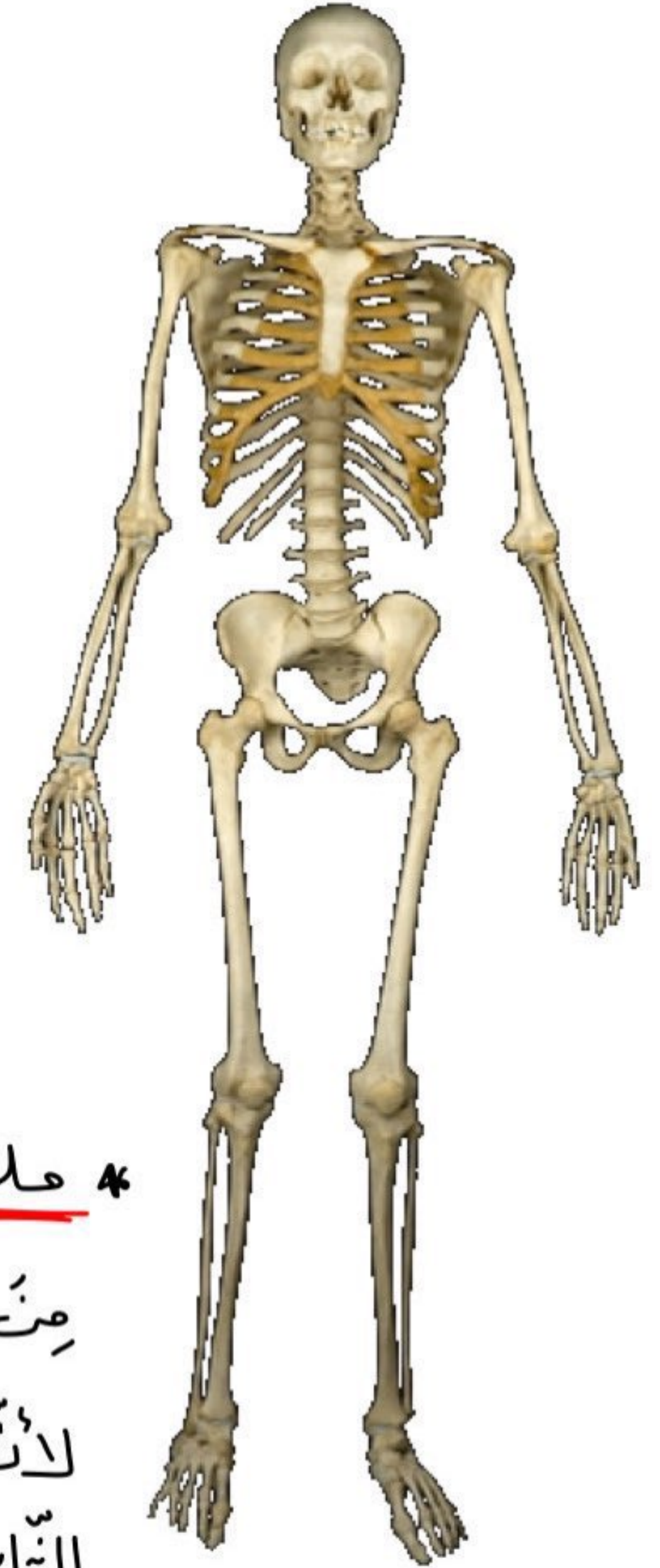


The Skeletal System

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(2021)



* ملاحظة

من المهم التركيز والتفصيل في الرسومات والصور وحفظها
لأنها مطلوبة وستكون حاضرة وموجودة في الاختبار
الثاني لهذه المادة.

تفريغ سجا زخول

Divisions of the Skeletal System

The main function of this system is support.

- The human skeleton consists of **206 bones**

- Bones of the skeleton are grouped into two principal divisions:

المحوري **Axial skeleton**

- Consists of the bones that lie around the **longitudinal axis** of the human body: ¹Skull bones, ²auditory ossicles (ear bones), ³hyoid bone, ⁴ribs, ⁵sternum (breastbone), and ⁶bones 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**.

Bone Tissue

→ part of:
Supportive Adult Connective Tissue.

Bone is a structural type of connective tissue characterized by the presence of a calcified extracellular matrix (called bone matrix) and three types of cells: Osteoblasts, Osteocytes and Osteoclasts.

Functions of bones:

- 1) Support fleshy structures.
- 2) Protect vital organs (example: the skull protects the brain).
- 3) Assist in movement.
- 4) Synthesis of blood elements.
- 5) Storage of fat.
- 6) Storage of minerals (calcium and phosphate).

→ الأنسجة اللحمية

مساعدة

المعادن

SPASSSS
Support protect

اختصاراً
للوظائف

→ in the red bone marrow

Cells of bones:

عملية التكلّس (وَرَدَ ذِكْرُهَا بِالسَّلايَةِ السَّابِقَةِ)

Osteoblasts



- Responsible for the **synthesis of the bone matrix**
- Responsible for the **calcification of bone**

Osteocytes



- **Maintain the bone**
- **Located inside spaces called lacunae**

هذه الخلايا تشكّل نواتج أنواع البناء والهدم وهذا ضروريّ خاصّة في مراحل النّوّه المبكّرة عند الإنسان كي لا يتضخّم العظم بل يتّخذ بشكل طبيعيّ.

الحفاظ

الثغرات

Osteoclasts



- Responsible for the **resorption (destruction) of bone**
- A type of **macrophage**

خراب / دمار من اقتصاص

في حال أنّ osteoclasts كان عملها أكثر من osteoblasts يتسبّب هذا بصفاة العظام وهو ما يحدث غالباً عند كبار السن.

Bone matrix:

- Bone matrix is formed of various ¹organic and ²inorganic molecules (mainly Ca^{2+} compounds).
- Collagen fibers is abundant in bone matrix.

يحتوي على نسبة عالية من الكولاجين

Periosteum:

- A thick connective tissue layer that covers the bone. ^{from outside}
- It's important in (1) the nourishment of bones, (2) the formation of bones and in (3) fracture repair. ^{تغذية}

إصلاح الكسر

Endosteum:

- A thin tissue layer that lines the cavities inside the bone.

Tetracycline and Bones

- Tetracycline is a fluorescent substance and it binds with great affinity with Ca^{2+} in recently deposited bone matrix.

لها إرتباط عالي مع الكالسيوم Ca^{2+}

Tetracycline must not be given to a pregnant or lactating women or to a child whose teeth are erupting, because it may bind to Ca^{2+} of the newly forming teeth of the child leading to the permanent discoloration of the teeth.

المترضعات
دائم / مستمر

تطلق
الكامل
لغير لون الأسنان ويجعلها
إلى اللون الأصفر نتيجة إرتباطها بالكالسيوم

Fig.1: Teeth with brownish discoloration due to use of tetracycline.



Tetracycline ال
لا تغطي الحوامل
ولا للأمهات
المرضعات حتى
لا يصل الأطفال
ويؤثر على نمو
وتطور الأسنان
ويحدث لهم
discoloration
إلى اللون الأصفر

Classification of bone

الcompact يكون

mainly من الخارج

والSpongy من
الداخل.

According to Gross Morphology:

o In a section of bone we have:

مضغوط

1. **Compact bone:** part of the bone appear as a dense area with generally no cavities.

اسفنجي

2. **Spongy bone:** part of bone that have several, small, interconnected cavities.

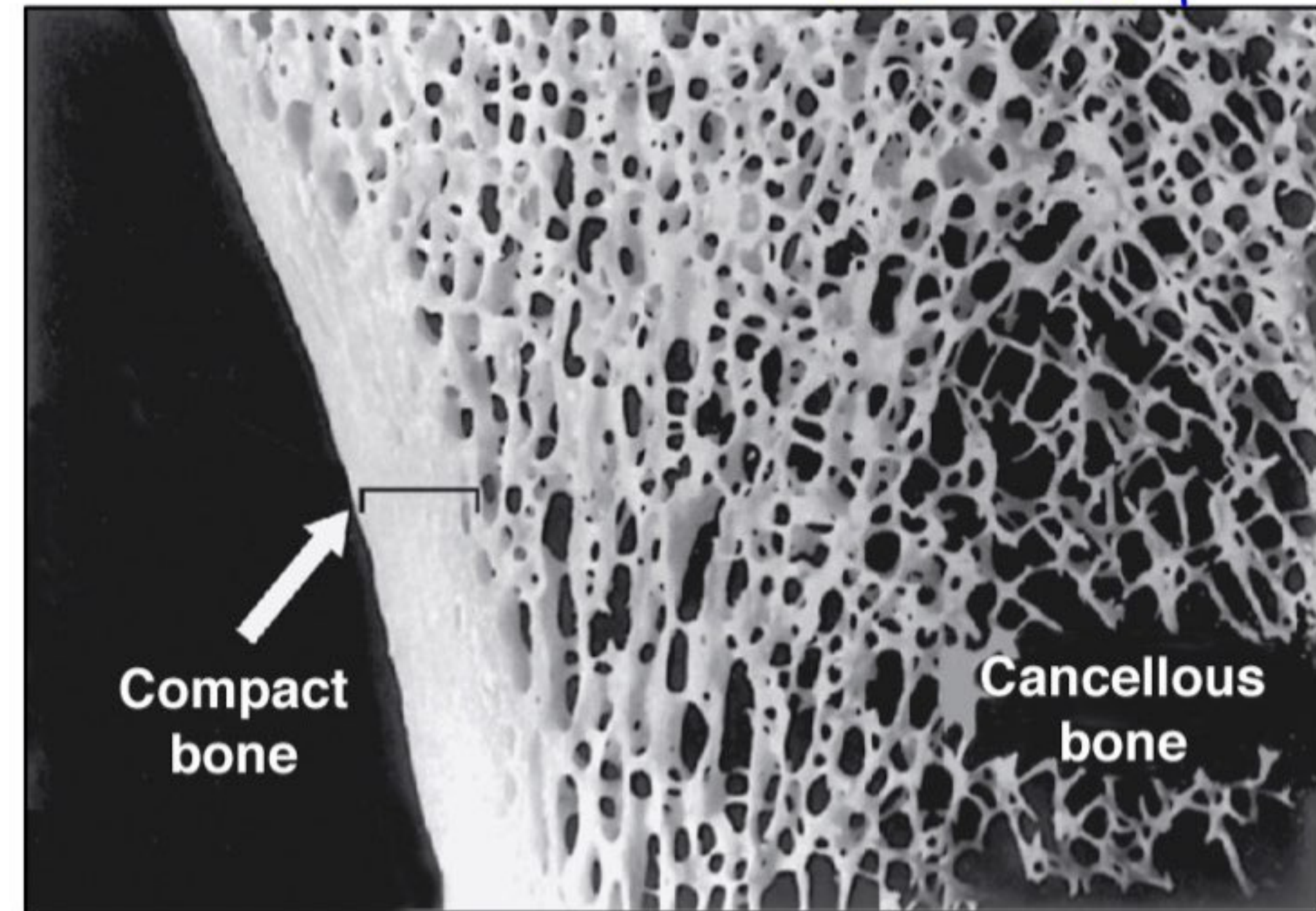


Fig.2: Compact and cancellous bone.

According to Histological Features: الاختلاف هنا يعتمد على الترتيب arrangement

1. **Primary (woven) bone** in which the collagen fibers of the matrix have no specific arrangement.

irregular

2. **Secondary (lamellar) bone** in which the collagen fibers are arranged in layers called lamellae.

regular

- In secondary bone, the lamellae usually form **concentric circles** around a central cavity in what's called **Osteons**. مُتَّحِدَة
المركز In the osteons, osteocytes are found in spaces called **lacunae** connected to each by **canaliculi**.

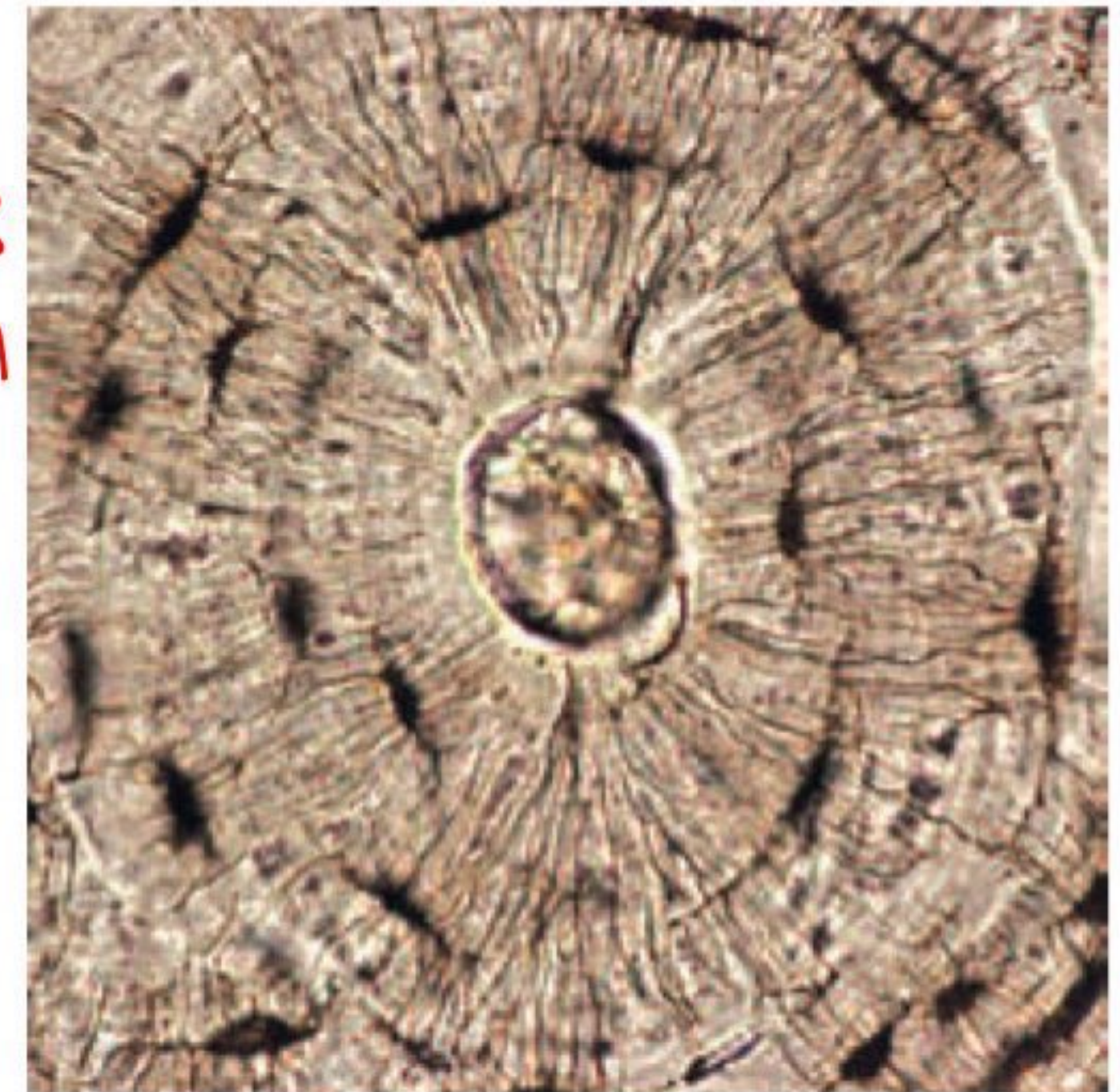


Fig.3: Osteon.

According to Shape:

1. Long Bones

- Greater length than width and are slightly curved for strength. طولها أكبر من عرضها
 - Has two expanded **epiphyses** formed mainly of spongy bone surrounded by a thin layer of compact bone. القصبية
موجود عند الأطراف
 - The middle tube-like **shaft** is called **diaphysis** and is formed of mainly compact bone with a thin layer of spongy bone surrounding a central cavity, the **medullary cavity**. تحتوي على موجود في الوسط
- Σ x: 1 Femur, 2 tibia, 3 fibula, 4 humerus, 5 ulna, 6 radius, 7 phalanges. bone marrow
الأصابع

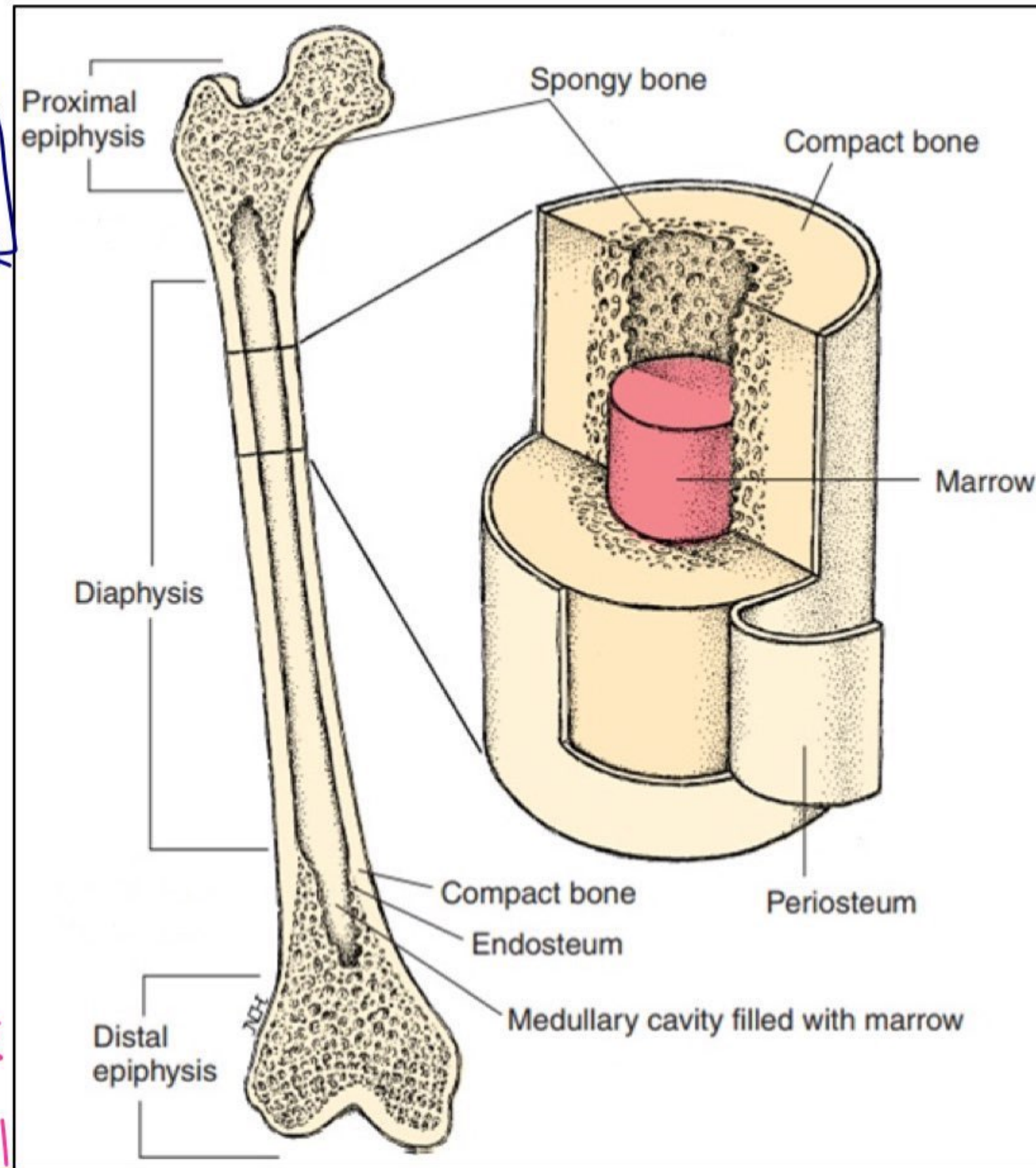


Fig.4: Parts of long bones.

2. Short bones

Cube-shaped and are nearly equal in length and width

Ex: ¹Carpal bones, ²navicular, ³cuboid



Short bone (trapezoid, wrist bone)

3. Flat bones

Thin and composed of two nearly parallel plates of compact bone tissue enclosing a layer of spongy bone tissue

Ex: ¹Cranial bones, ²sternum, ³ribs, ⁴scapulae



Flat bone (sternum)

4. Irregular bones

Complex shapes and cannot be grouped into any of the previous categories

Ex: ¹Vertebrae, ²hip bones, ³some facial bones, ⁴calcaneus



Irregular bone (vertebra)

5. Sesamoid bones

Found within tendons. Protect the tendons from excessive wear

Patellae



Sesamoid bone (patella)

Bone Growth

يسمح للمفصلة بالنمو بشكل طولي
لكن عندما يصل الشخص لمرحلة
البلوغ سوف يتحول إلى عظم
وبالتالي سيتوقف النمو.

- ❑ Increase in length of bones occur at site of epiphyseal plate (made of hyaline cartilage) before they're closed. After closure of the plates during adulthood, no further increase in bone length can occur. The time of closure of the plate is specific for the bone. This can be used to determine the age of the person.
- ❑ Increase in width of bone can occur throughout life.
- ❑ Bone growth is affected by several hormones in the body, like growth hormone.

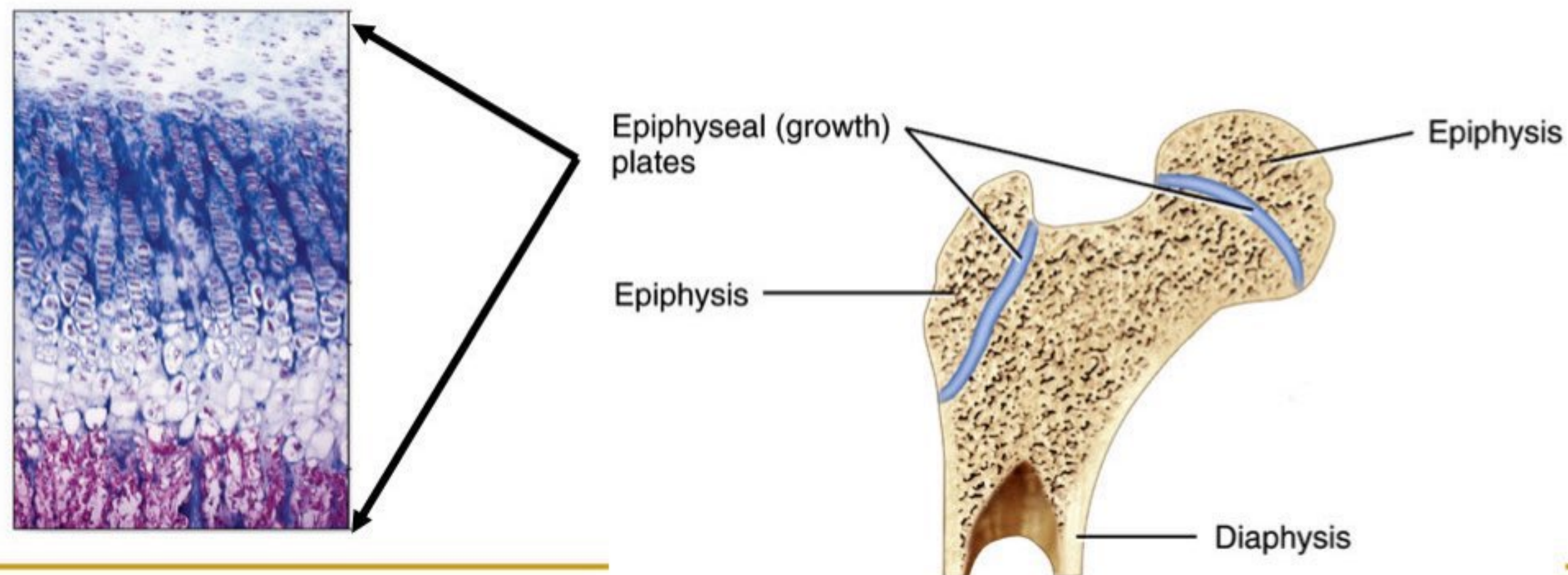


Fig.5: Epiphyseal growth plate.

■ The Axial Skeleton

Axial Skeleton



الجمجمة ← The Skull

- The skull is the bony framework of the head. It's formed of 22 bones divided into two sets:

1. Cranial bones

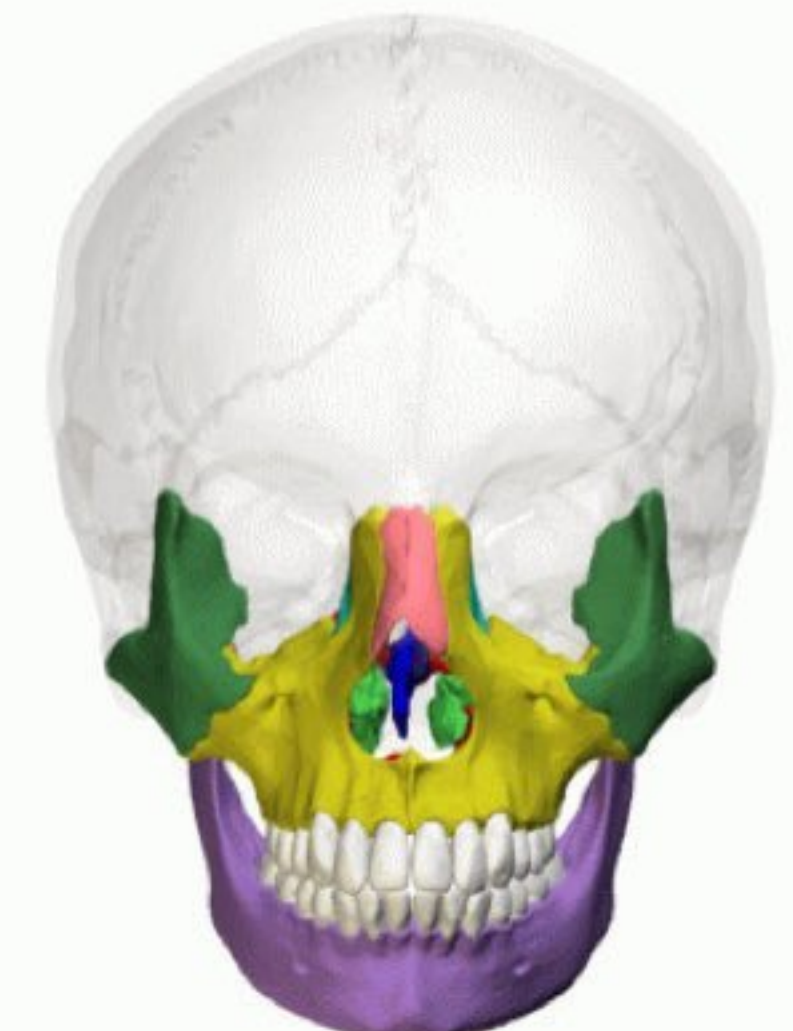
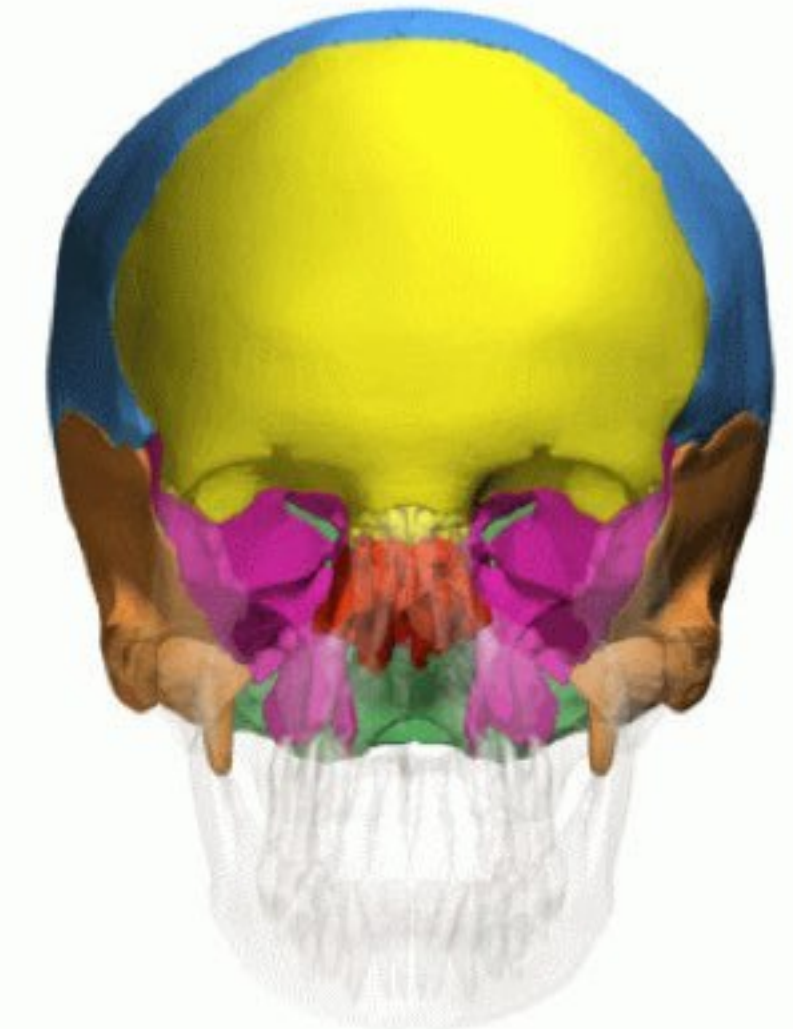
- Eight cranial bones that form the cranial cavity which encloses the brain.
- Frontal bone, two parietal bones, two temporal bones, the occipital bone, the sphenoid bone and the ethmoid bone.

8 C
bones →

2. Facial bones

- Fourteen facial bones that form the face.
- Two nasal bones, two maxillae, two zygomatic bones, two lacrimal bones, two palatine bones, two inferior nasal conchae, vomer and the mandible.

14 F
bones →

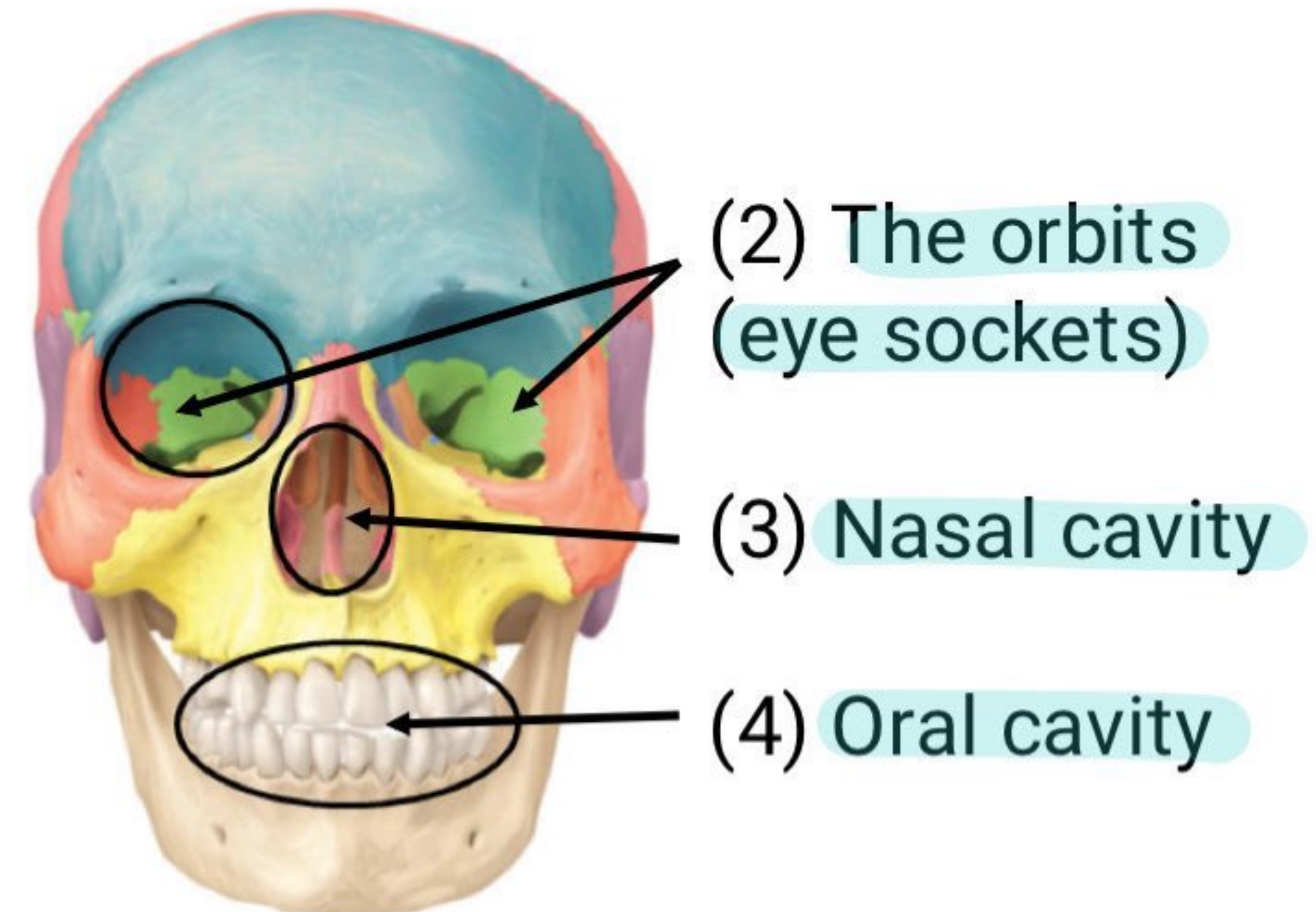
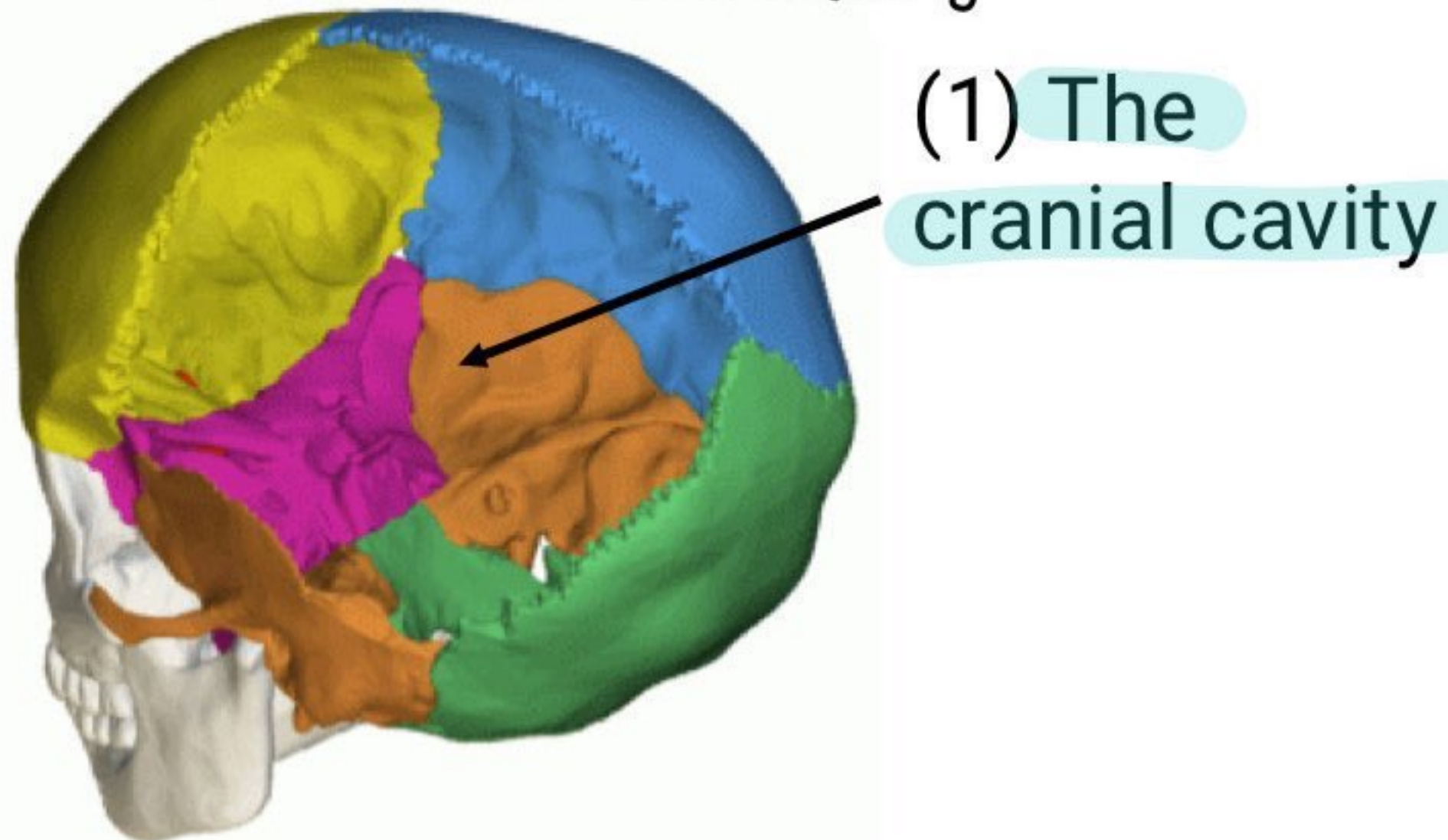


Features of the Skull

- The cranial and facial bones protect the brain and special sense organs.
- Bones of the skull are attached to each other by immovable joints called suture, except the mandible which is attached to the skull by a movable joint.

الوصلة التي بينهم غير متحركة

● Cavities of the skull



(5) Paranasal sinuses

(6) Middle and inner ear cavities within the petrous part of the temporal bone

Cranial Bones:

□ Temporal Bones

= base

- Form the lateral aspects and floor of the cranium.
- Consists of 5 parts: ¹squamous part, ²petrous part, ³tympanic part, ⁴mastoid part, and the ⁵styloid process.

□ Occipital 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*.
- The *foramen magnum*, the largest foramen in the skull, is located in this bone.

فتحة

□ Sphenoid Bone

- Called the '*Keystone*' bone because it's attached to all other cranial bones.
- Has a body and two wings – *butterfly bone*.



■ **Ethmoid Bone**

- Located in the midline between the two orbits
- Has a transverse (cribriform) plate that forms the roof of the nasal cavity
- Contains two projections on each side called the superior and middle nasal conchae. These form part of the lateral wall of the nasal cavity
- Has a perpendicular plate

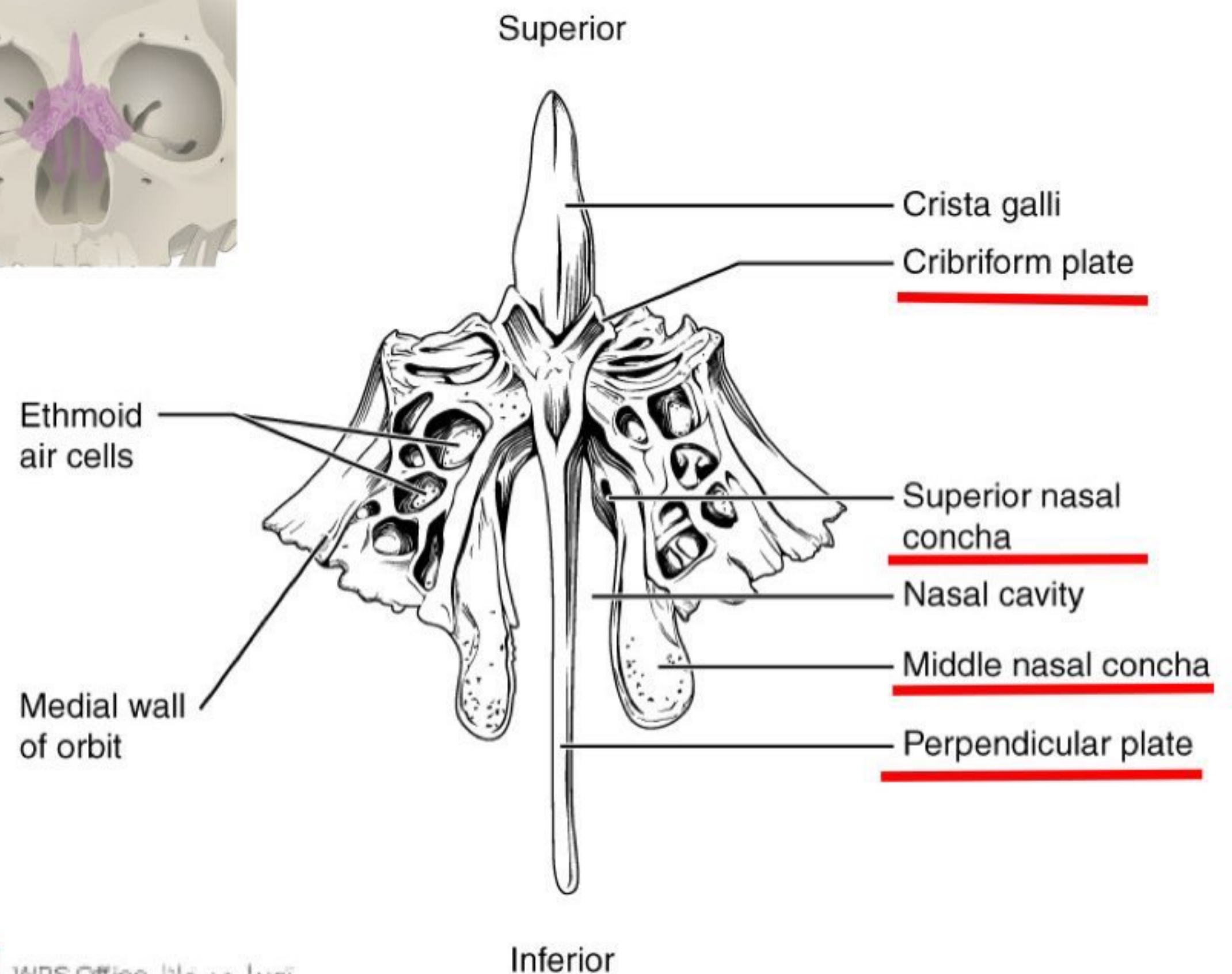
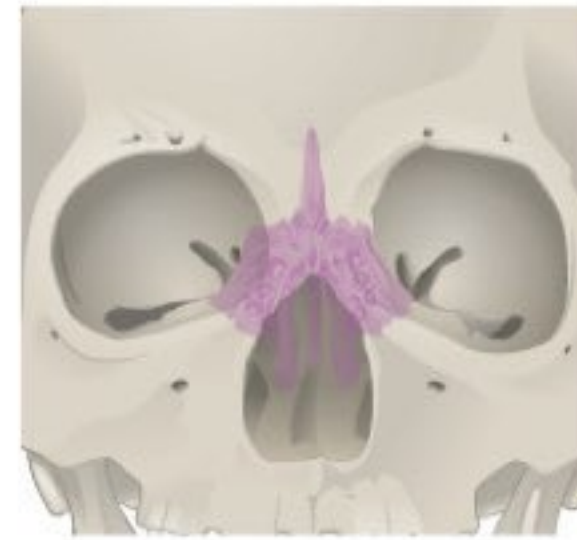


Fig.6: The ethmoid bone.

Facial Bones:

- **Nasal Bones** → bridge of the nose
- **Maxillae (the upper jawbone)**
 - Has processes: (1) **Palatine process** which forms the **hard palate** with the palatine bones, (2) **Alveolar process** which contains teeth sockets.
- **Zygomatic Bones** → Cheekbones
- **Inferior Nasal Conchae**
 - Form part of the lateral wall of the nasal cavity.
- **Lacrimal bone**
 - Forms part of the medial wall of the orbit. Related to lacrimal sac.
 - Has alveolar process that contains sockets for the teeth.
- **Mandible (lower jawbone)**
 - The largest, strongest facial bone. The only movable skull bone.

عظمة في آخر
سقف الحلق

سقف
الحلق

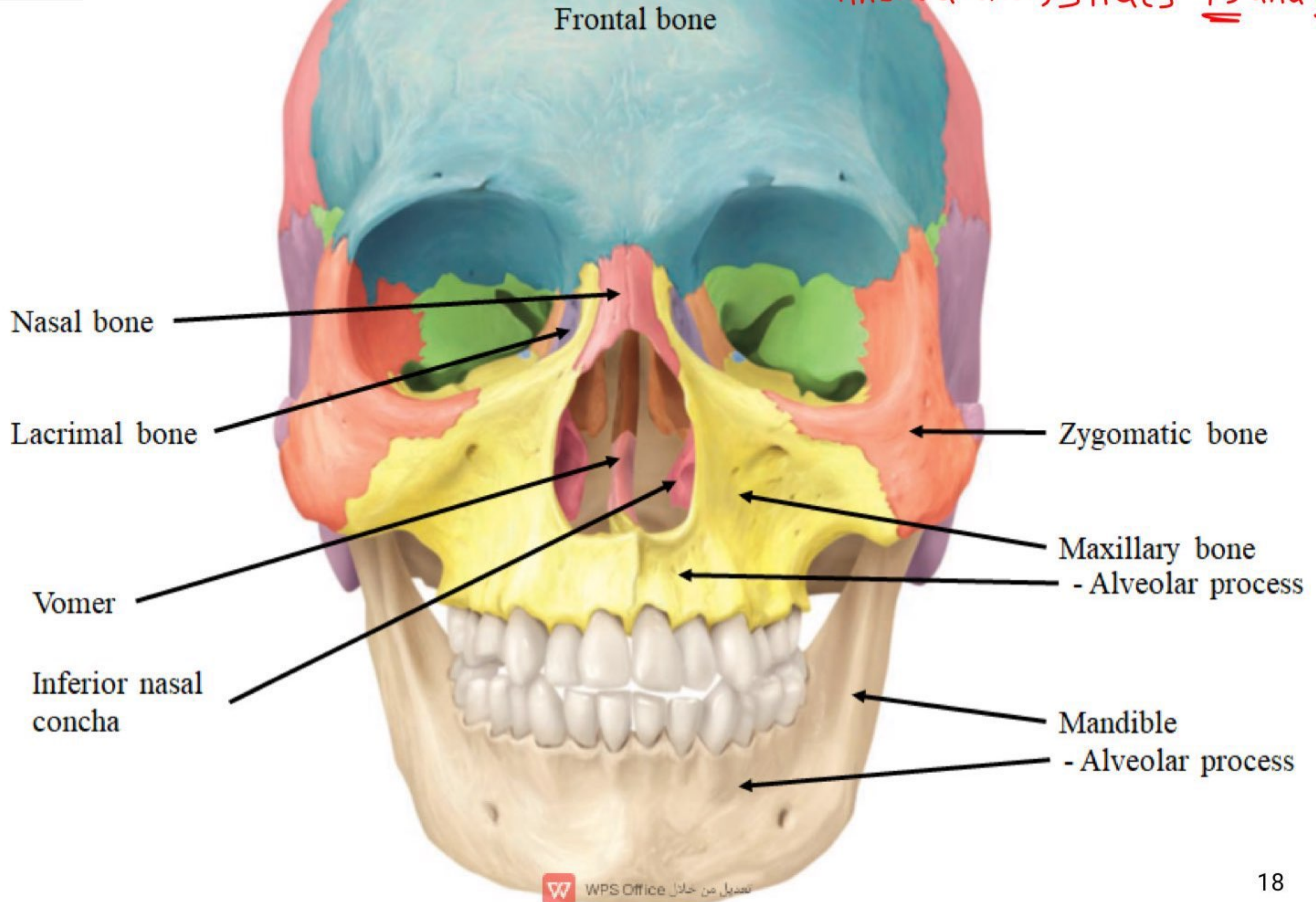
نتوءات صغيرة موجودة
داخل ال Maxillae بالأمكان
التي تخرج منها الأسنان

Frontal / Anterior View

Fig.7

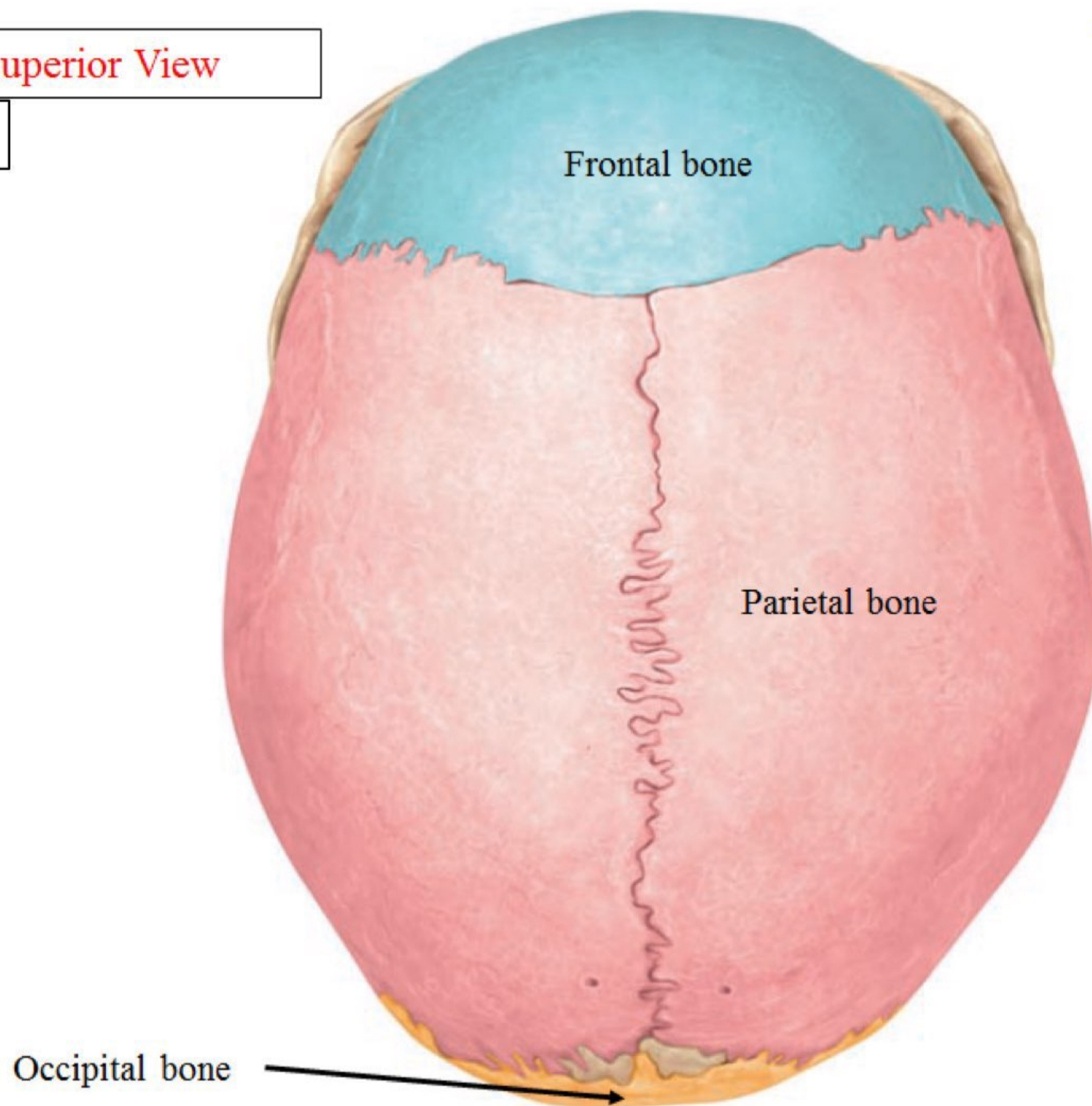
* الرجاء مراجعة المقسمة

(introduction) slides 15 and 16



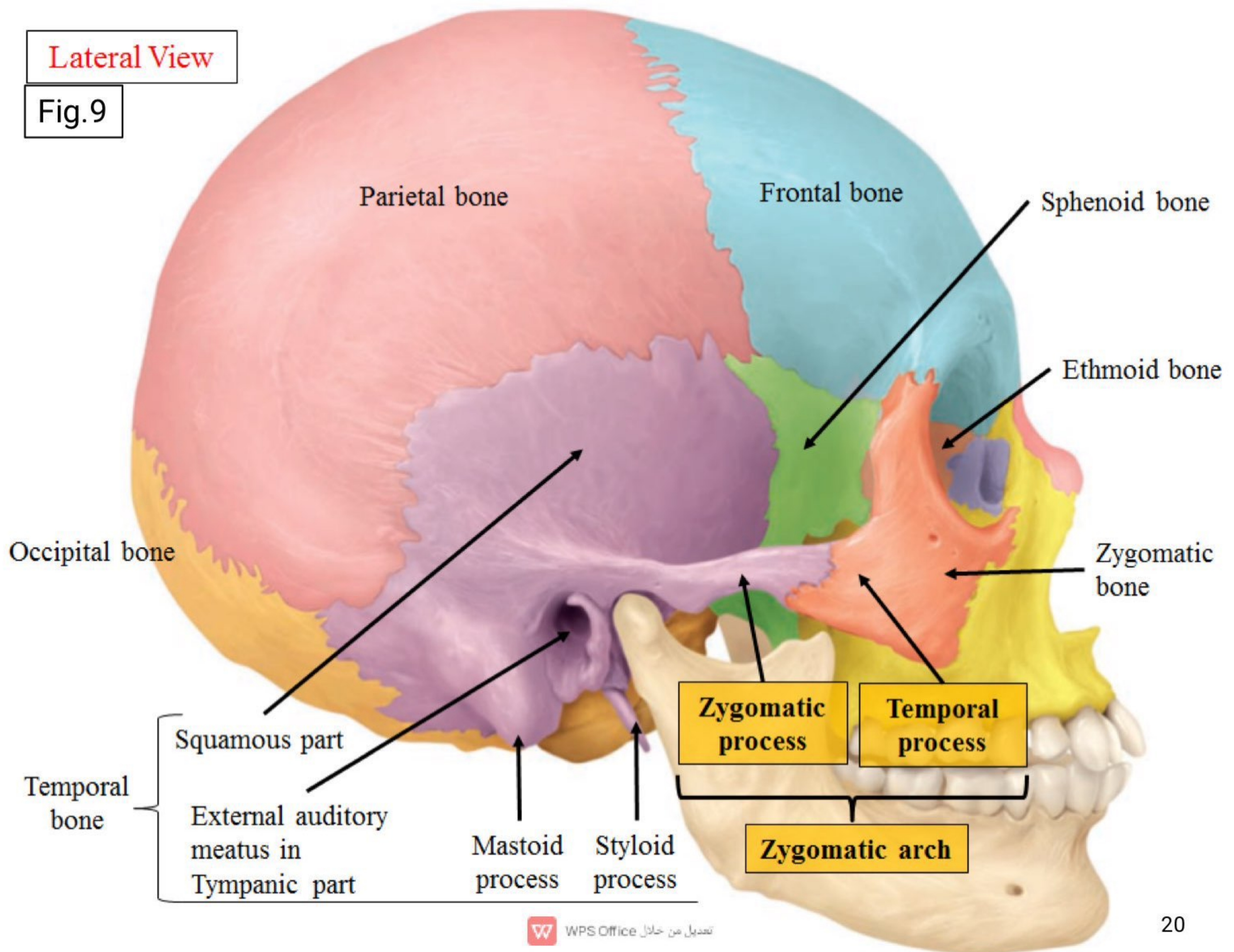
Superior View

Fig.8



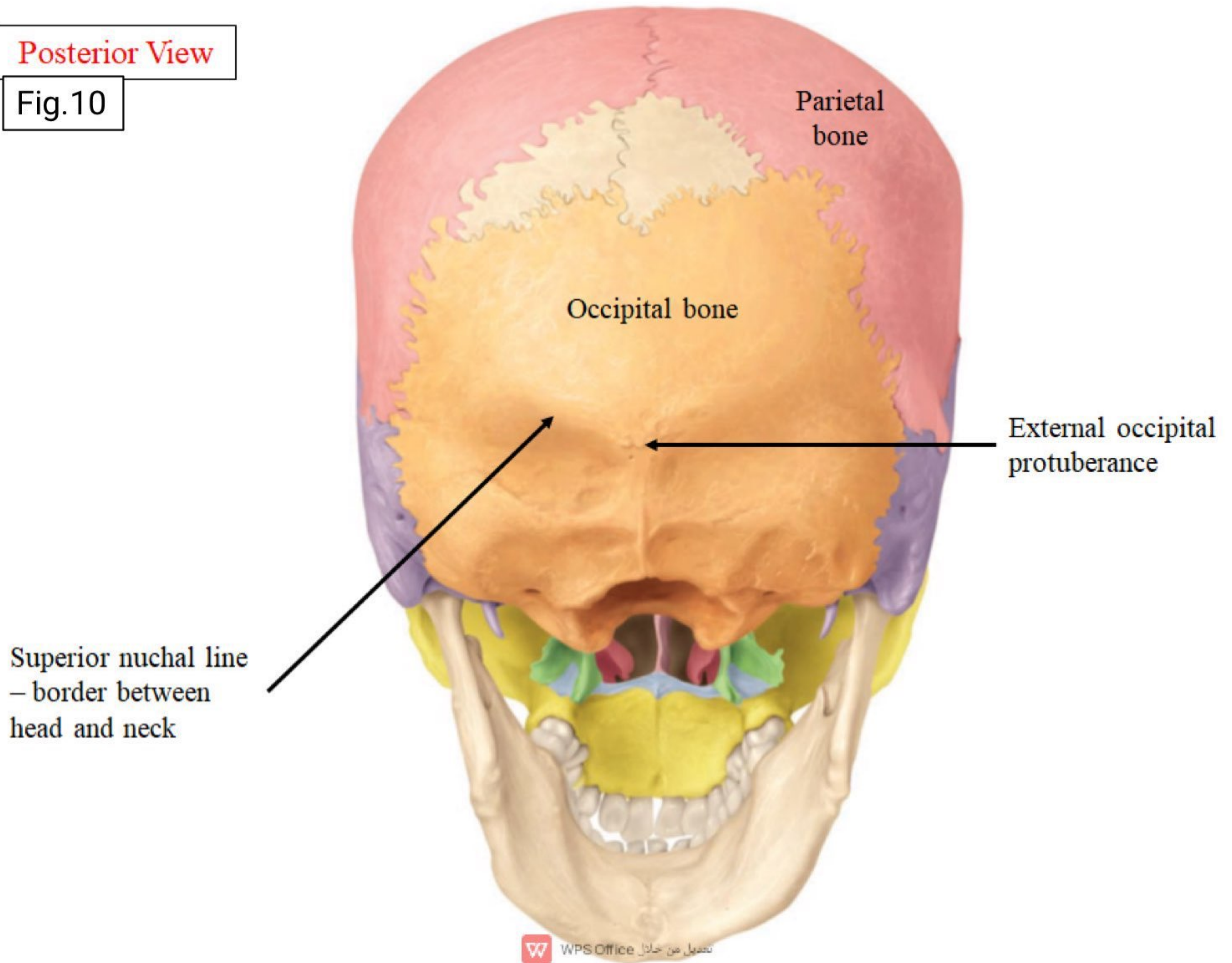
Lateral View

Fig.9



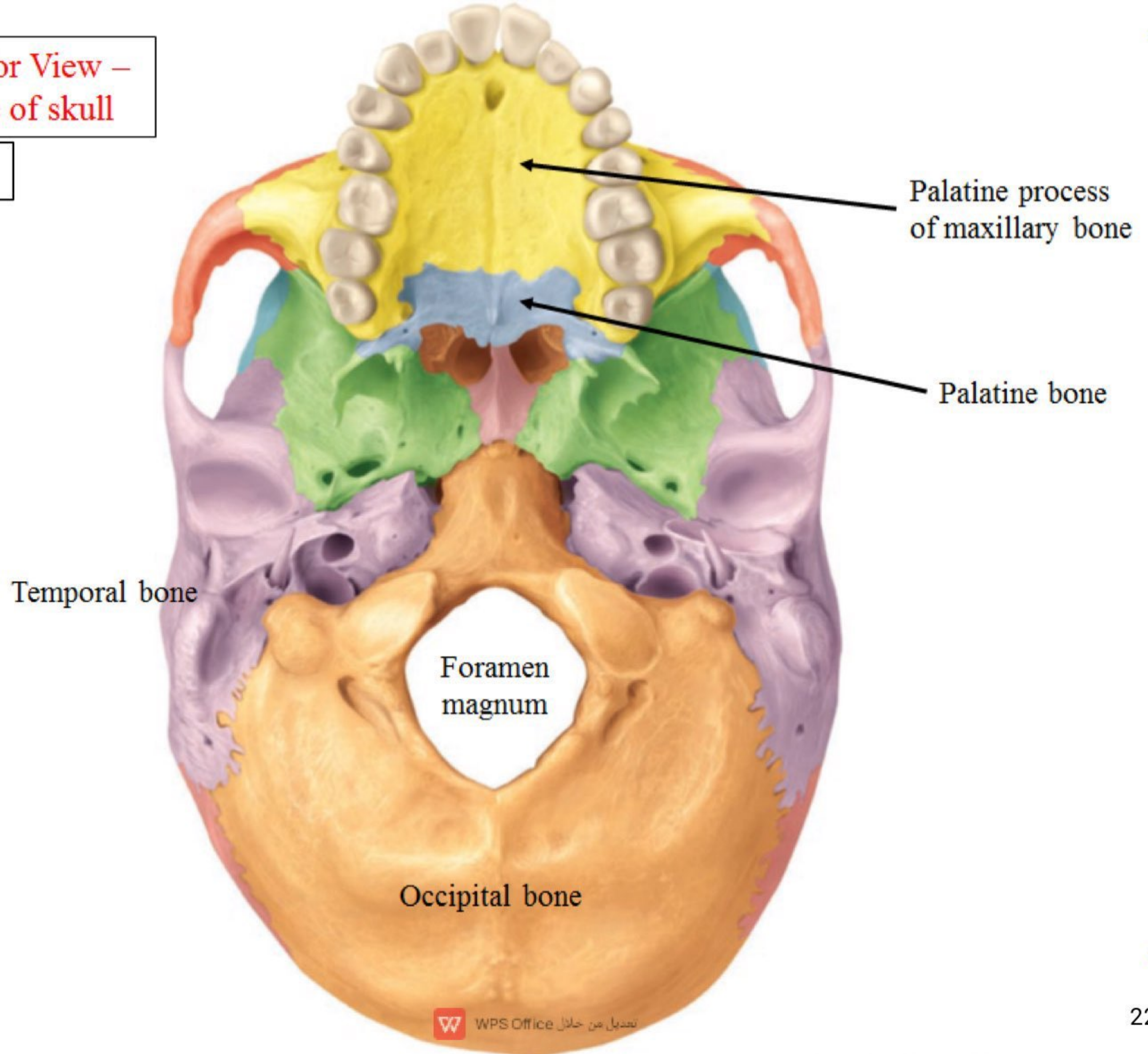
Posterior View

Fig.10



Inferior View –
Base of skull

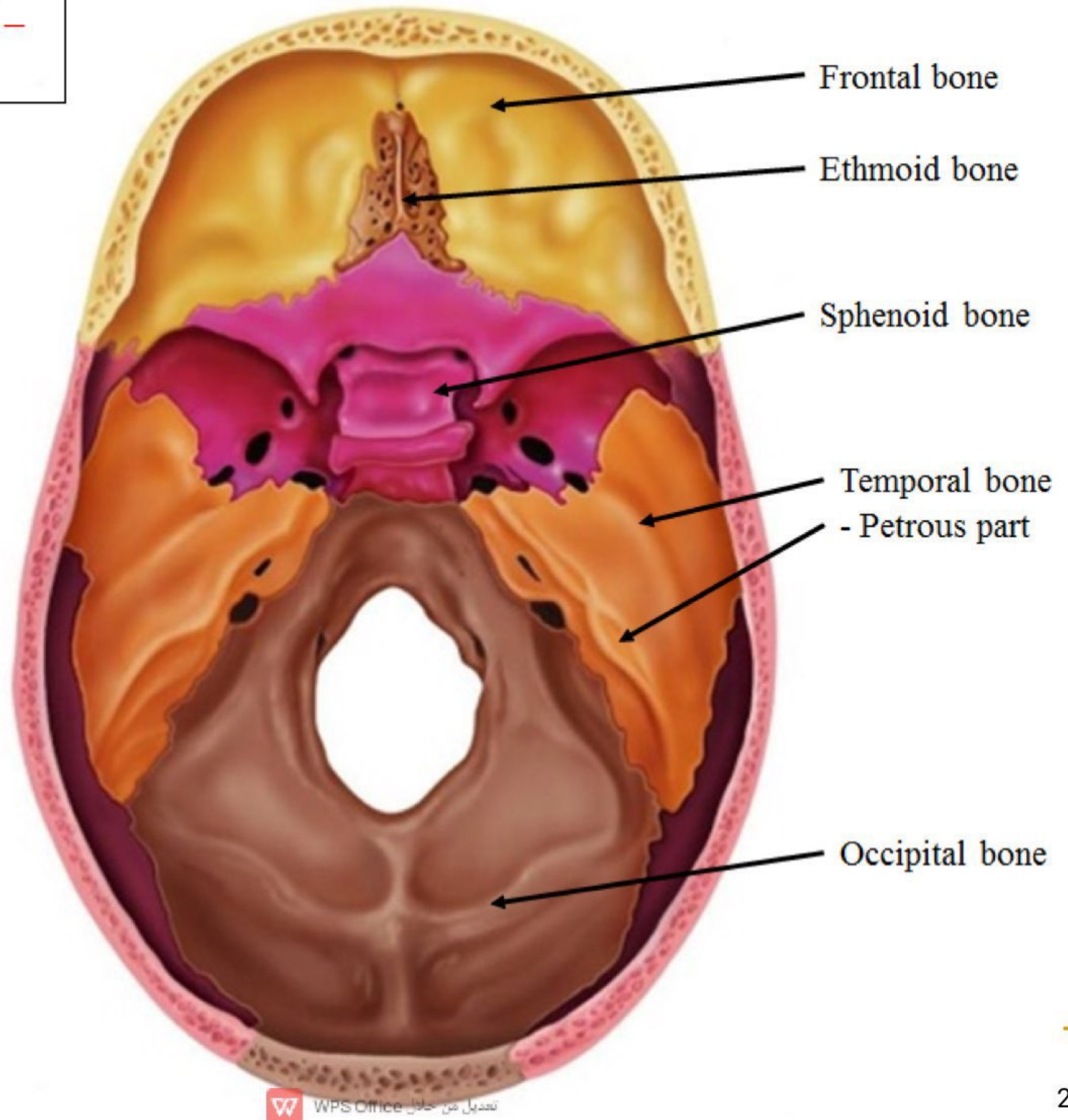
Fig.11



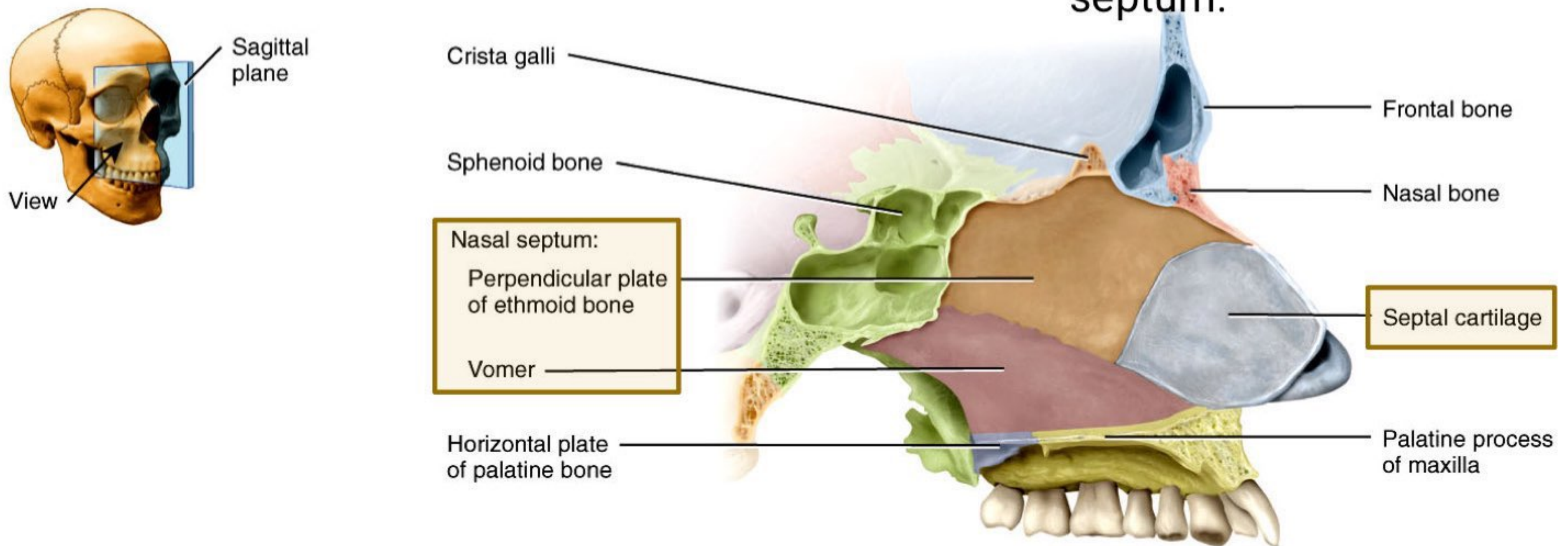
Interior of the skull –
Cranial cavity

Fig.1

2



The Nasal Septum:



- ❑ A partition that divides the nasal cavity into right and left parts.
- ❑ It's formed of:
 1. The perpendicular plate of the ethmoid bone and the vomer bone **posteriorly.** → الجزء الخلفي
 2. Septal cartilage **anteriorly.** → الجزء الأمامي

Main Sutures: → درزات

- 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.

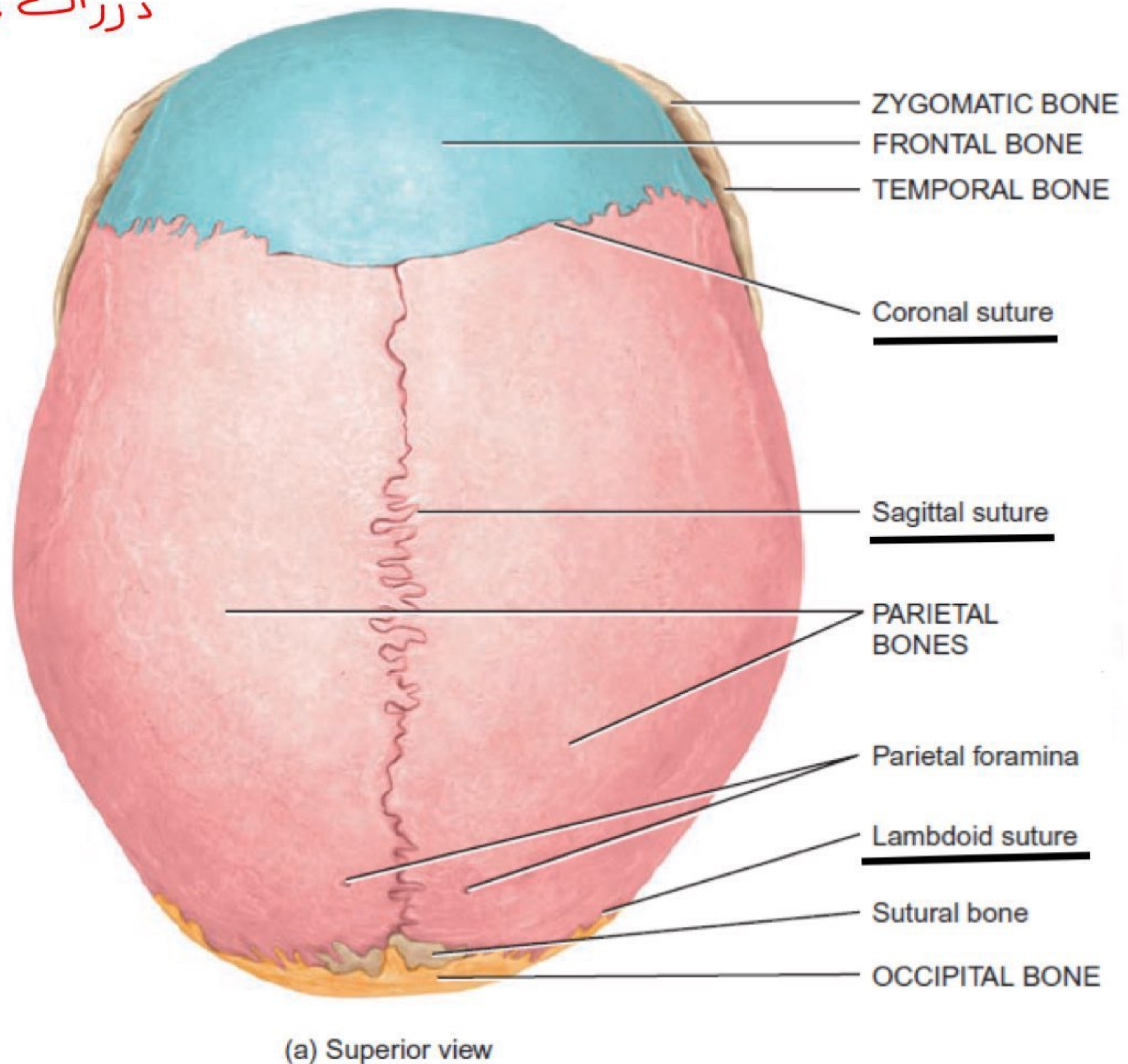


Fig.14: Some of the main sutures of the skull.

Paranasal Sinuses:

الجيوب الأنفية

- ❖ Cavities within cranial and facial bones near the nasal cavity.
- ❖ Secretions produced in the sinuses drain into the nasal cavity.
- ❖ Serve as resonating chambers that intensify and prolong sounds.
- ❖ Found in the Frontal, ethmoid, sphenoid and maxillary bones.

برية
غرفة
صدي

الجيوب الأنفية توجه في ٦ أجزاء داخل الجمجمة
ولكن إخراجها يتم من خلال التجويف الأنفي

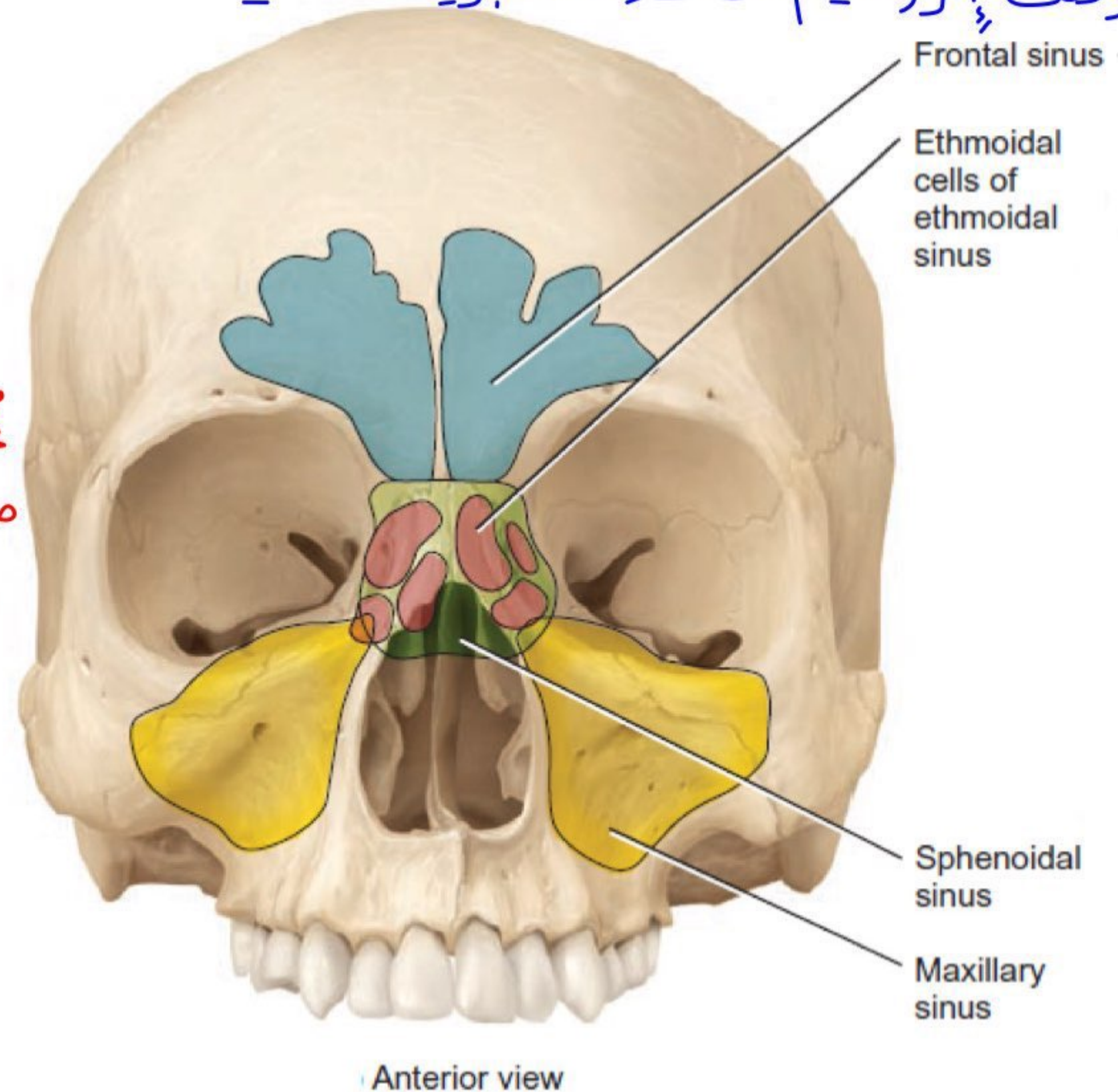


Fig.15: Paranasal sinuses.

Fontanelles: → فتحات موجودة داخل skull

- ❑ 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.
- ❑ The largest of these fontanelles are the anterior and posterior fontanelles.

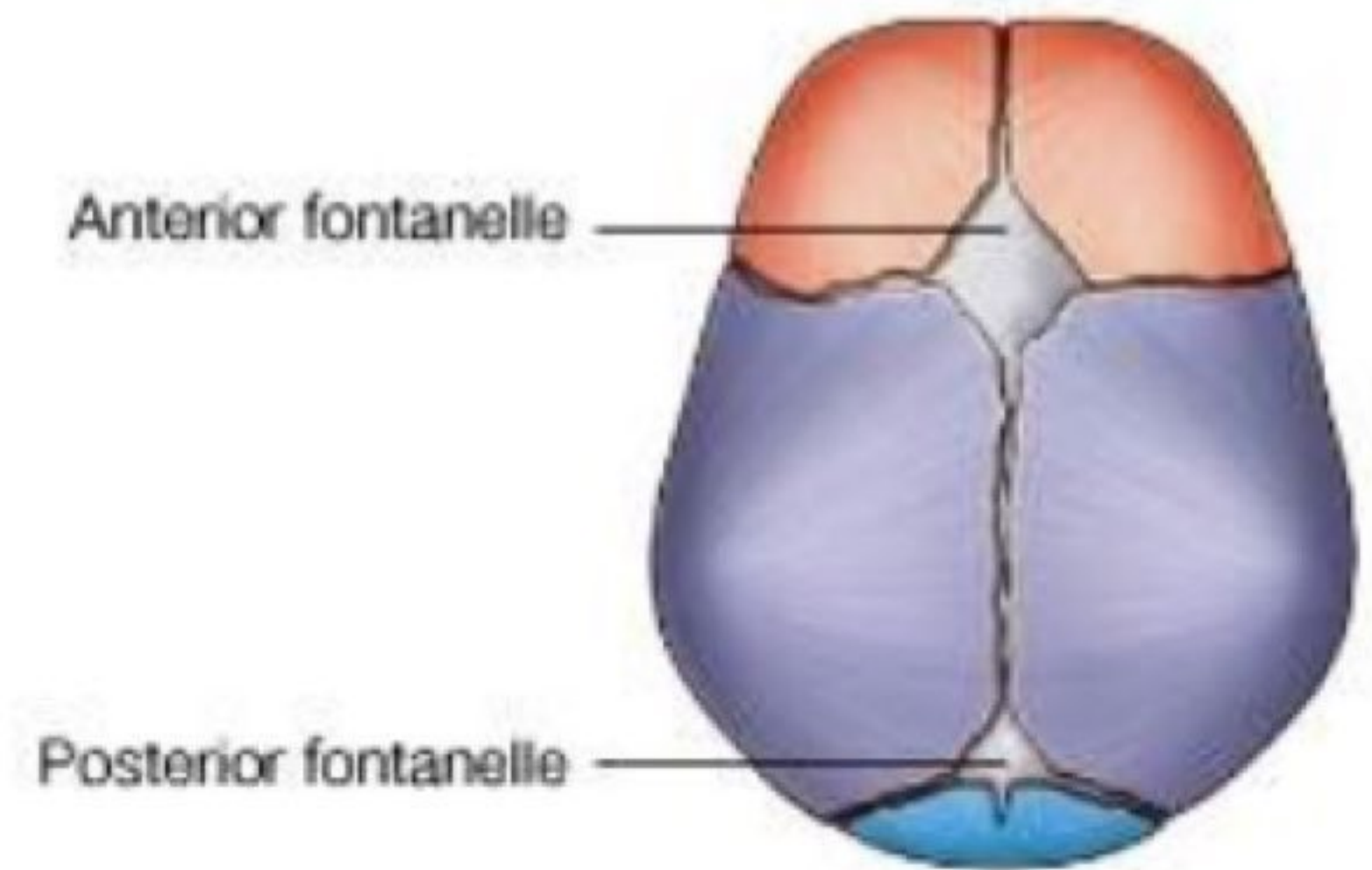


Fig.16: Anterior and posterior fontanelles.

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. It's also attached to the larynx.

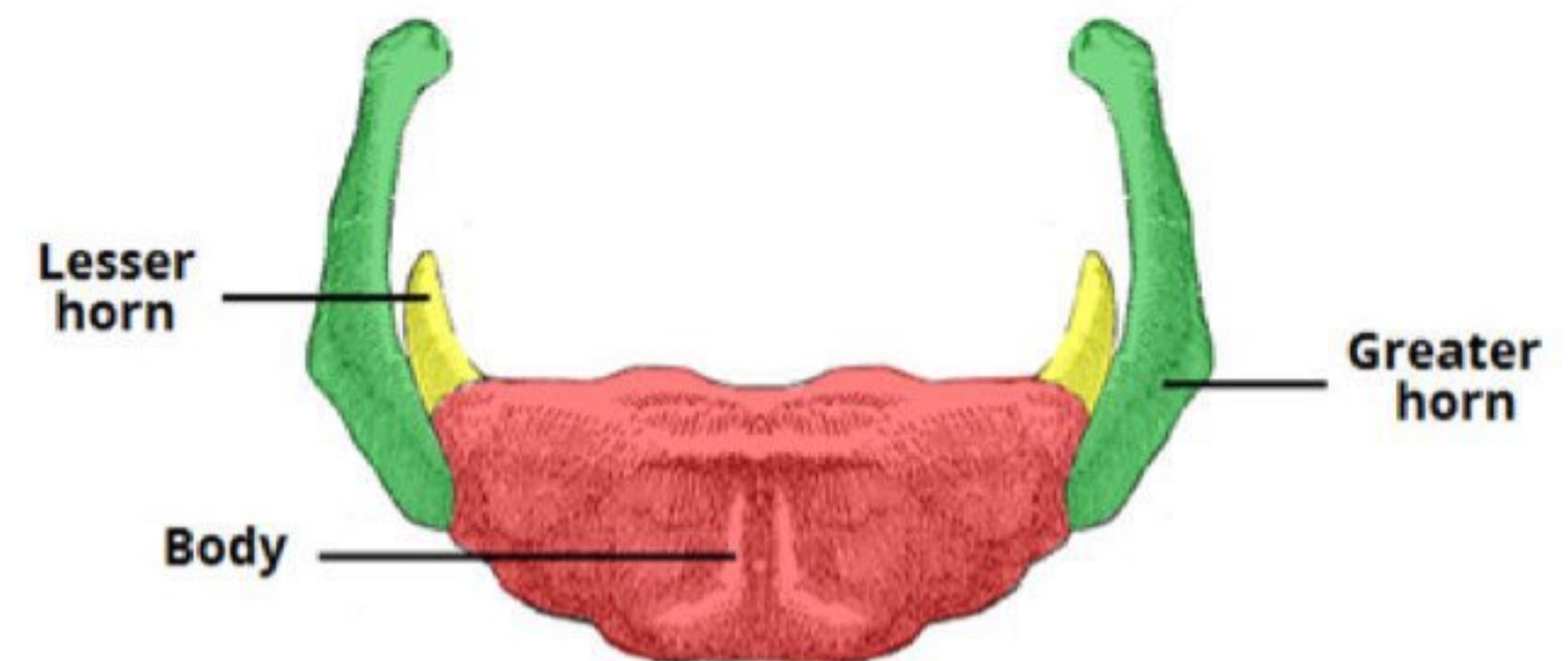
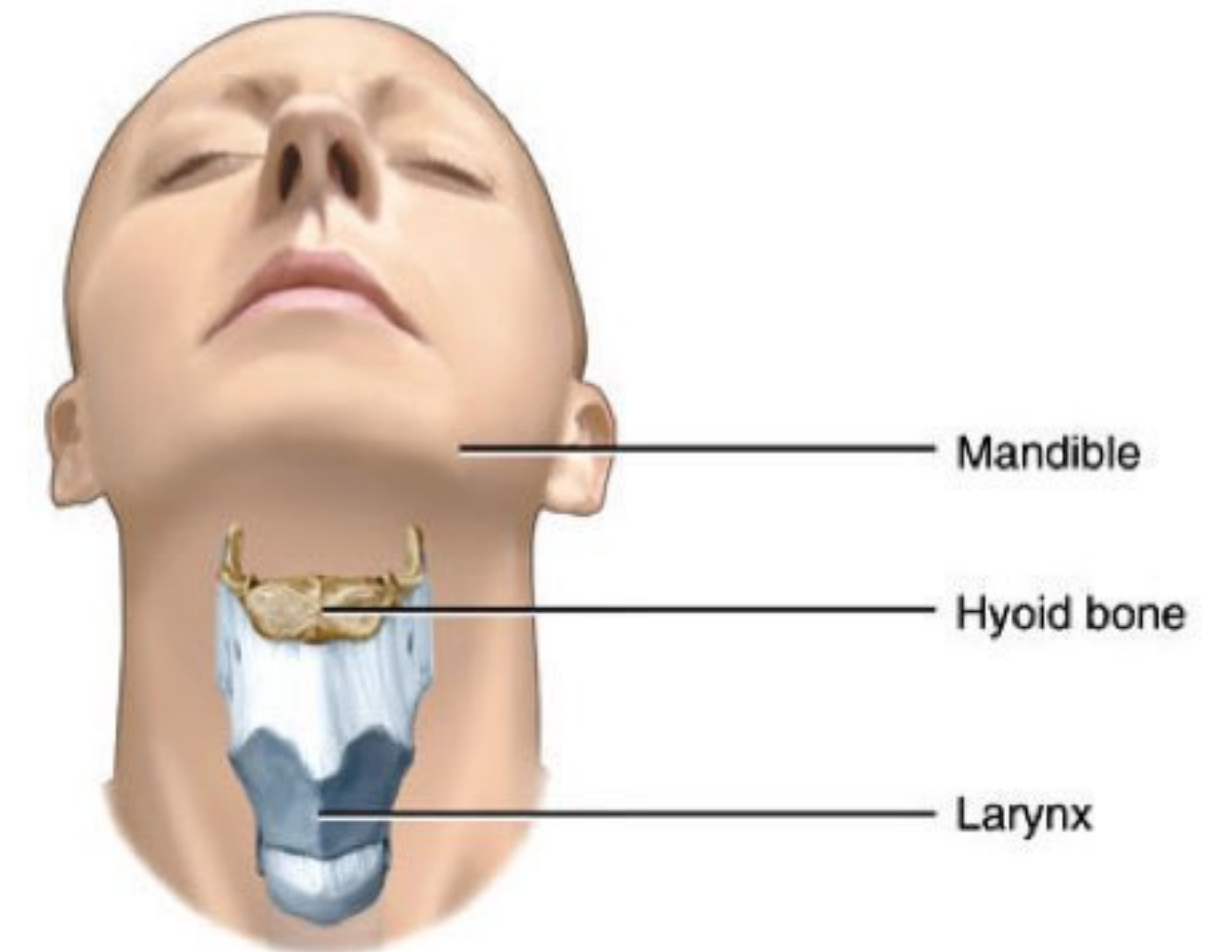


Fig.17: The hyoid bone.

Skeletal system :-

Skeletal → bones , joints
علاقة

→ system
مسؤول عن
Support.

* عدد العظام في الجهاز الهيكلي = 206 bones

⇒ Two types of bones !

1 Axial Skeleton

العظام التي تبني حوائط المحر

الطولي للجسم (Longitudinal axis)

وهم :

- skull bones
- auditory ossicles (ear bones) → middle ear موجود بال
- hyoid bone → Neck موجودة داخل
- ribs → رibs
- sternum (breast bone)
- bones of the vertebral column

Function :- protection of vital organs.

Skull → يحمي الدماغ

vertebral column → Spinal cord يحمي الحبل الشوكي

ribs + sternum → يحمي الرئة والقلب

2 Appendicular skeleton.

Consist of : 1) upper and lower Limbs .

2) girdles.

* girdles connect Limbs with axial skeleton.

* Function :- movement.

* Bone tissue :-

- type of connective tissue.
- consists of :-

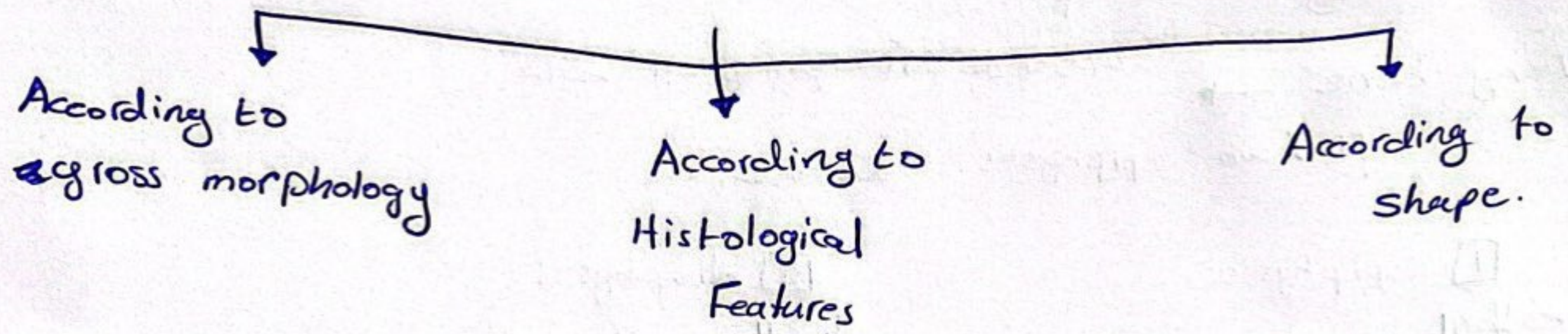
1 calcified extracellular matrix

← يحتوي على نسبة عالية من الكالسيوم.
↓ called
(bone matrix)

types of

- 2 three cells :
- ① Osteoblasts
 - ② osteocytes
 - ③ osteoclasts.

classification of bone



* According to gross morphology

1 compact bone → أقوى ، مضغوط ولا يوجد تجاويف .
يتكون من الخارج ويظهر كثافة كثيفة

2 Spongy bone → في فراغات وتجاويف أكثر قليل .
تتكون من الداخل

* According to Histological Features :-

1 primary (woven) bone
يكون فيها collagen fibers غير منتظمة .

2 Secondary (lamellar) bone .
تكون collagen fibers منتظمة في طبقات تسمى lamellae

lamellae form circles around central cavity → Osteons
موجود داخل Osteons
Osteocytes موجود بمنطقة تسمى Lacunae

ويعبر بين الـ Osteocytes Connection
هذا الـ Connection اسم
Canaliculi

* According to shape :-

1 Long bone → عظام أطول تبعها أكثر من العرض
!! Two epiphyses ومكونة من

1 epiphyses
الجزء الموجود بالاطراف
Spongy bone - مكونة من كمية عالية من
compact bone - و طبقة من

2 diaphyses
الجزء الموجود بالوسط
(القصبية)
- تحتوي على كمية عالية من
compact bone
و كمية قليلة من spongy bone

medullary cavity في انسي اساه
↓
bone marrow تحتوي على
مسئولة عن synthesis for blood cells.

examples :- Femur (عظمة الفخذ), Tibia و Fibula (موجودة بالرجل), humerus, ulna, radius, phalanges (موجودة بال upper extremities عظام الاصابع)

2 Short bones : عظام تكون فيها الطول والعرض متساوي

cube-shaped → شكل مكعب

examples :- Carpal bones, navicular, cuboid → موجودة بالرجل

3 Flat bones : عظام مسطحة مكونة من مخطط
من compact bones وطبقة
من spongy bone

examples : cranial bones, sternum, ribs, scapulae (لوح الكتف)

4 irregular bones : عظام لا هي طويلة ولا قصيرة ولا مستطحة
← هي التسمية ان الشكل تبعها غير مستطيم
vertebrae, hip bones, some facial bones, calcaneus (عظمة موجودة بالرجل)

5 sesamoid bones :- موجودة بين الاوتار
patellae (الركبة صاعدة) ←

* النمو إما يكون طولي أو عرضي .

- النمو بشكل عرضي ما يوقف
مع عمر معين

- نمو العظام سواء بشكل طولي
أو عرضي يعتمد على الهرمونات
مثل: growth hormon

epiphyseal
plate

بصير بمنطقة اسمها



(made of
hyaline cartilage)

إلى موجودة بار
epiphyses

فيتمثل نمو لحد ما يتوقف نمو السطح

و يتحول إلى bone structure

* The Axial skeleton :-

العظام التي موجودة حول المحور الطولي للجسم .

□ The skull

- skull is the bony framework of the head.
الجمجمة في الخلف للرأس .

- formed of 22 bones



* Cranial bones

- 8 cranial bones that
formed cranial cavity
which encloses the brain
هم :

- 1 Frontal bone
- 2 parietal bones
- 2 temporal bones
- 1 occipital bone
- 1 sphenoid bone
- 1 ethmoid bone

* Facial bones

- 14 facial bones → Form the face

هم :

- 2 nasal bones
- 2 maxillae bones → الفك العلوي
- 2 zygomatic bones → العظام الوجنية
- 2 lacrimal bones → النخاع العظمي
- 2 palatine bones → عظام الحنك
- 2 inferior nasal conchae → صهارة الأنف السفلية
- 1 vomer → العظم للقوس
- 1 mandible → عظم الفك السفلي

Features of the skull :-

→ cranial and facial bones protect ① the brain ② special sense organs.

→ العظام بالجمجمة متصلة ببعض
لكن هي غير متحركة يعني ما يتخلل العظام
يتحركوا ويبعدوا عن بعض

اسم المفصل الي بيناتهم Suture
الخطة الوحيدة الي صمومتها تتحرك هي
mandible → movable joint

→ Cavities : 6 cavities of the skull

- ① cranial cavity → تحتوي الدماغ
- ② The orbits (eye sockets) → تبجي فيهم العين
- ③ Nasal cavity
- ④ oral cavity
- ⑤ paranasal sinuses
- ⑥ Middle and inner ear cavities → موجودة في petrous part of the temporal bone

Frontal lobe
يقاب

Frontal bone
وكذلك

* كل Lobe مقابله عظمة ← يعني