

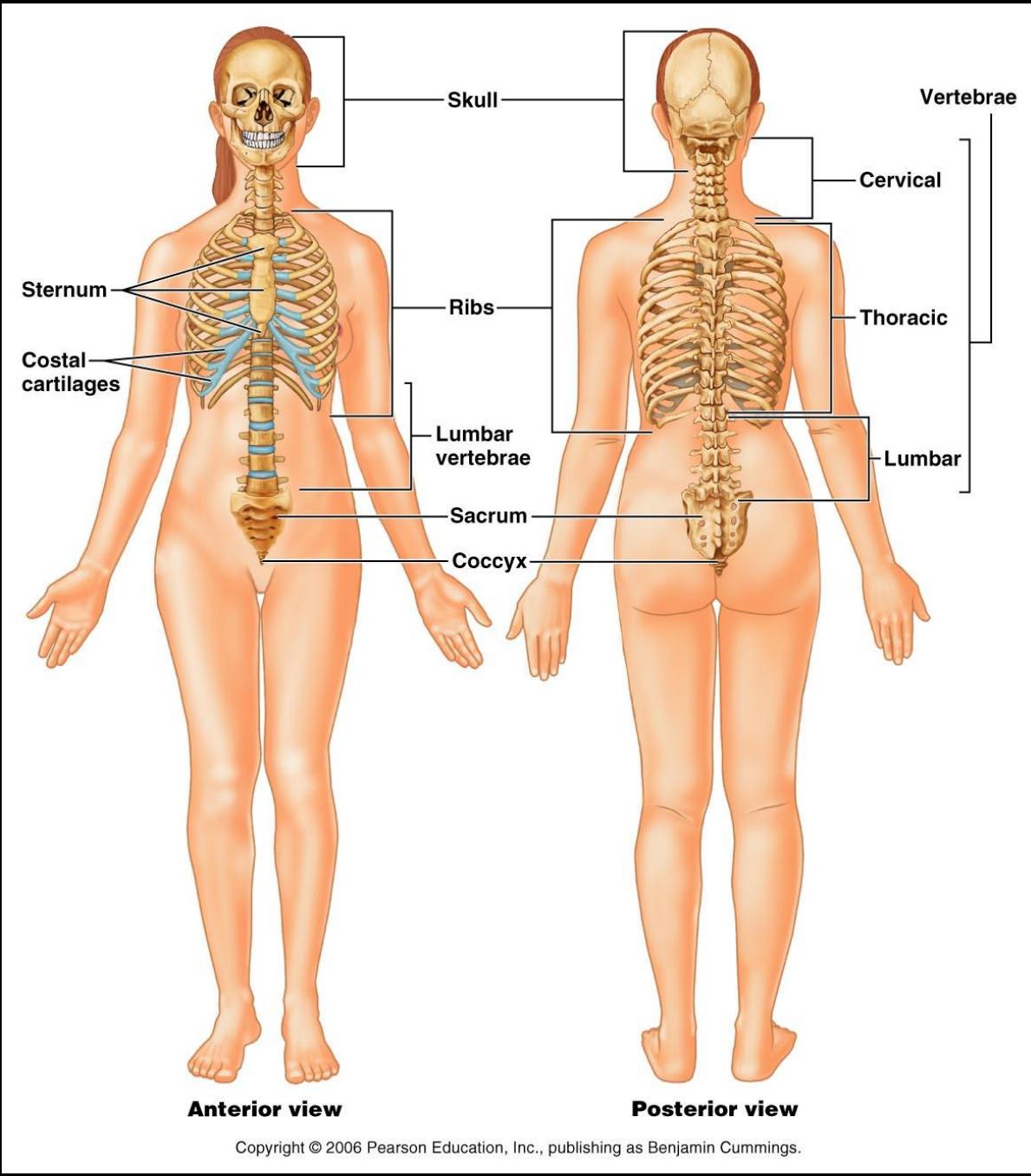


# *The skull*



Danil Hammoudi.MD





**Figure 7.1**

# THE SKULL

- = 22 BONES [actually 29]
- ALL FUSED EXCEPT ONE.:HYOID BONE
- JOINTS = SUTURES
- CRANIAL CAVITY 8 BONES=CRANIAL BONES
- 14 LEFT = FACIAL BONES
- 3 MORE IN THE EARS

- The Skull cranial vault (which encloses the brain) bones are formed by **intramembranous ossification**.
- While the **bones that form the base of the skull are formed by endochondrial ossification**.
- The bones enclosing the brain have large flexible fibrous joints (sutures) which allow firstly the head to pass through the birth canal and secondly postnatal brain growth.
- Ossification continues postnatally, through puberty until mid 20s.
- Note that in old age the sutures are in some cases completely ossified.
- In the entire skeleton, early ossification occurs in the jaw and at the ends of long bones

**Cranium** – protects the brain and is the site of attachment for head and neck muscles

### **Facial bones**

Supply the framework of the face, the sense organs, and the teeth

Provide openings for the passage of air and food

Anchor the facial muscles of expression

**Eight bones form the *neurocranium* (braincase), a protective vault surrounding the brain and medulla oblongata.**

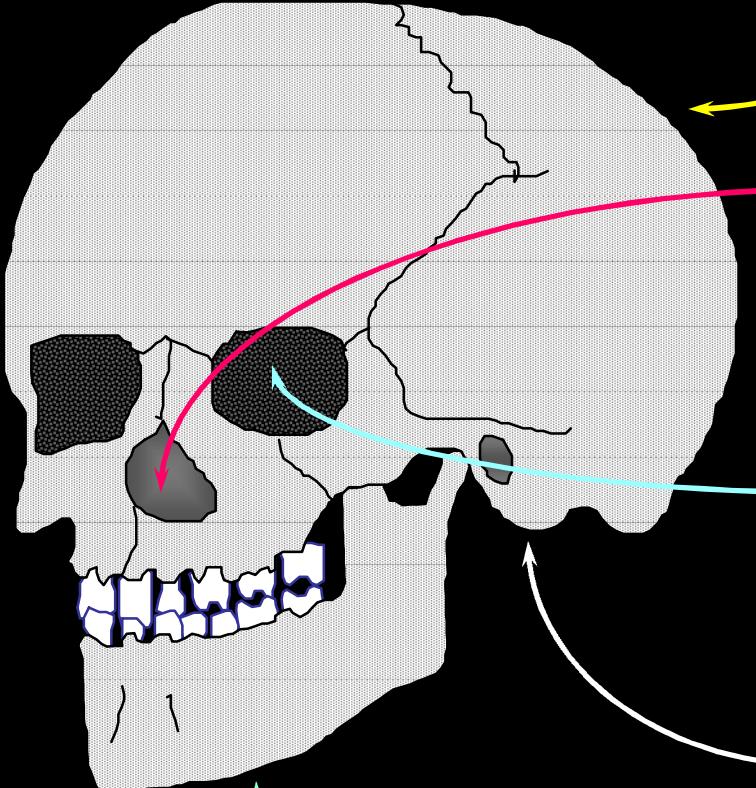
**Fourteen bones form the *splanchnocranum*, the bones supporting the face.**

**Encased within the temporal bones are the six ear ossicles of the middle ear.**

**The hyoid bone, supporting the larynx, is usually not considered as part of the skull, as it does not articulate with any other bones.**

- The meninges are the three layers, or membranes, which surround the structures of the central nervous system.
- They are known as the dura mater, the arachnoid mater and the pia mater.
- Other than being classified together, they have little in common with each other.
- In humans, the anatomical position for the skull is the **Frankfurt plane**, where the lower margins of the orbits and the upper borders of the ear canals are all in a horizontal plane.
- This is the position where the subject is standing and looking directly forward.

## SKULL II Roles



Cranial vault or Neurocranium encloses & protects the *brain*

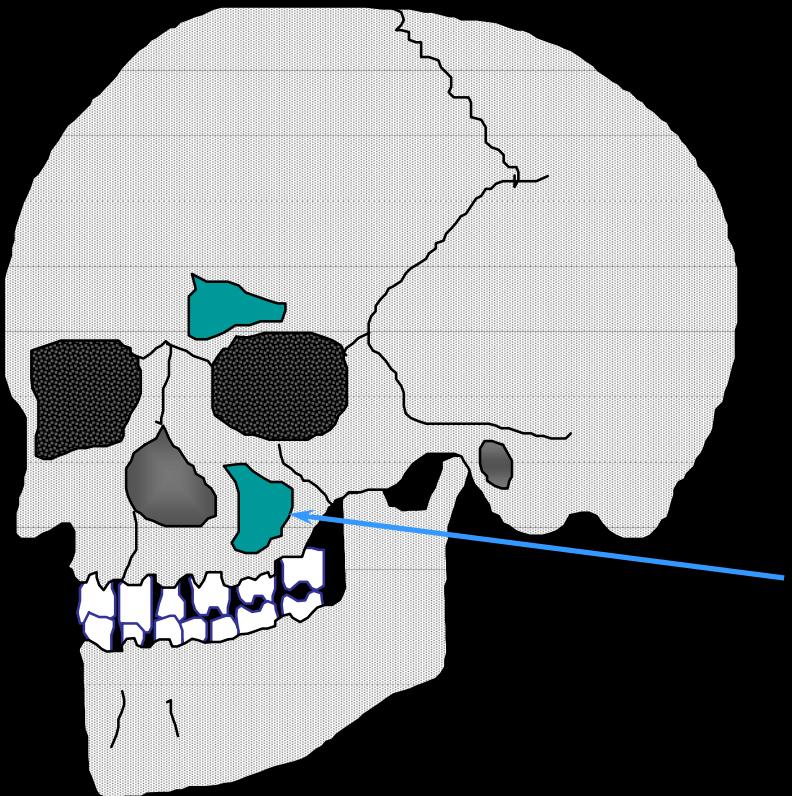
Facial bones create openings for the *respiratory & alimentary* systems

Facial bones create space & protection for *special-sense organs*, e.g., orbit for the eye

Neurocranium *articulates* with the spine for tight attachment, but free movement, of the head

Jaw (mobile) & maxilla have teeth for *mastication*

## SKULL III More roles



♦ Neurocranium provides *many holes* - foramina - for vessels & nerves to enter & leave

♦ Skull bones provide *anchorage* to the protective scalp

♦ Skull includes non-airway air-filled chambers - *sinuses*

♦ Skull bones provide anchorage for the *muscles of facial expression*

### In the skull (22):

#### Cranial bones:

1. frontal bone
2. parietal bone (2)
3. temporal bone (2)
4. occipital bone

sphenoid bone

ethmoid bone

### Facial bones:

5. zygomatic bone (2)
6. superior and inferior maxilla
9. nasal bone (2)
7. mandible
- palatine bone (2)
- lacrimal bone (2)
- vomer bone
- inferior nasal conchae (2)

### In the middle ears (6):

- malleus (2)
- incus (2)
- stapes (2)

### In the throat (1):

- hyoid bone

## Paired Cranial Bones:

- Parietals
- Temporals

## Unpaired Cranial Bones:

- Frontal
- Occipital
- Sphenoid
- Ethmoid

## Paired Facial Bones:

- Lacrimals
- Nasals
- Zygomatics
- Maxillae
- Palatines
- Inferior Nasal Conchae

## Unpaired Facial Bones:

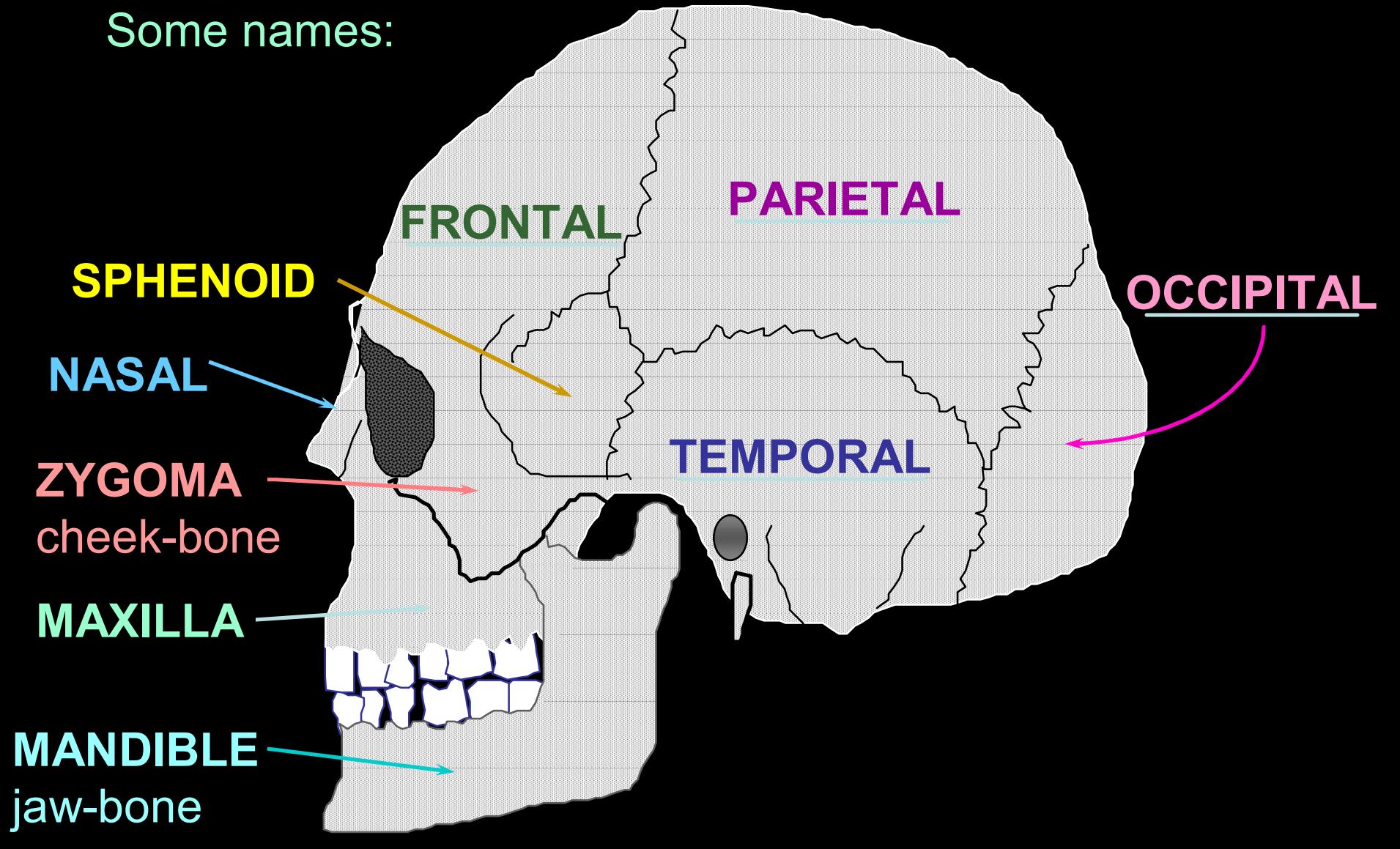
- Vomer
- Mandible
- Hyoid

# SKULL BONES I

Lateral view

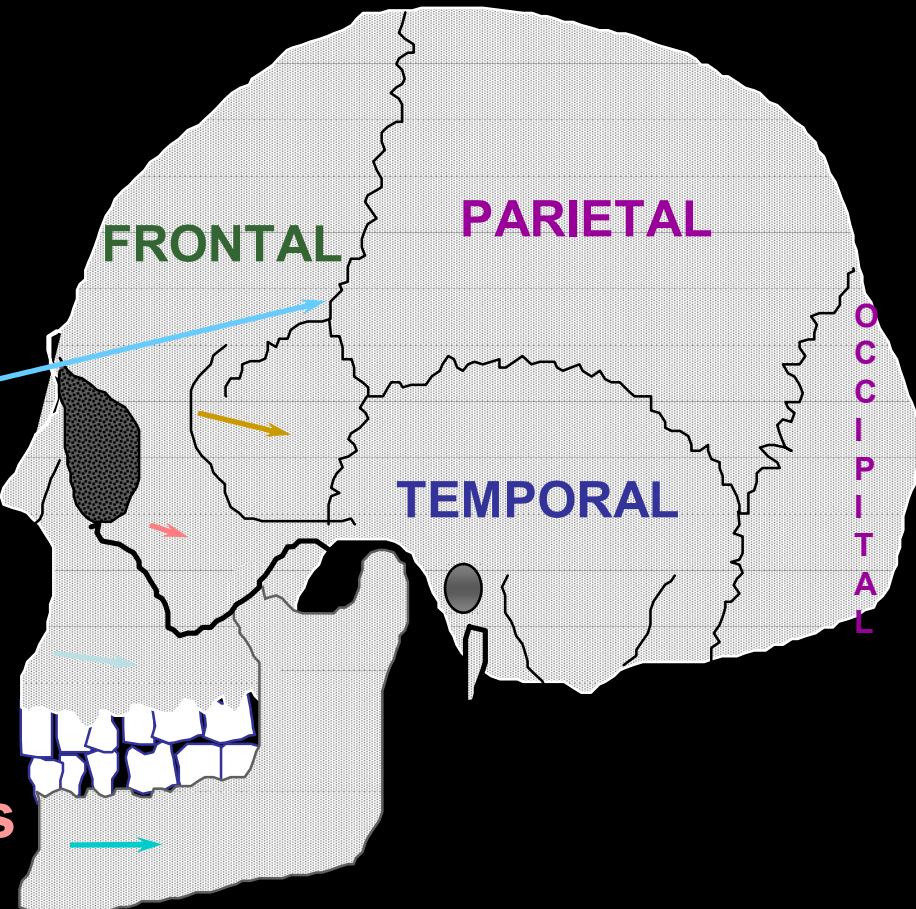
The vault bones are mostly large & curved; the facial are many, mostly small, & fitted into a complex mosaic.

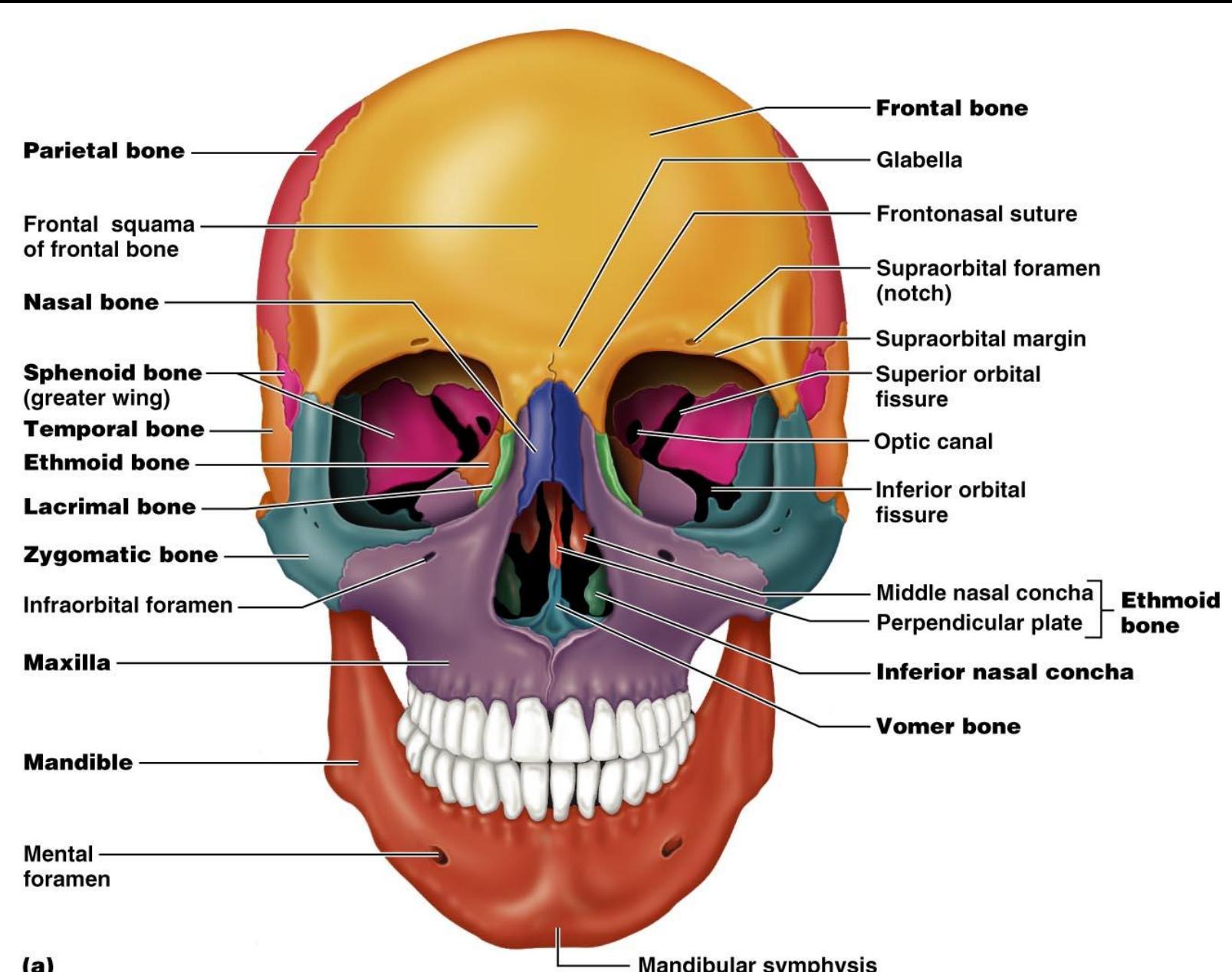
Some names:



## SKULL BONES II

- ◆ Other bones are deep in the skull & not seen from the outside
- ◆ Some bones are paired; some are single. With more views, this will sort itself out
- ◆ The wiggly lines demarcating the bones are the sutures, which have their own names, as do the points where they meet.
- ◆ These & other bony landmarks are used in measurements of the skull to check how growth is proceeding





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Figure 7.2a

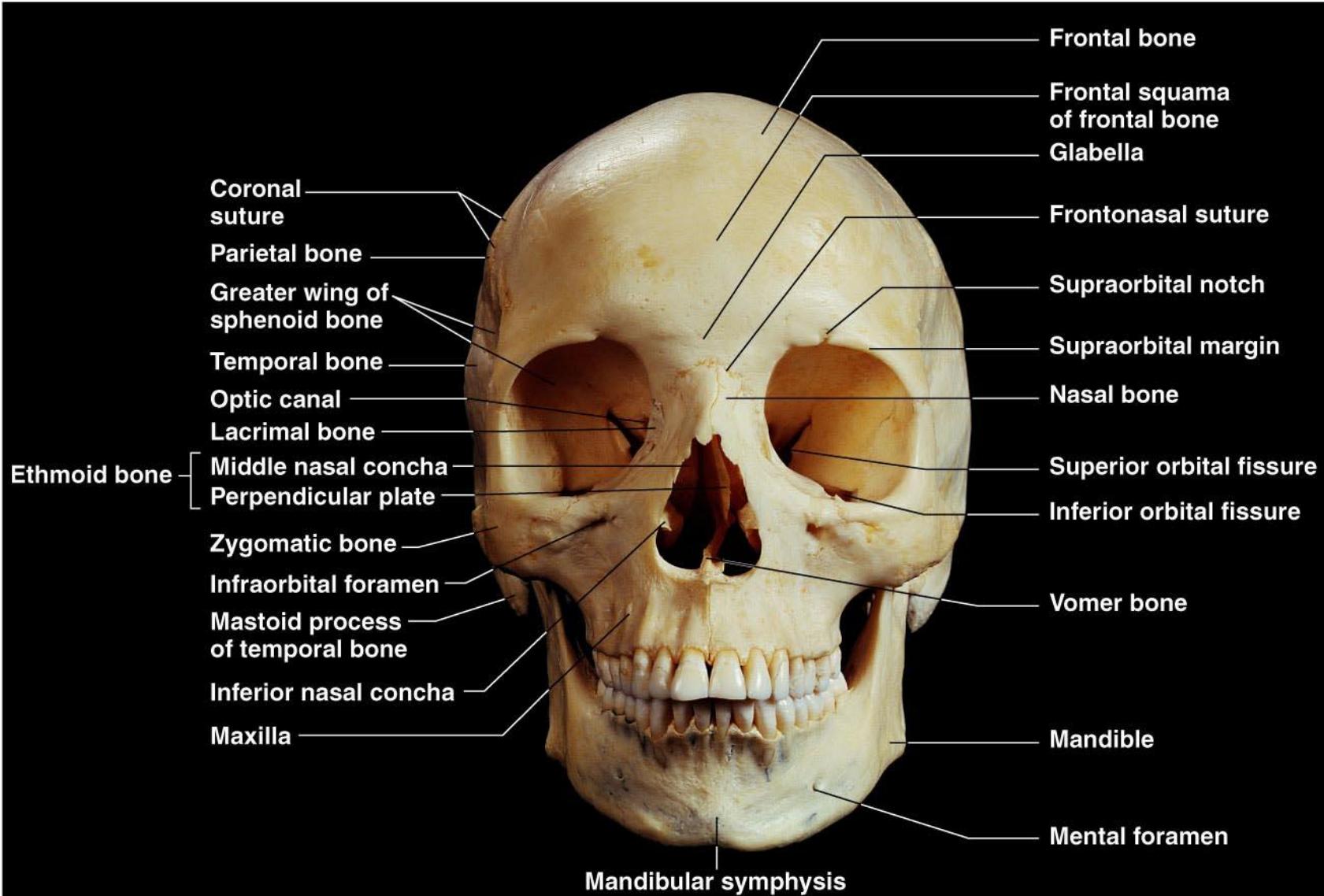
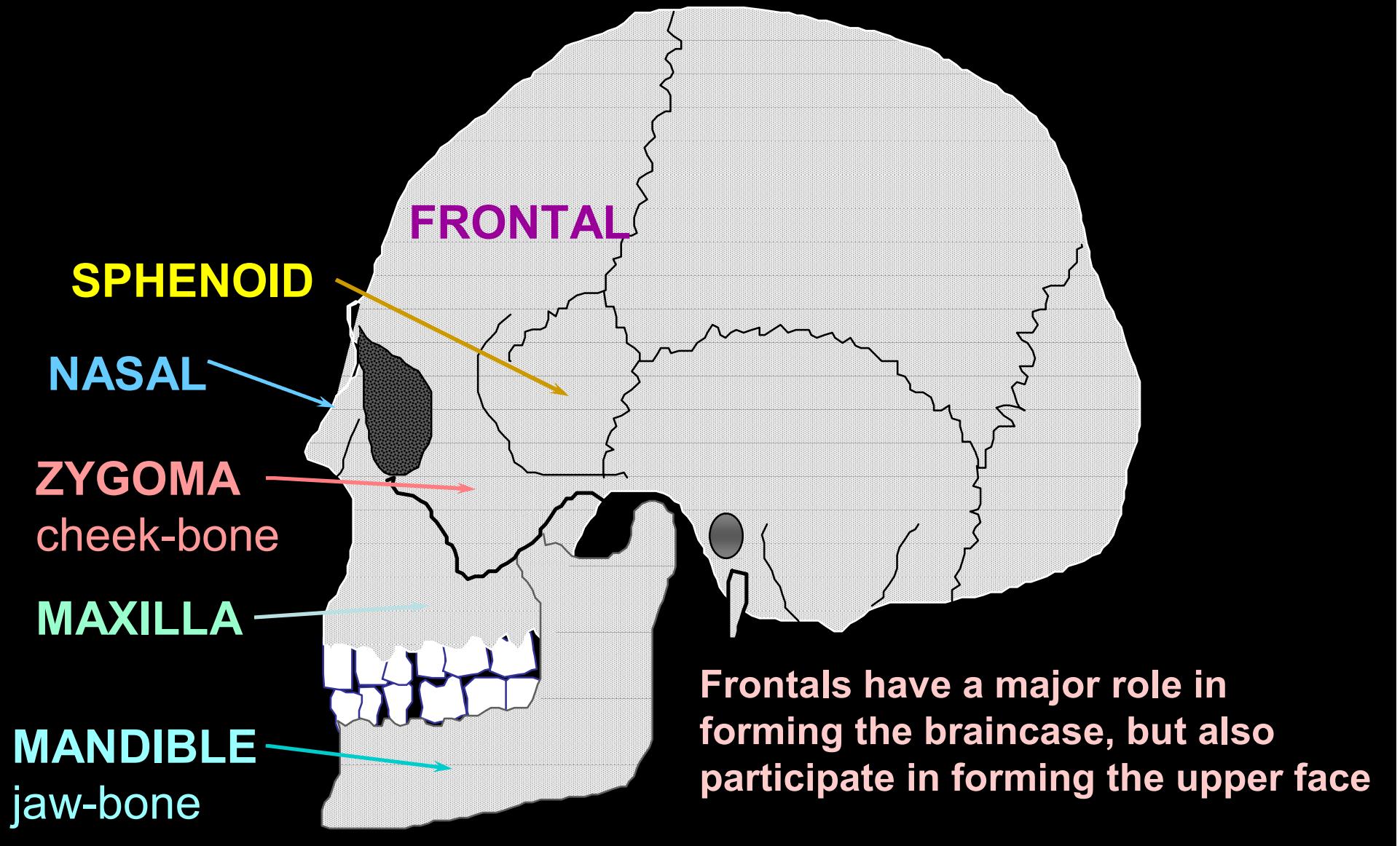


Figure 1 Skull, anterior view.

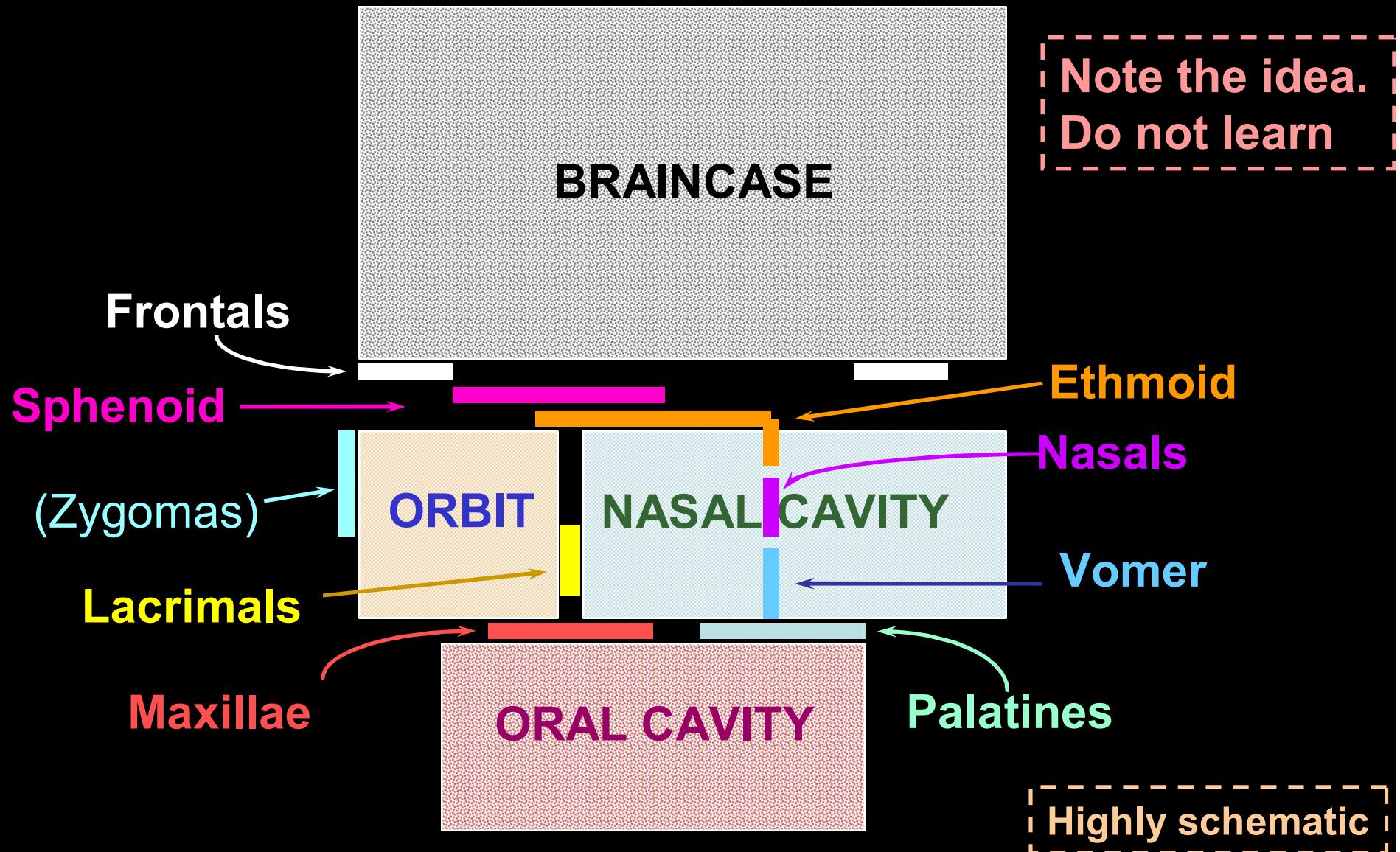
# SKULL BONES V Facial bones Lateral view

The facial bones are many, mostly small, & fitted into a complex mosaic. Some names:



# FACIAL BONES: Separation roles

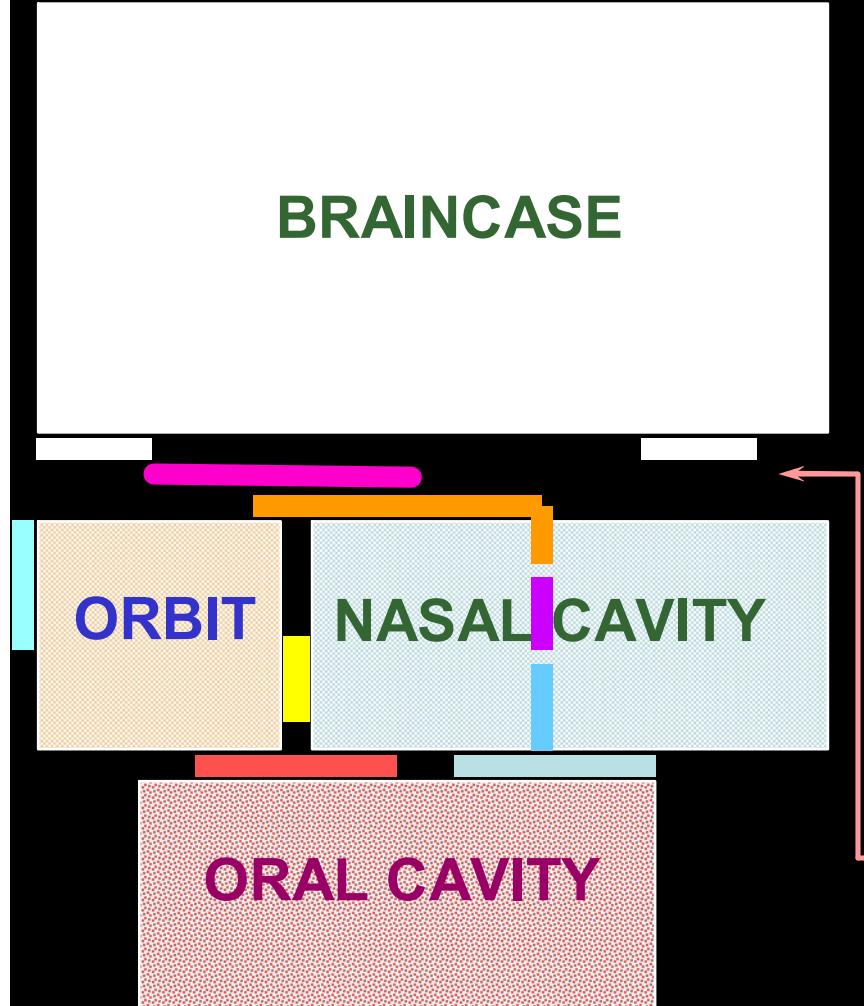
A way to make sense of the many facial bones is to note their roles in separating the face into various compartments



## FACIAL BONES: Separation roles II

The details are less significant than the implications

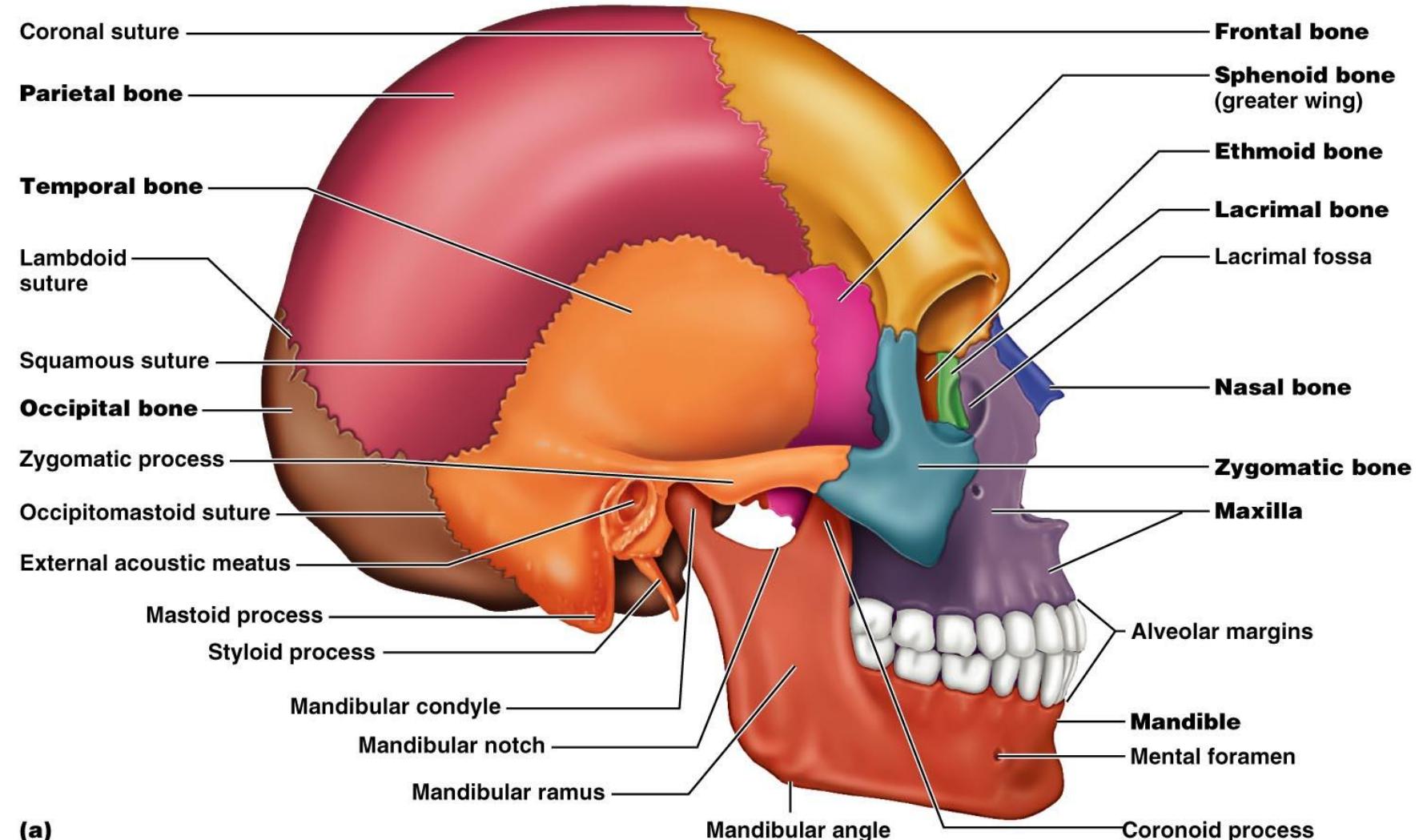
The separations are thin & often incomplete, so that events in one compartment can affect structures in another, e.g., spread of infection, tumor, effects of trauma, bleeding



The orbit's wall has so many contributors, it is easier to note which 3 bones do not participate

Likewise for the nasal cavity

One can work out which bones will be seen *inside* the anterior skull, looking down



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Figure 7.3a

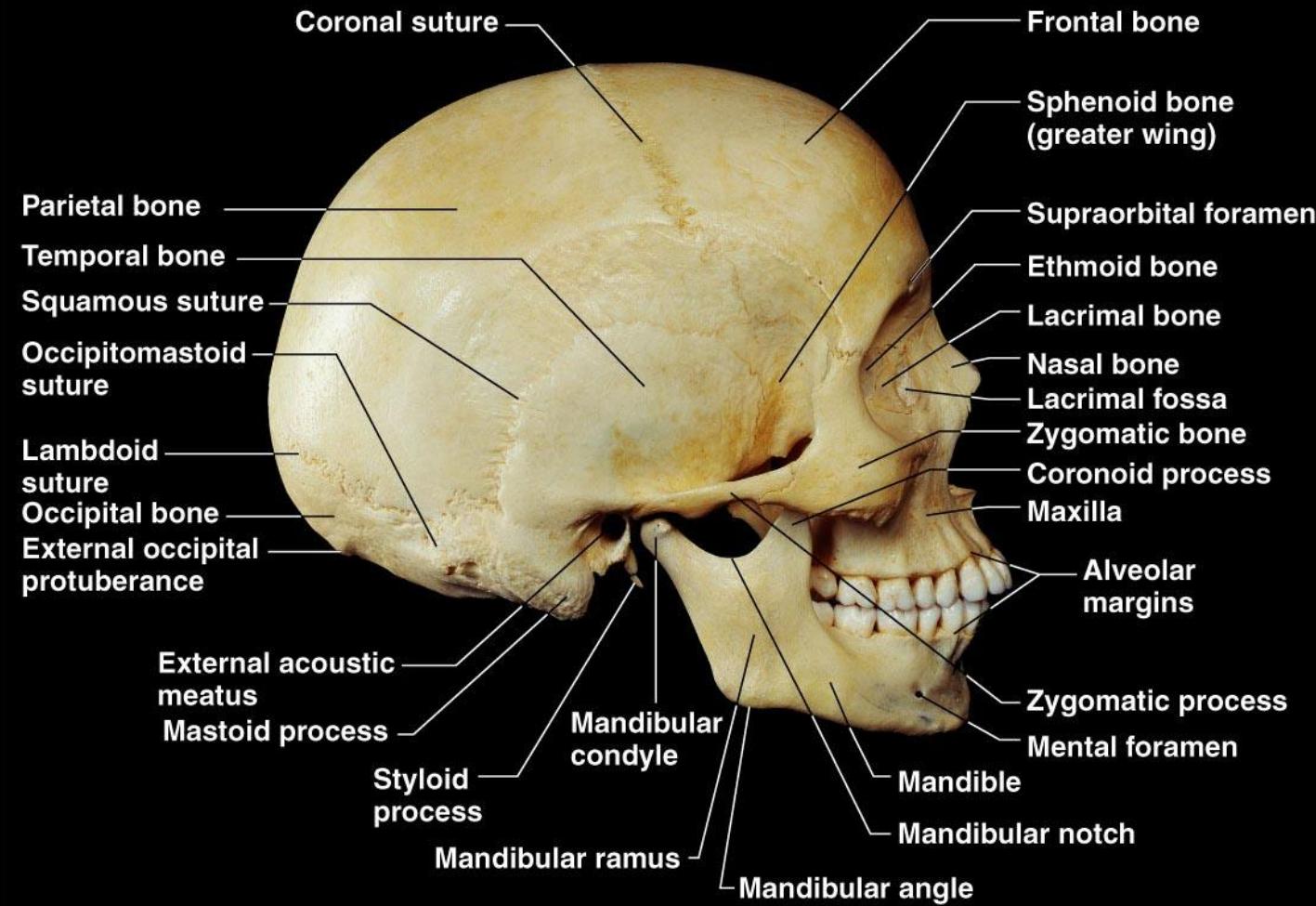
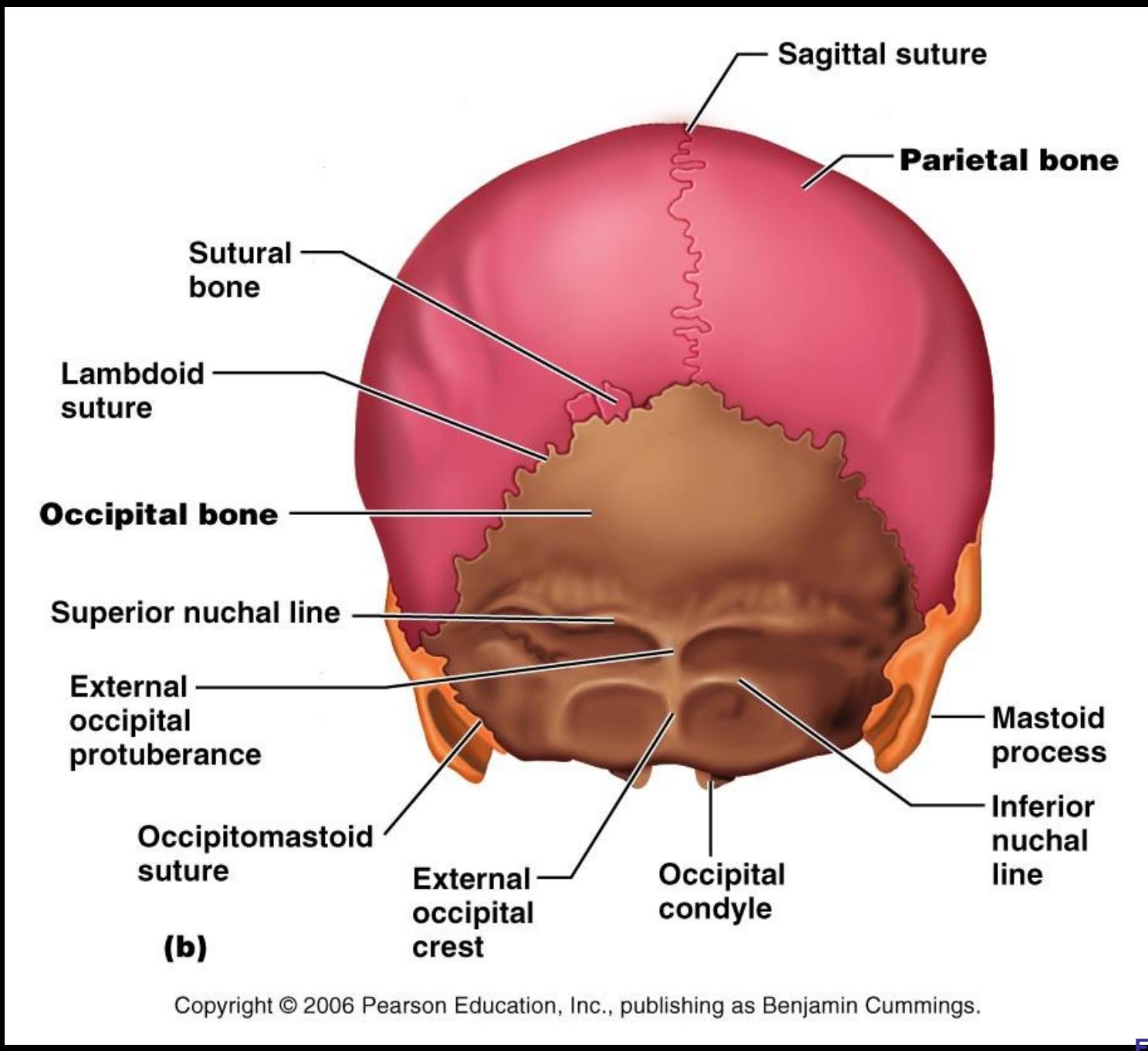
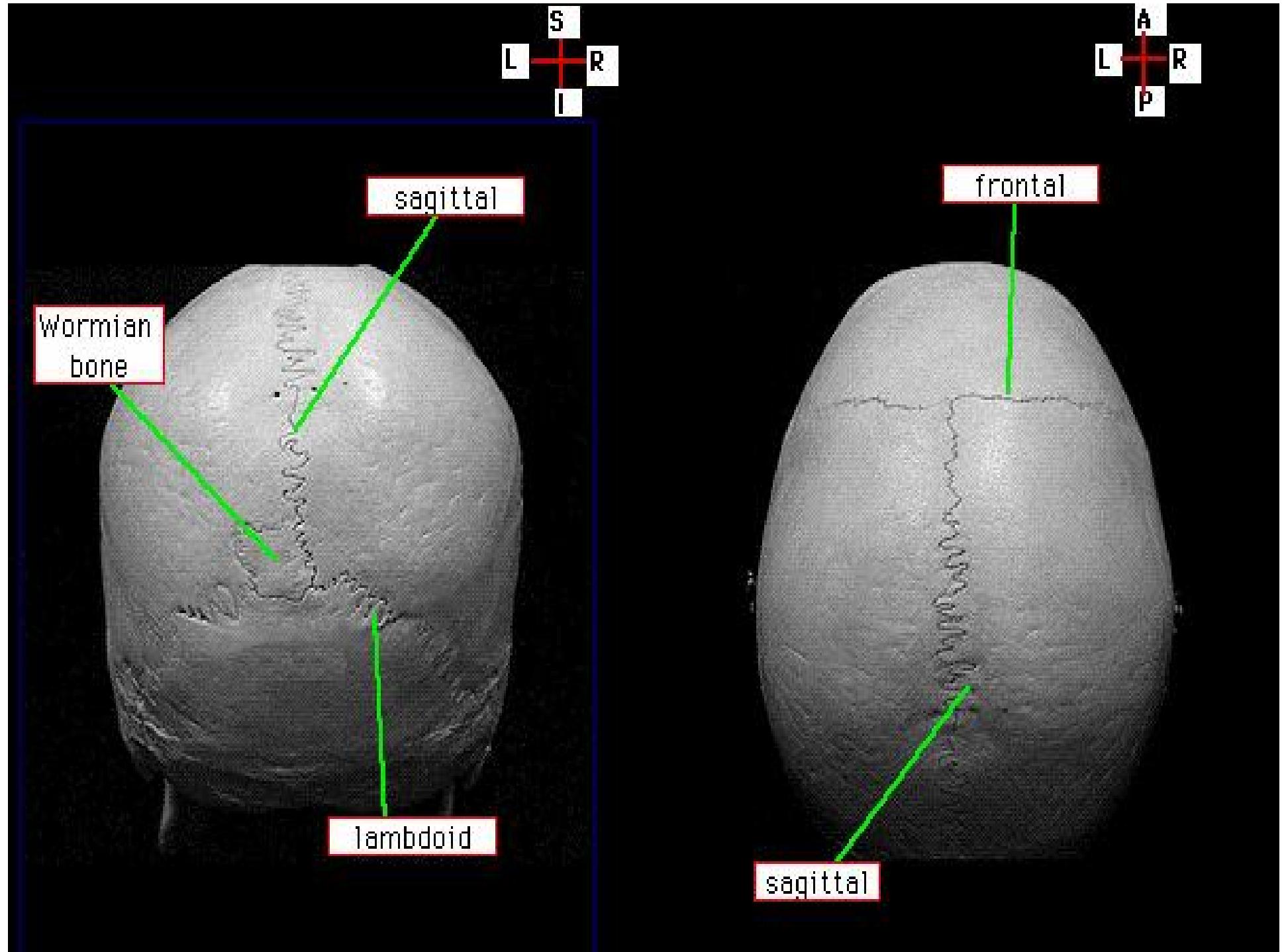


Figure 2 Skull, right external view of lateral surface.



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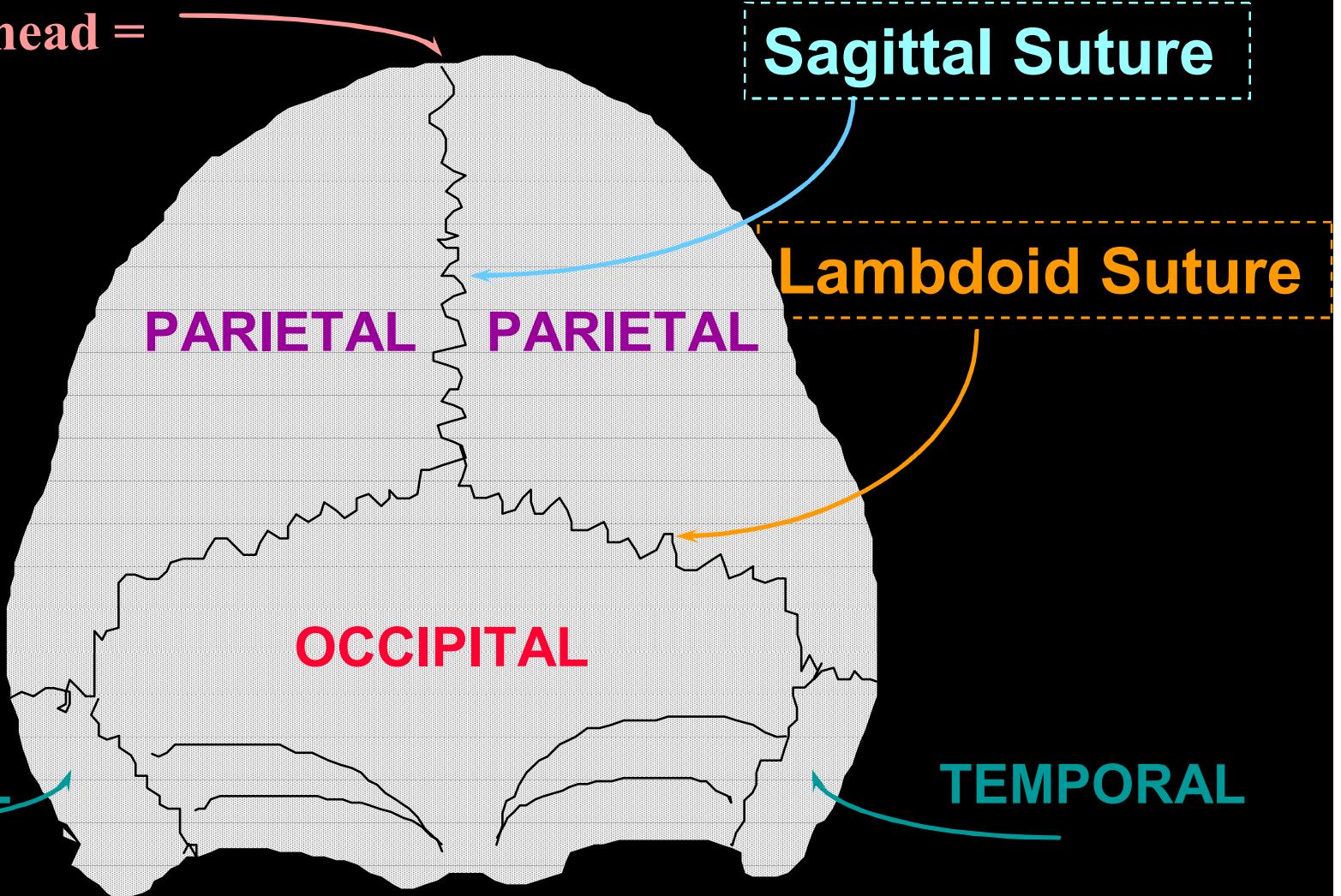
Figure 7.2b



# SKULL BONES III

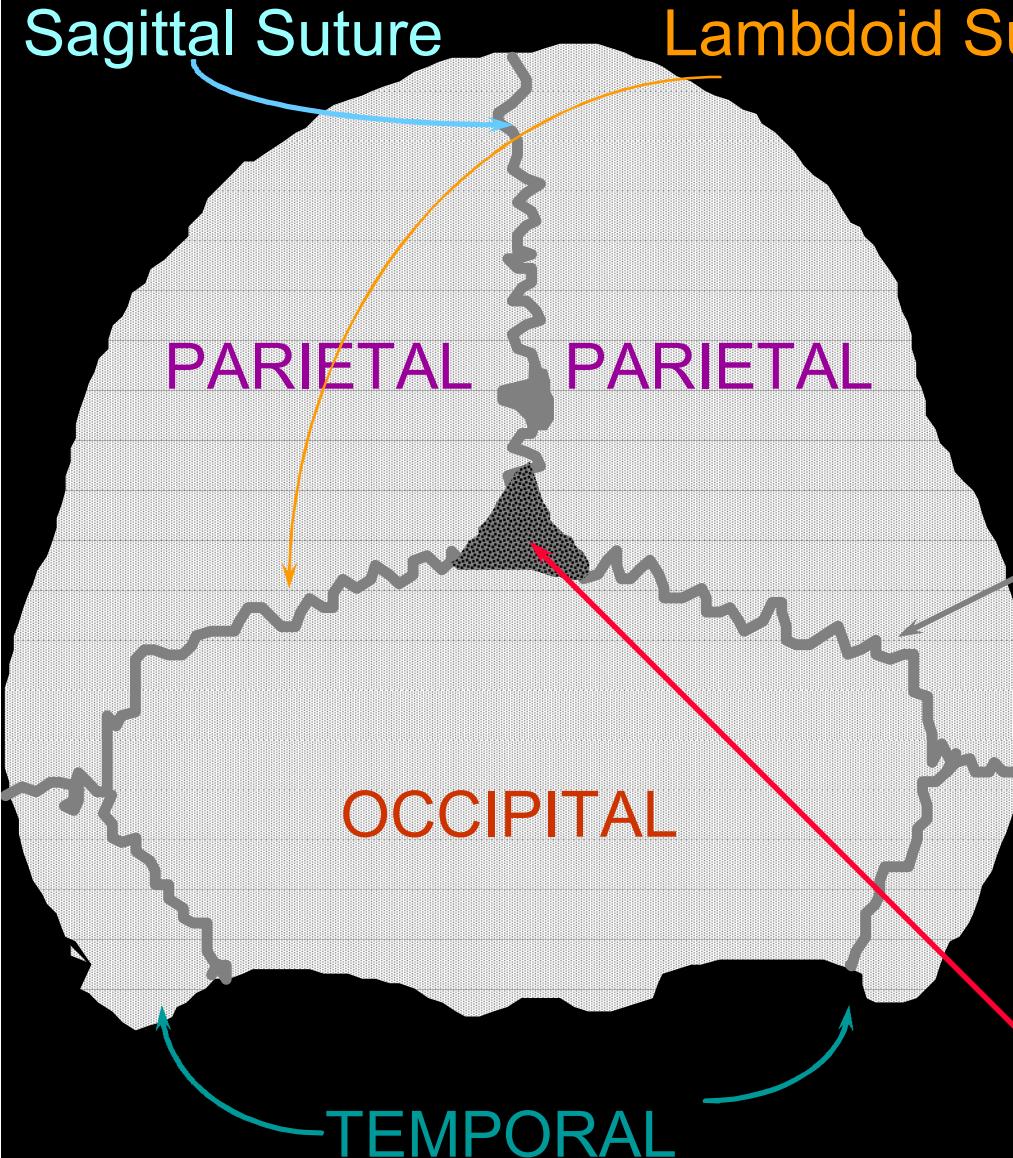
Posterior view

Top of the head =  
VERTEX



Two PARIETALS, Two TEMPORALS, One OCCIPITAL

## SKULL BONES IV Infant's skull



### Posterior view

Other views Marieb

Fig 5.13, p.126

- ◆ The bones develop independently, then grow until they almost meet
- ◆ Until late in life, they remain separated by sutural connective tissue
- ◆ At three-way meeting points, the connective tissue is extensive & creates a soft spot in the skull - a *fontanelle* - e.g.

**POSTERIOR FONTANELLE**

**The anterior fontanelle is larger, & stays soft for over a year**

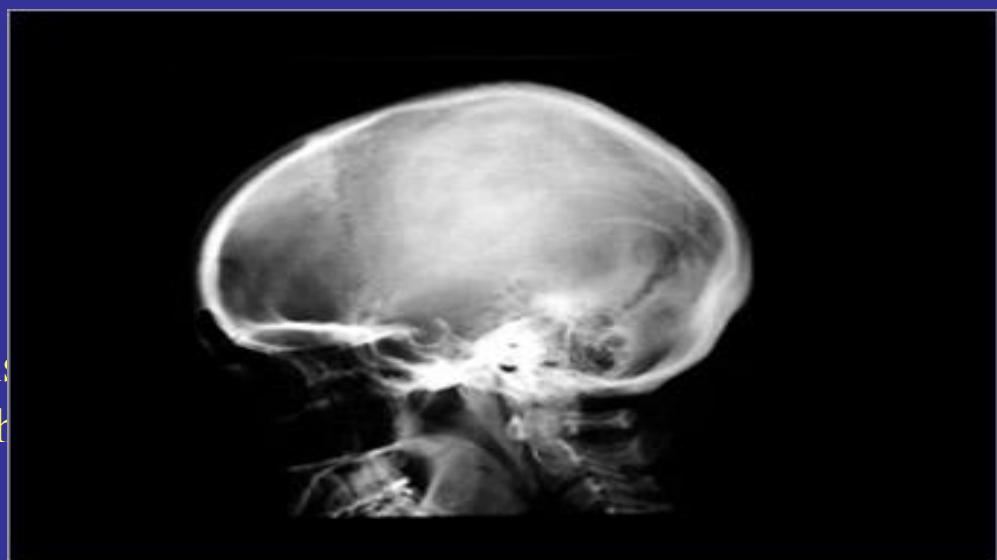
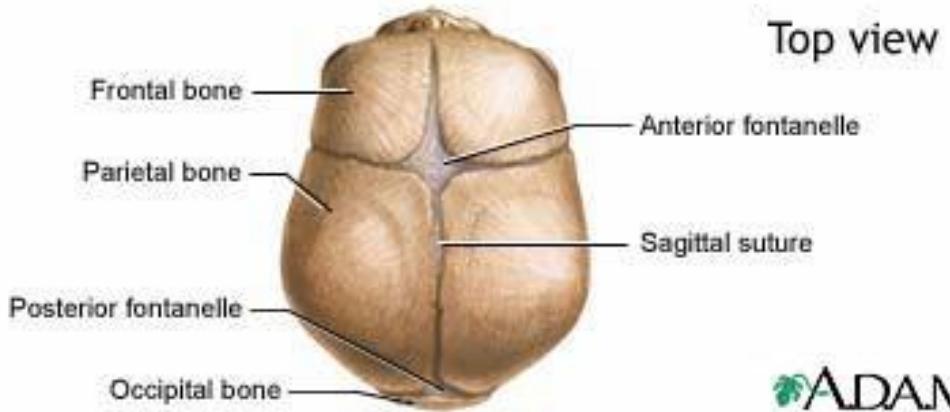
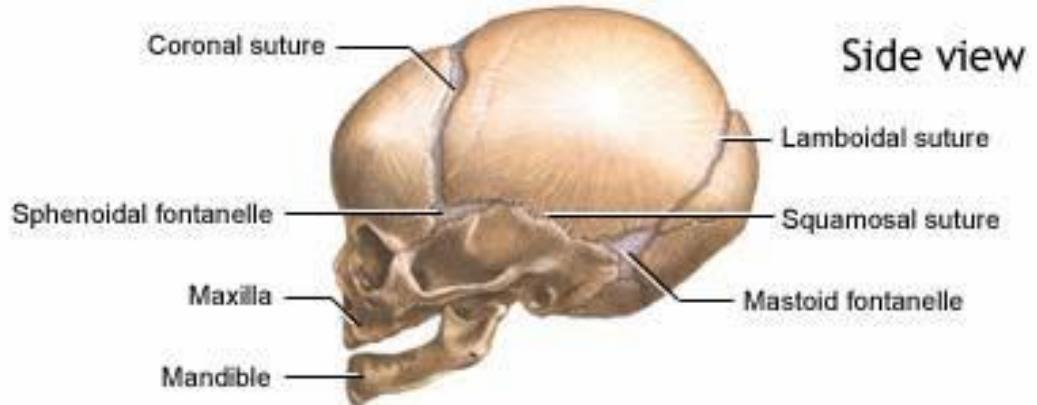
**Coronal Suture:** Articulation between the parietal bones and the frontal bone.

**Squamous Suture:** Articulation between the temporal bones with the parietal bones.

**Lambdoid Suture:** Articulation of the parietal bones and the occipital bone.

**Occipitomastoid Suture:** Articulation between the occipital bone and the mastoid process of the temporal bone.

**Sagittal Suture:** You can't really see this one, but it is on the very top of the cranium. The articulation between the parietal bones.



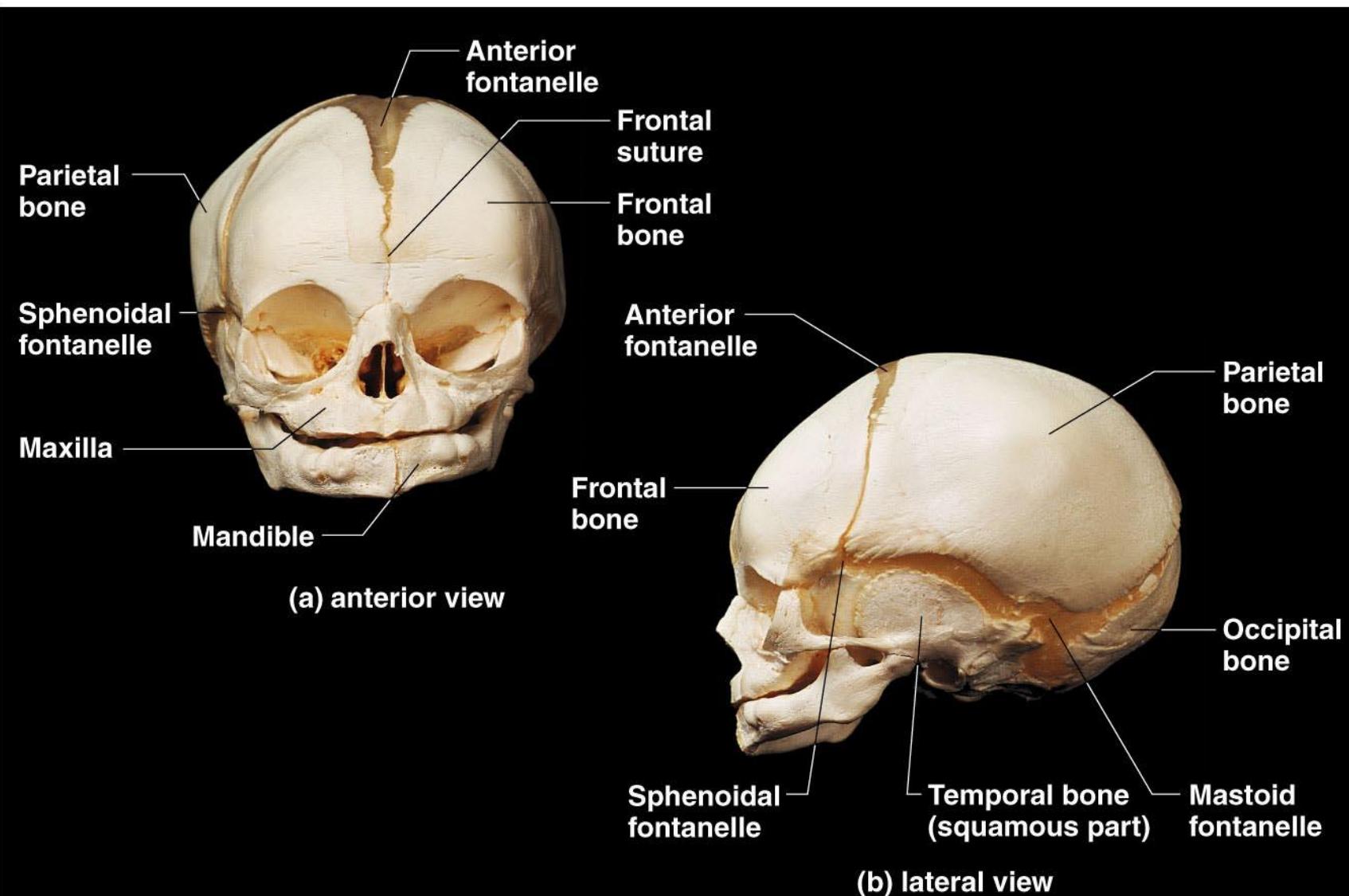
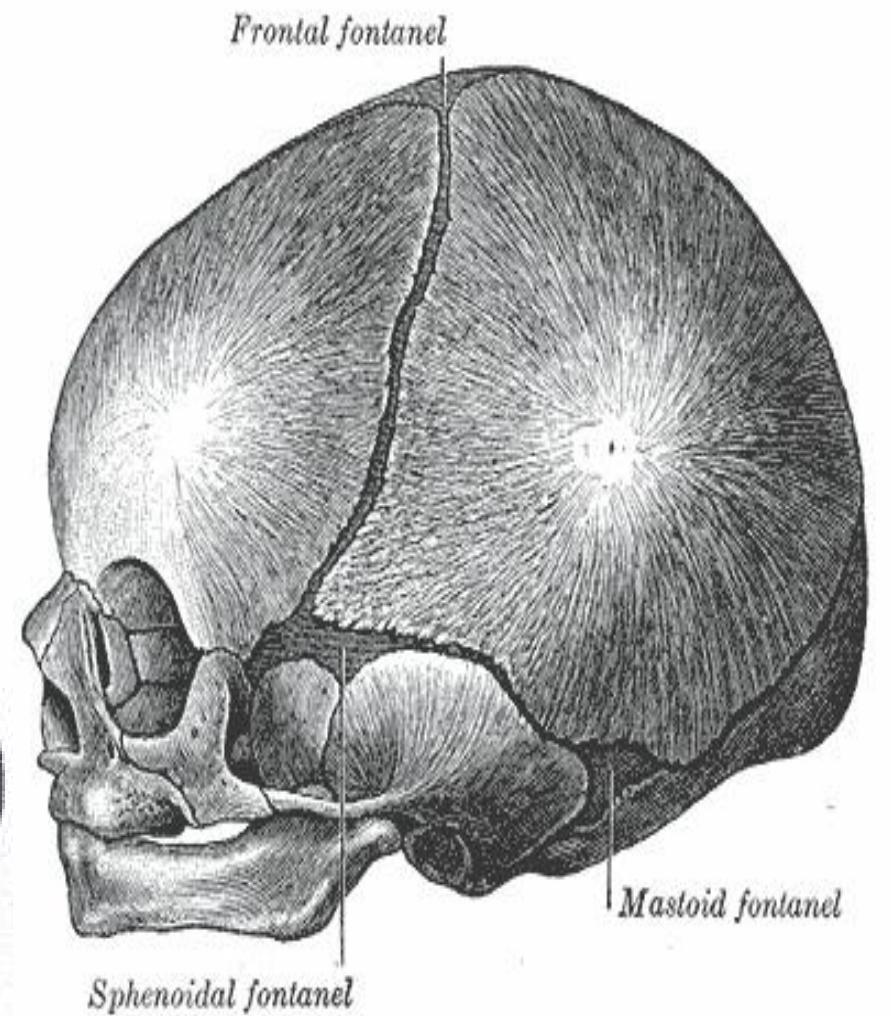
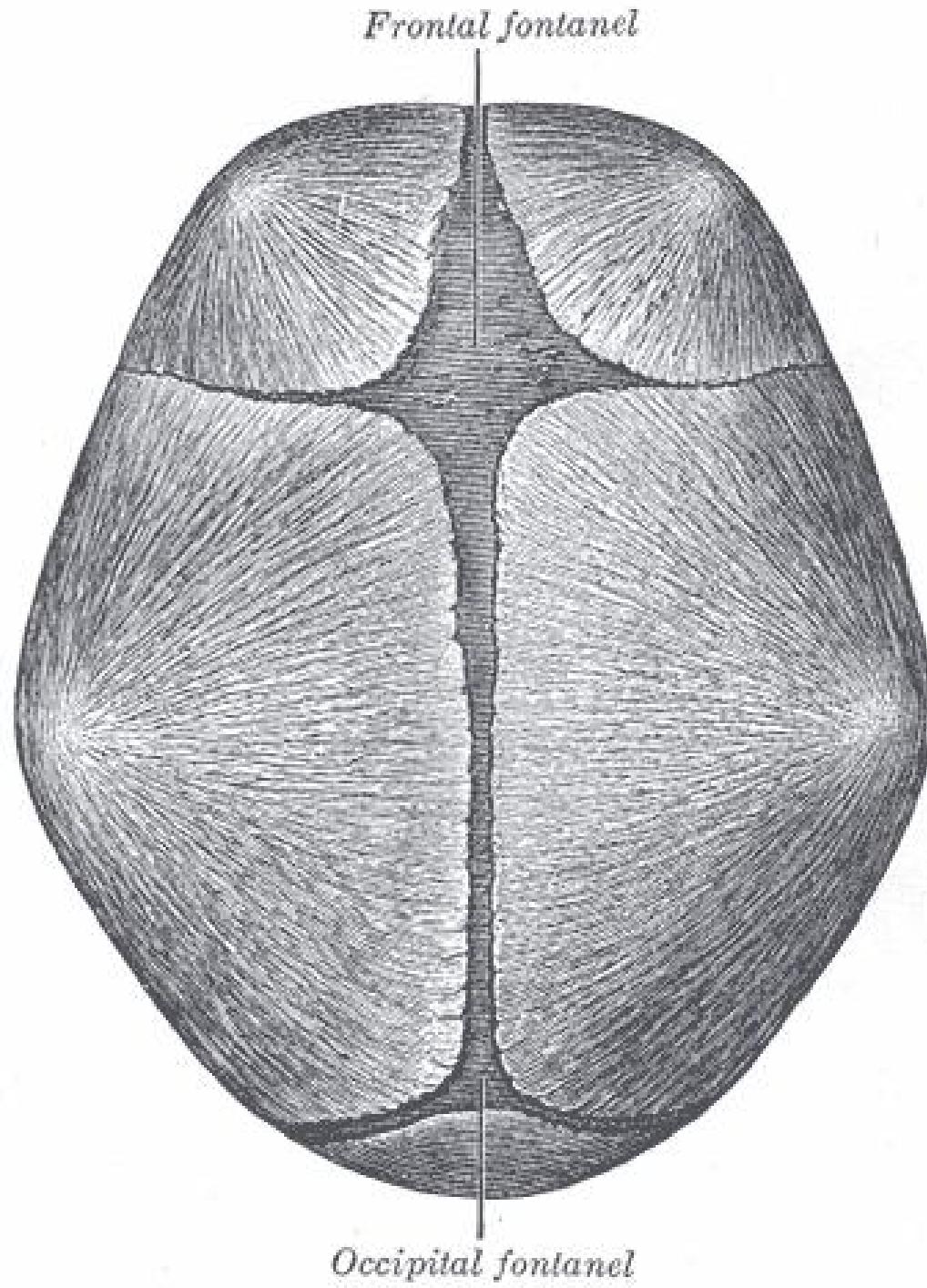


Figure 16 Fetal skull.

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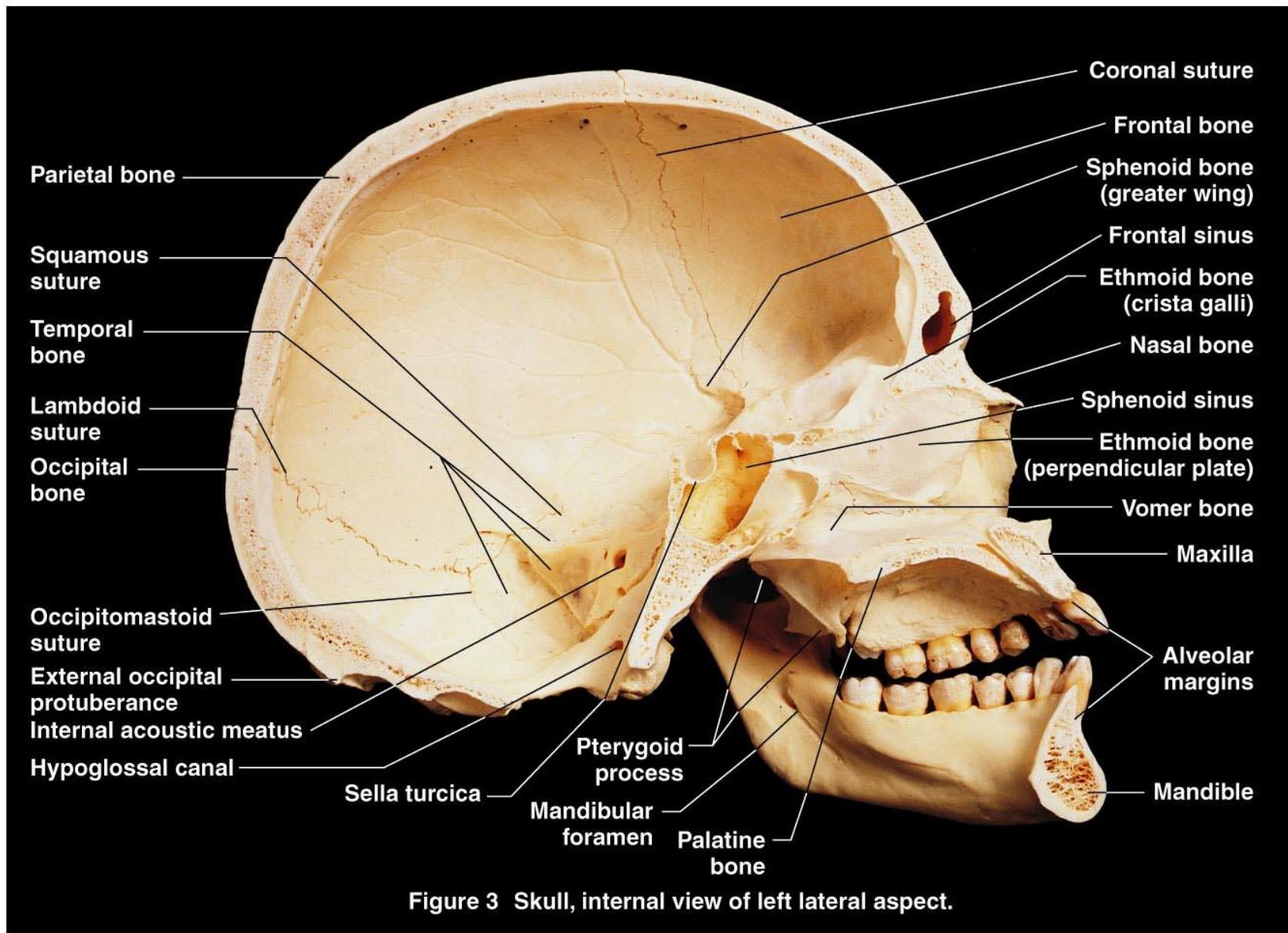
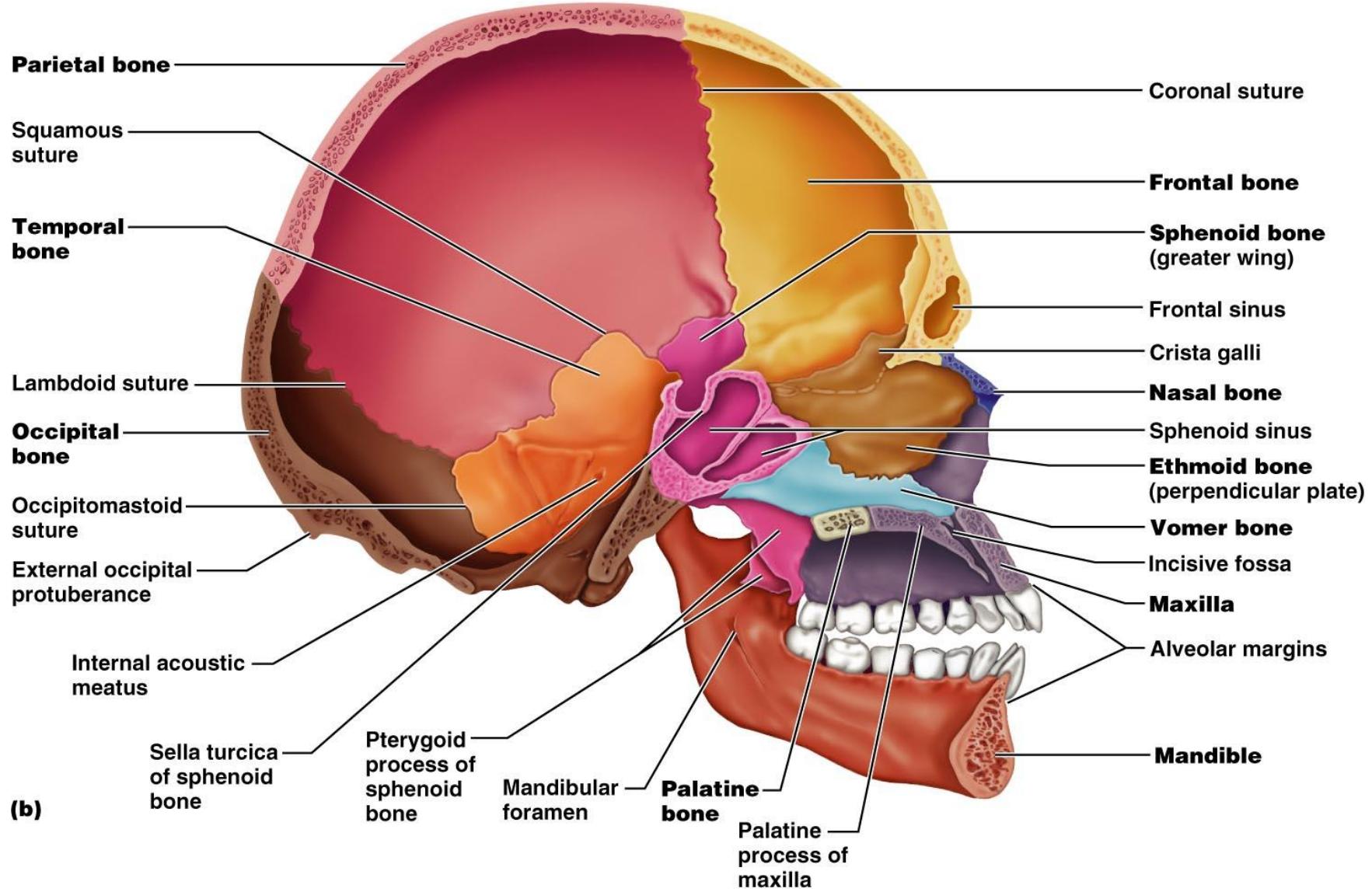


Figure 3 Skull, internal view of left lateral aspect.

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Figure 7.3b

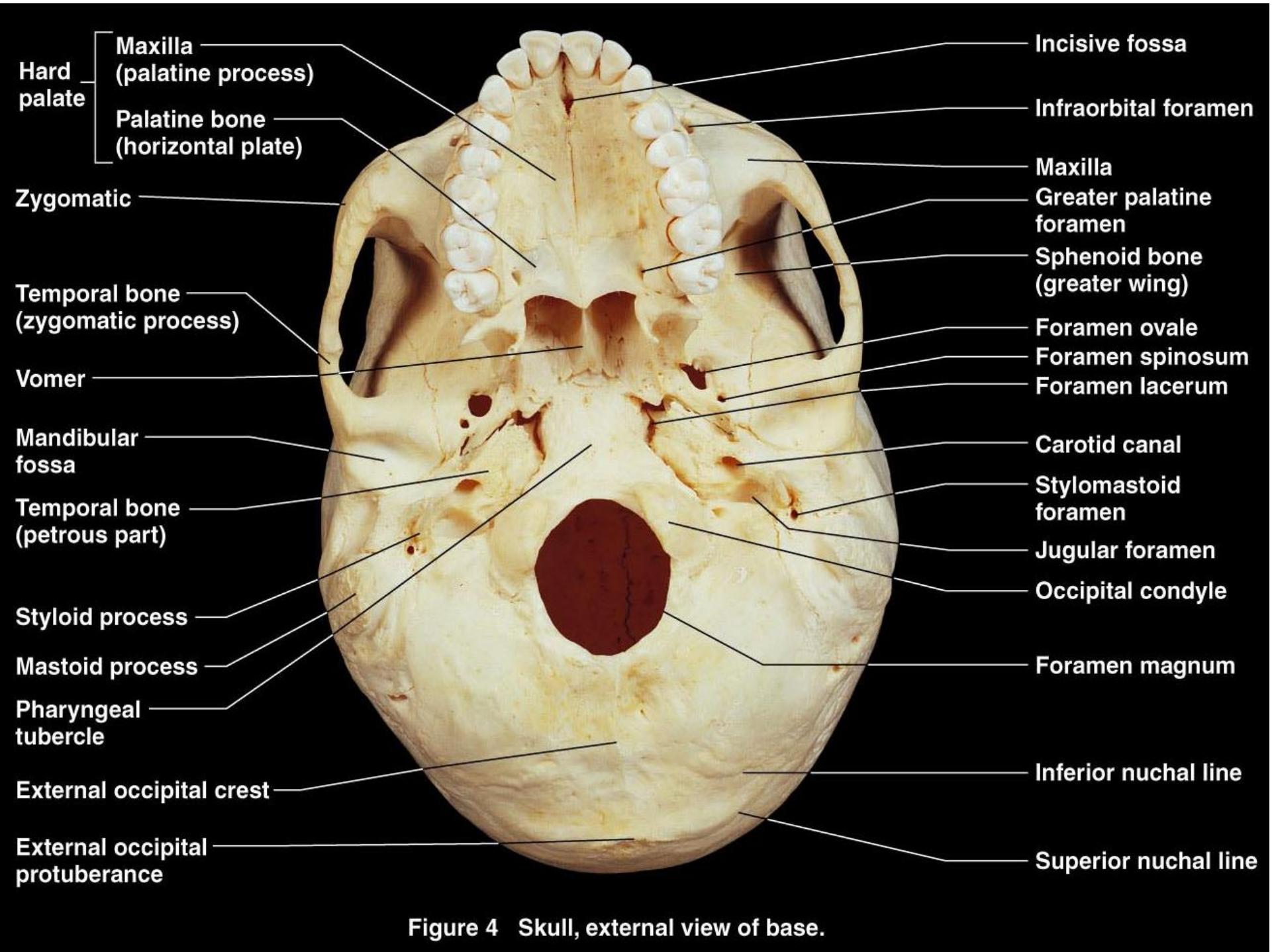
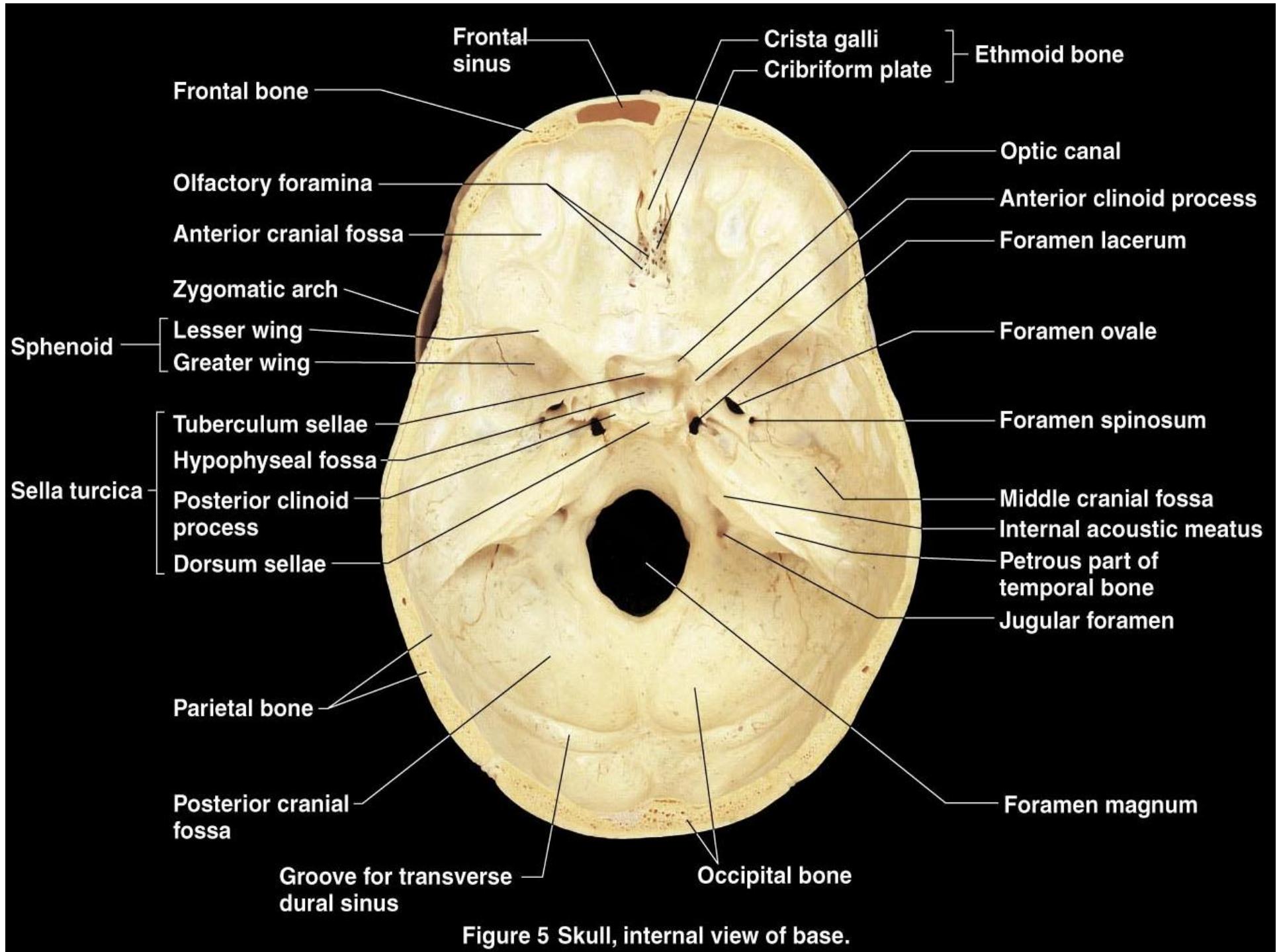


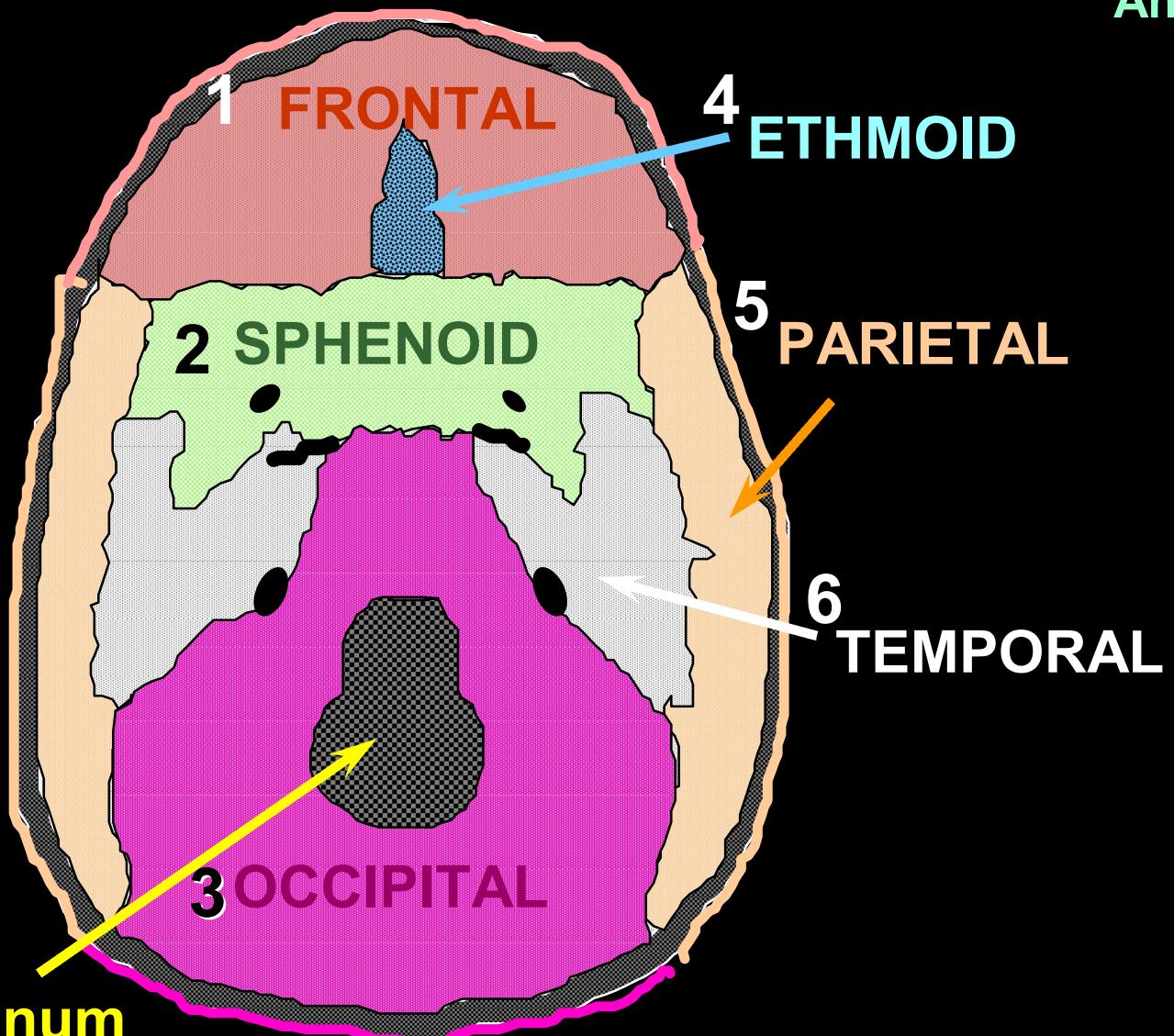
Figure 4 Skull, external view of base.



# SKULL BONES VI CRANIAL BASE

Internal view

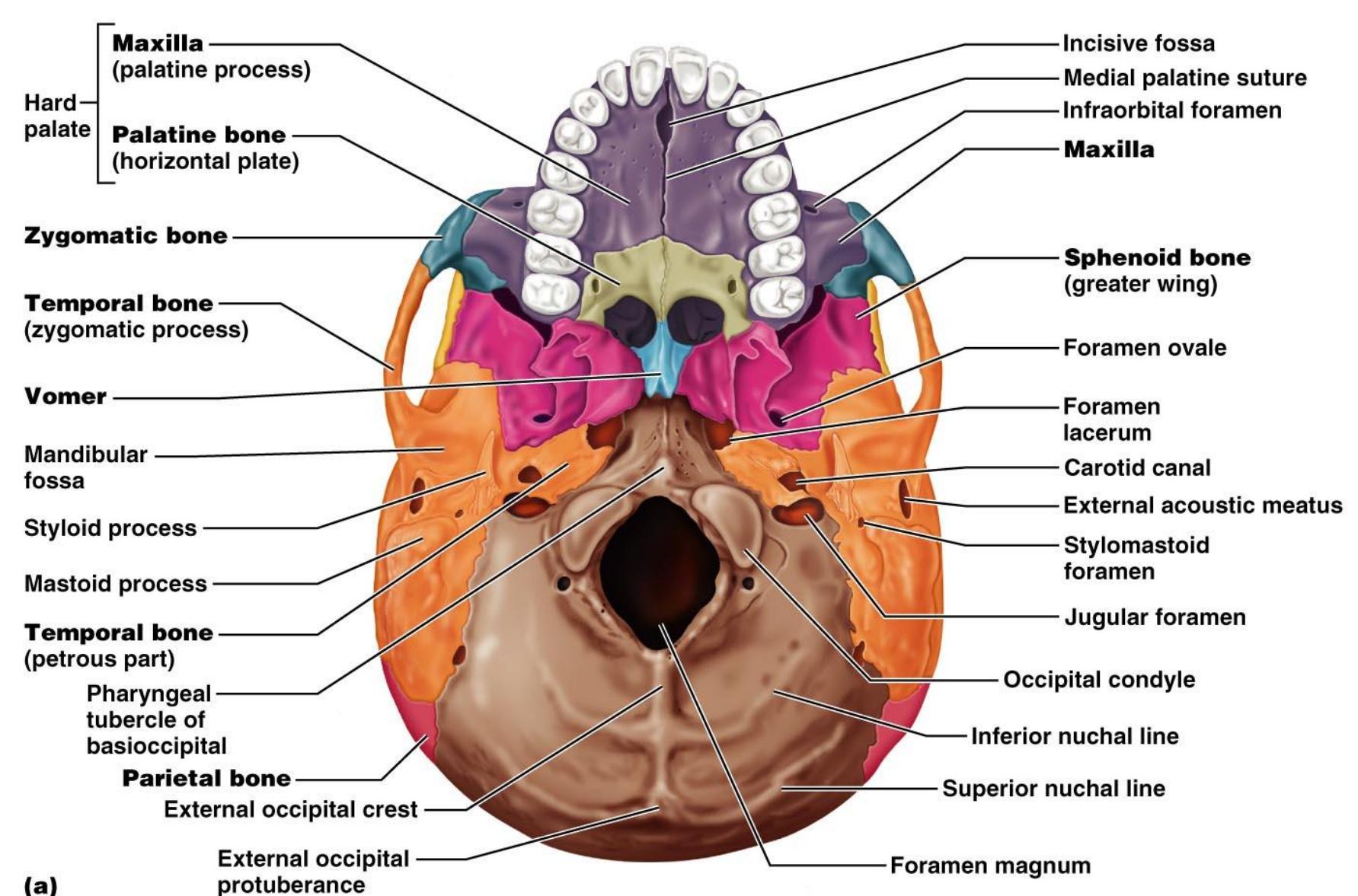
Anterior



**Foramen magnum**

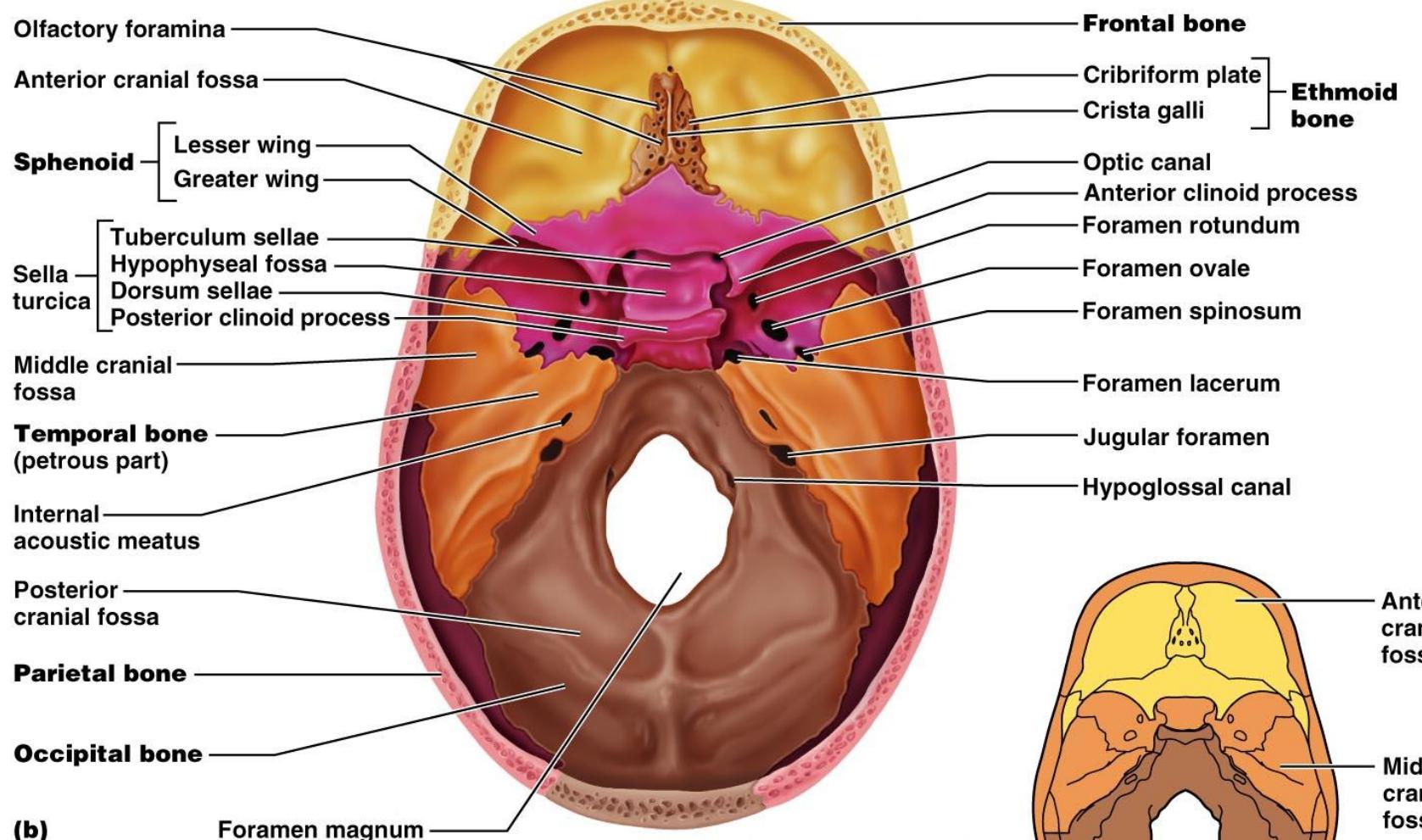
for brainstem to connect with spinal cord, & vessels & wrappings to continue through

Posterior



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Figure 7.4a

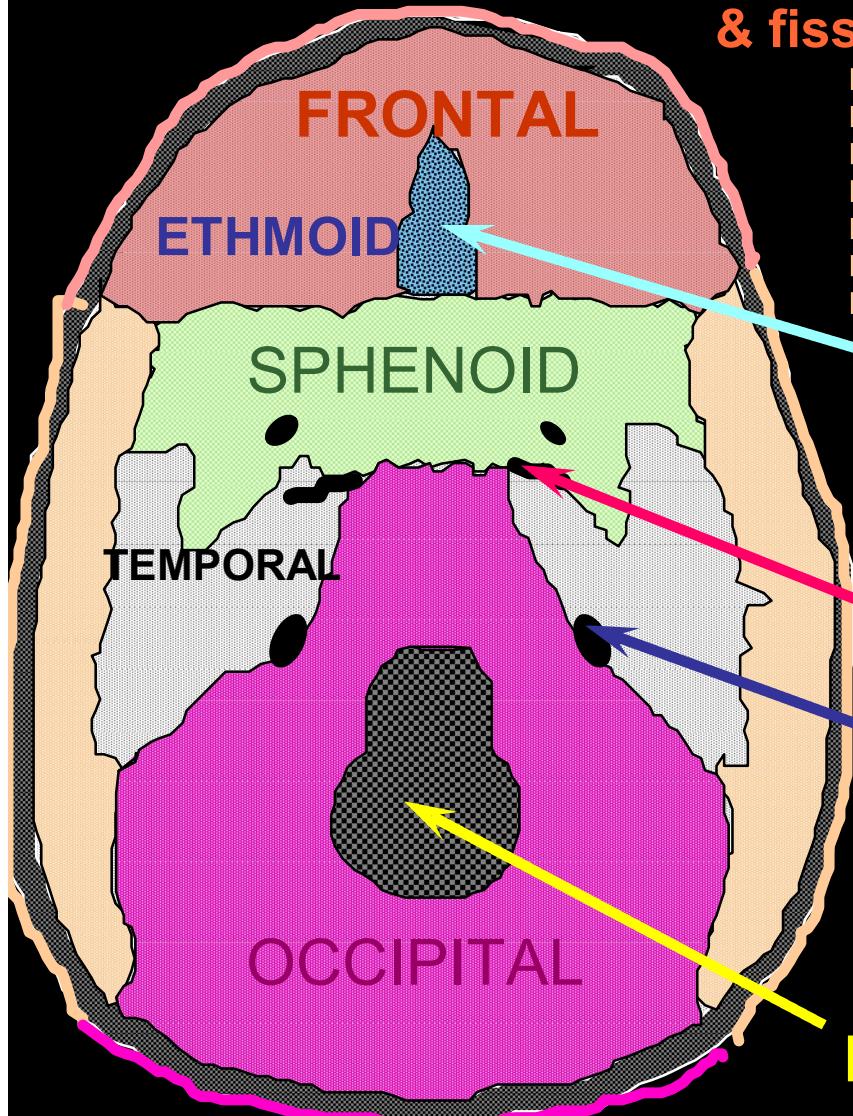


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Figure 7.4b

# SKULL BONES VII CRANIAL BASE

## Foramina



Neurocranium provides *many holes* - foramina & fissures - for vessels & nerves to pass thru

With several vessels & 12 pairs of cranial nerves, many holes are needed, even with some sharing

The ethmoid bones are riddled with many holes for the fine branches of olfactory nerves (I)

Canal for carotid artery

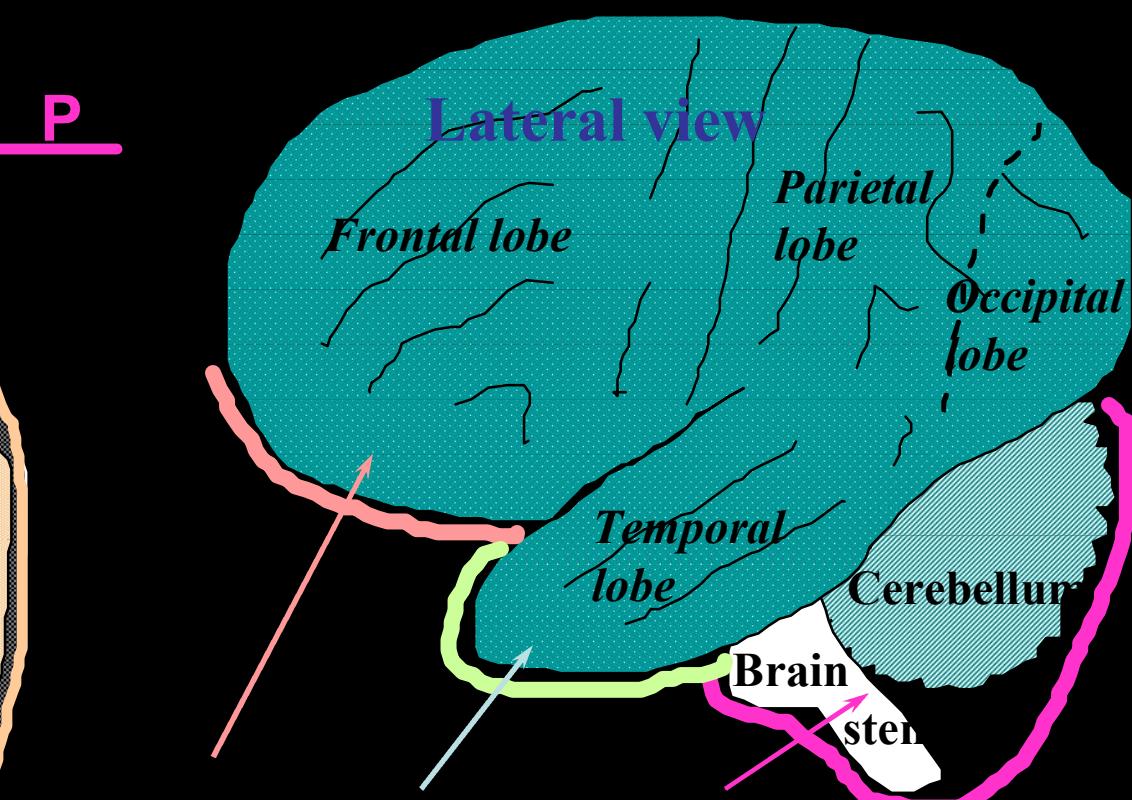
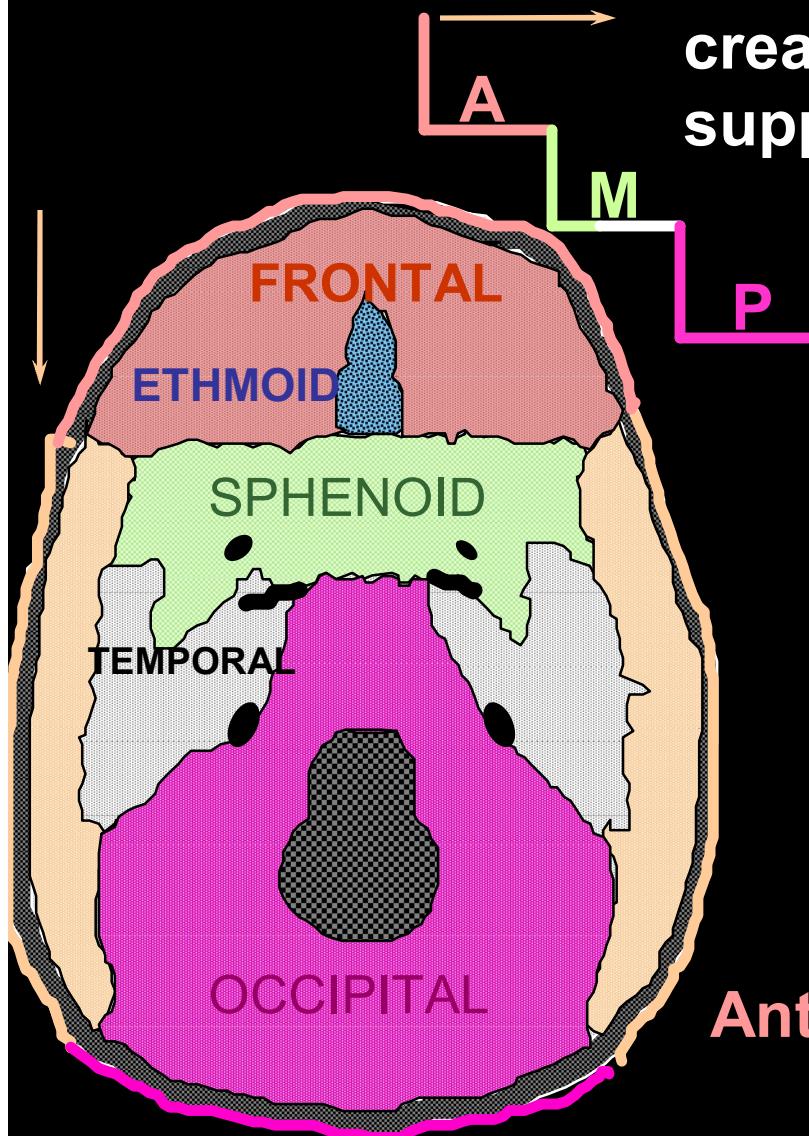
Jugular foramen for brain's venous drainage & Cranial nerves IX, X, & XI

Foramen magnum for brainstem-spinal cord & vertebral arteries

# SKULL BONES VIII as Brain case

What is not apparent in a sketch of the inside of the skull base is that it is stepped, getting deeper going posteriorly

creating, for each level, a *cranial fossa*, supporting a different part of the brain

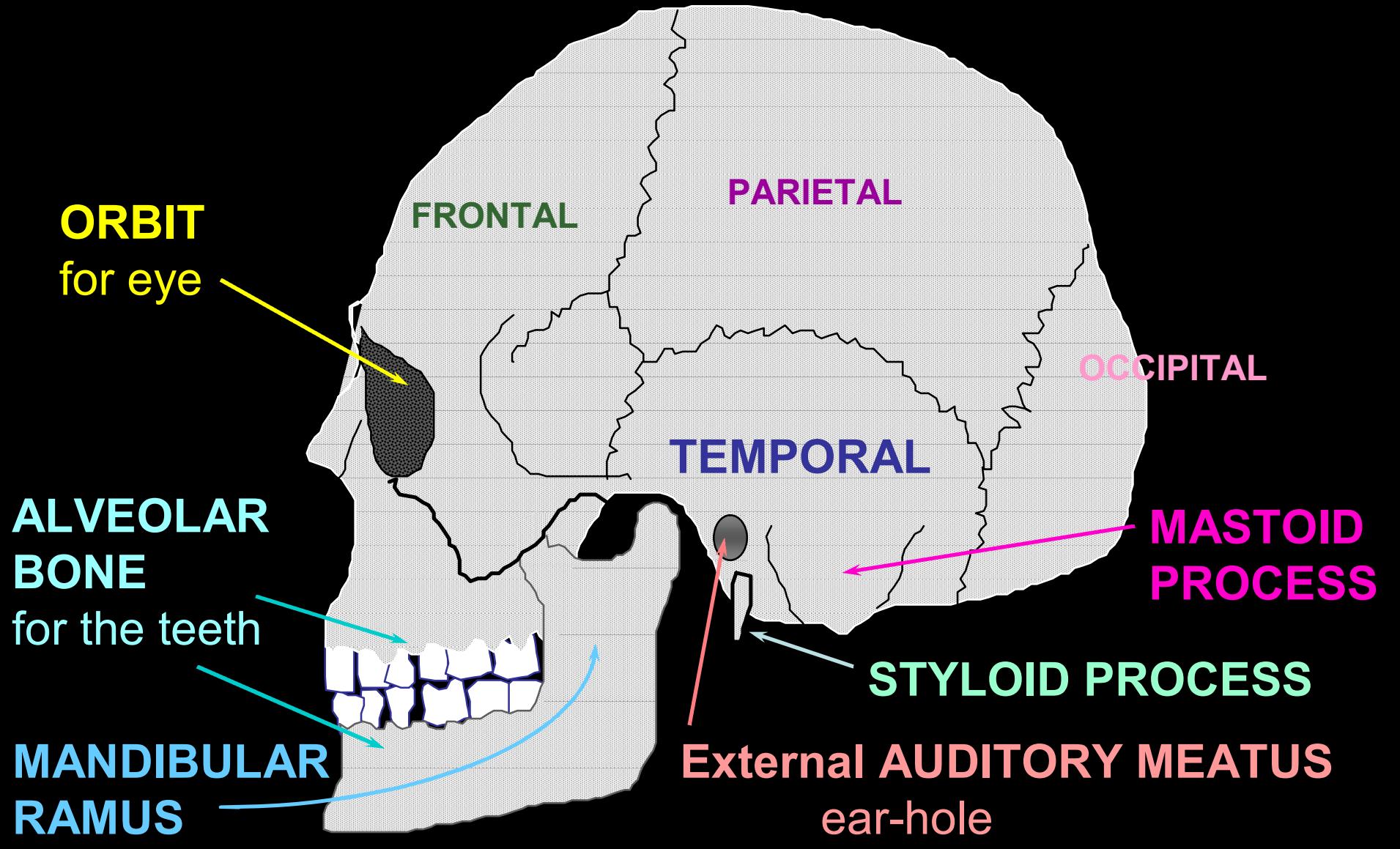


Anterior, Middle & Posterior  
Cranial fossae

# SOME SKULL STRUCTURES

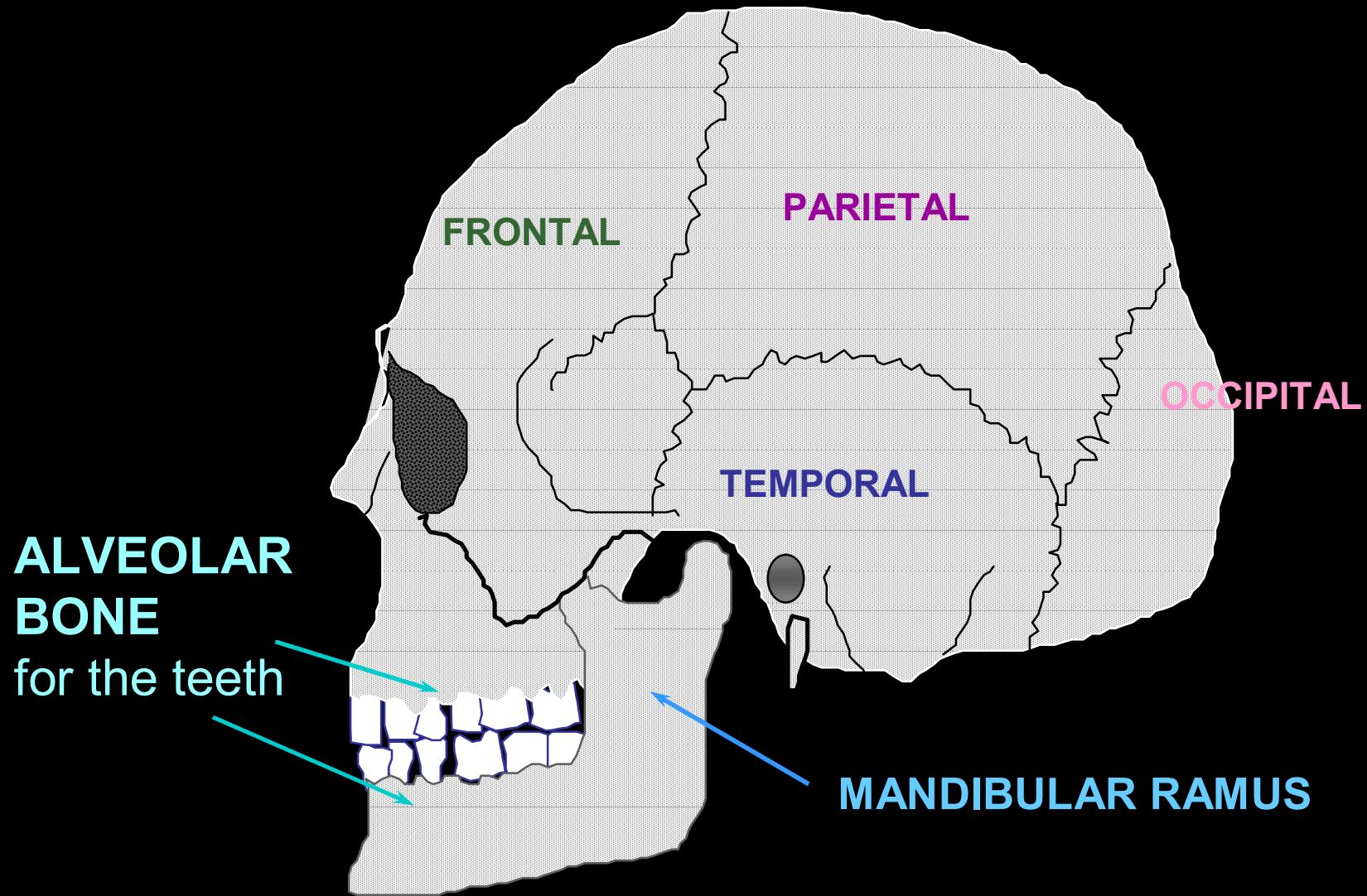
Lateral view

Note: the three features of the temporal bone; & that the maxilla & mandible both have an alveolar ridge for the teeth

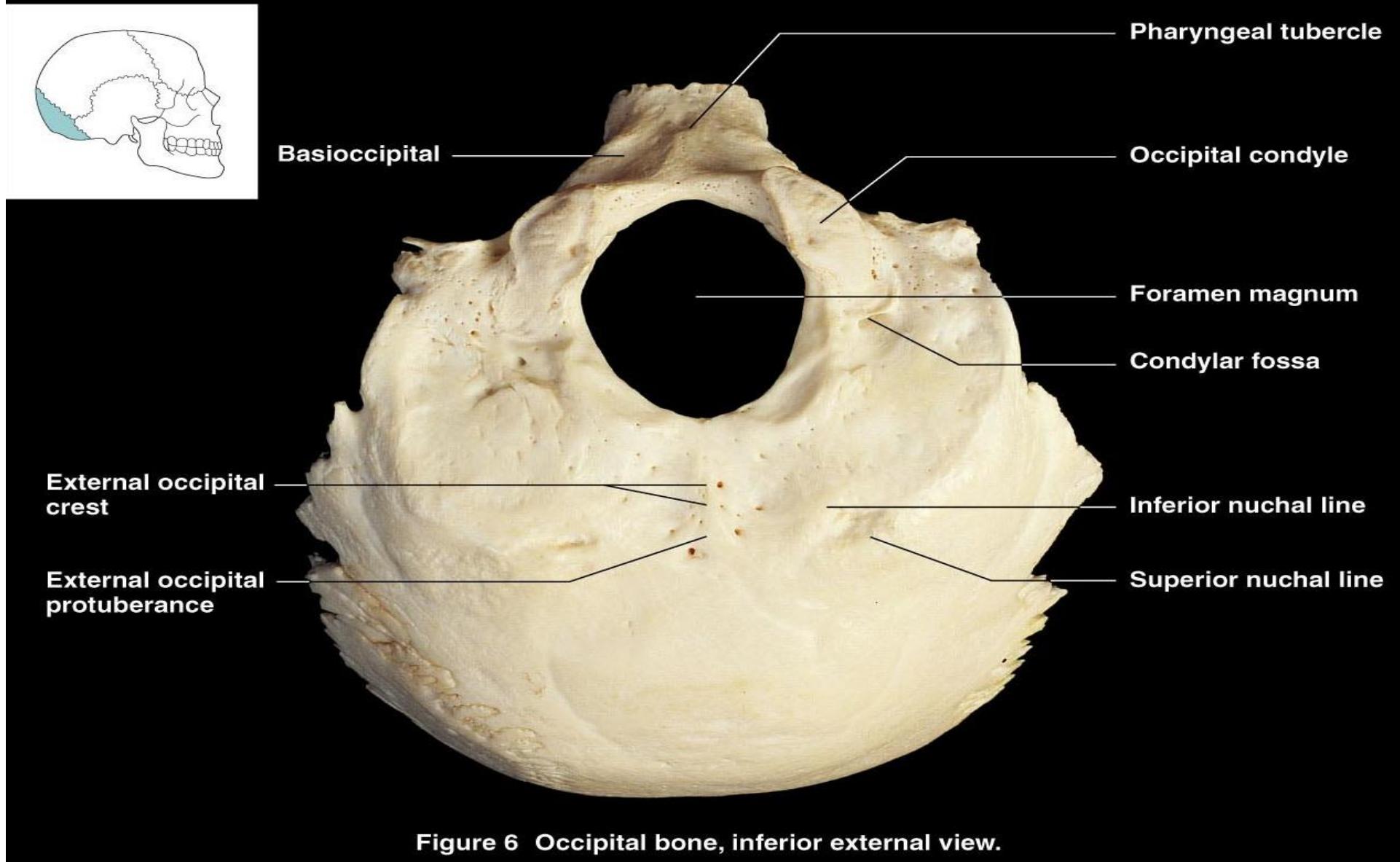


# SOME SKULL STRUCTURES

Lateral view



Major markings: the sella turcica, hypophyseal fossa, and the pterygoid processes  
Major openings include the foramina rotundum, ovale, and spinosum; the optic canals;  
and the superior orbital fissure



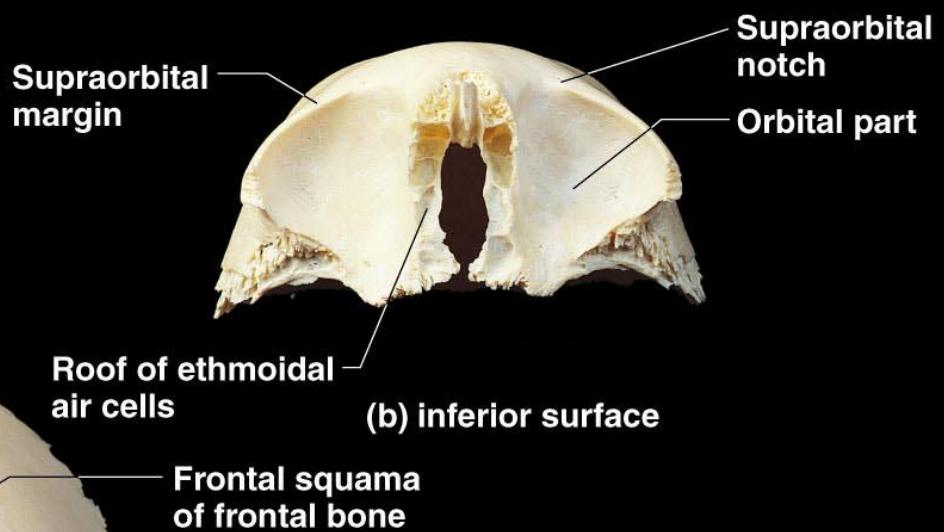
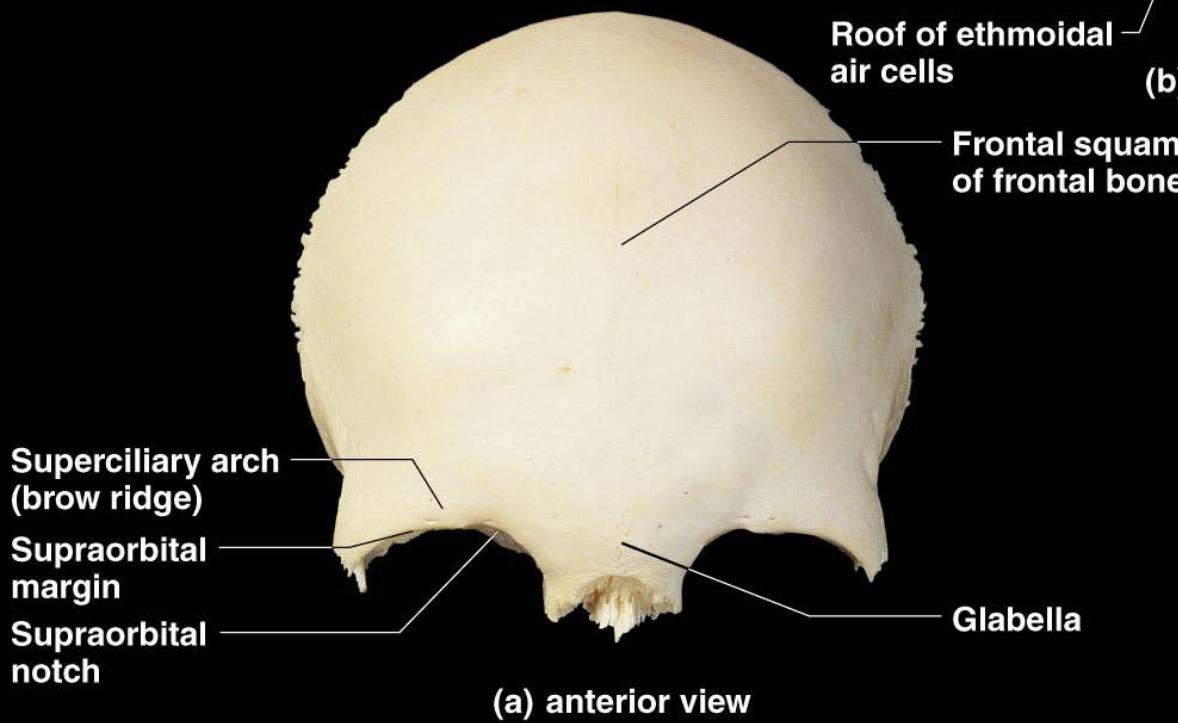
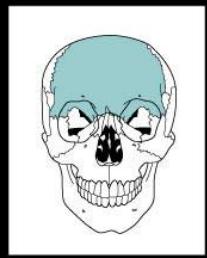
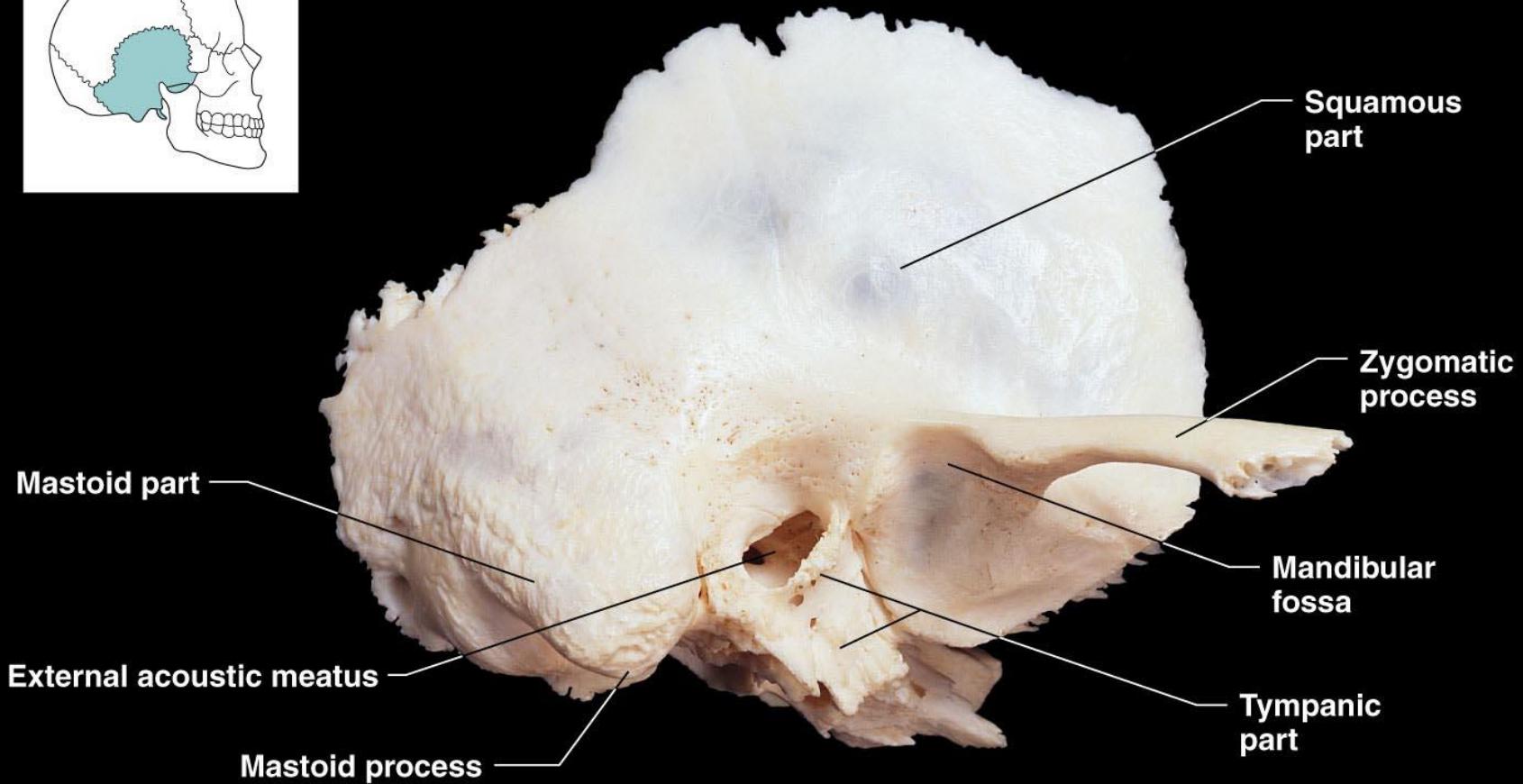
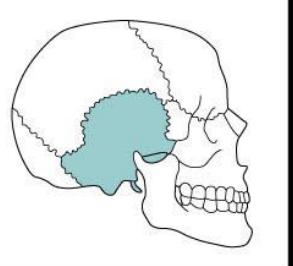


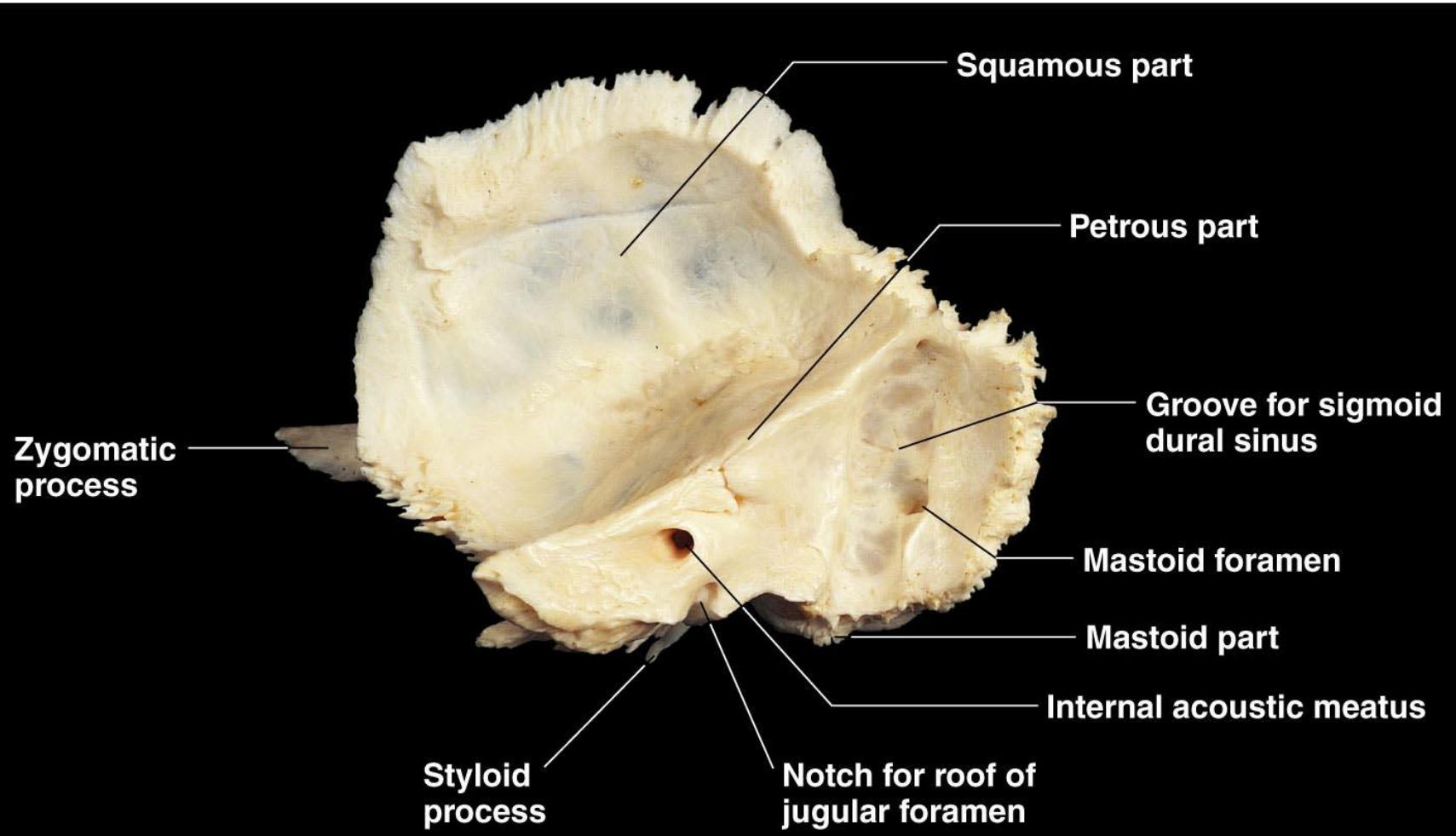
Figure 7 Frontal bone.

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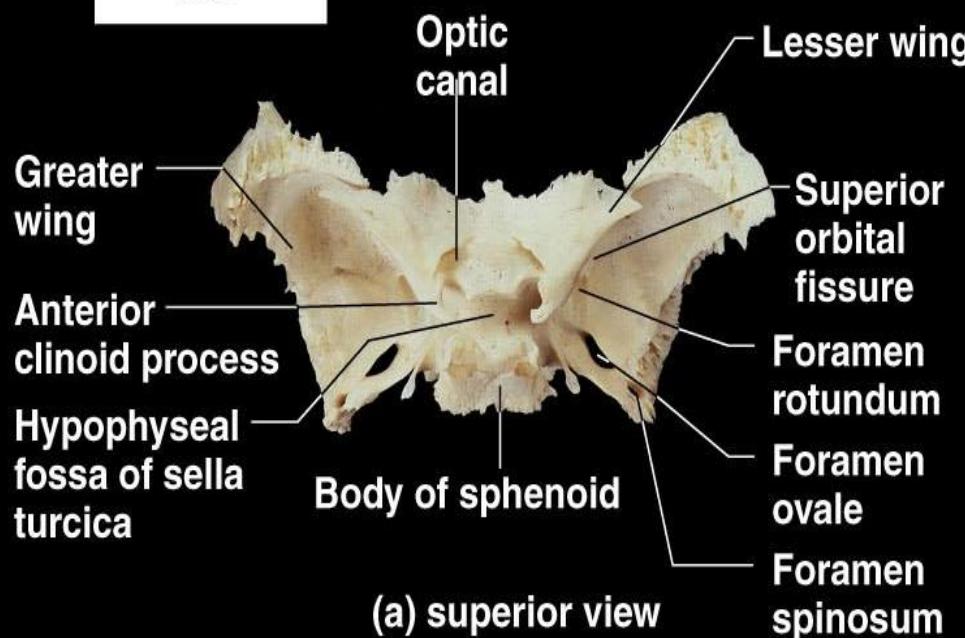
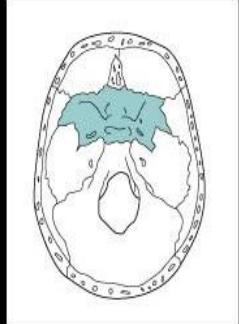
(a) right lateral surface

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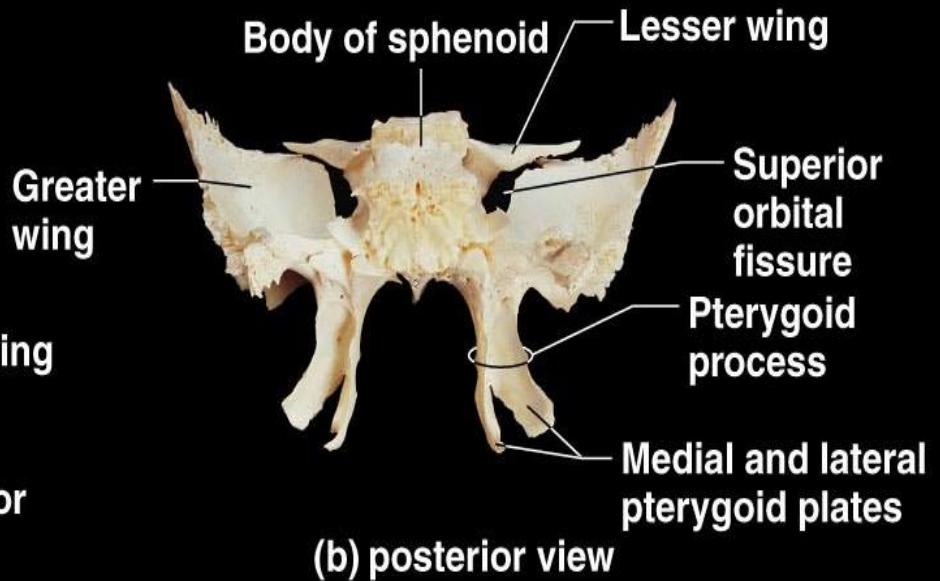


(b) right medial view

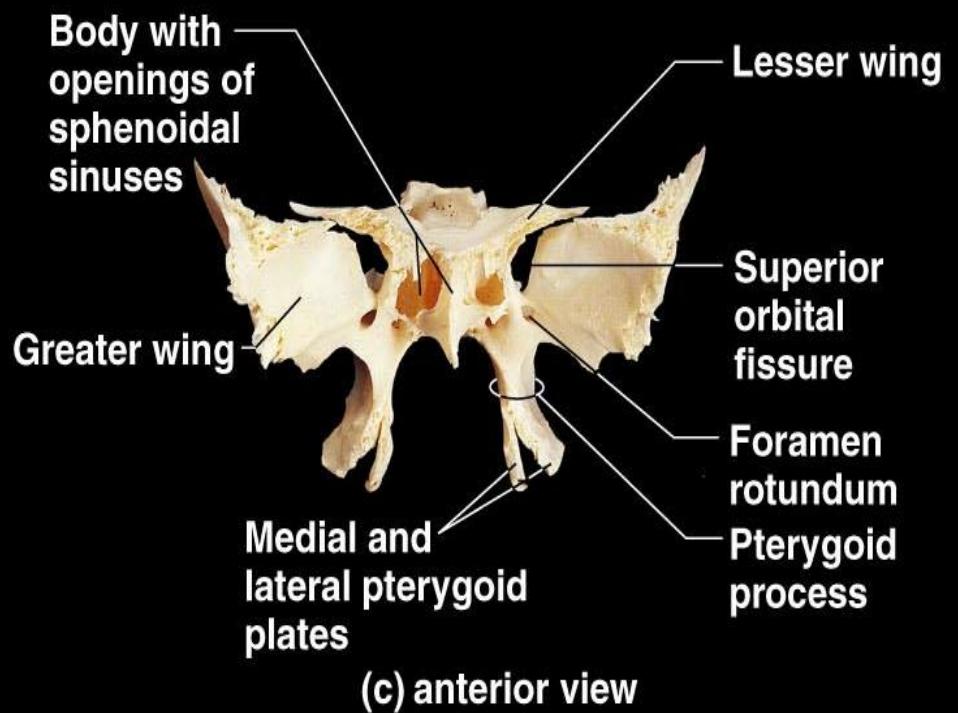
**Figure 8 Temporal bone.**



(a) superior view



(b) posterior view



(c) anterior view

Figure 9 Sphenoid bone.

The sphenoid forms part of the eye orbit and helps to form the floor of the cranium.

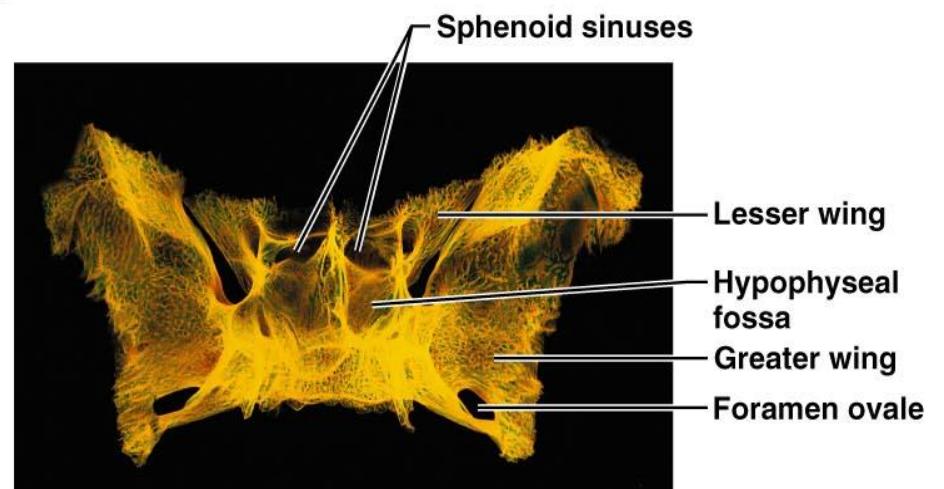
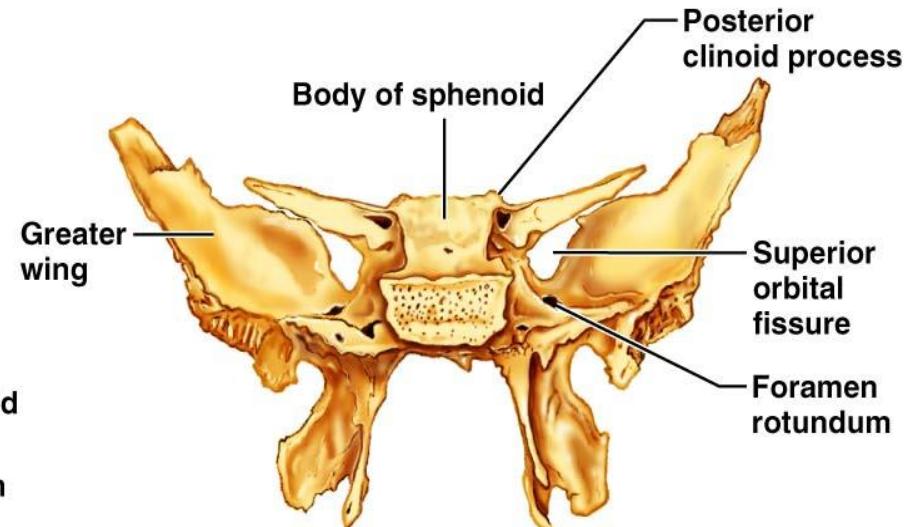
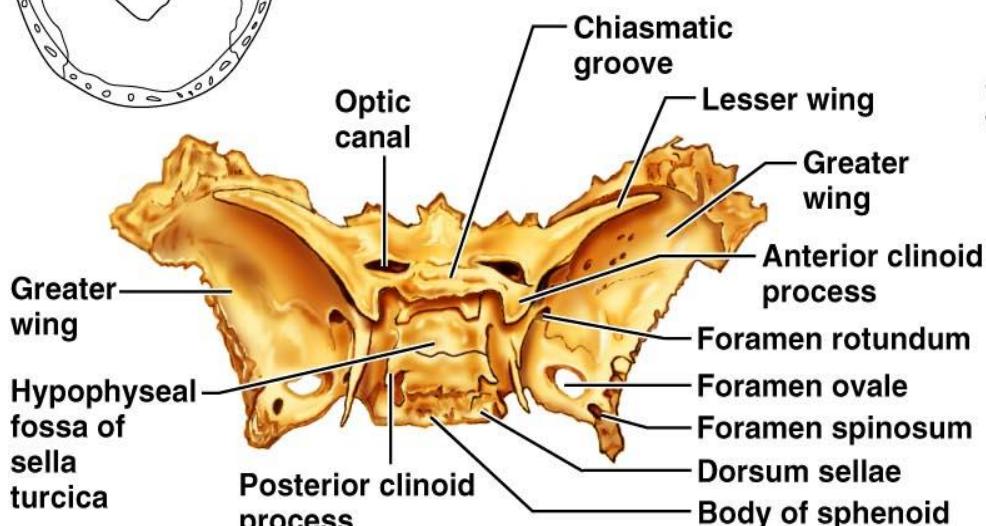
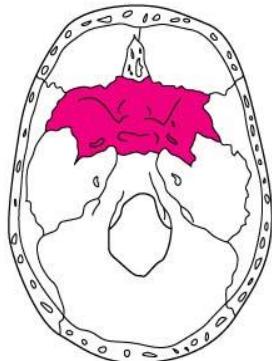
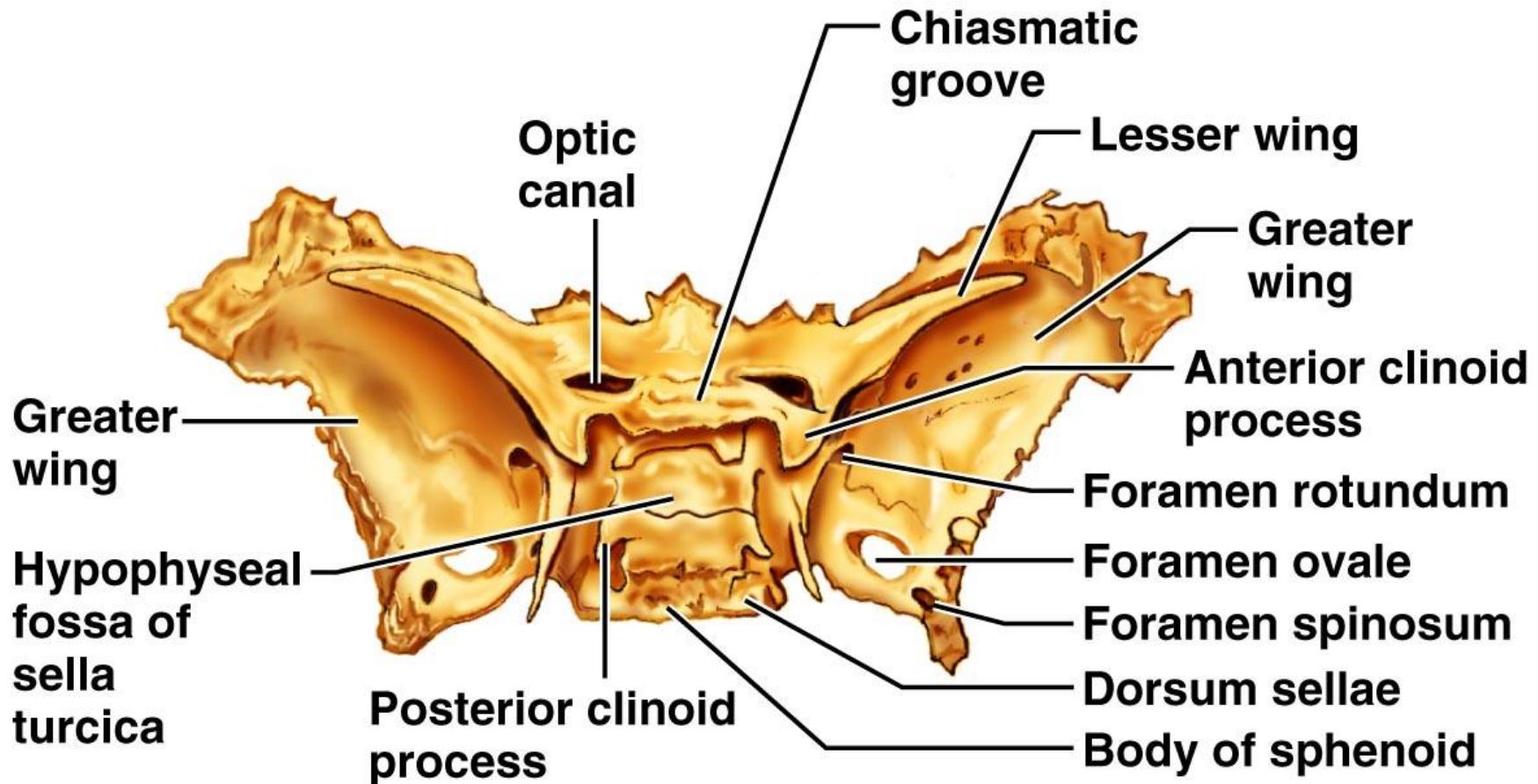


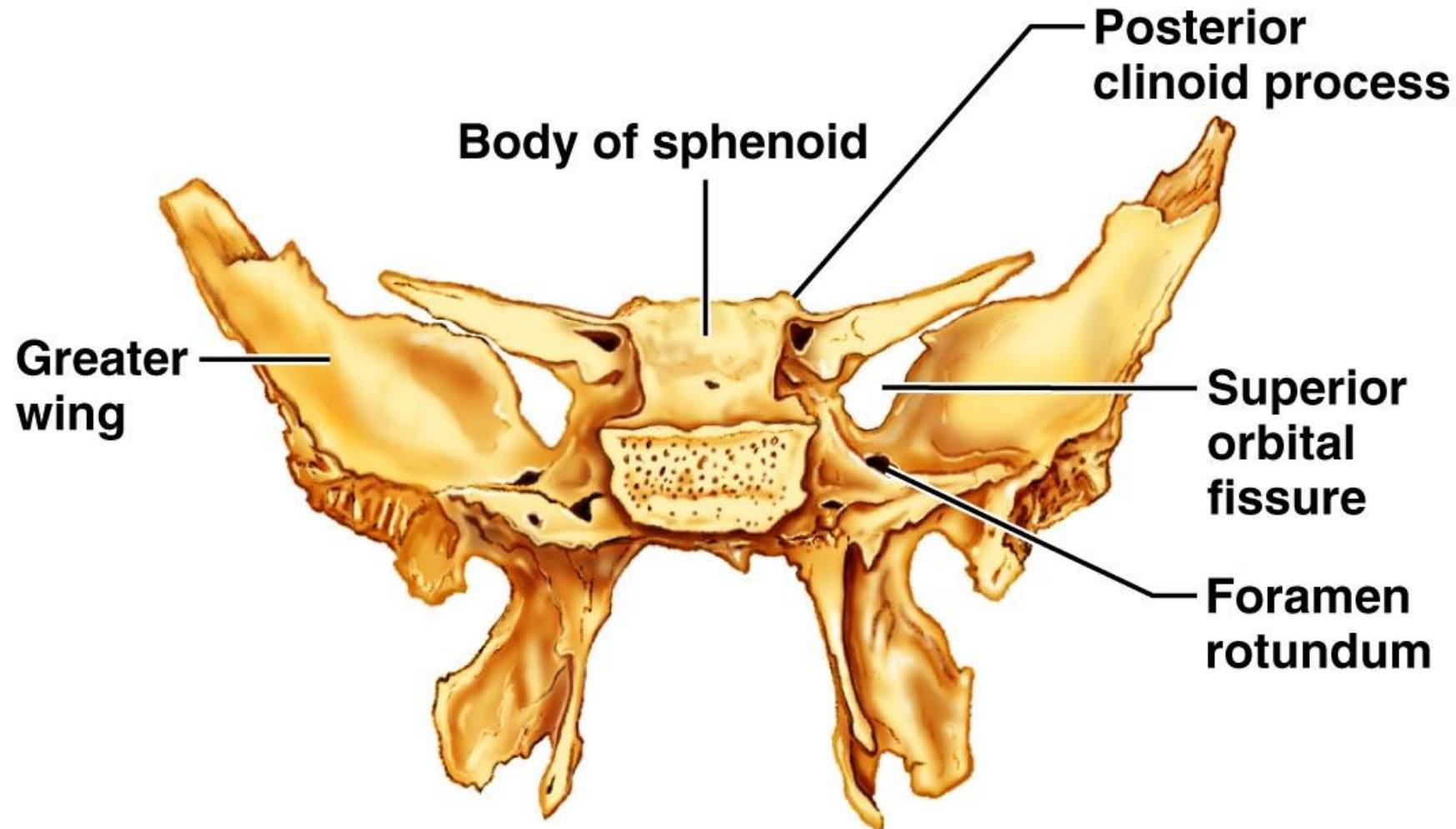
Figure 7.6



**(a) Superior view**

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Figure 7.6a



**(b) Posterior view**

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Figure 7.6b

The sphenoid forms part of the eye orbit and helps to form the floor of the cranium.

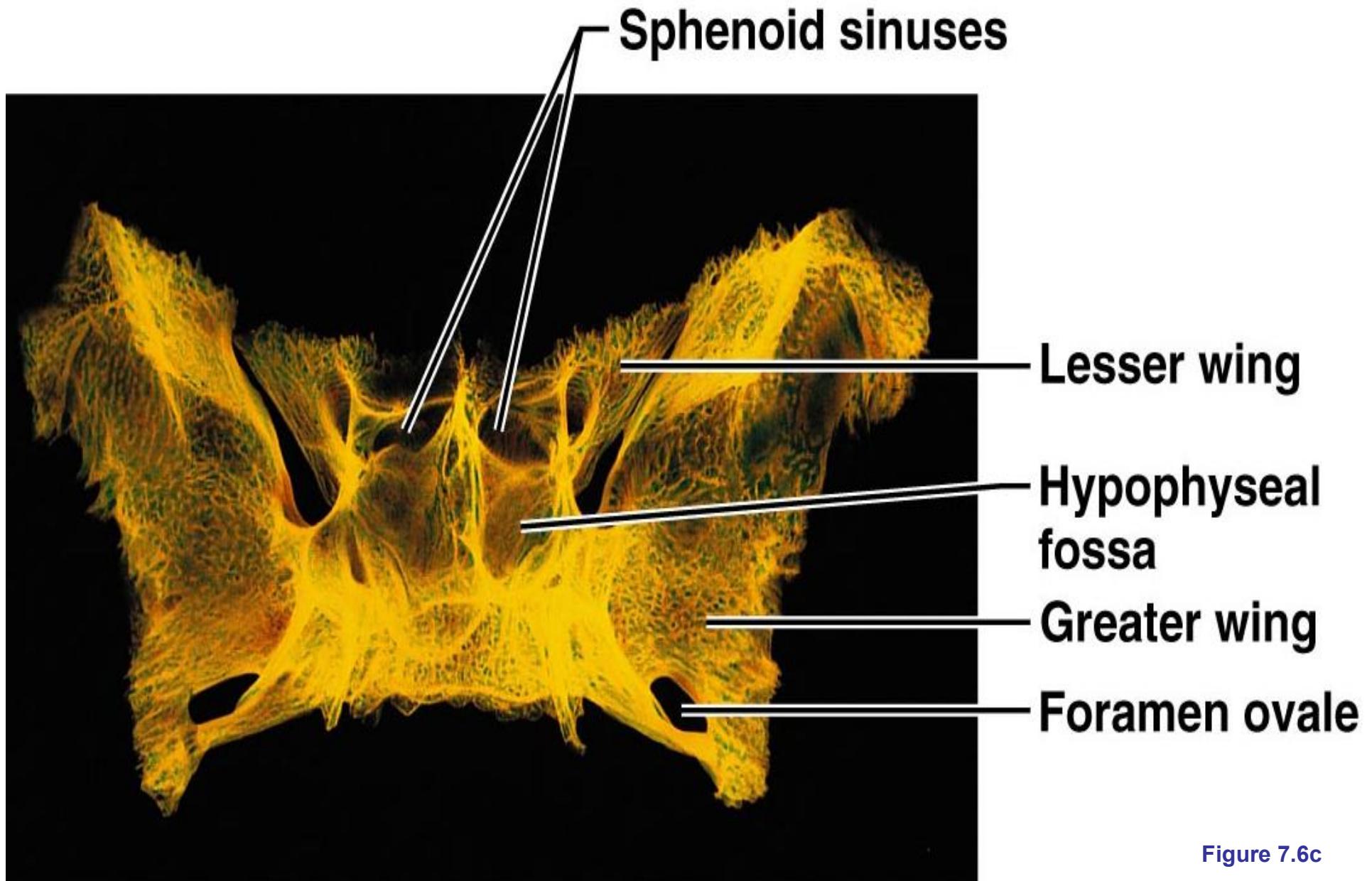


Figure 7.6c

The ethmoid forms the medial portions of the orbits and the roof of the nasal cavity.

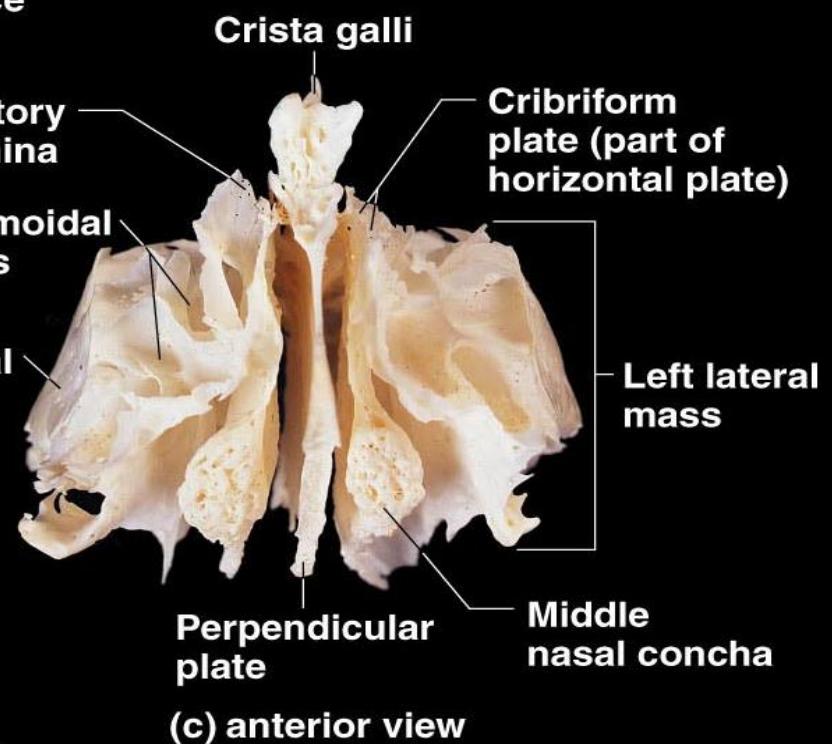
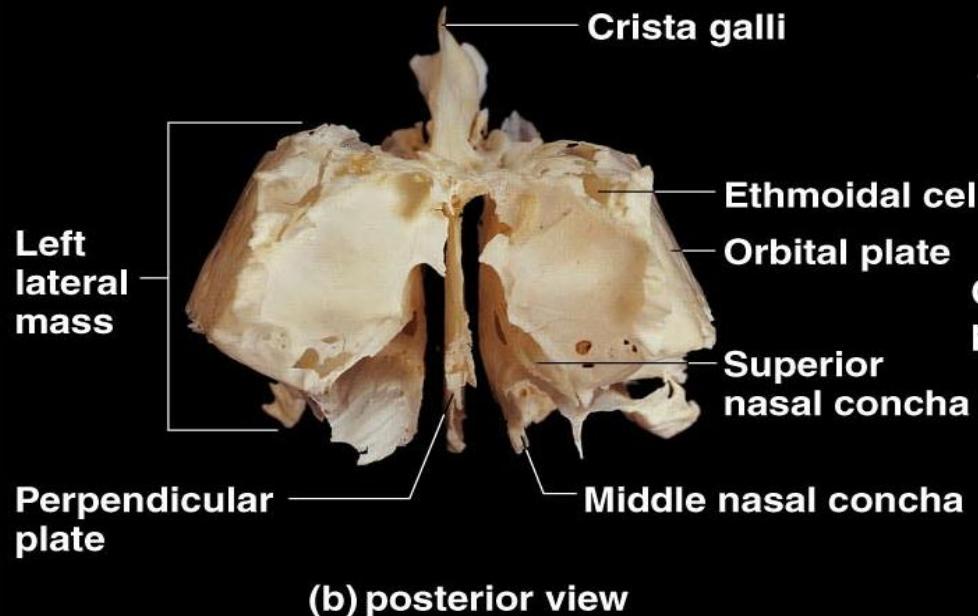
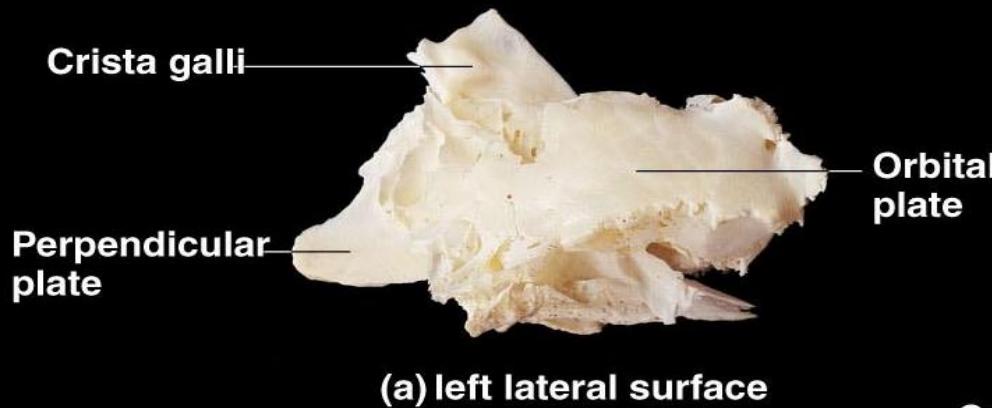
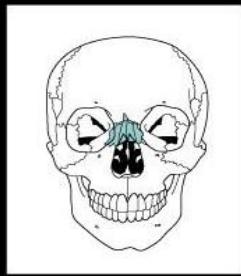
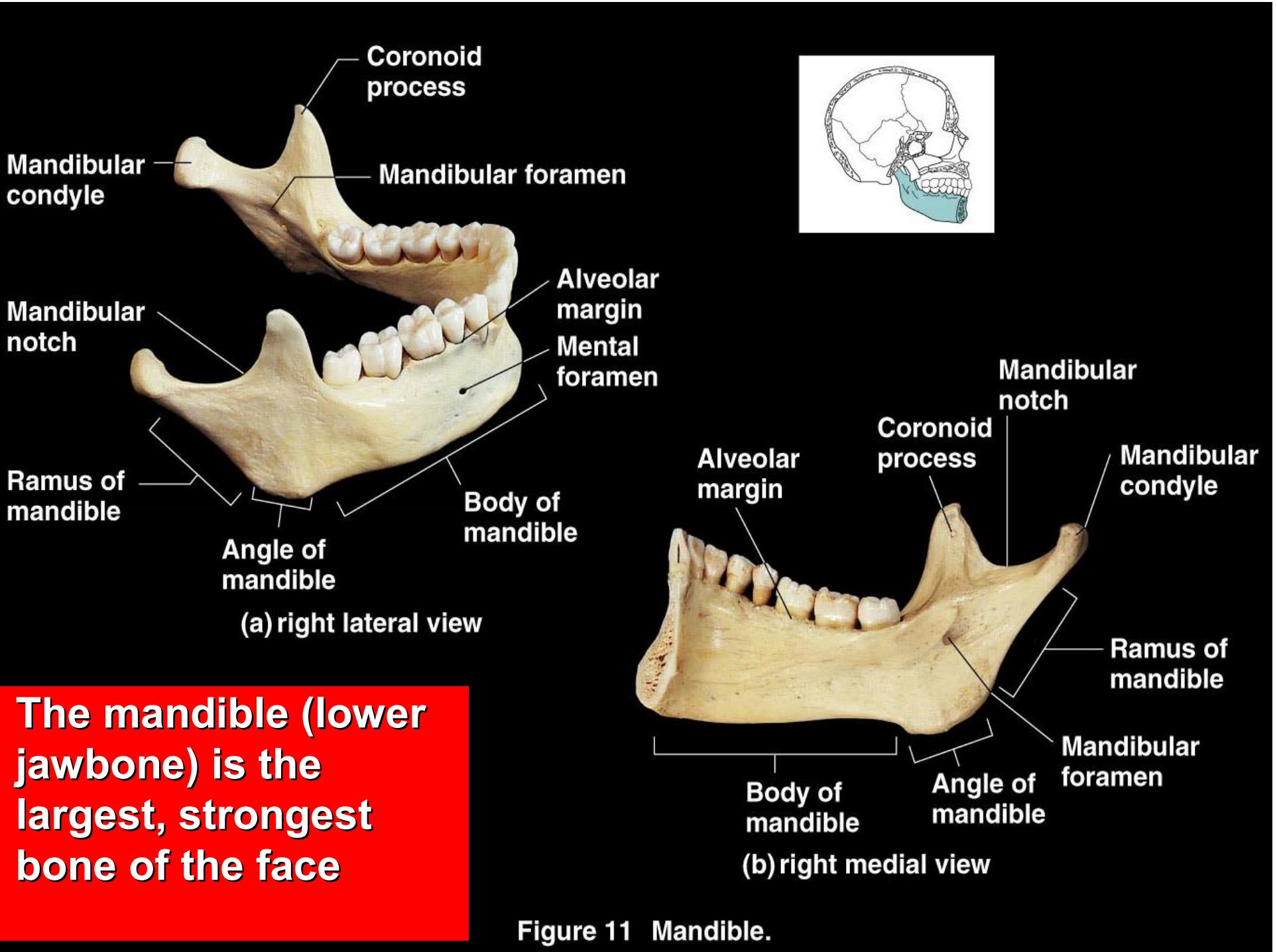
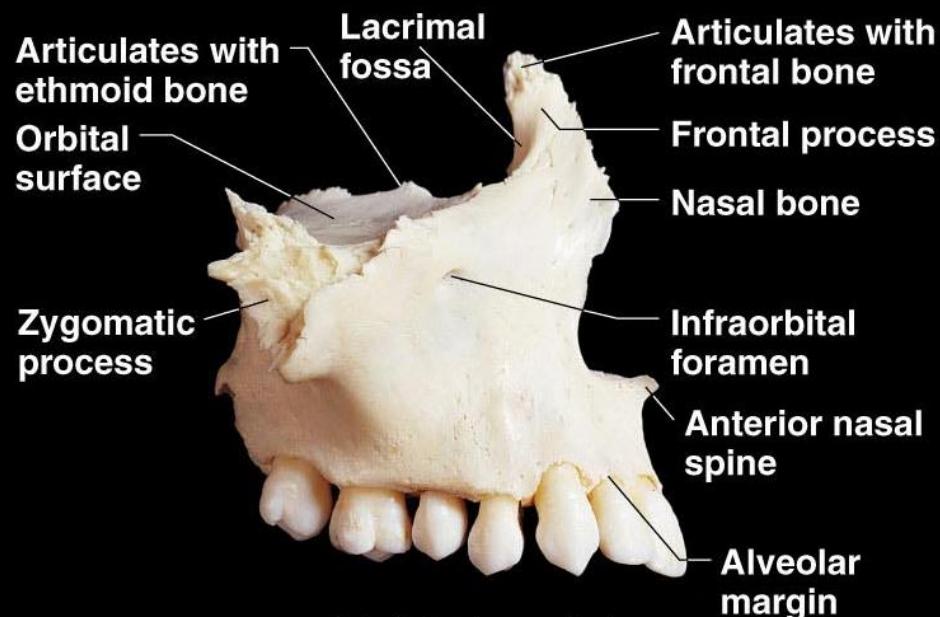


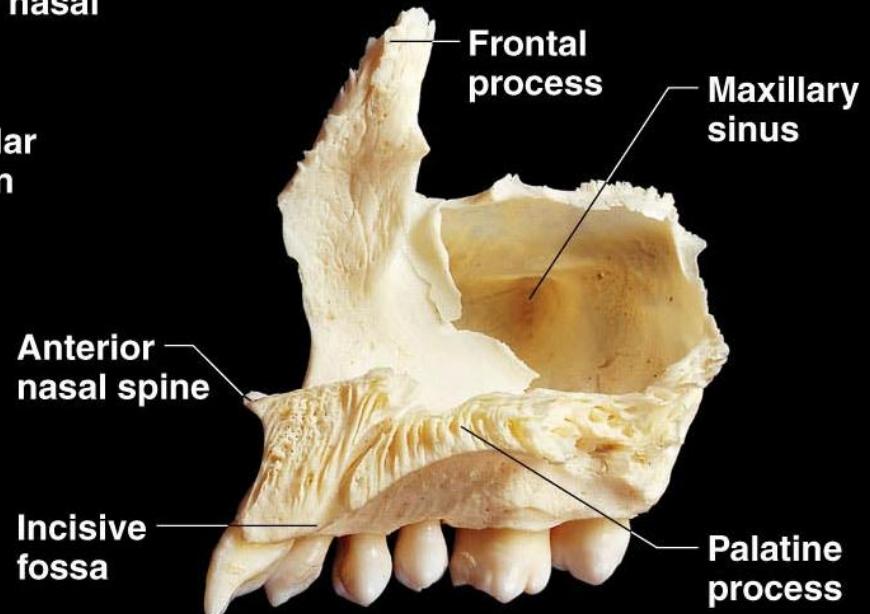
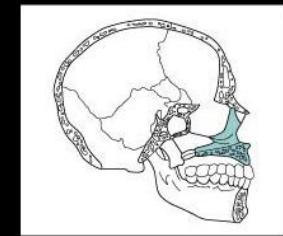
Figure 10 Ethmoid bone.

Major markings include the cribriform plate, crista galli, perpendicular plate, nasal conchae, and the ethmoid sinuses





(a) right lateral view



(b) right medial view

Figure 12 Maxilla.

The palatine articulates with six bones: the sphenoid, ethmoid, maxilla, inferior nasal concha, vomer and opposite palatine



**Hard Palate**  
**Maxillae (palatine processes)**  
**Palatines**  
**Transverse palatine suture**  
**Anterior Palatine Foramen (incisive fossa)**

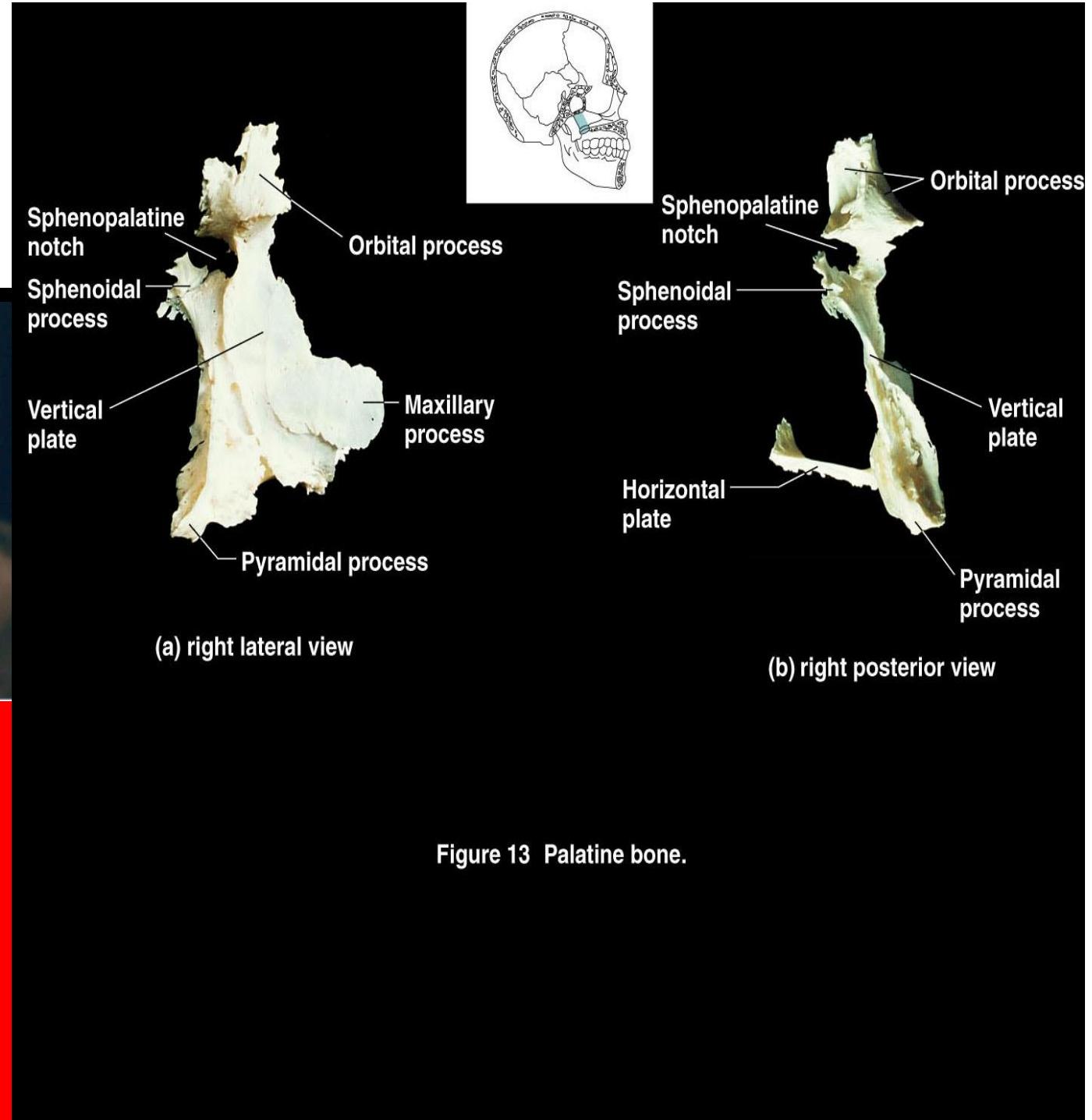
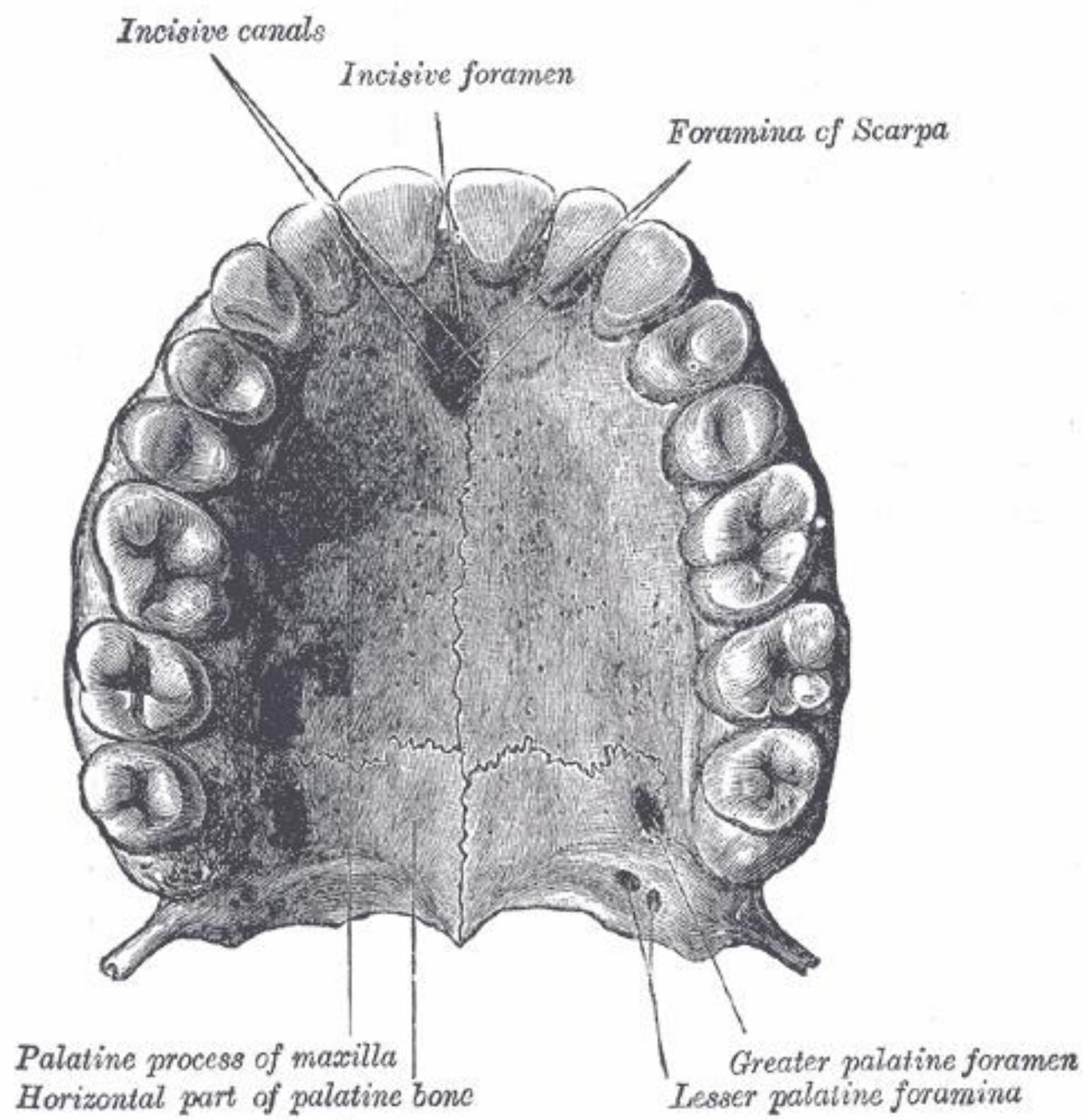


Figure 13 Palatine bone.



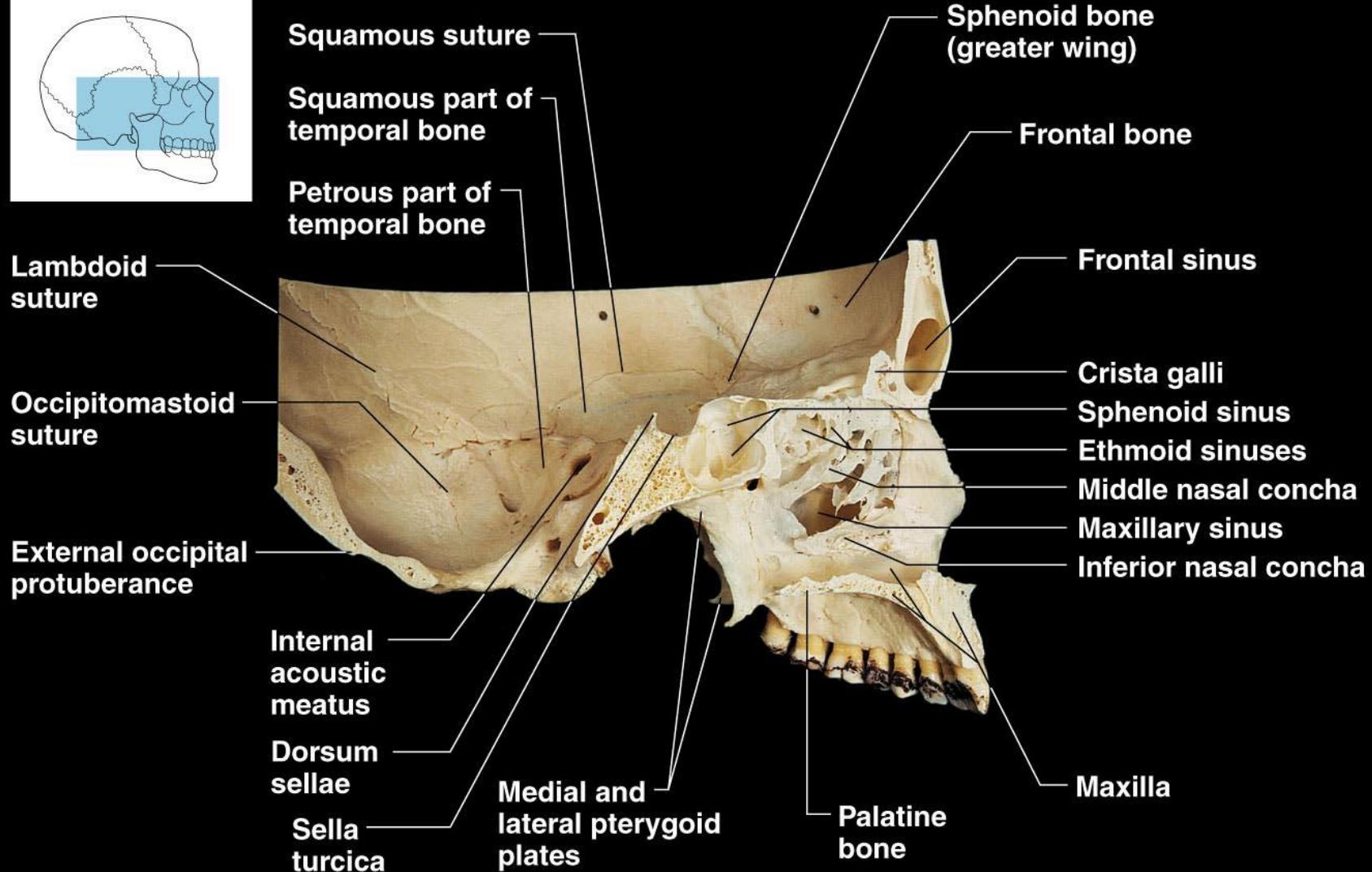
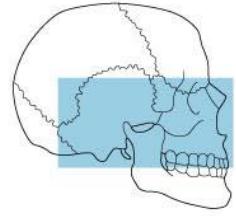


Figure 15 Nasal cavity, left lateral wall.

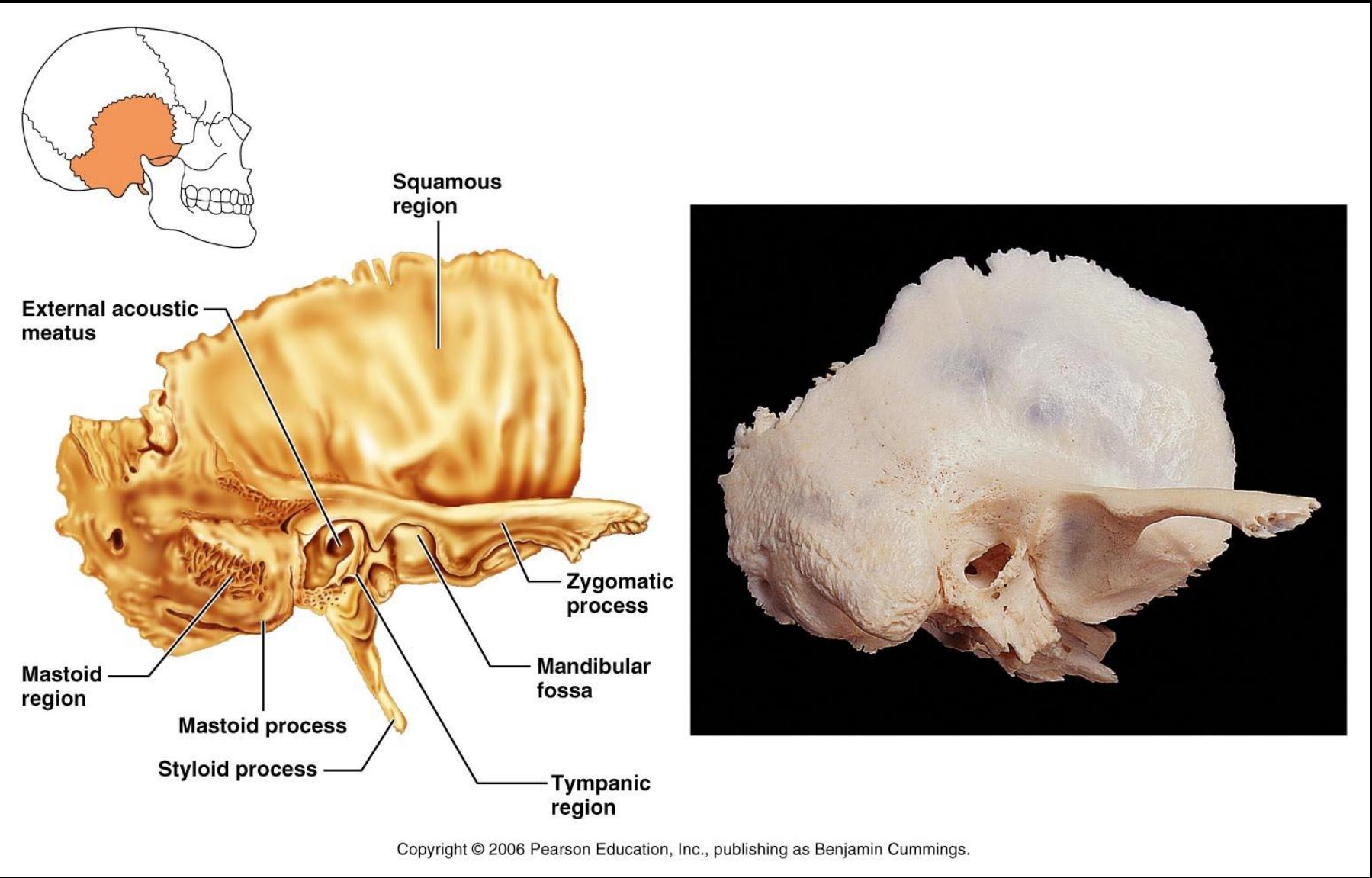


Figure 7.5

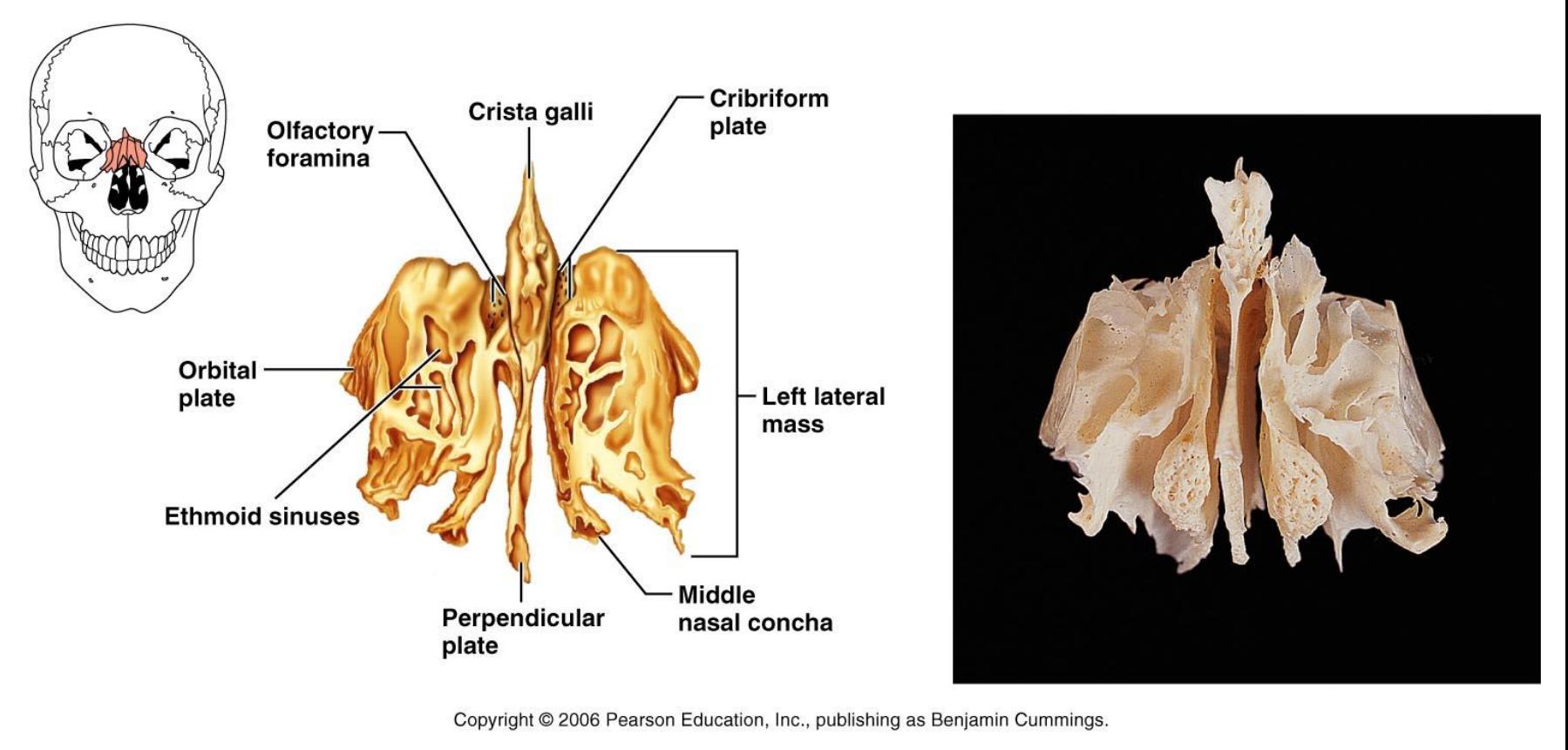
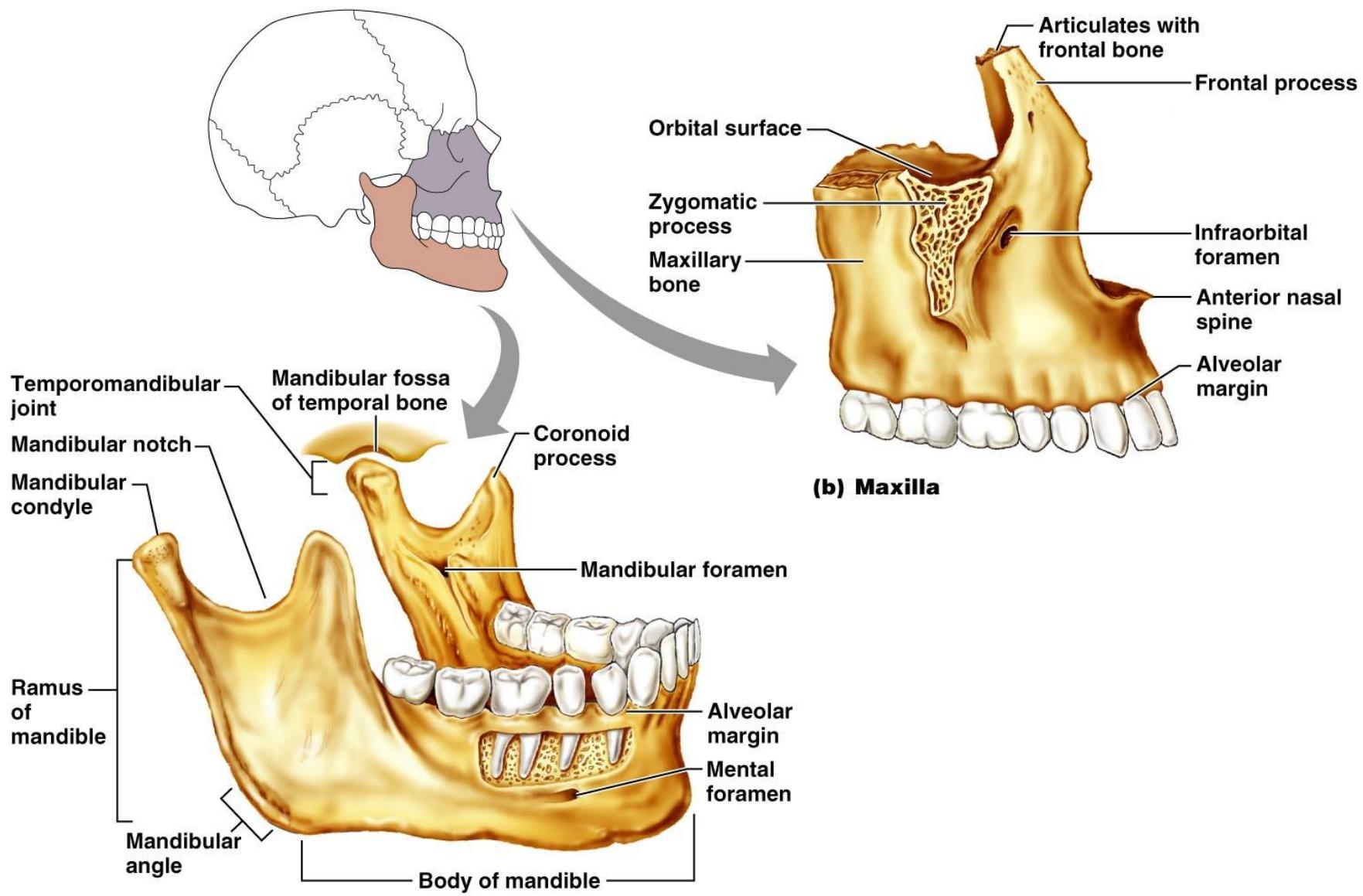
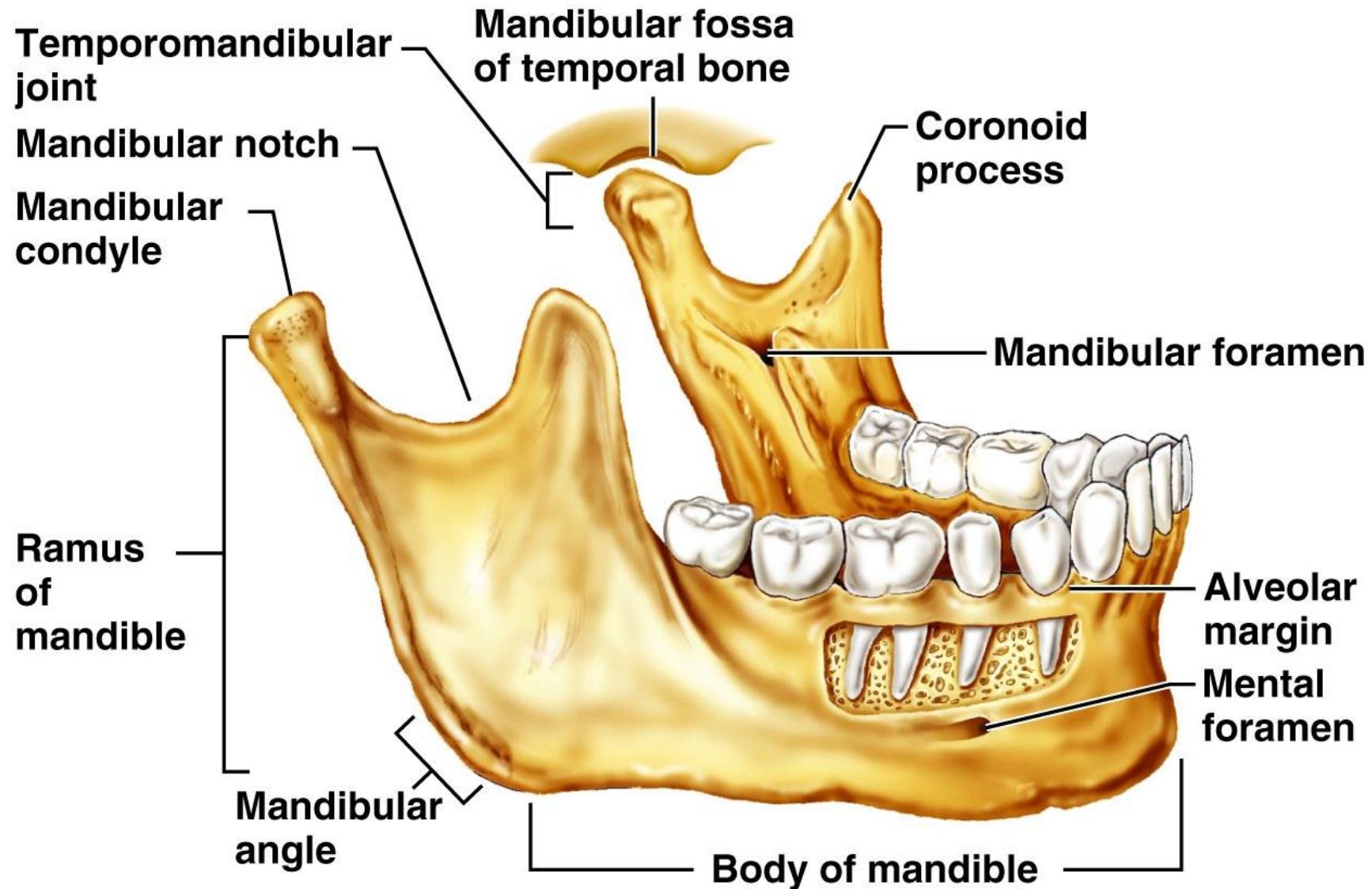


Figure 7.7



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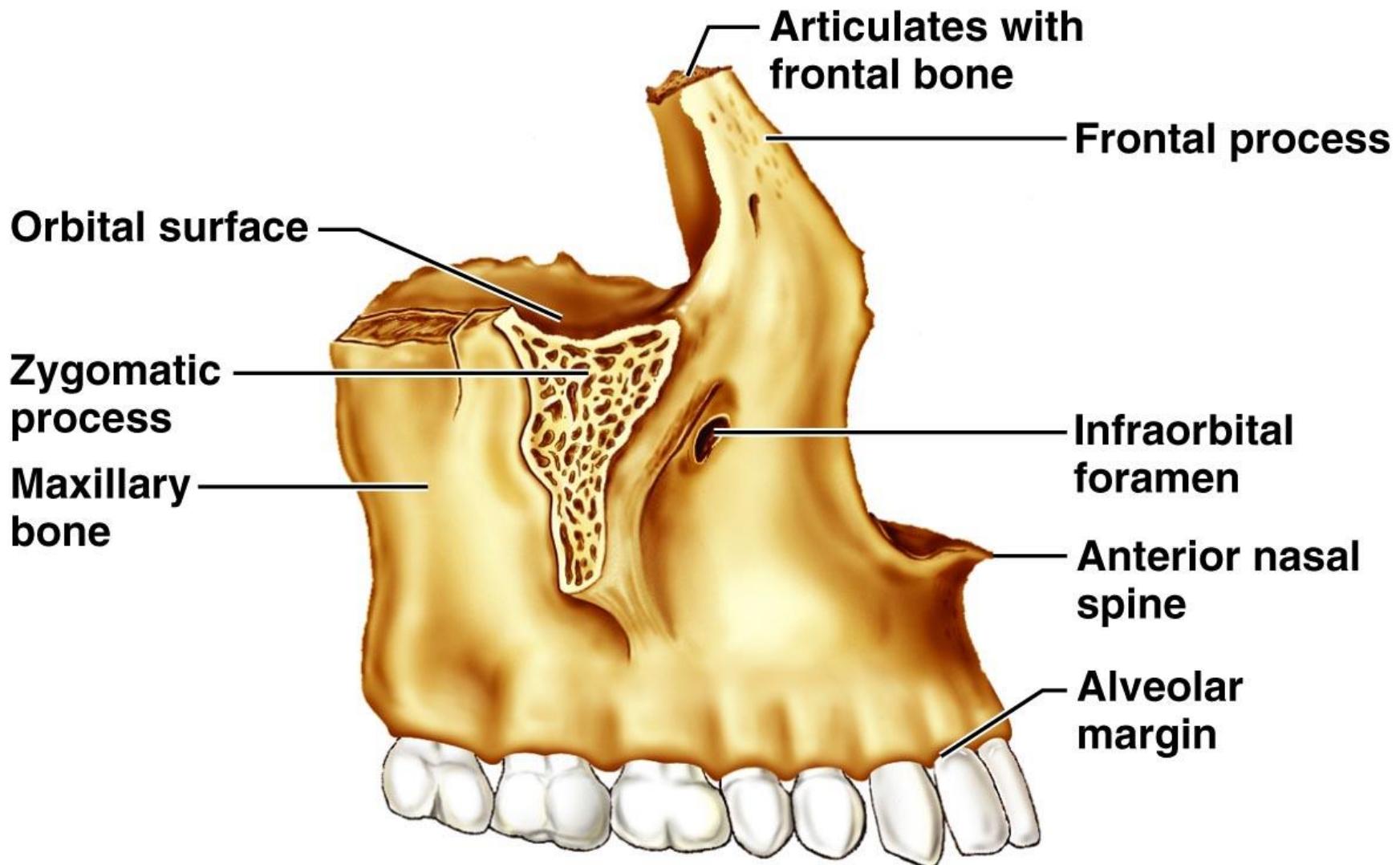
Figure 7.8



**(a) Mandible**

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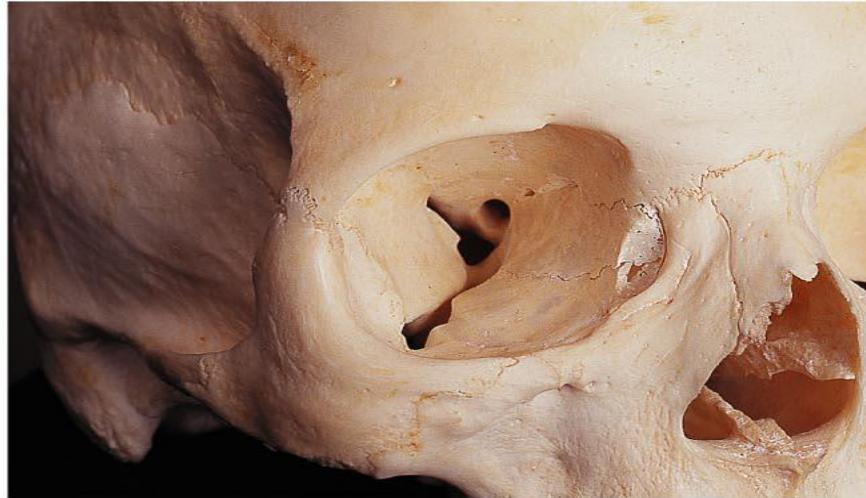
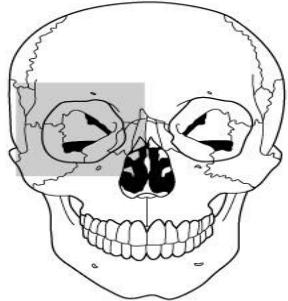
**Figure 7.8a**



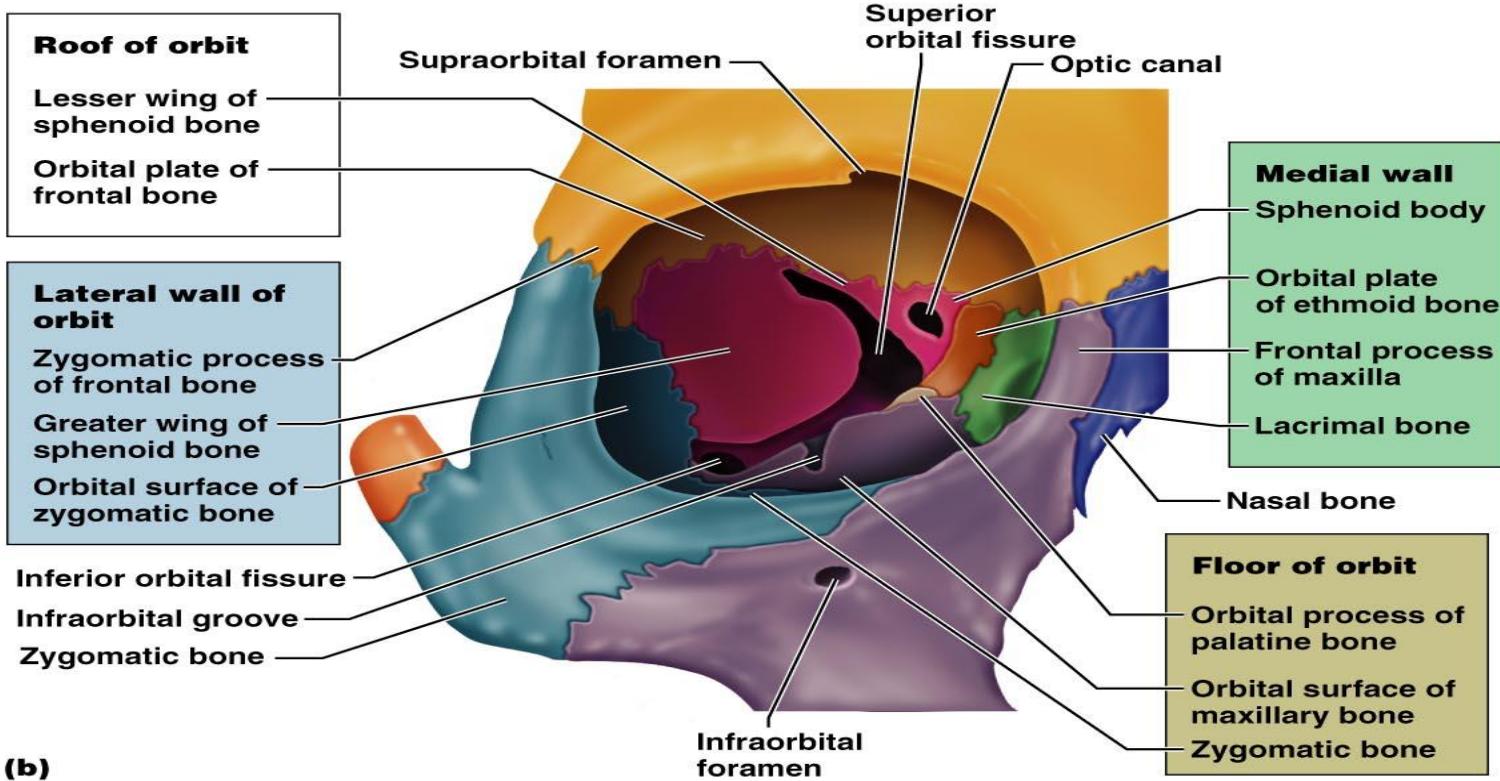
**(b) Maxilla**

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Figure 7.8b



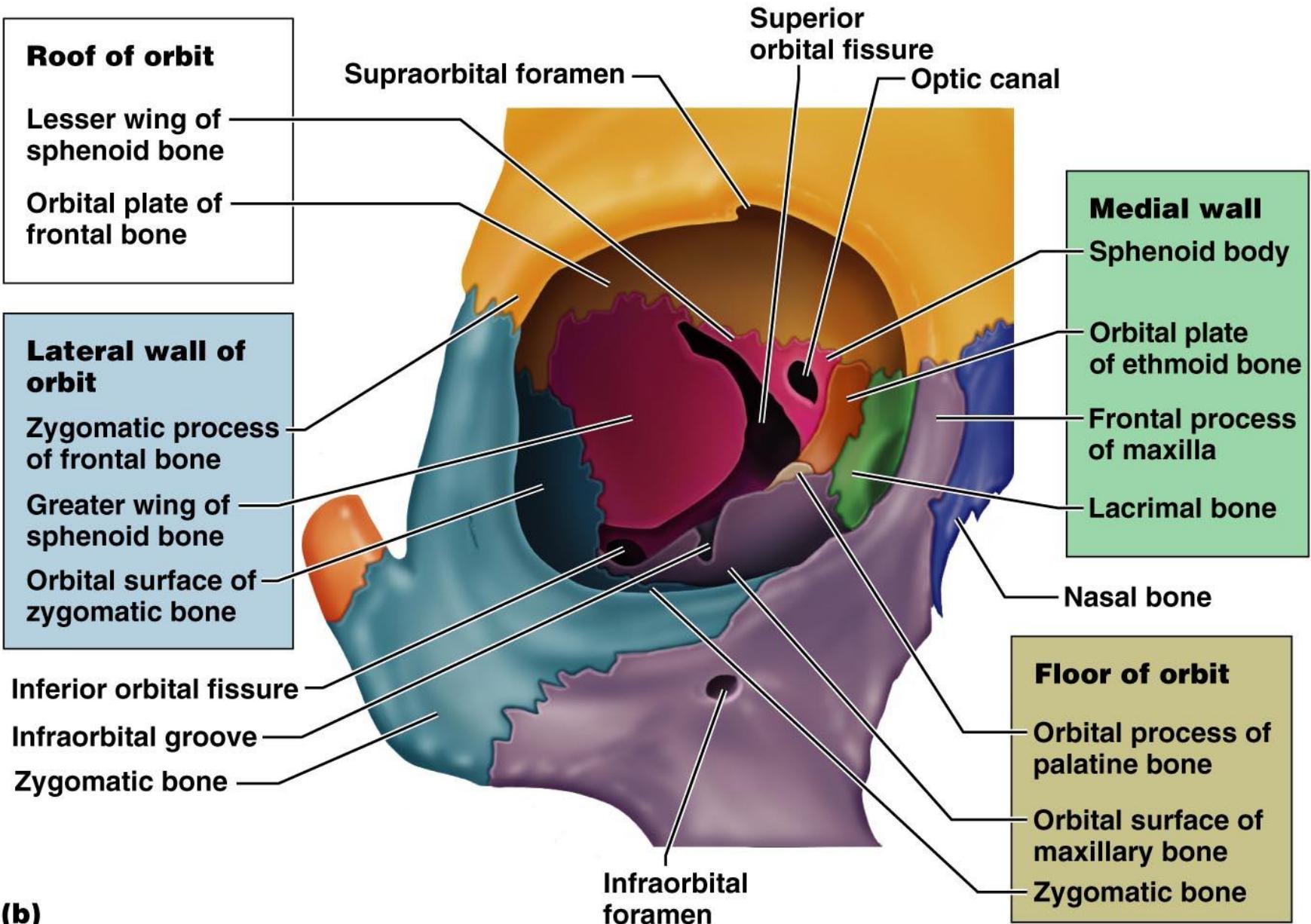
**(a)**



**(b)**

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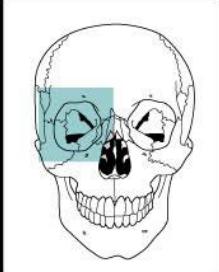
**Figure 7.9**



(b)

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Figure 7.9b

**Roof of orbit**

Orbital plate of frontal bone

Lesser wing of sphenoid bone

**Lateral wall of orbit**

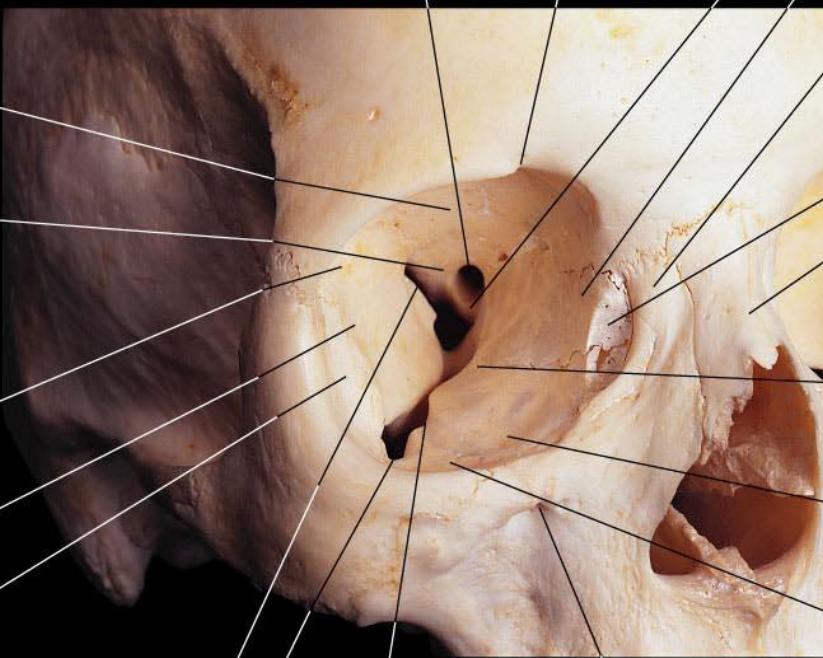
Zygomatic process of frontal bone

Greater wing of sphenoid bone

Orbital surface of zygomatic bone

Superior orbital fissure

Inferior orbital fissure



Optic canal

Supraorbital notch

**Medial wall**

Sphenoid body

Orbital plate of ethmoid bone

Frontal process of maxilla

Lacrimal bone

Nasal bone

**Floor of orbit**

Orbital process of palatine bone

Orbital surface of maxillary bone

Zygomatic bone

**Figure 14 Bony orbit.**

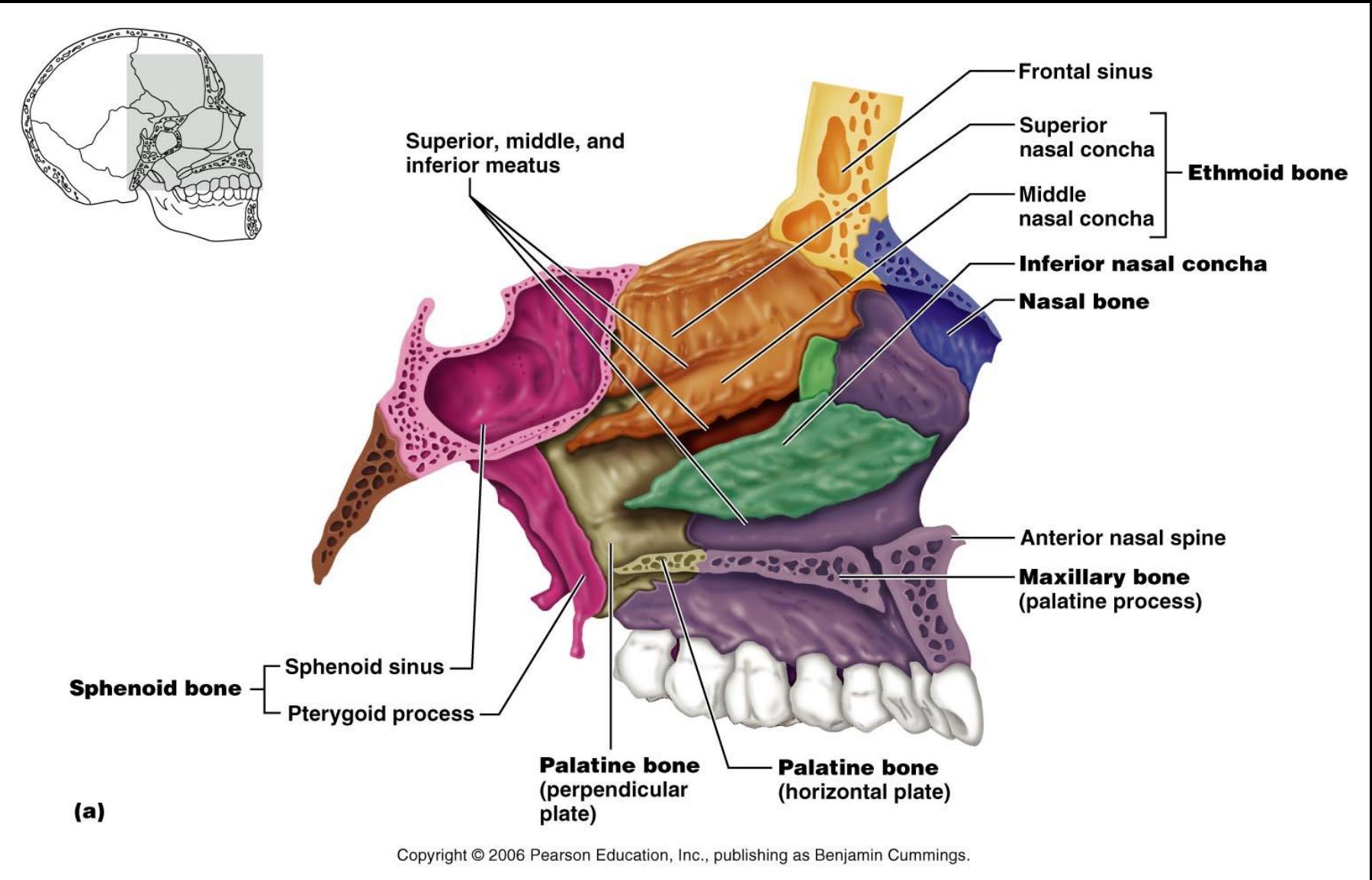


Figure 7.10a

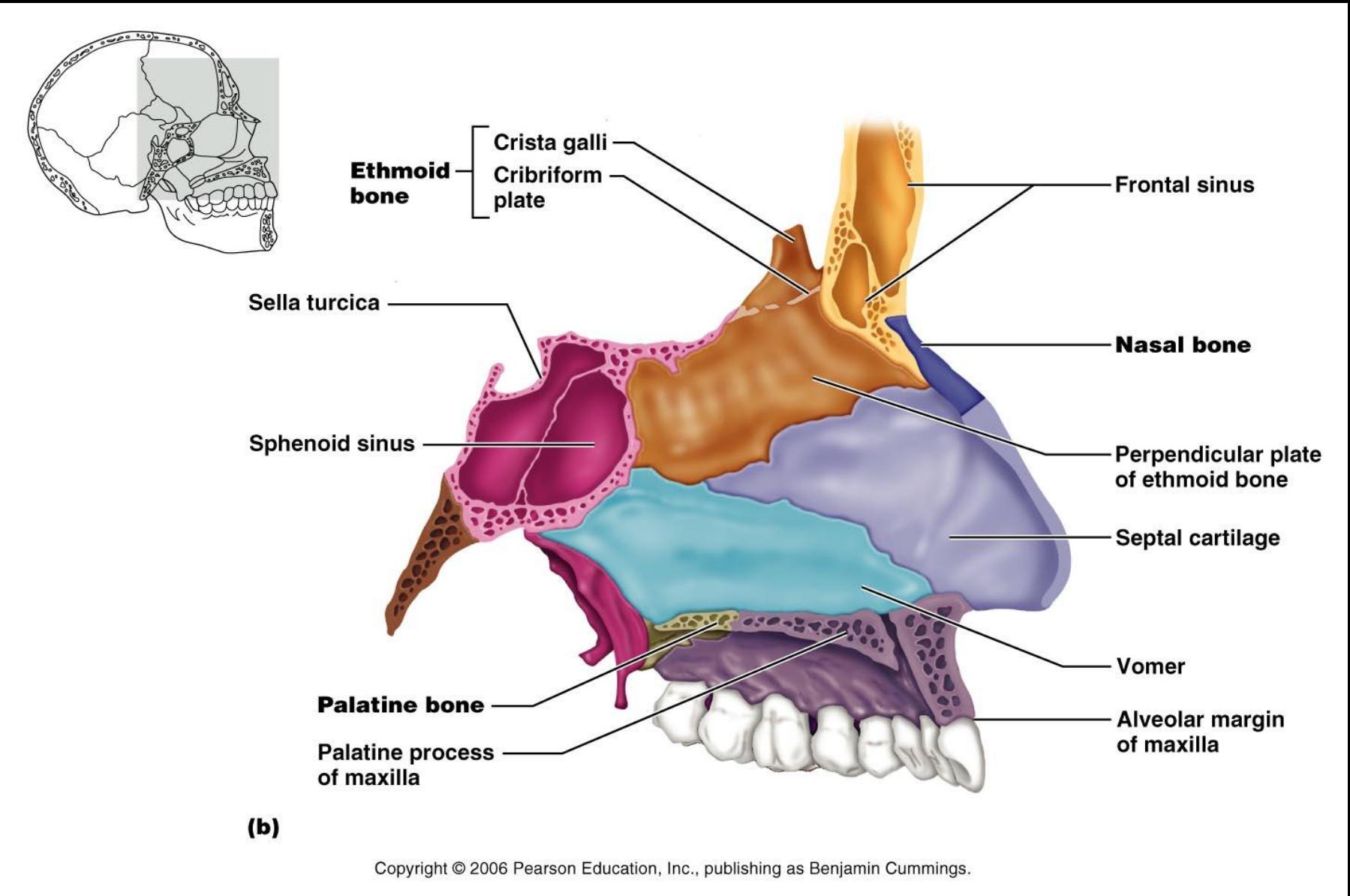
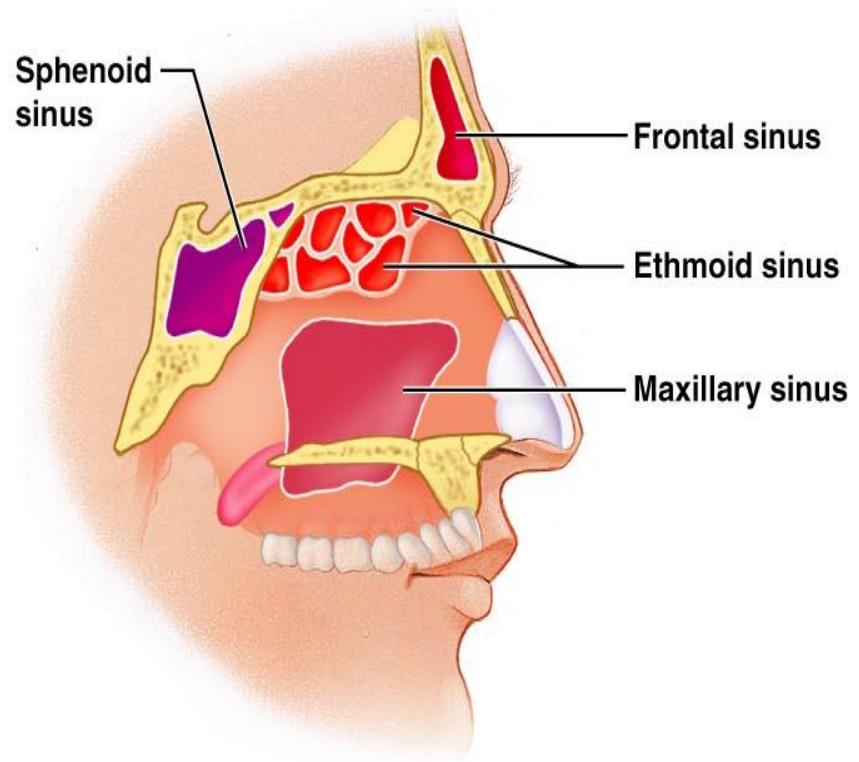
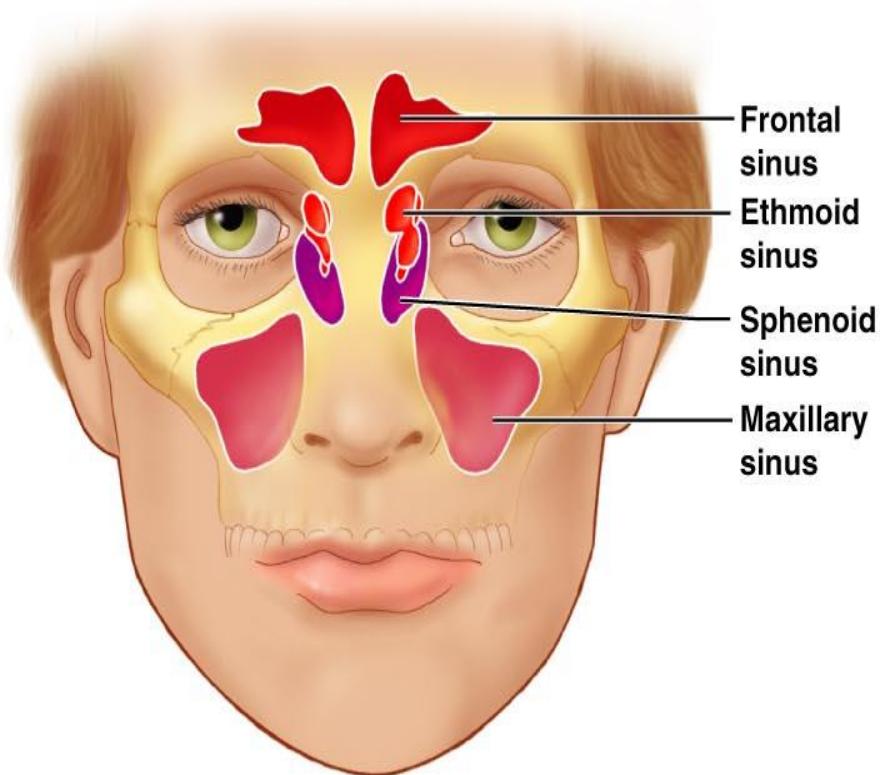


Figure 7.10b



**sinus cavities, which are air-filled cavities lined with respiratory epithelium, which also lines the large airways.**

**The exact functions of the sinuses are unclear; they may contribute to lessening the weight of the skull with a minimal reduction in strength, or they may be important in improving the resonance of the voice.**

**Paranasal sinuses** are air-filled spaces, communicating with the nasal cavity, within the bones of the skull and face.

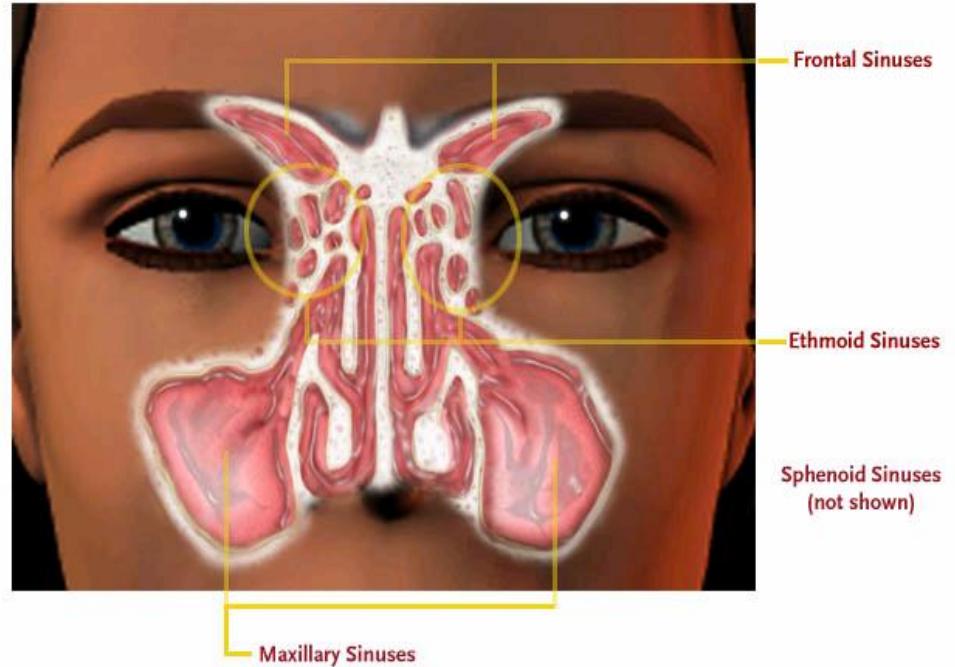
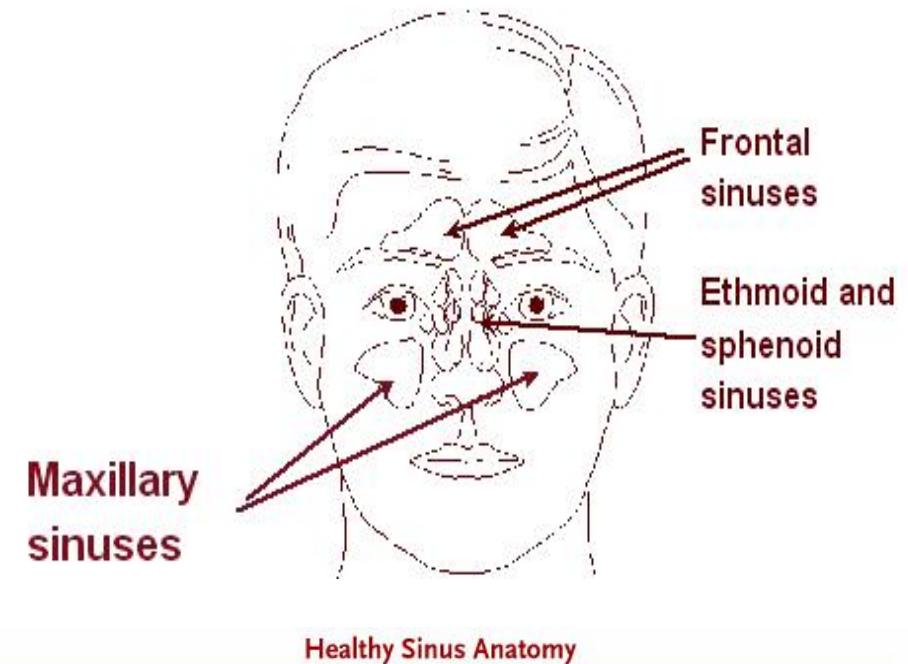
Humans possess a number of paranasal sinuses, divided into subgroups that are named according to the bones within which the sinuses lie:

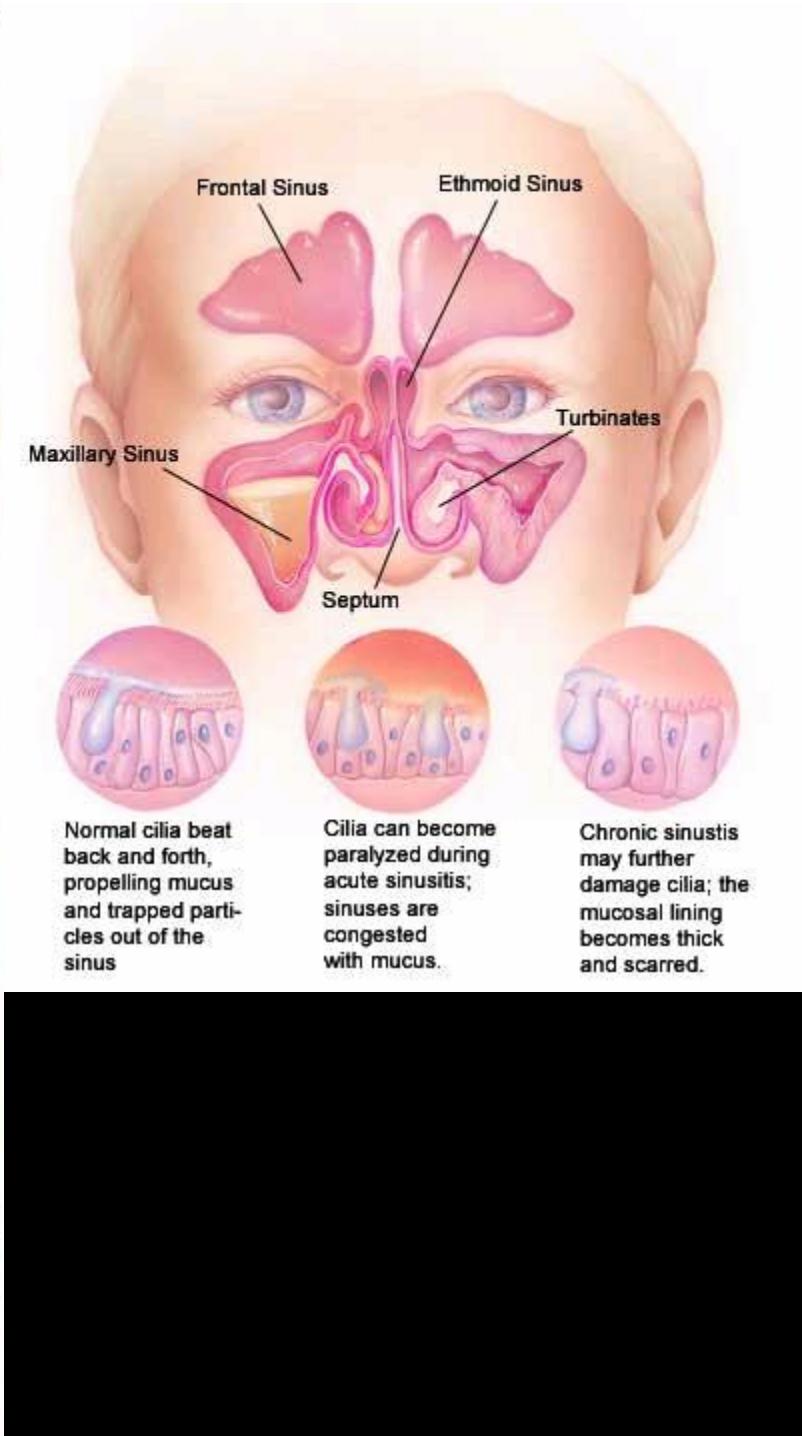
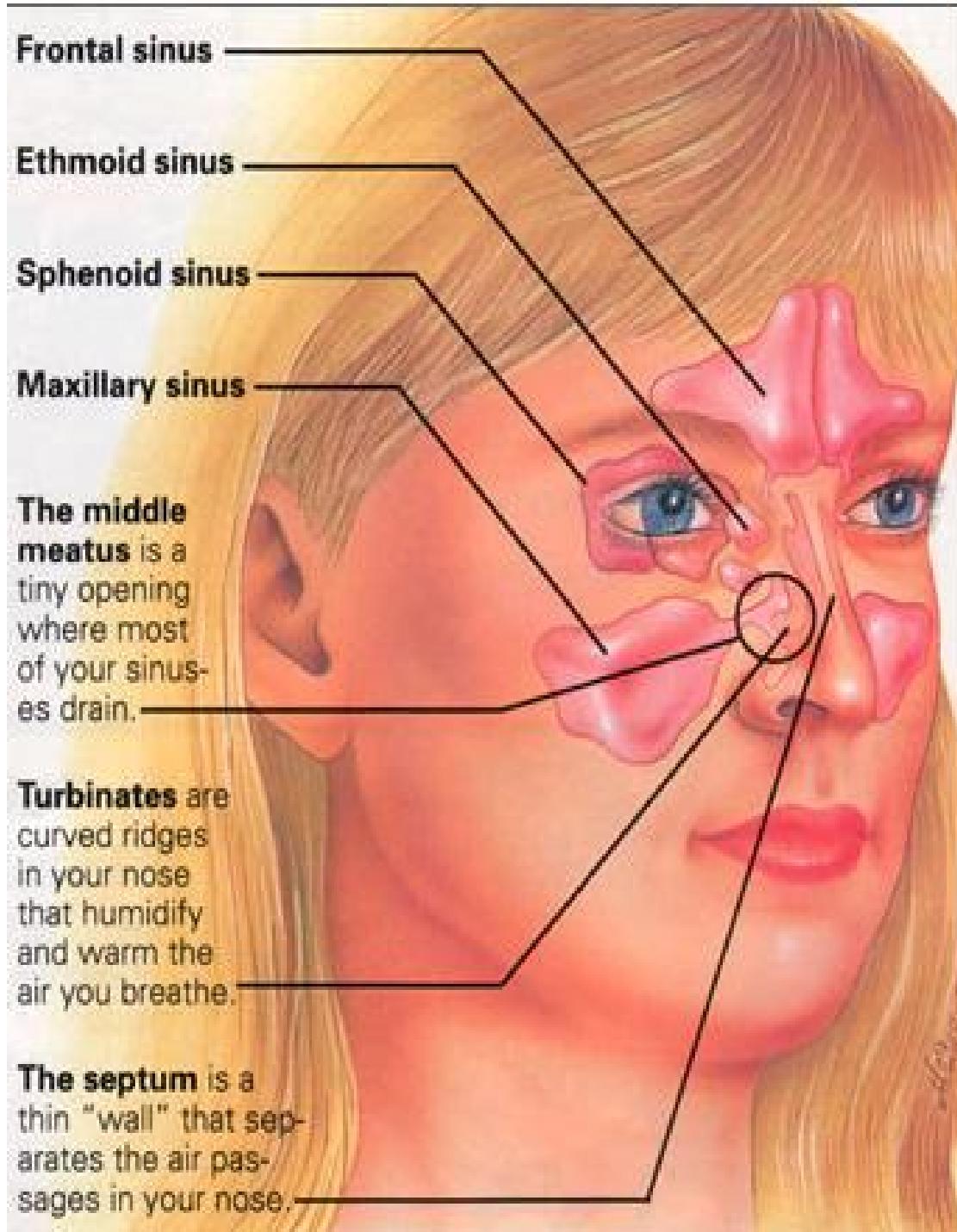
**the maxillary sinuses**, also called the maxillary antra and the largest of the paranasal sinuses, are under the eyes, in the maxillary bones (cheek bones).

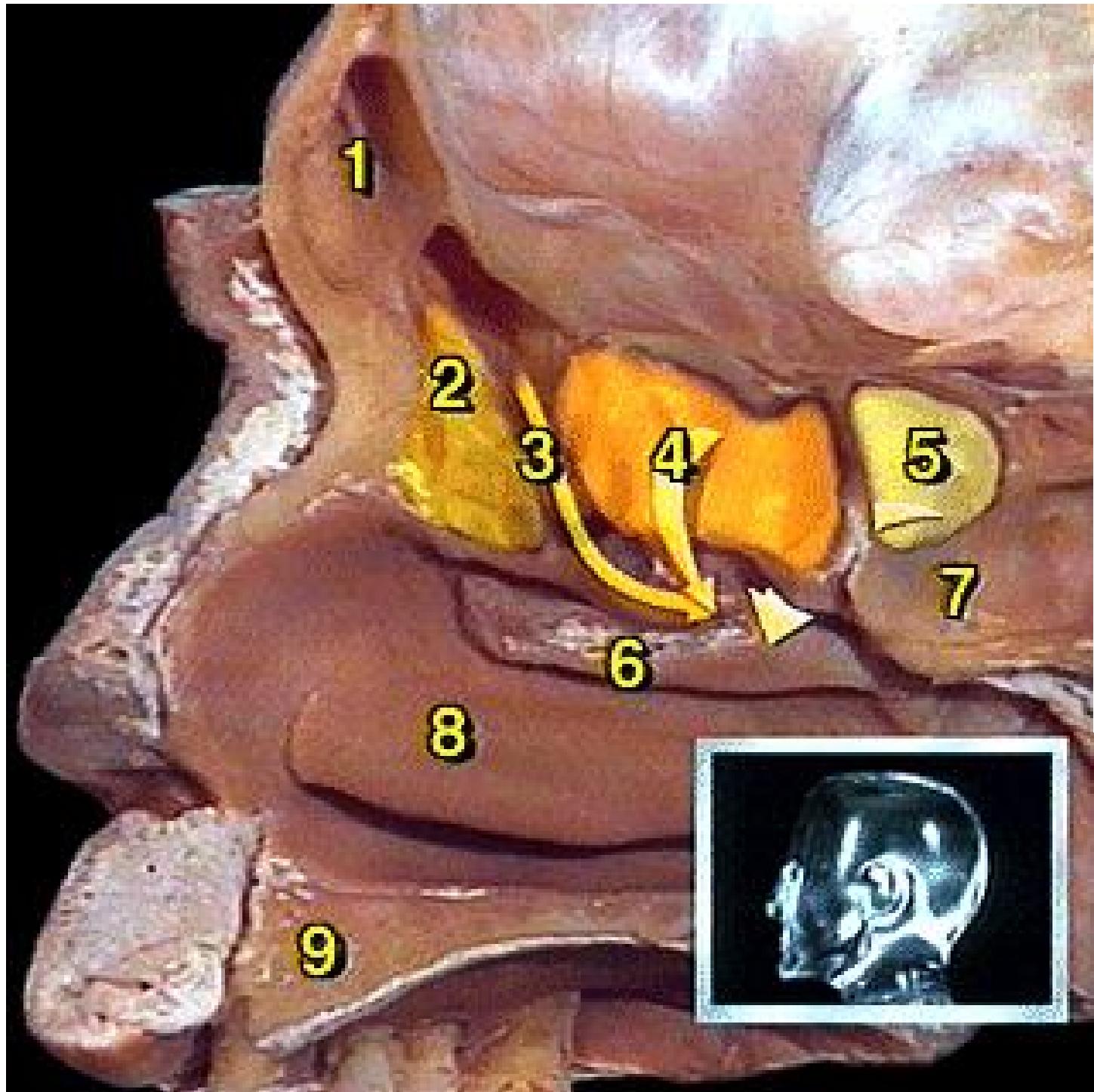
**the frontal sinuses**, over the eyes, in the frontal bone, which forms the hard part of the forehead.

the ethmoid sinuses, which are formed from several discrete air cells within the ethmoid bone between the nose and the eyes.

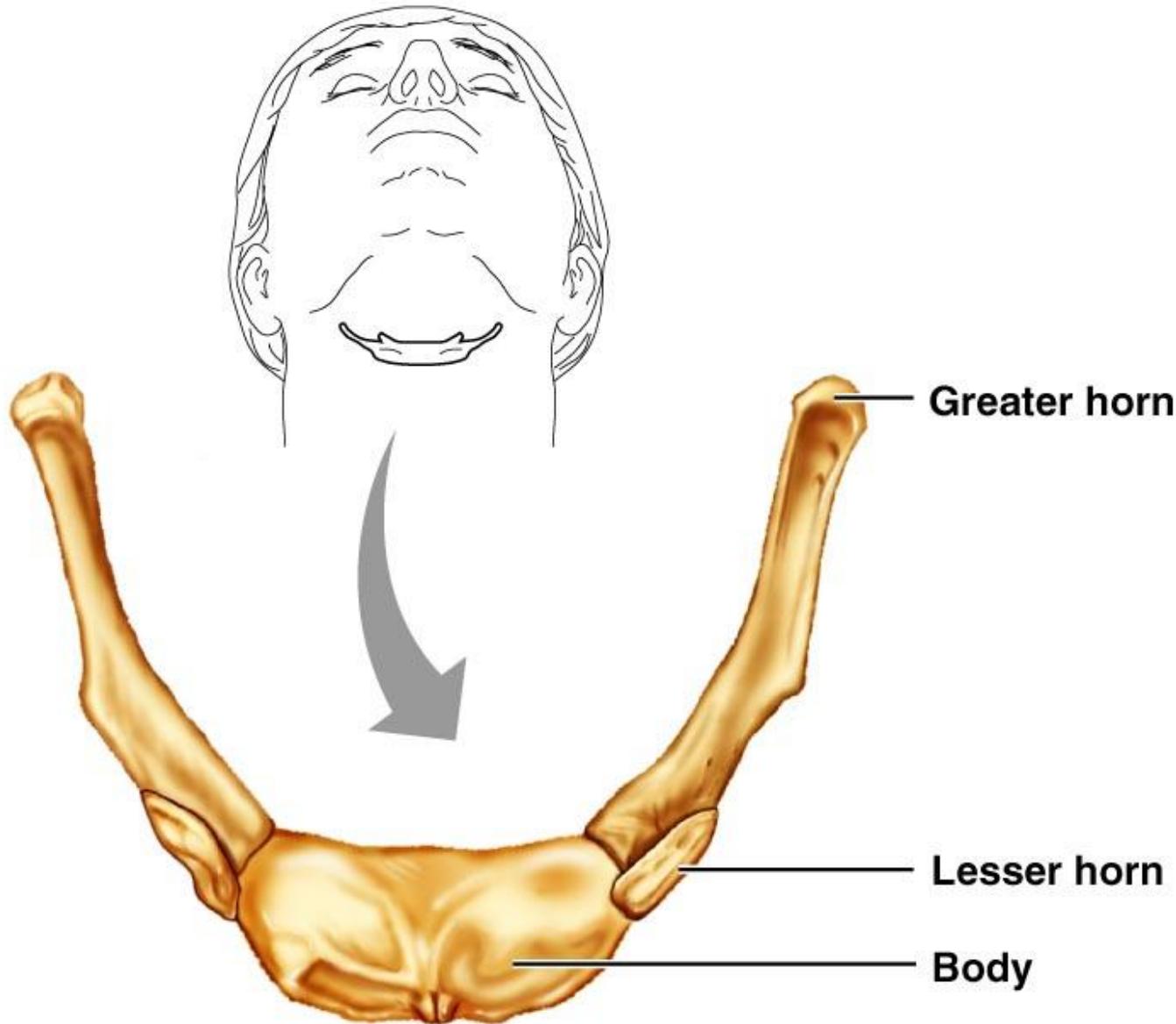
**the sphenoid sinuses**, in the sphenoid bone at the center of the skull base under the pituitary gland.





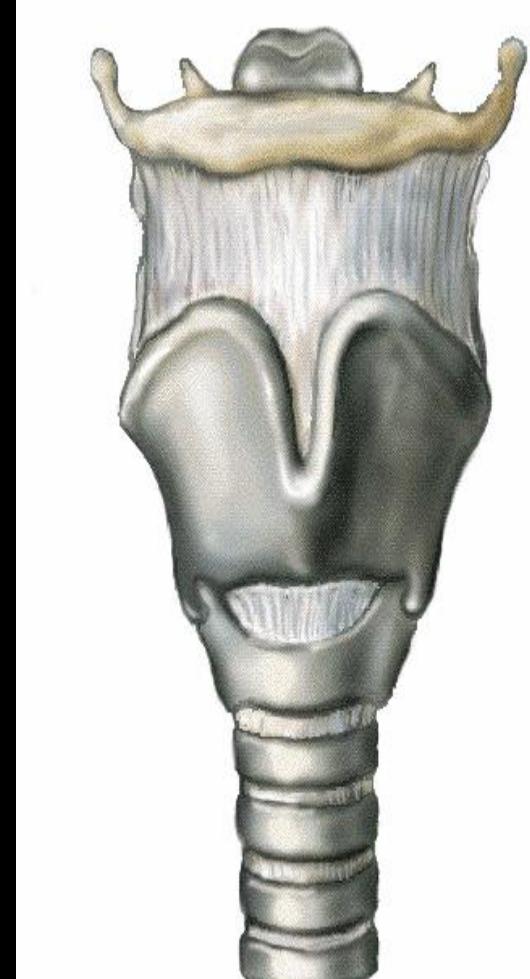
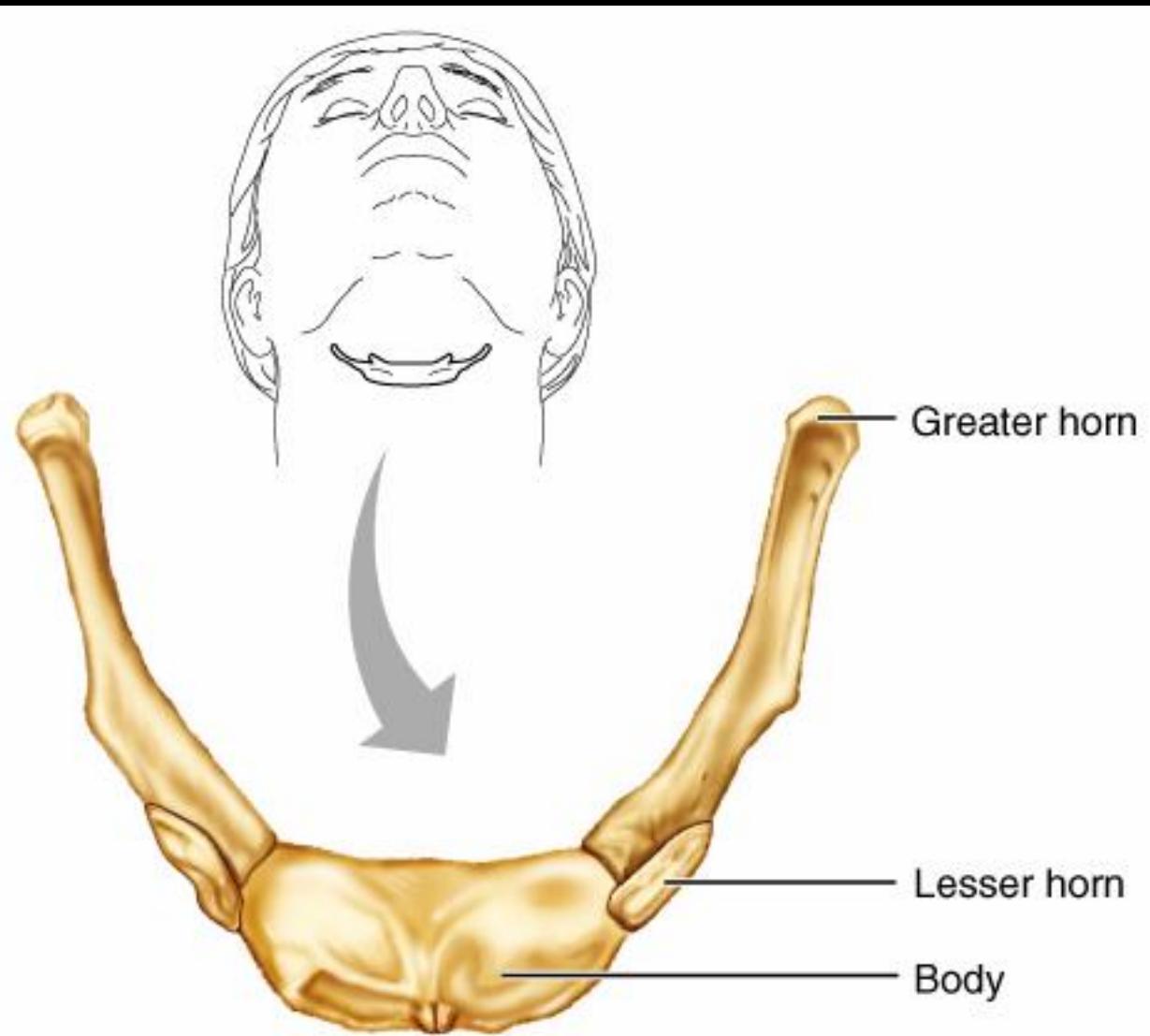


1. Frontal sinus
2. Anterior ethmoidal sinus
3. Infundibulum
4. Middle ethmoidal sinus
5. Posterior ethmoidal sinus
6. Remainder of middle concha
7. Sphenoidal sinus
8. Inferior concha
9. Hard palate

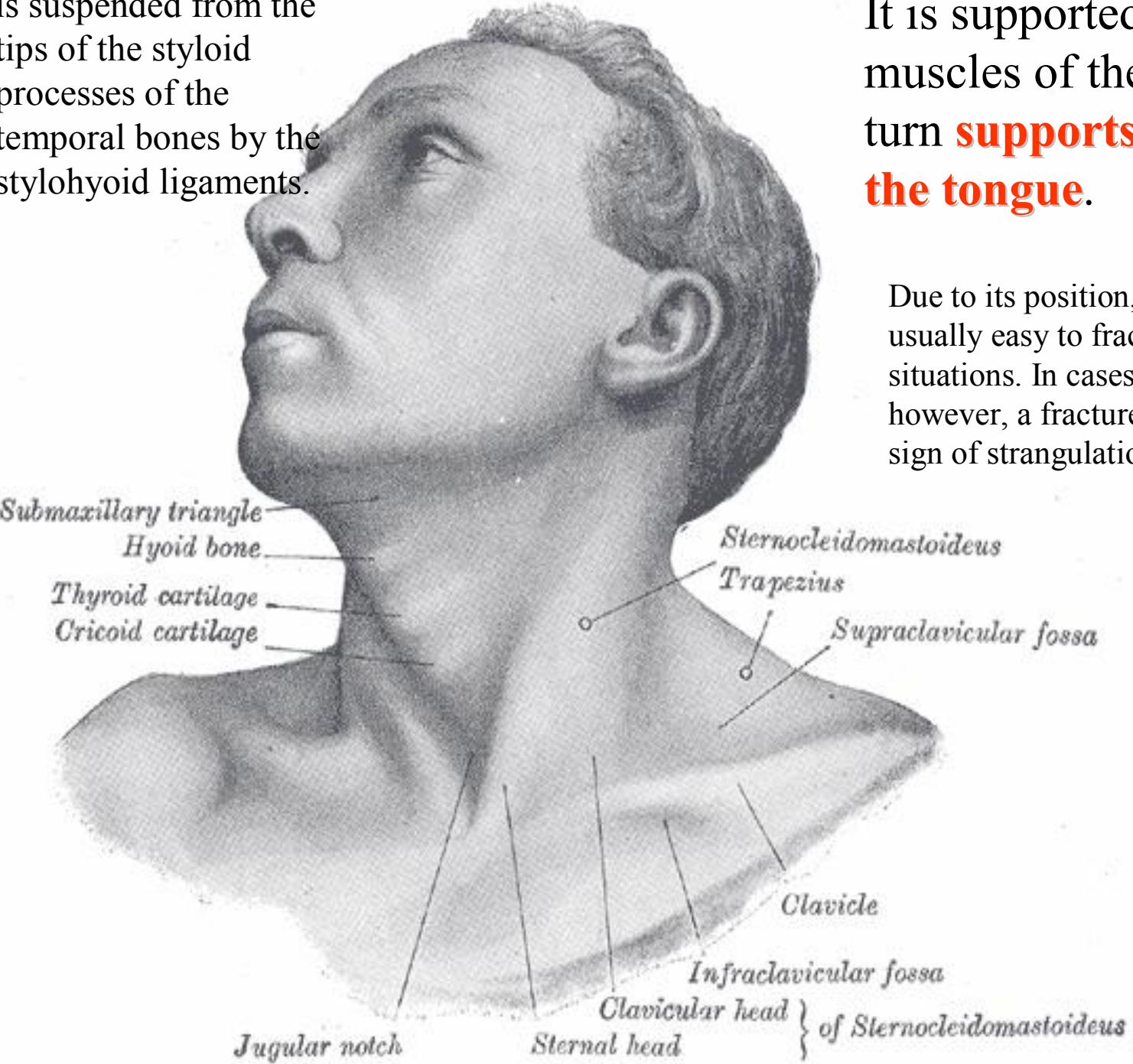


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Figure 7.12



is suspended from the tips of the styloid processes of the temporal bones by the stylohyoid ligaments.



It is supported by the muscles of the neck and in turn **supports the root of the tongue.**

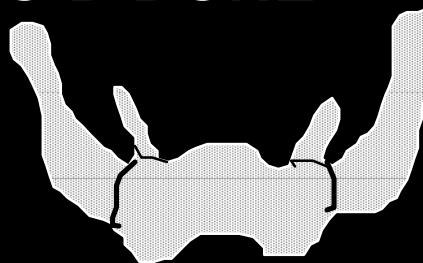
Due to its position, the hyoid bone is not usually easy to fracture in most situations. In cases of suspicious death, however, a fractured hyoid is a strong sign of strangulation.



## SKULL & HYOID BONE

Skull bones provide anchorage to the protective scalp, and for the muscles of facial expression

However, some muscles of the tongue & larynx have a separate anchor point in a small independent bone in the neck - the HYOID BONE



view from front

The hyoid bone is connected by long ligaments to the skull & is an element of the axial skeleton

## **Marieb Fig 5.11, p. 125 Correction**

**The leader for the Sagittal suture is in the correct place - on the midline, but the only suture line shown is the cross-wise one - the Coronal suture**