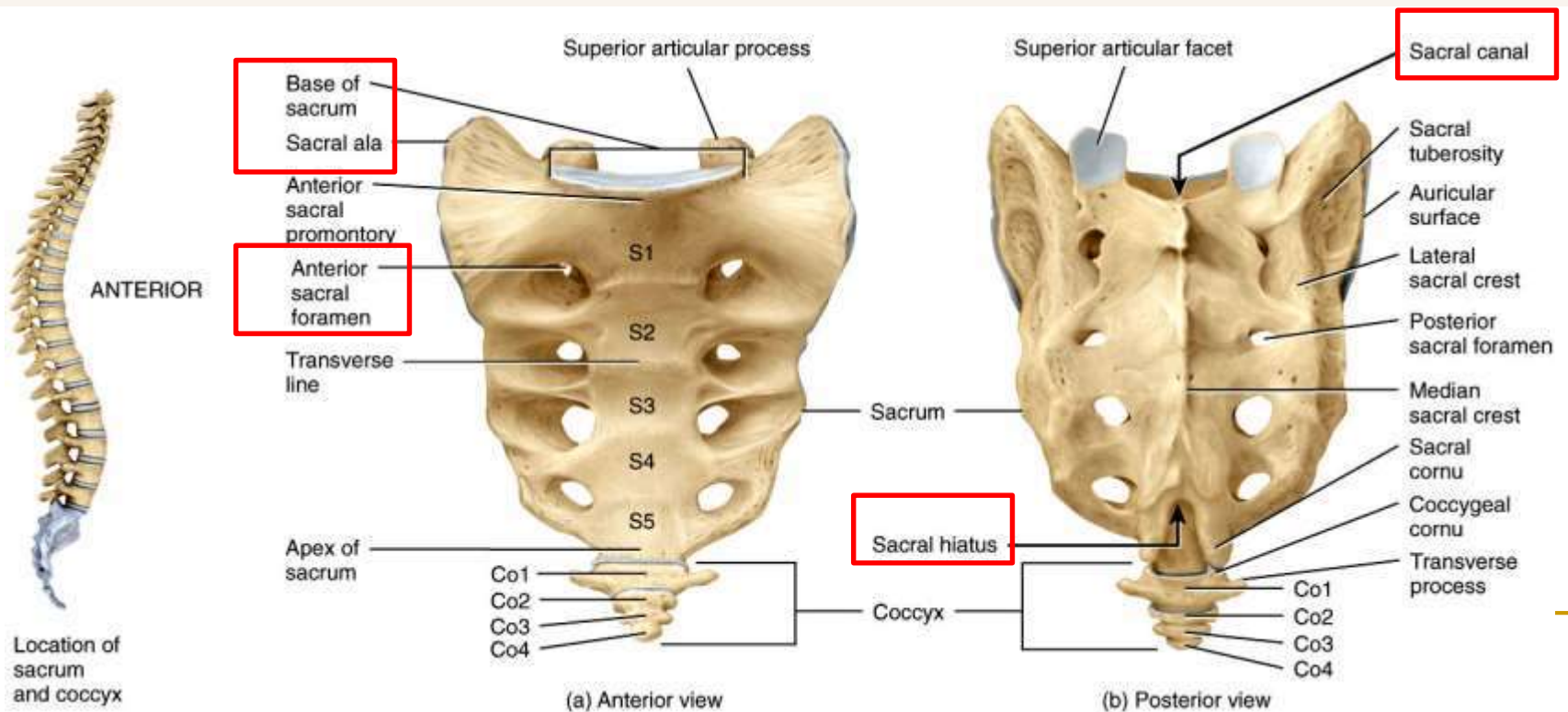
The sacrum is a triangular bone formed by the union of five sacral vertebrae (S1–S5)

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



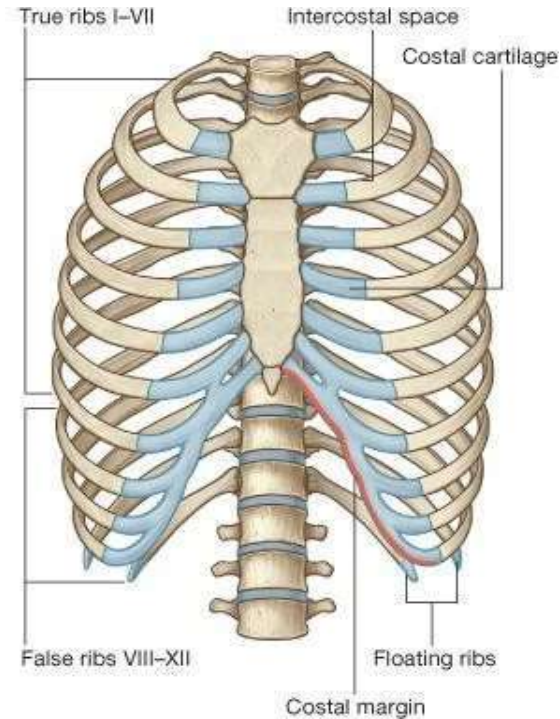
Intervertebral Disc

- *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.

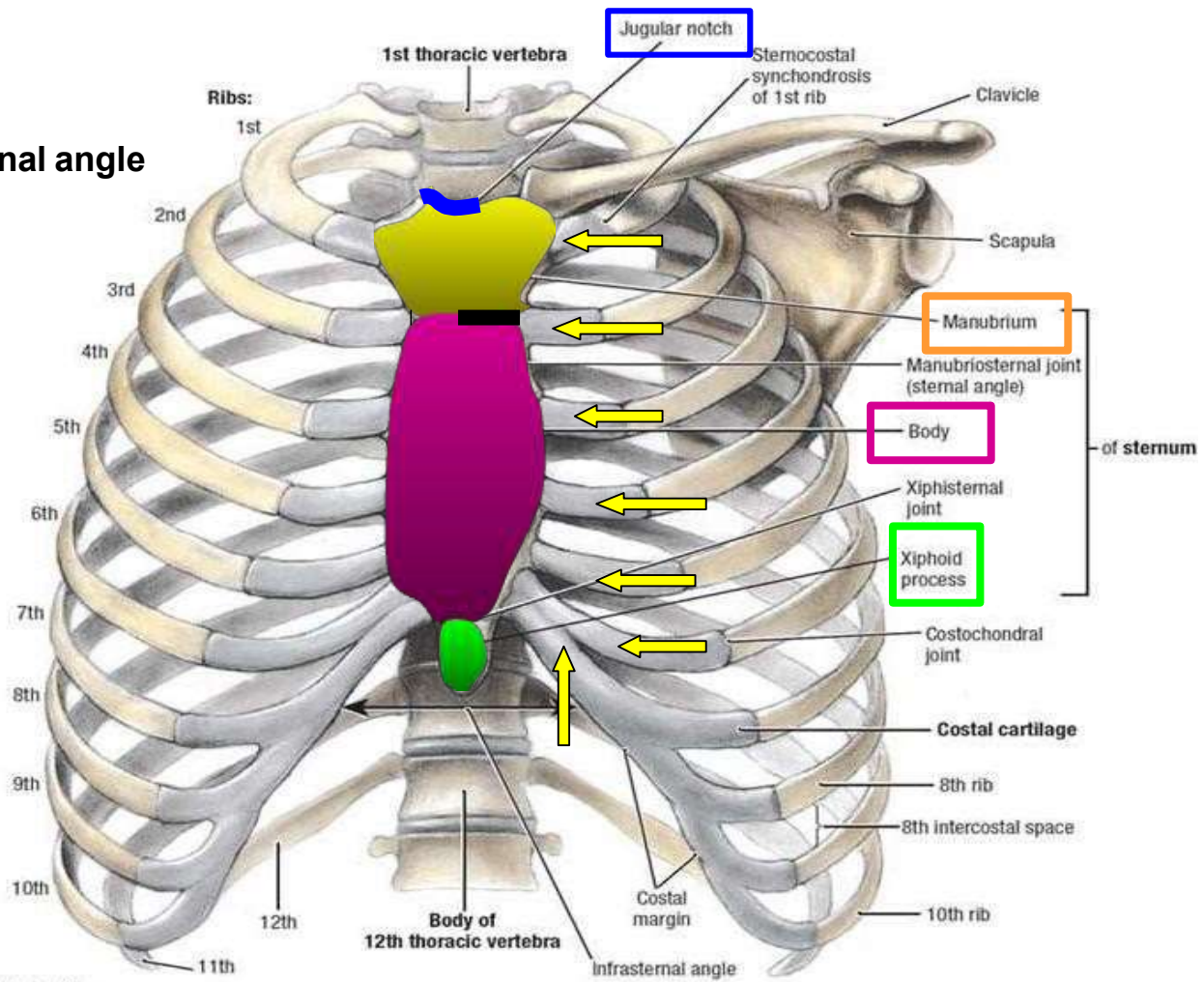


Thoracic cage

- **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.

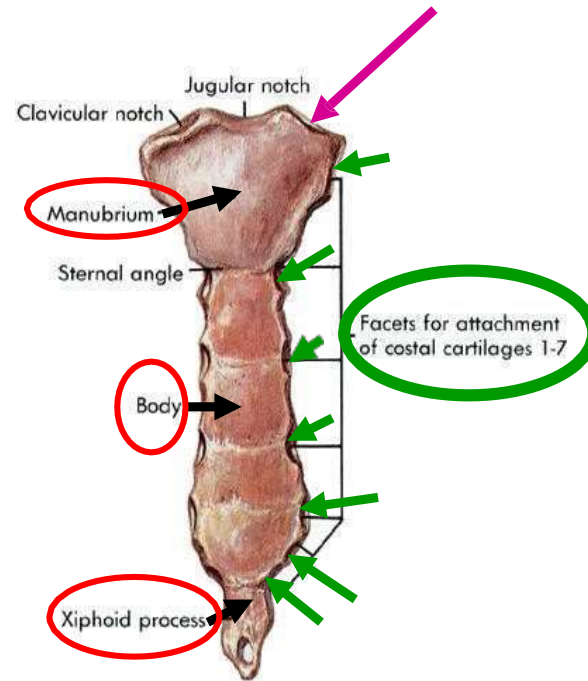


Sternal angle



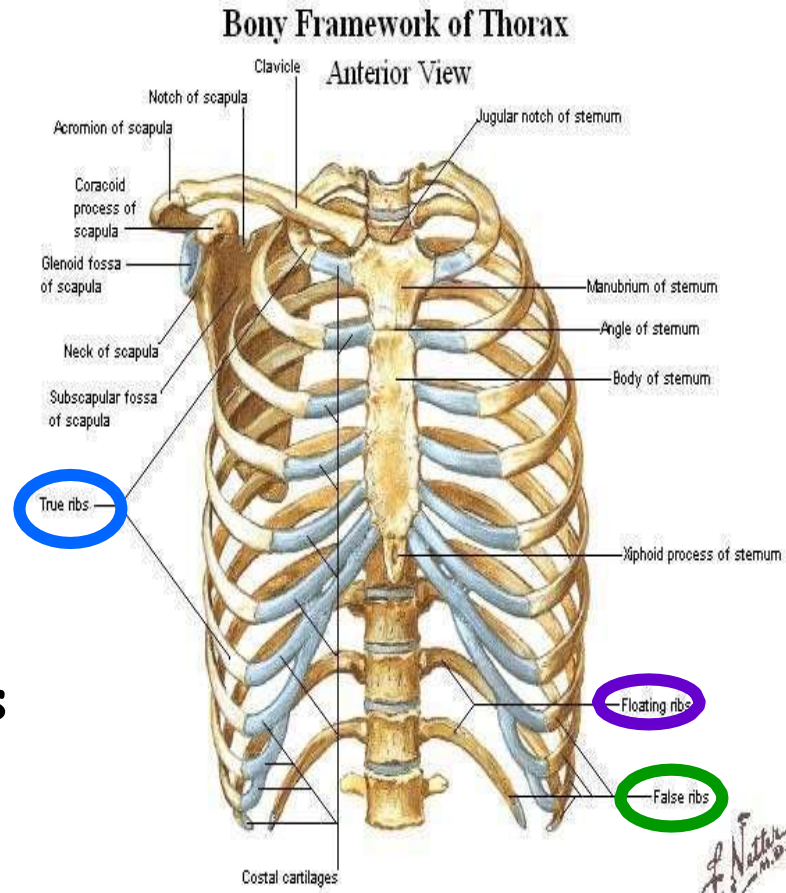
The Sternum

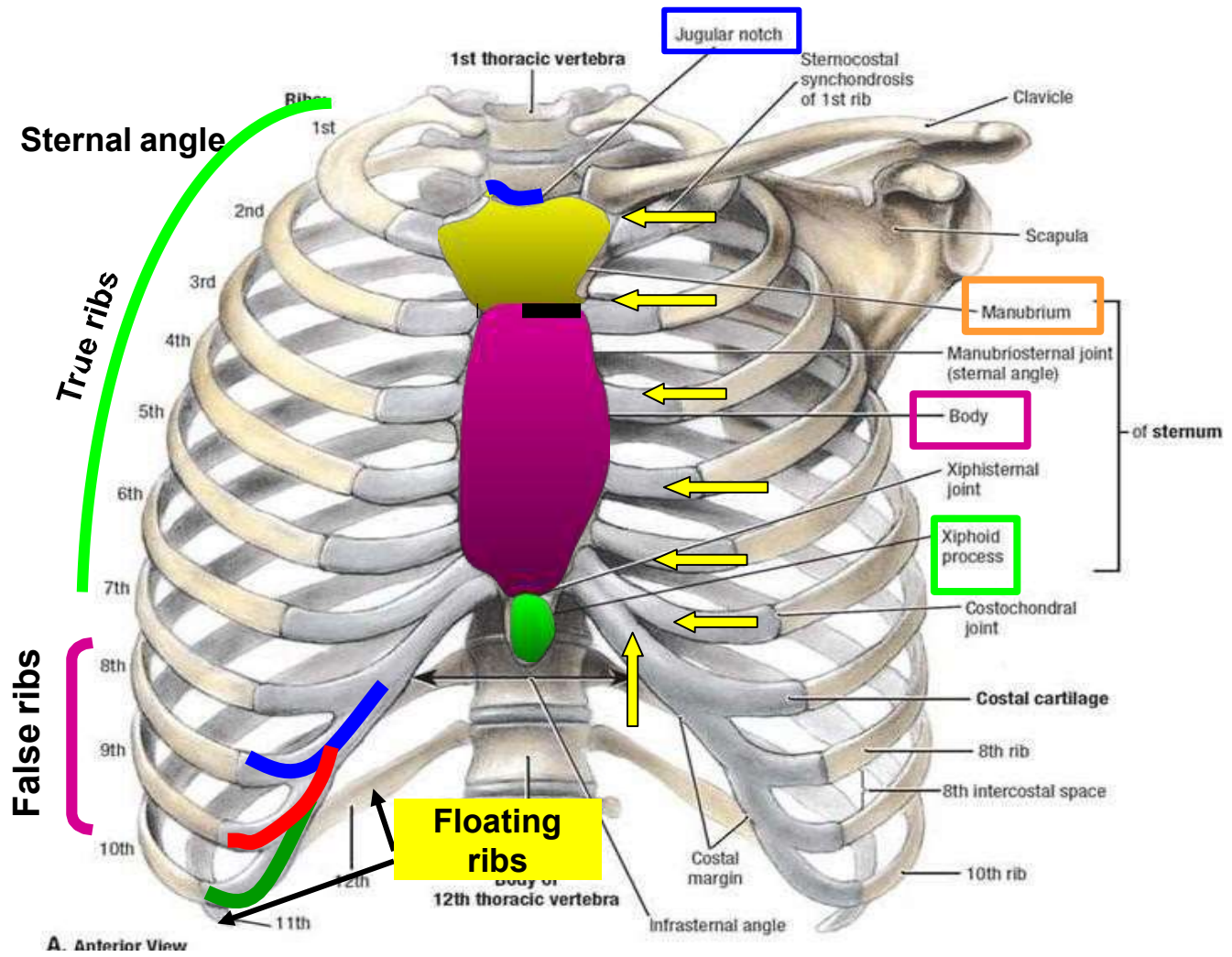
- **Formed of 3 parts**
→ manubrium,
body & xiphoid
process.
- **Articulates with** →
clavicles & upper 7
costal cartilages.



The Ribs

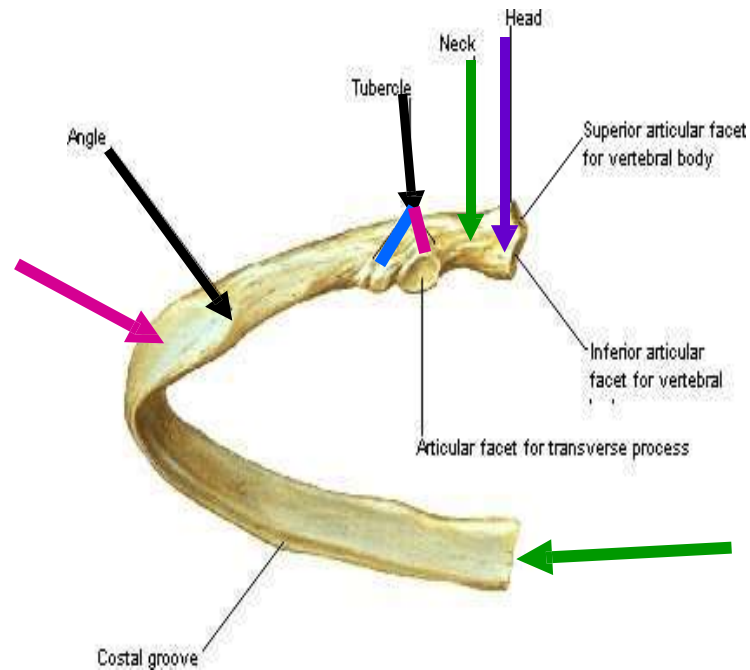
- **12 pairs** of ribs articulate with the thoracic vertebrae.
- **Upper seven** are **true ribs** as each articulates by its costal cartilage to the sternum.
- **Lower five** are **false ribs** as their costal cartilages fail to reach the sternum.
- **Last two** are called **floating ribs** as their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





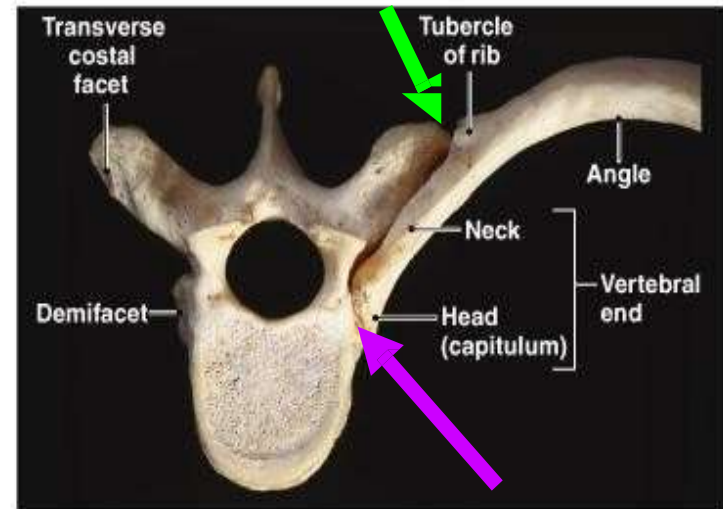
Parts of a typical rib

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

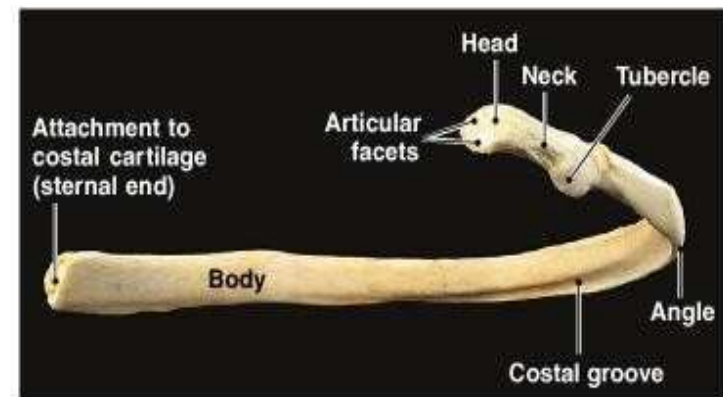


Articulation of vertebra to rib

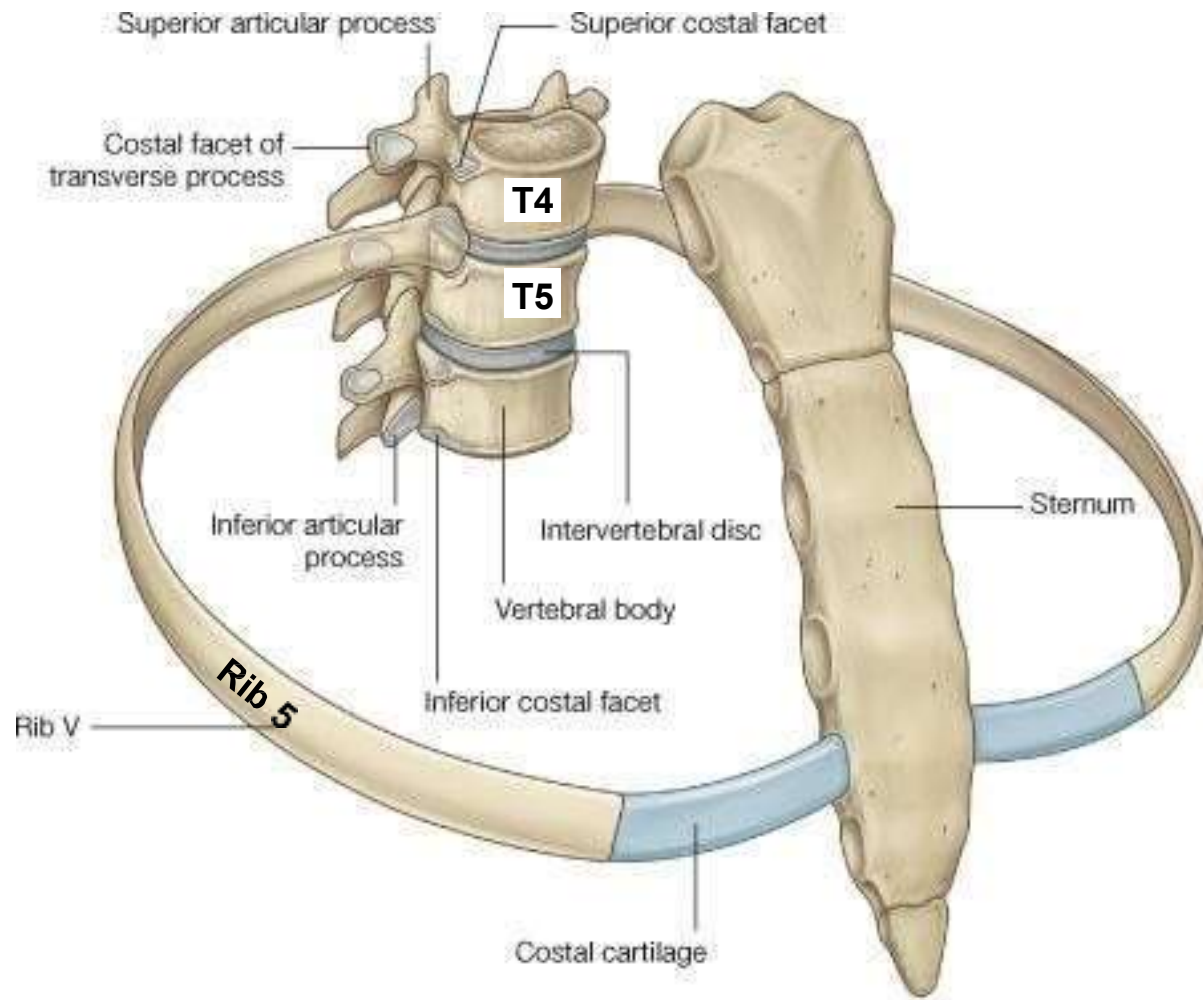
- **Head** of rib articulates with **Body** of vertebra
- **Tubercle** of rib articulates with **Transverse process** of vertebra



(a) Superior view



(b) Posterior view





Thank You
Thank You
Thank You!!!!