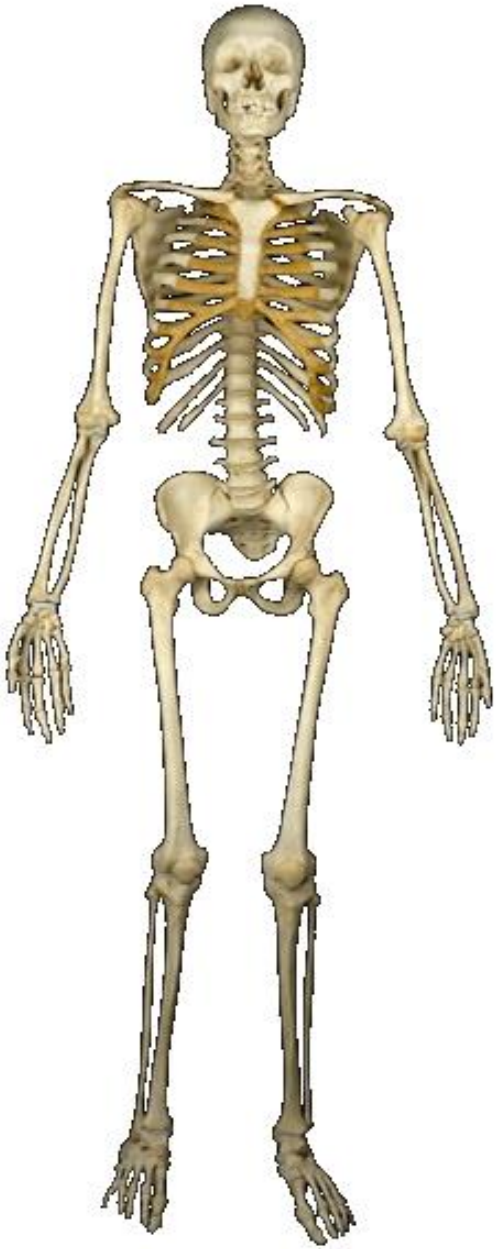
The Skeletal System



توصيات قبل لتدرس السنابتر :

Dr. Mustafa Saad
(2021)

- حاول استخدم تطبيق لتتخيل أماكن العظم كويس (يسهل الدراسة ألف)

← إلي استخدمه الدكتور بس اختاروا المناسب إلكم

- فيديوهات توضيحية yt / animation

- repetition is the mother of learning

- Good luck -

Divisions of the Skeletal System

- The human skeleton consists of ***206 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.

★ Function:

connective

Bone Tissue

adult — embryo
proper — supportive — fluid
Bone — cartilage

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.

(calicum) متكلس

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).

Ca^{+2} PO_4^{-3}

1. How many bones are in the adult human skeleton? (Q1)

A. 196

B. 206

C. 210

D. 226

2. Which of the following is NOT part of the axial skeleton? (Q2)

A. Skull

B. Vertebral column

C. Rib cage

D. Pelvic girdle

Cells of bones:

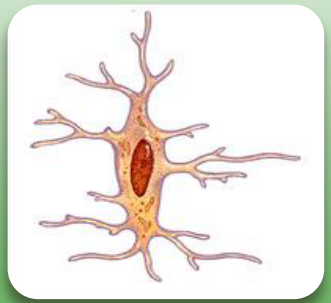
children ★

Osteoblasts

bone synthesis

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

تكليس



Osteocytes

- Maintain the bone
- Located inside spaces called lacunae

فجوات

old granny ★

Osteoclasts

destruction

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

Bone matrix:

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

irregular regular

Periosteum:

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

إصلاح الكسر

داخلي

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.

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.

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

Classification of bones

gross morphology
histological features
shape

According to Gross Morphology: تكوين

- In a section of bone we have:

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

(cancellous) → إسفنجي

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

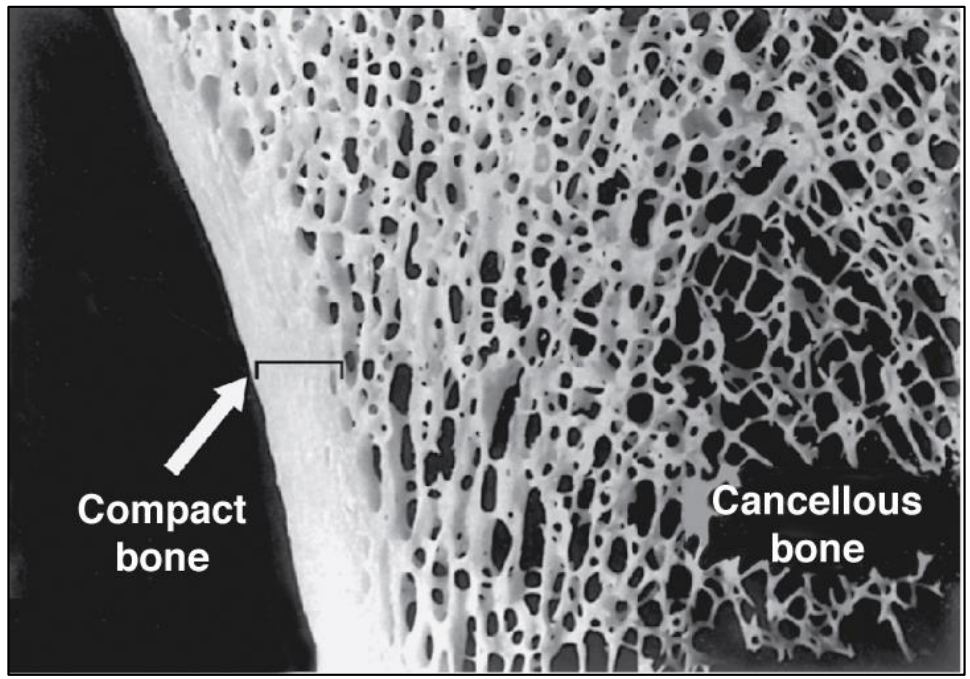


Fig.2: Compact and cancellous bone.

إسفنجي

According to Histological Features:

خصائص نسيجية

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

منسوجة

(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. In the osteons, osteocytes are found in spaces called lacunae connected to each by canaliculi.

دائرة متحدة المركز

قنوات مائية

Fig.3: Osteon.

Concentric rings of bone matrix in compact bone are called

A) lamellae.

B) lacunae.

C) canaliculi.

D) endosteum.

A

According to Shape:

long bones - flat bones - sesamoid bone

short bones - irregular bones

1. Long Bones

- Greater length than width and are slightly curved for strength.
- Has two expanded ***epiphyses*** formed mainly of spongy bone surrounded by a thin layer of compact bone.
- 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***.
- Femur, tibia, fibula, humerus, ulna, radius, phalanges. (14)

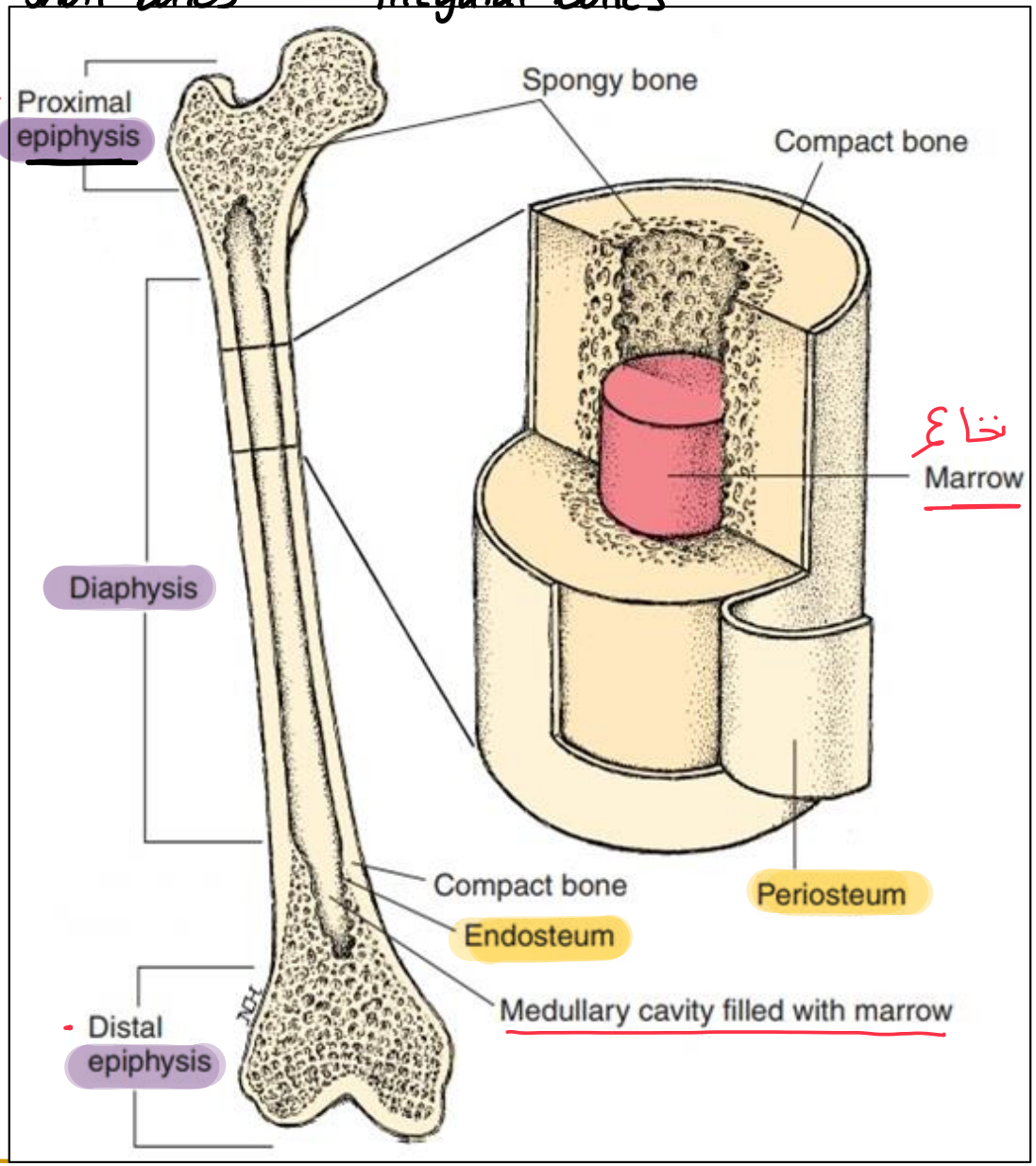


Fig.4: Parts of long bones.

21. What is contained within the medullary canal of a long bone?

A. trabeculae
B. lamellae
C. marrow
D. osteoblasts and osteoclasts

Answer is C:

2. Short bones

- Cube-shaped and are nearly equal in length and width
- Carpal bones, navicular, cuboid

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
- Cranial bones, sternum, ribs, scapulae

Flat bone (sternum)

4. Irregular bones

- Complex shapes and cannot be grouped into any of the previous categories
- Vertebrae, hip bones, some facial bones, calcaneus

Irregular bone (vertebra)

5. Sesamoid bones

- Found within tendons. Protect the tendons from excessive wear
- Patellae

Sesamoid bone (patella)

9. Which of the following is **NOT** a "long" bone?

A. the humerus
B. the tibia
C. a carpal
D. a metacarpal

Answer is C: A "long bone" has a length that is significantly longer than its width. A carpal (a bone of the wrist) is a short bone.

10. Which one of the following is a bone that is embedded within a tendon?

A. sphenoid
B. hyoid
C. ethmoid
D. sesamoid

Answer is D: Sesamoid refers to like a sesame seed

Bone Growth

- 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.

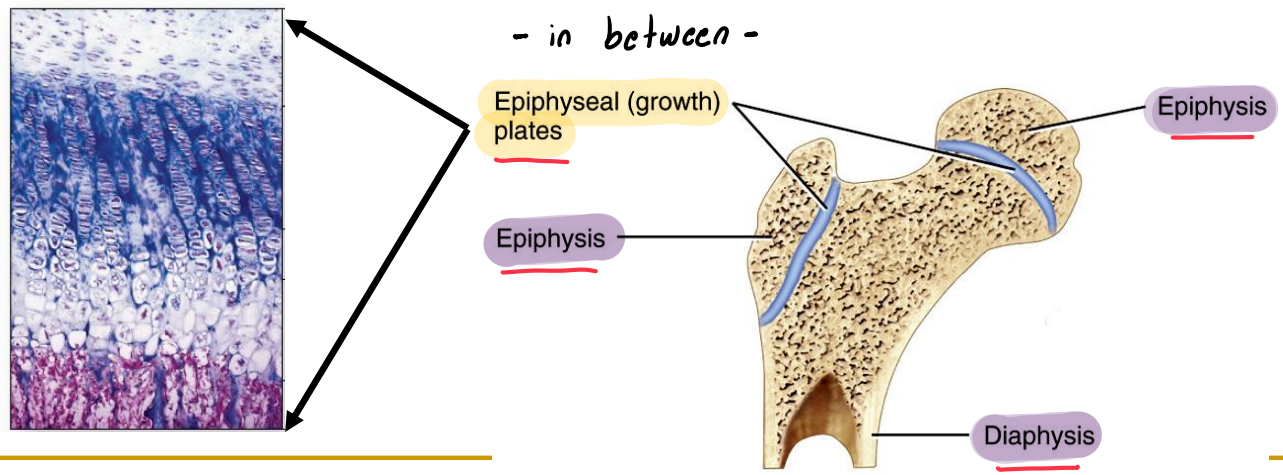


Fig.5: Epiphyseal growth plate.

Bones grow in length at the:

- A) epiphysis
- B) diaphysis
- C) epiphyseal plate
- D) periosteum

C

24. Where is the epiphyseal plate of a long bone located?

A. in the diaphysis
B. between the diaphysis and the epiphysis
C. in the epiphysis
D. in the medullary canal

Answer is B: The "plate" is the hyaline cartilage between the shaft (diaphysis) and end (epiphysis) of a long bone

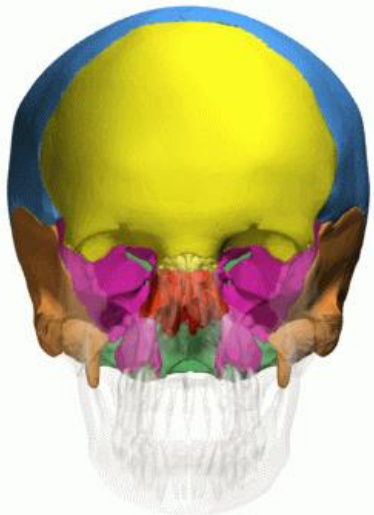
The Axial Skeleton

- skull — 22 bones
- hyoid — 1
- vertebral column — 26
- thoracic cage
  - sternum 1
  - ribs 12

The Skull

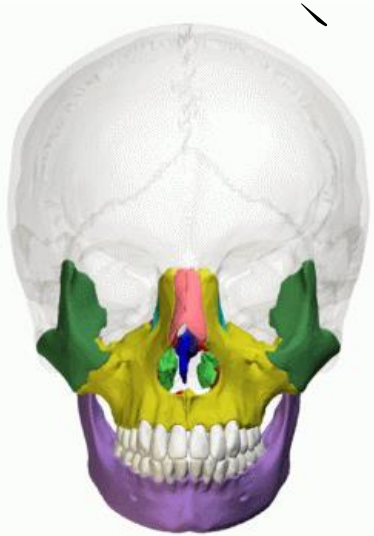
- The skull is the bony framework of the head. It's formed of 22 bones divided into two sets:

1. **Cranial bones** 8 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.



2. **Facial bones** 14 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.

not pair



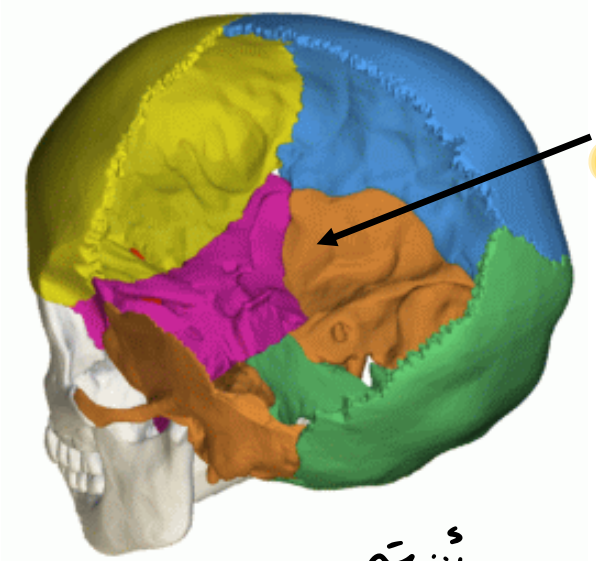
Identify an example of a cranial bone.

- A) ethmoid
- B) nasal
- C) vomer
- D) zygomatic

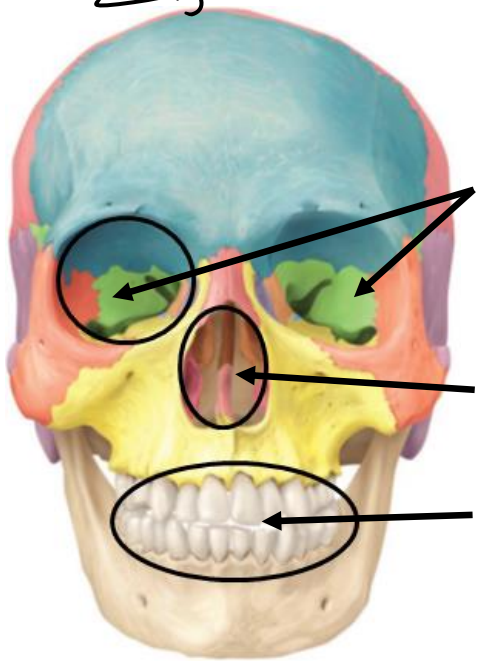
A

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 (غرز), except the mandible which is attached to the skull by a movable joint. (إستثناء)
- Cavities of the skull: 6 cavities → سؤال سنوات



(1) The cranial cavity



(2) The orbits (eye sockets)

(3) Nasal cavity

(4) Oral cavity

(5) Paranasal sinuses (جيوب أنفية) (4)

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

Cranial Bones:

temporal → sphenoid
occipital → ethmoid

Temporal Bones

- 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

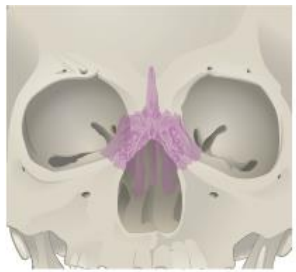
- Forms the posterior part and most of the base of the cranium.
- The perceptible protrusion on the back of the head is the *external occipital protuberance*.
- The *foramen magnum*, the largest foramen in the skull, is located in this bone. (occipital bone)

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

عاموديّ



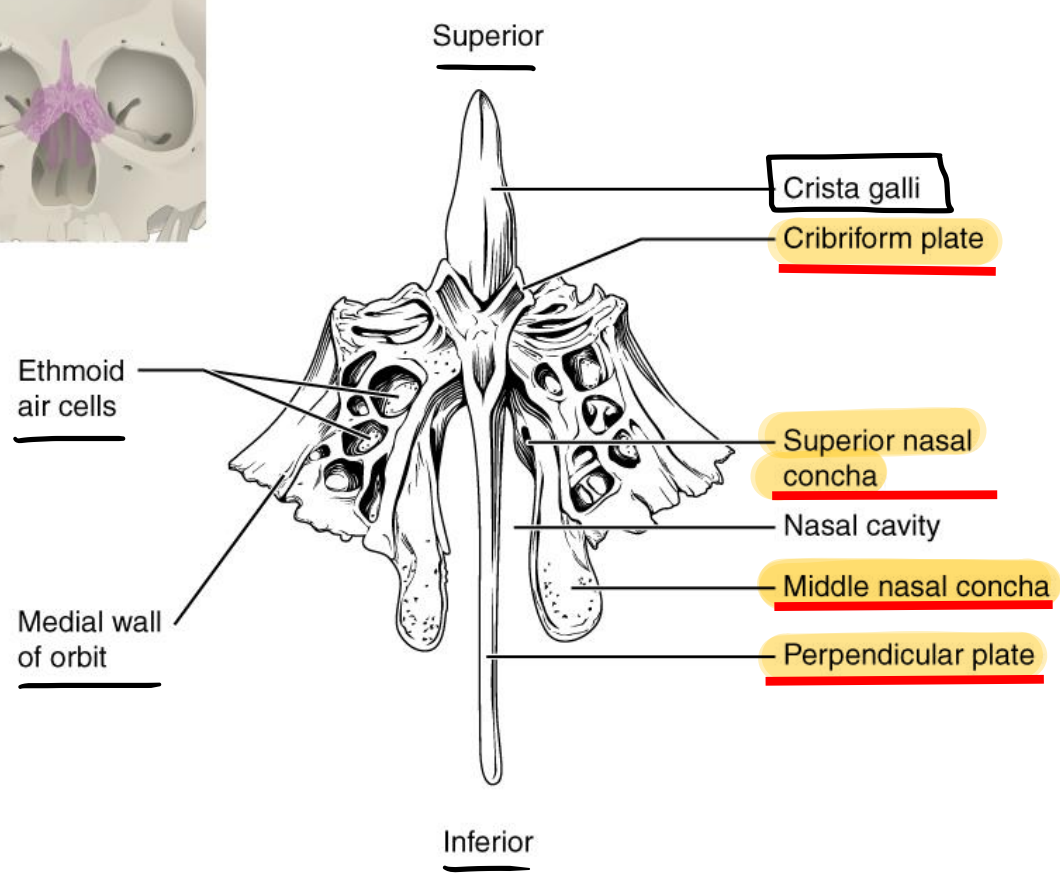


Fig.6: The ethmoid bone.

The cranial bone(s) that forms the most posterior portion of the skull is/are the _____ bone(s).

- A) ethmoid
- B) occipital
- C) parietal
- D) sphenoid

B

The cranial bone(s) shaped like a butterfly that forms the sides and floor of the cranium is/are the _____ bone(s).

- A) ethmoid
- B) occipital
- C) sphenoid
- D) temportal

C

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.

تجاويف

- **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.

- **Mandible (lower jawbone)**
  - The largest, strongest facial bone. The only movable skull bone.
  - Has alveolar process that contains sockets for the teeth.

The upper jaw is formed by the:

- A) mandible
- B) maxillae
- C) vomer bone
- D) zygomatic bones

B

The lower jaw is formed by the:

- A) mandible
- B) maxillae
- C) vomer bone
- D) zygomatic bones

A

The only movable bone of the skull is the:

- A) cranium
- B) mandible
- C) maxilla
- D) vomer

B

The cheek bones are predominately formed by the _____ bones.

- A) maxillae
- B) parietal
- C) temporal
- D) zygomatic

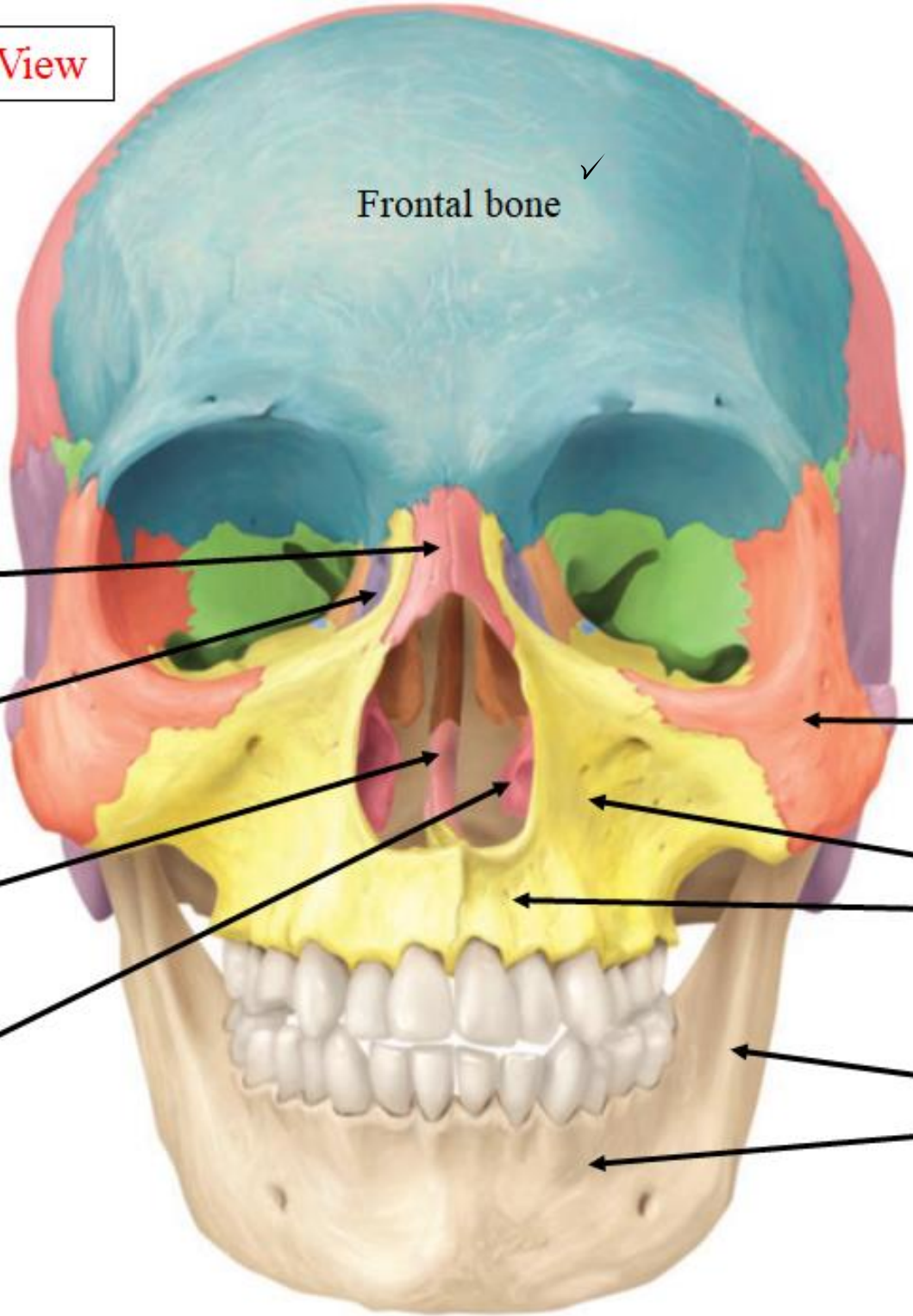
D

The hard palate is formed by the _____ and _____ bones.

- A) mandible: maxillae
- B) maxillae: palatine
- C) palatine and zygomatic
- D) zygomatic and vomer

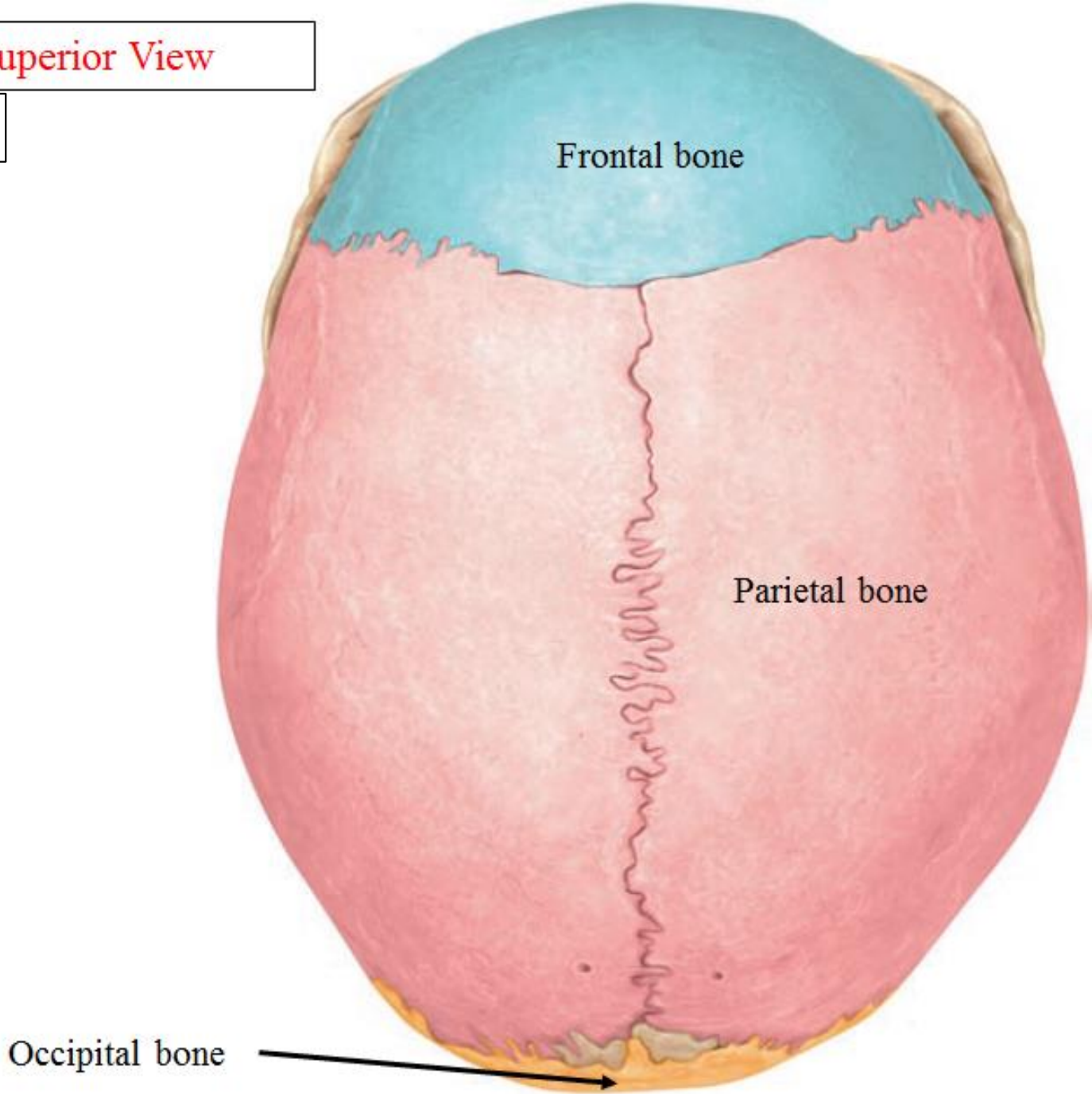
Frontal / Anterior View

Fig.7



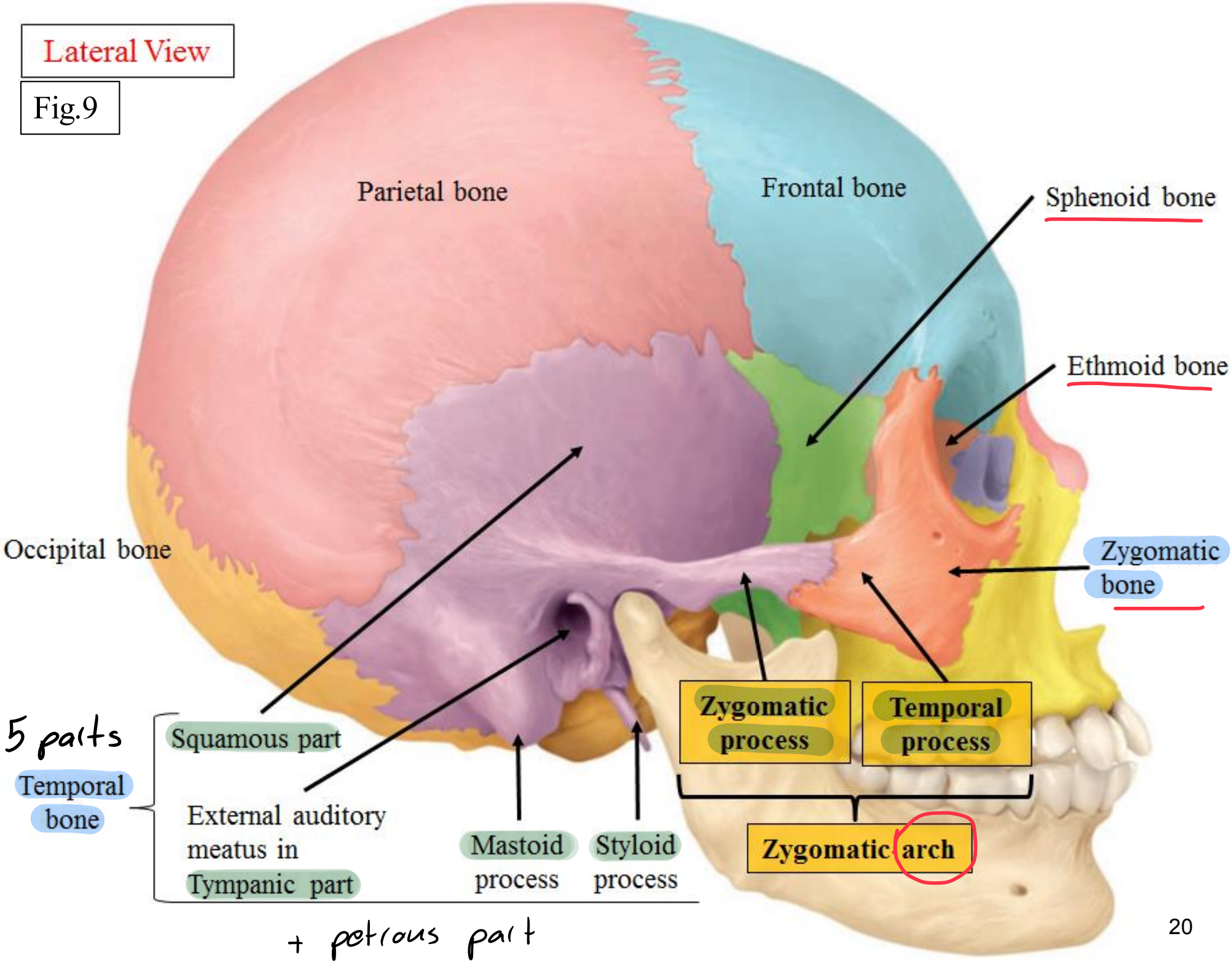
Superior View

Fig.8



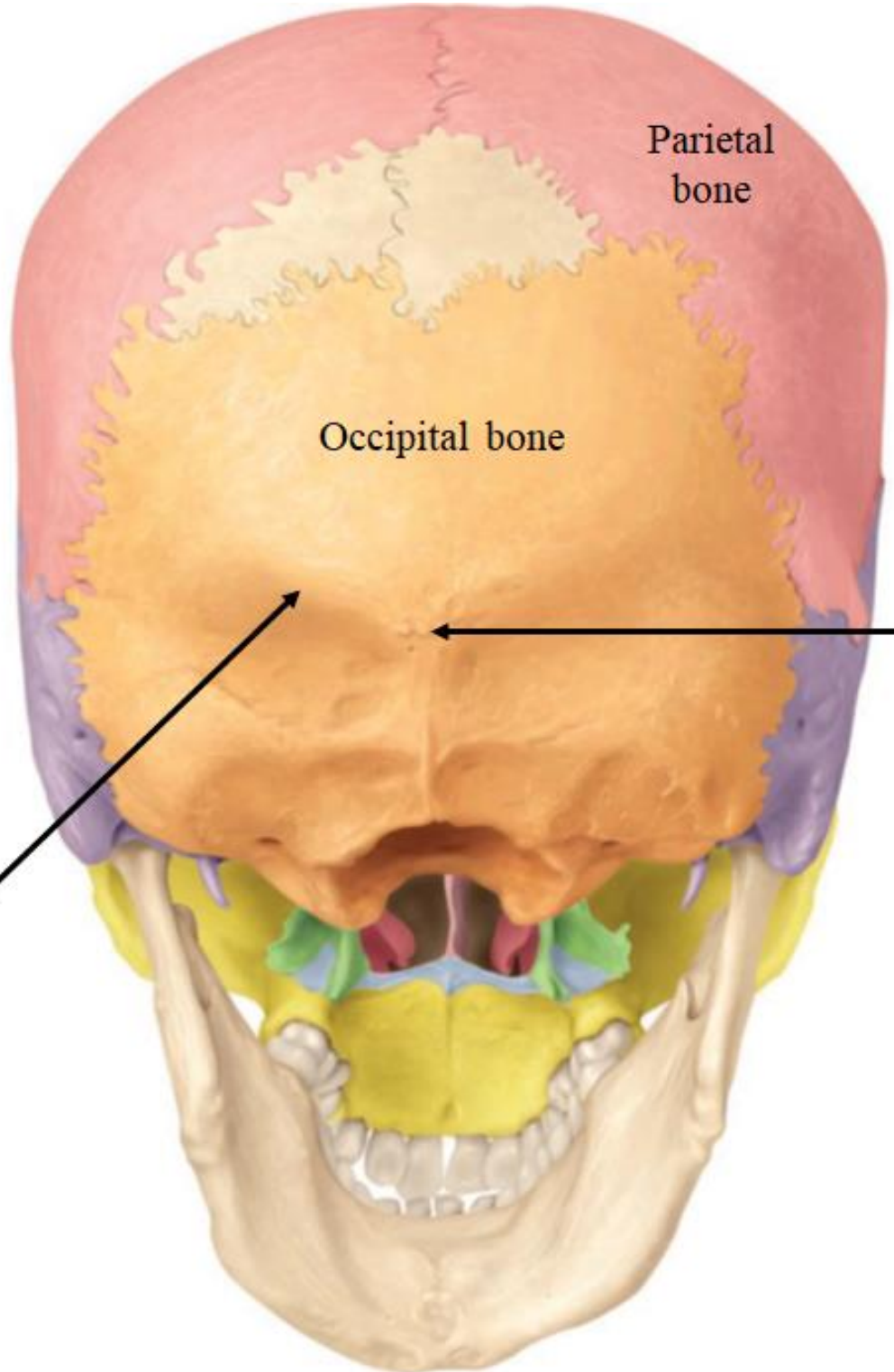
Lateral View

Fig.9



Posterior View

Fig.10



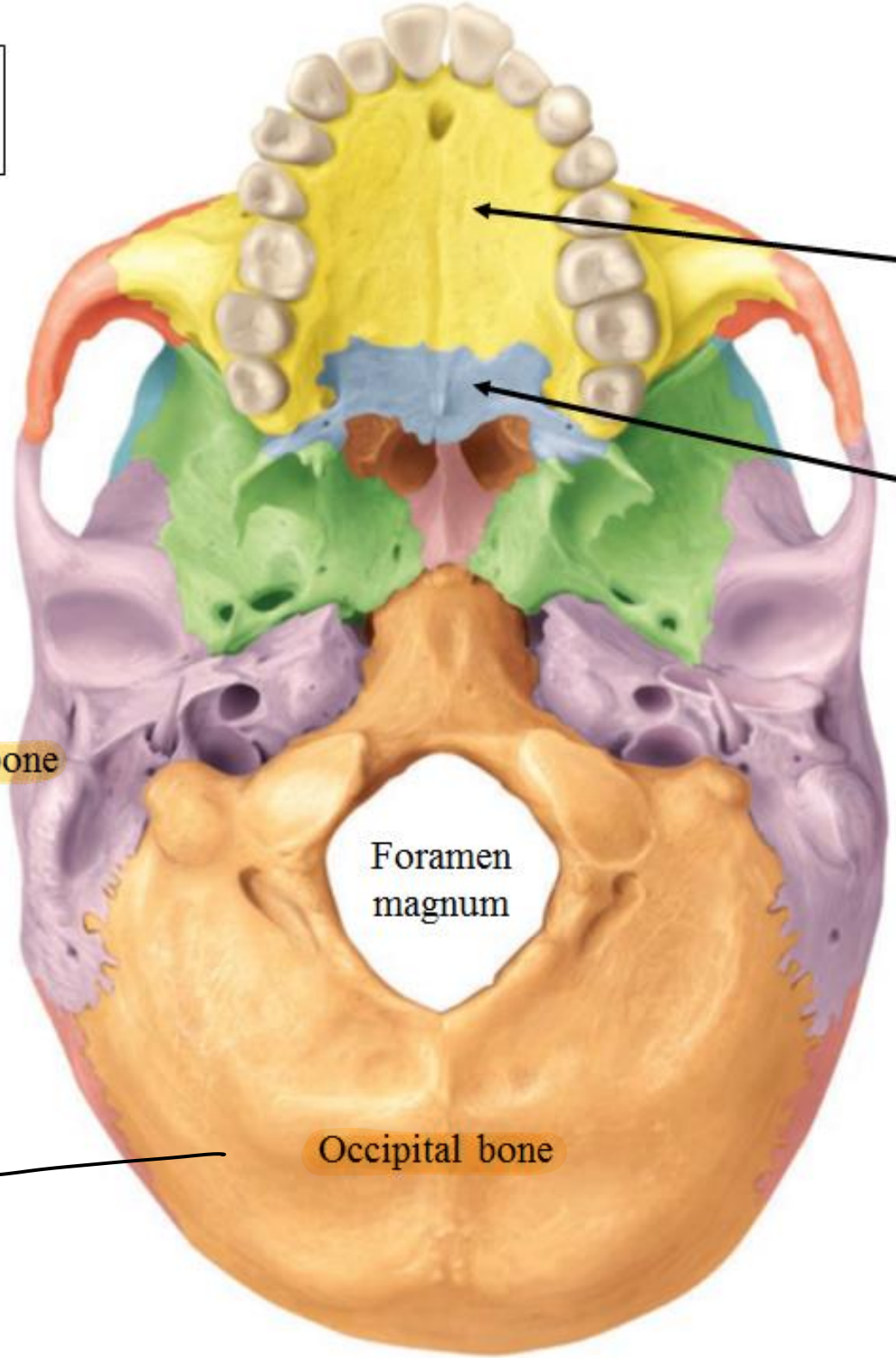
External occipital protuberance

نتوء

Superior nuchal line – border between head and neck

Inferior View –
Base of skull

Fig.11

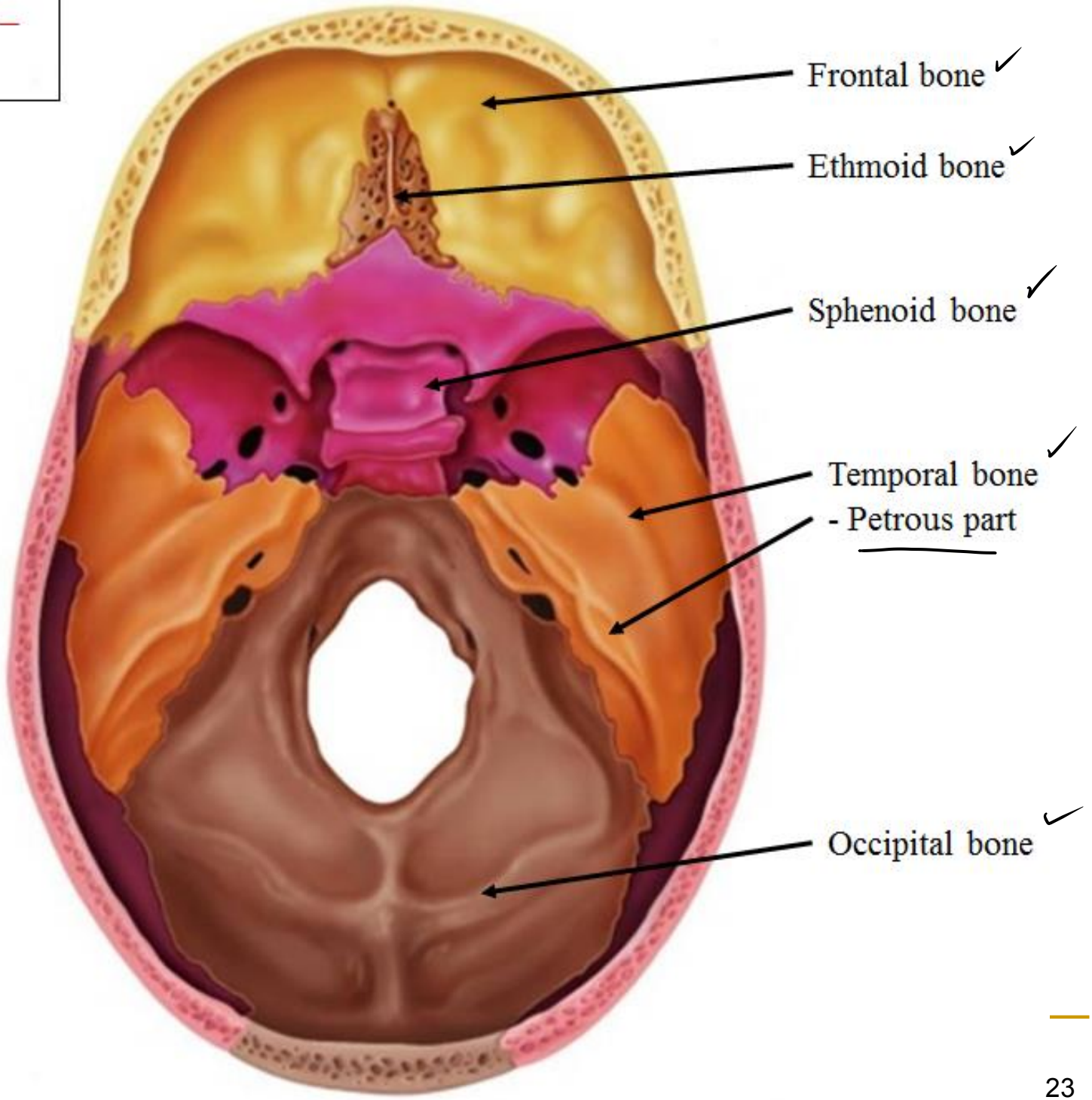


facial bones

cranial bones

Interior of the skull – Cranial cavity

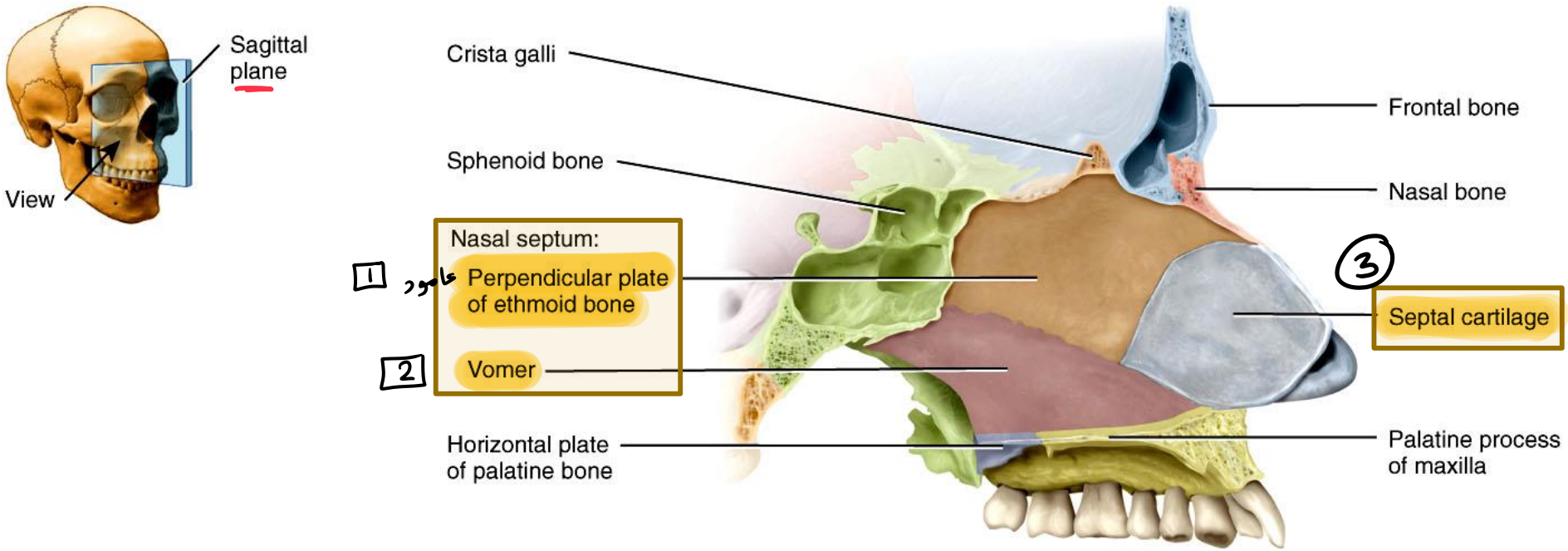
Fig.12



The Nasal Septum:

أجزاءه مهمين

Fig.13: 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.
2. Septal cartilage anteriorly.

The nasal septum is formed by the _____bone and the perpendicular plate of the _____.

A) nasal; ethmoid

B) ethmoid; nasal

C) ethmoid; vomer

D) vomer; ethmoid

غزل

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.

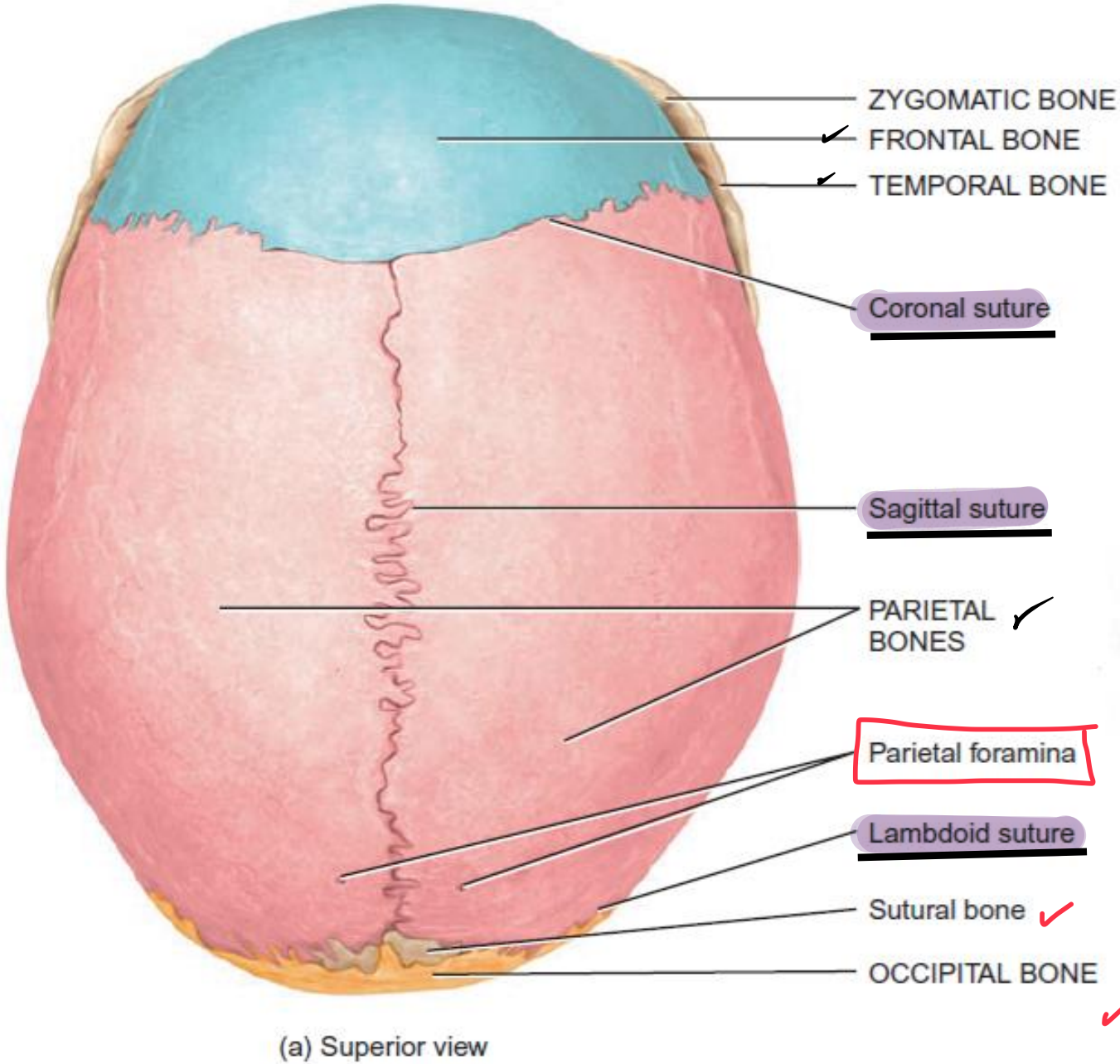


Fig.14: Some of the main sutures of the skull.

The suture between the parietal and occipital bones is the _____ suture.

A) coronal

B) lambdoidal

C) sagittal

D) squamosal

حيوب أنفية

Paranasal Sinuses: (4 sinuses)

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

Keystone butterfly

3 cranial
- Frontal
- ethmoid
- sphenoid

1 facial
- maxillary

= 4 pts

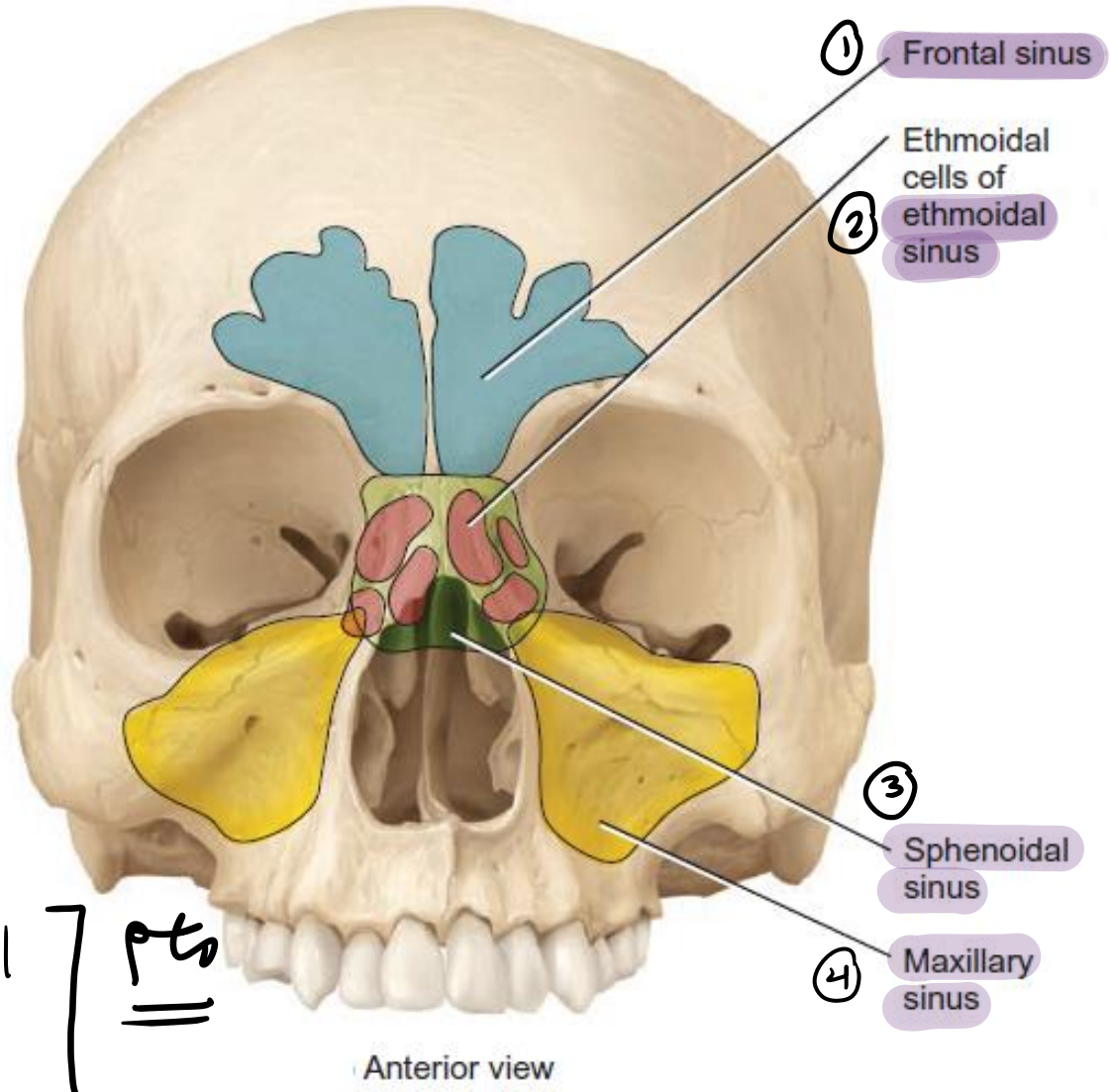


Fig.15: Paranasal sinuses.

Identify the four paranasal sinuses associated with the skull.

- A) temporal, mandibular, sphenoidal and mastoid
- B) frontal, maxillary, mandibular and nasal
- C) temporal, maxillary, mastorid and ethmoidal
- D) frontal, maxillary, sphenoidal and ethmoidal

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

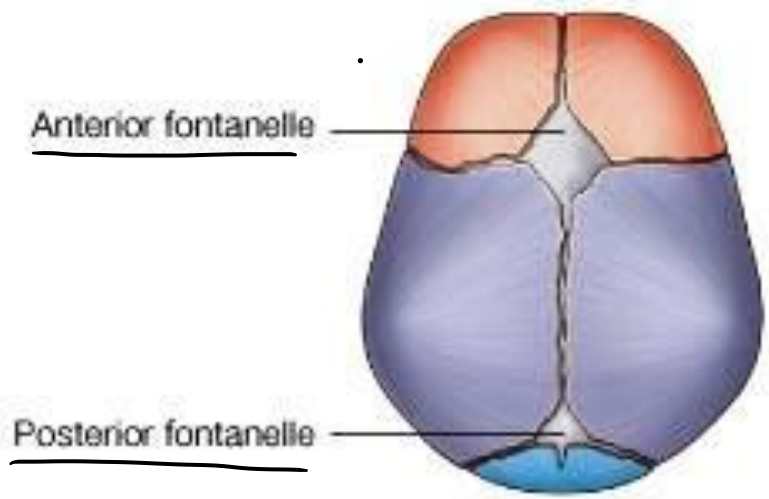


Fig.16: Anterior and posterior fontanelles.

The Hyoid Bone

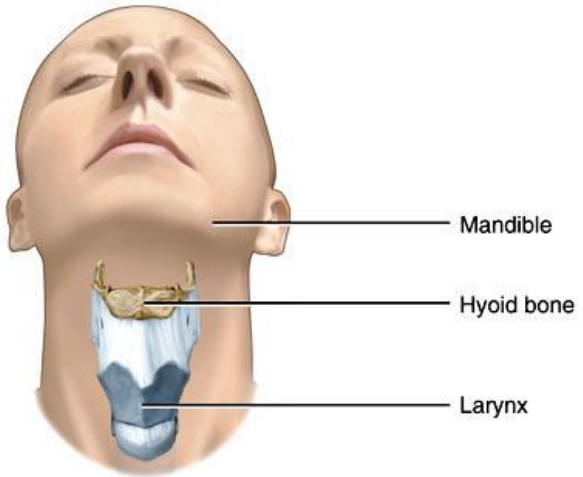
- Located in the upper part of the neck

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.

أربطة

حنجرة



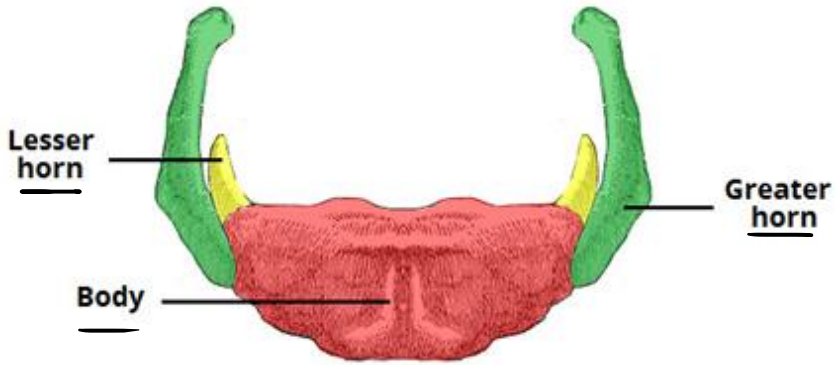


Fig.17: The hyoid bone.

What is the name of the U-shaped bone located superior to the larynx?

- A) hyoid
- B) thyroid
- C) zygomatic arch
- D) clavicle

What is the only bone in the body that does not articulate with another bone?

- A) patella
- B) hyoid
- C) (distal) phalanges
- D) occipital

The Vertebral Column

26 bones

- 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,** in the neck region
  - 12 **thoracic,** to which the ribs are attached
  - 5 **lumbar,** support the lower back
  - 1 **sacrum,** triangular in shape and consists of five fused sacral vertebrae
  - 1 **coccyx,** triangular in shape and consists of four fused coccygeal vertebrae

- The vertebral column is curved to varying degrees in different locations
  - Curves increase the column strength
  - Help maintain balance in the upright position
  - Absorb shocks during walking, and help protect the vertebrae from fracture

- These curves are:
  - Cervical ✓
  - Thoracic ✓
  - Lumbar ✓
  - Sacral ✓

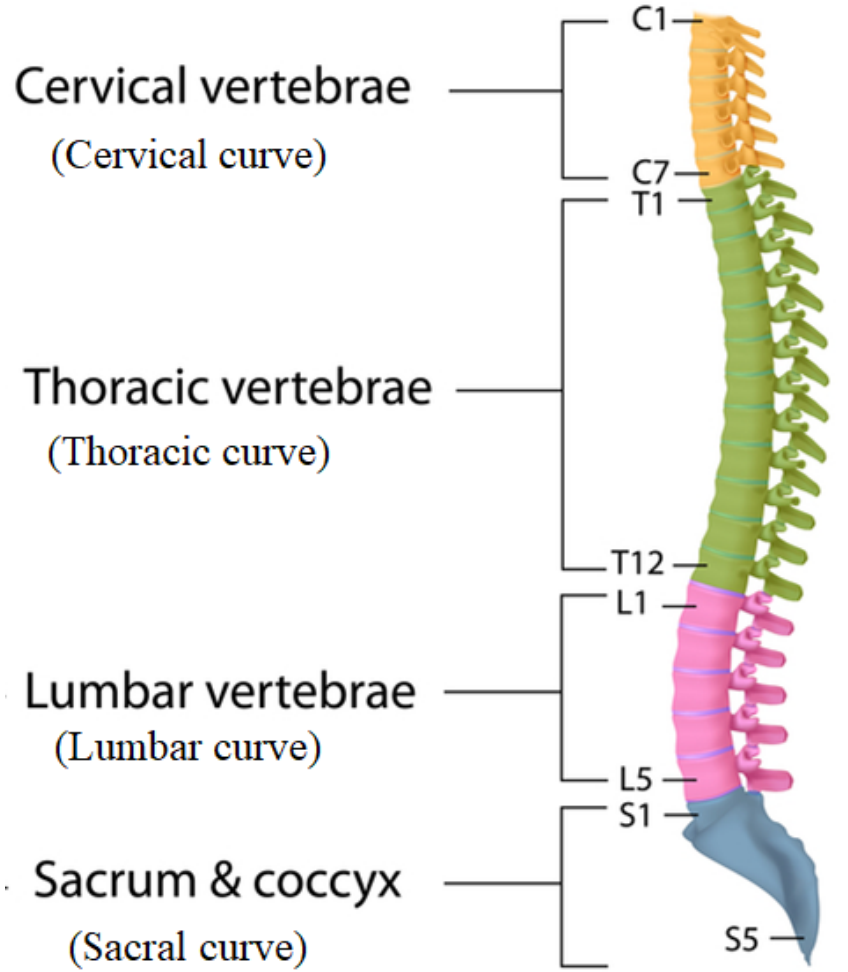


Fig.18: Curves of the vertebral column.

Within the vertebral column there are _____ cervical vertebrae, _____ thoracic vertebrae and _____ lumbar vertebrae.

- A) 5:10:5
- B) 5:12:5
- C) 7:12:5
- D) 7:12:7

C

The adult sacrum consists of _____ vertebrae fused together.

- A) 5
- B) 7
- C) 12
- D) 31

A

The atlas is also known as the _____ vertebrae.

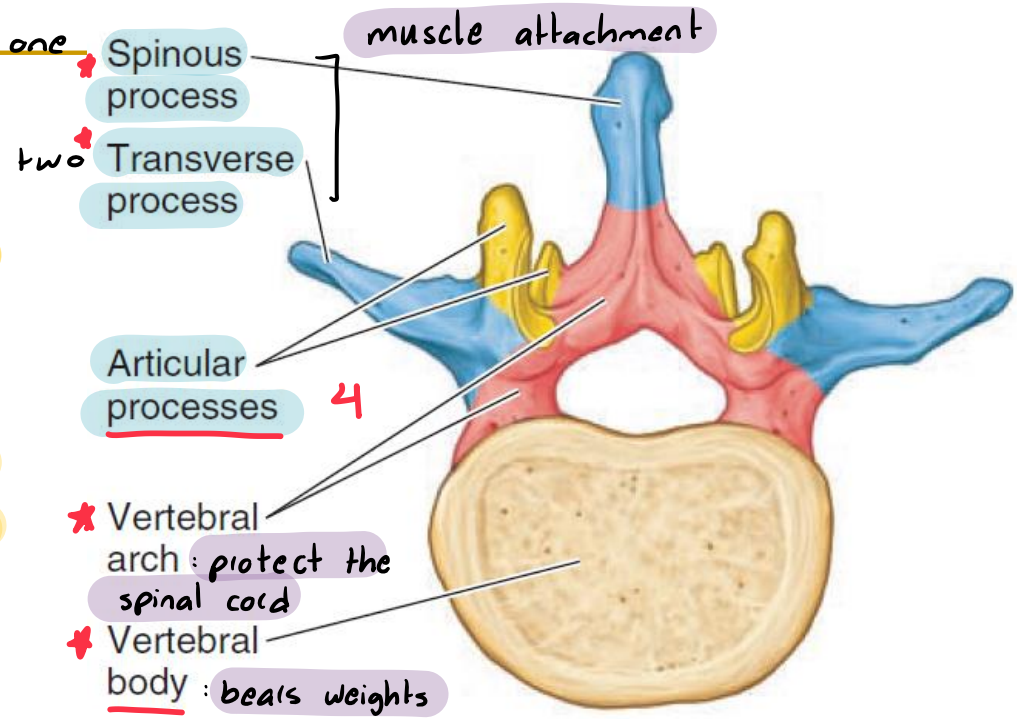
- A) C1
- B) C2
- C) C7
- D) T1

A

The Vertebrae:

- Each vertebra has: (1)Body that bears weights, (2)Vertebral arch that protect the spinal cord, (3)One spinous and two transverse processes for muscle attachment, and (4)Joints for articulation with ribs and other vertebrae.

- The first cervical vertebra (atlas) articulates with the occipital bone of the skull. The second cervical vertebra (axis) has a process (dens) that articulates with atlas.



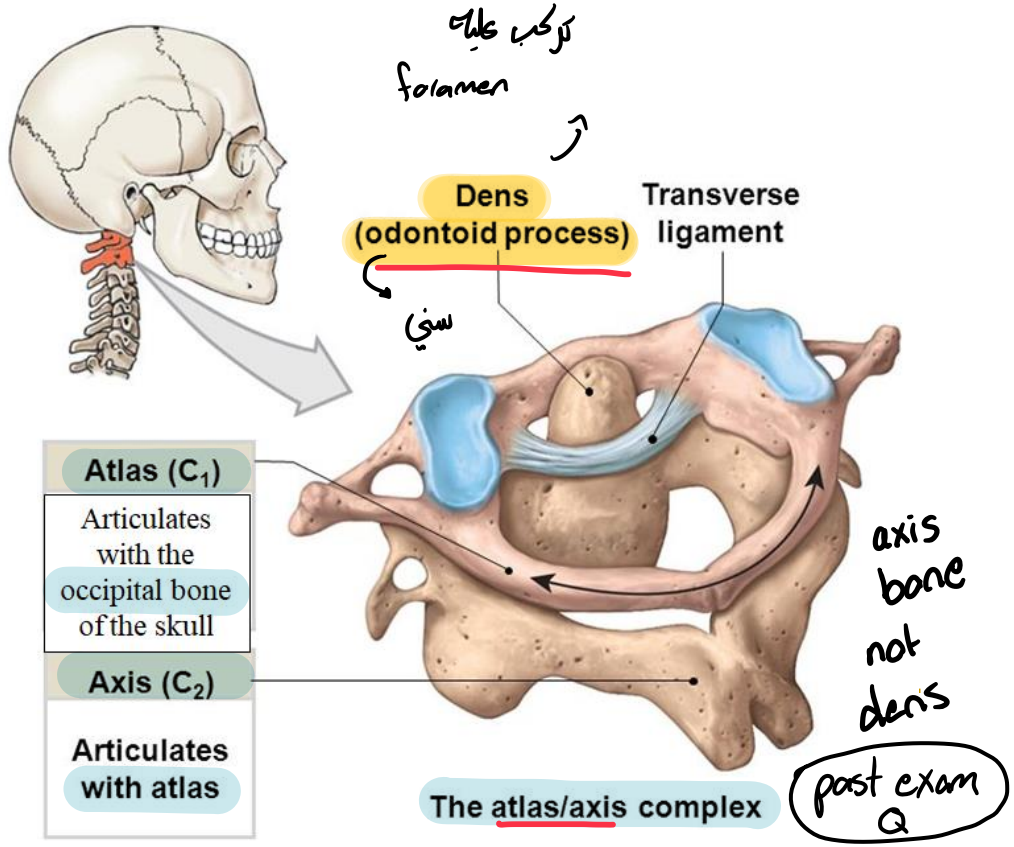


Fig.19: Above, parts of vertebra. Below, atlantoaxial joint.

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- The body and the vertebral arch surrounds a foramen تقبّي called the *vertebral foramen*. When the vertebrae are stacked on each other, the vertebral foramina will align together to form the *vertebral canal* through which the spinal cord passes.

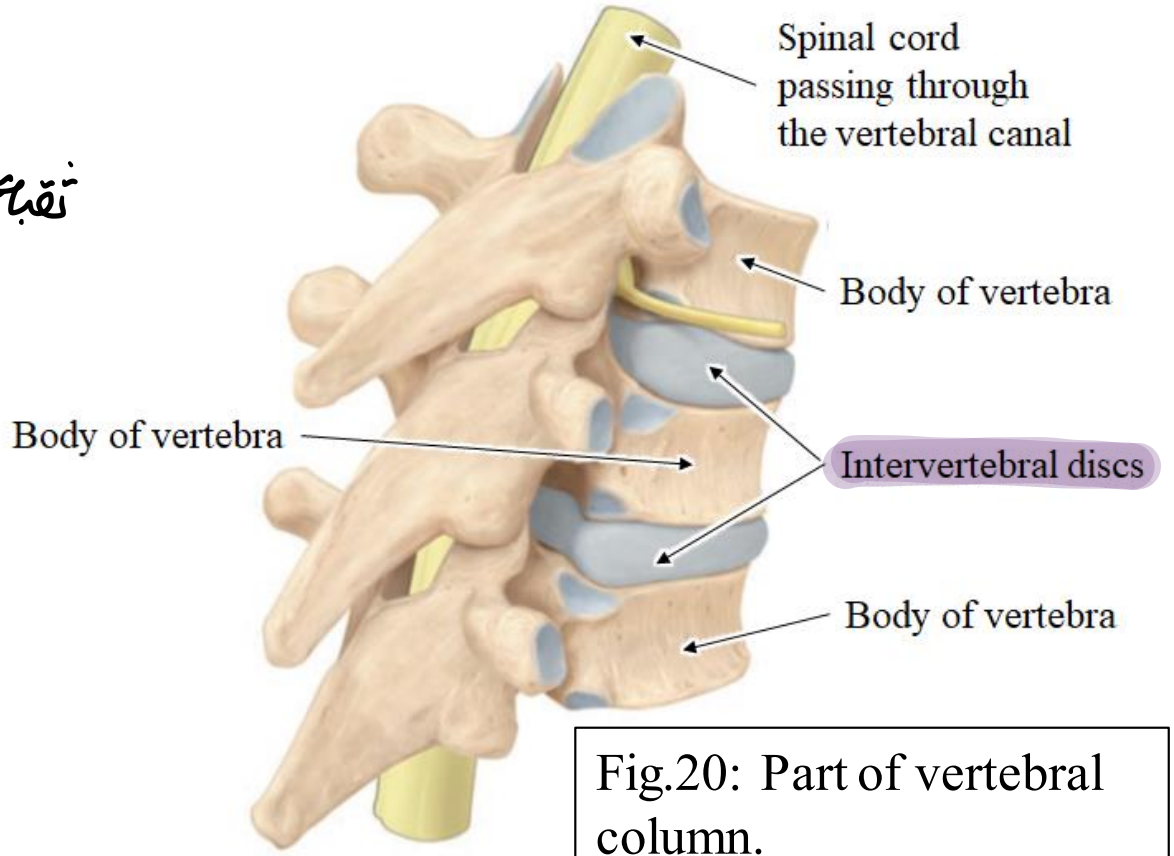


Fig.20: Part of vertebral column.

- Found between the bodies of adjacent vertebrae are the Intervertebral Discs (formed of fibrocartilage). The function of these discs is to:
  - Form strong joints
  - Permit various movements of the vertebral column تسمح
  - Absorb vertical shock

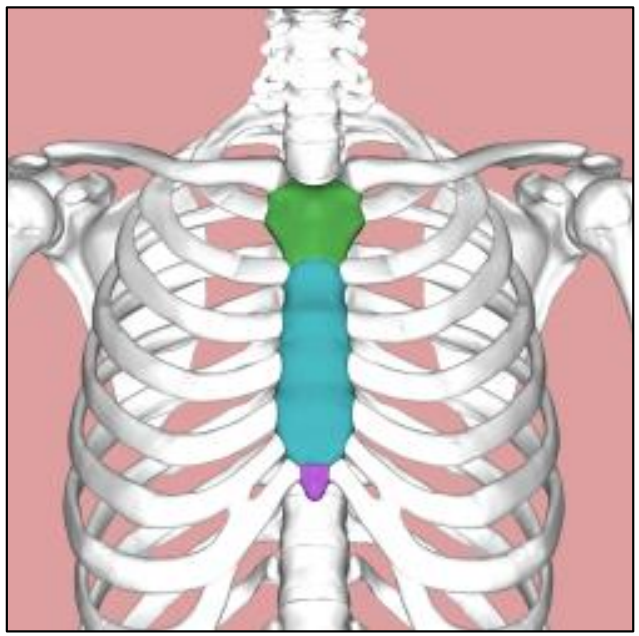
The Thoracic Cage

- Thoracic cage is formed by the:
  - Sternum 1
  - Ribs 12
  - Costal cartilages (attach ribs to sternum)
  - Thoracic vertebrae

- Functions:
  - Enclose and protect the organs in the thoracic and abdominal cavities
  - Provide support for the bones of the upper limbs
  - Play a role in breathing

The Sternum (Breastbone):

- Located in the midline of the anterior aspect of the thoracic cage.
- Consists of the manubrium, body and xiphoid process.
- The manubrium is attached to the body at an angle called the sternal angle.
- To it are attached the clavicles and the costal cartilages.



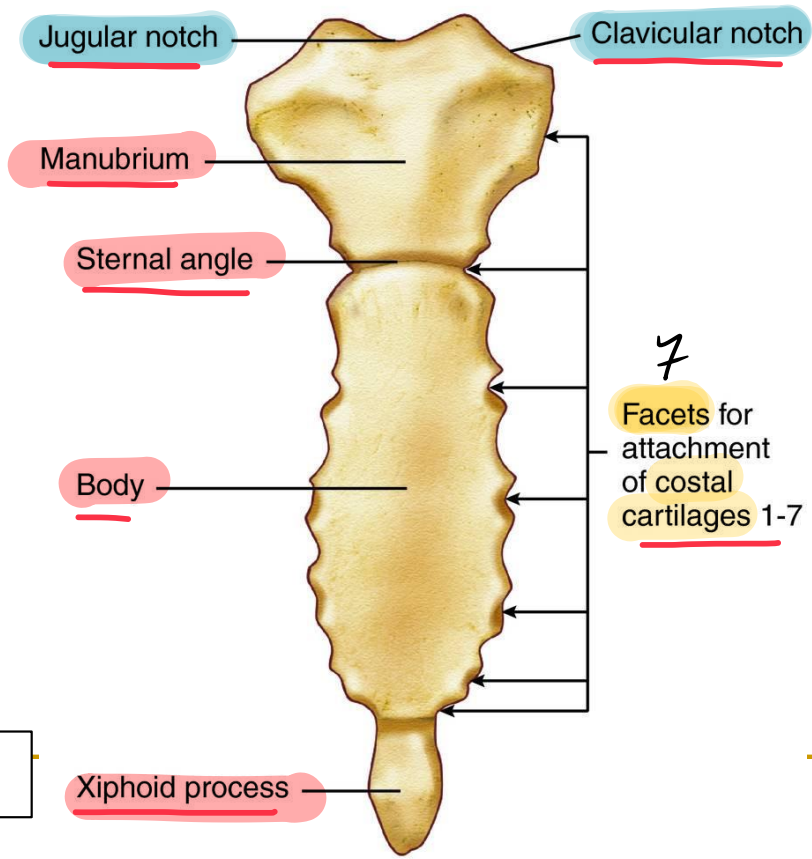


Fig.21: The sternum. Position and features.

74. Where is the xiphoid process?

A. on the sternum
B. on the humerus
C. on the temporal bone
D. on the tibia

Answer is A: At the inferior end of the body of the sternum. The temporal bone has a mastoid and a styloid process.

Identify the three sections of the sternum from most superior to most inferior.

- A) body, manubrium and xiphoid process
- B) body, xiphoid process and manubrium
- C) manubrium, xiphoid process and body
- D) manubrium, body and xiphoid process

The breastbone is also known as the:

- A) clavicle
- B) manubrium
- C) scapula
- D) sternum

The Ribs: 12

- Twelve pairs of ribs give structural support to the sides of the thoracic cavity.
- The upper seven pairs are called *true ribs* because they're attached to the sternum by their own costal cartilages.
- Pairs 8-10 are called *false ribs* because their costal cartilages are attached, anteriorly, to the costal cartilages of the 7th rib.
- Pairs 11 and 12 are called *floating ribs* because they have no anterior attachment.
- Each rib articulates with the body and transverse process of the thoracic vertebrae.

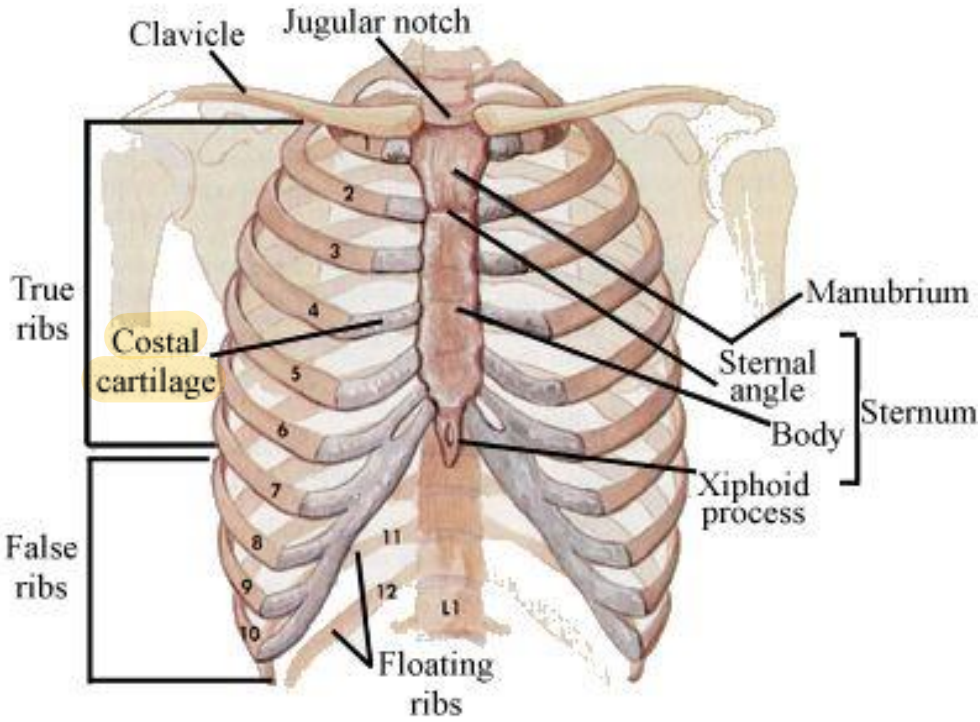


Fig.22: Above, types of ribs. Below, articulation of a rib to a vertebra.

The Appendicular Skeleton

The Upper Limb

- Each upper limb has 32 bones
- Two separate regions

1. The *pectoral (shoulder) girdle* which attaches upper limb to trunk → 2 bones in each: Clavicle and Scapula
2. The *free part (30 bones)*:

- 1 Humerus (arm)
- 1 Ulna + 1 Radius (forearm)
- 8 Carpal bones (wrist)
- 5 Metacarpals and 14 Phalanges (hand)

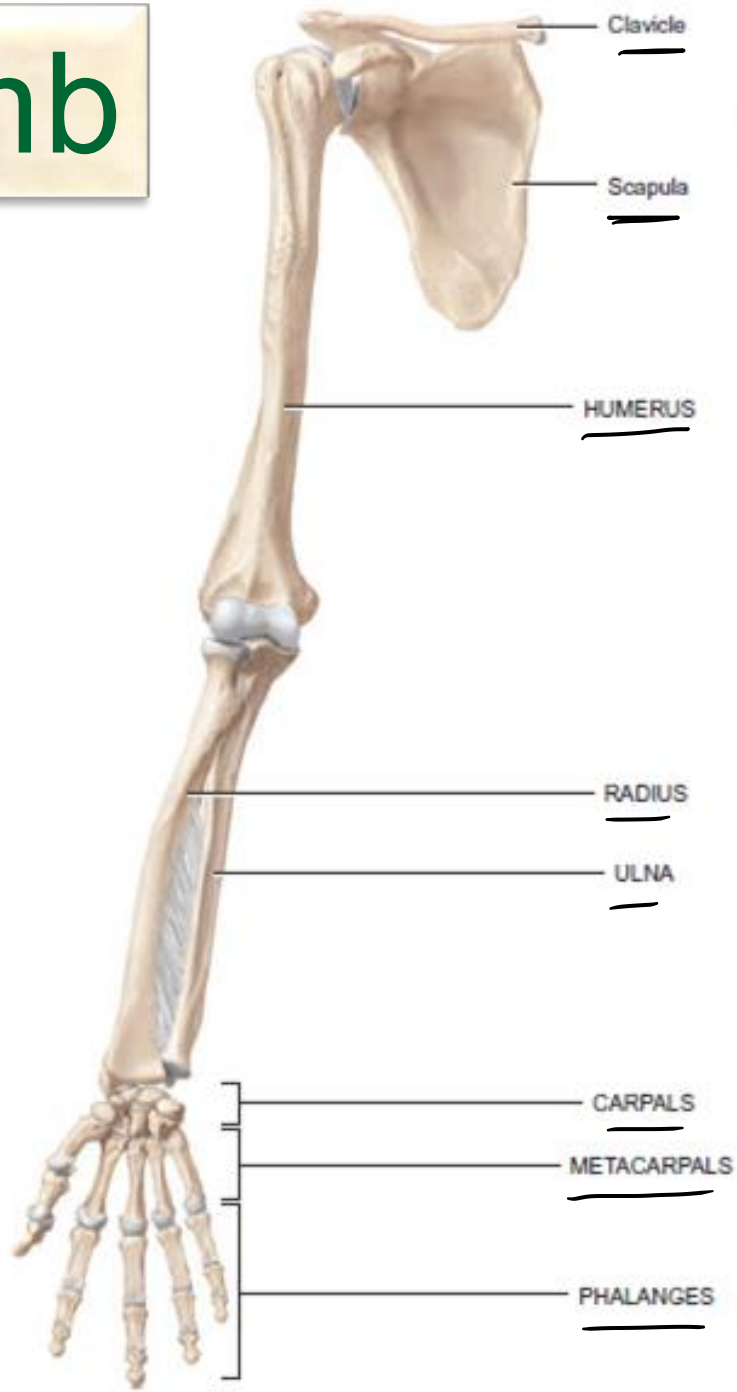


Fig.23: Anterior view of the upper limb bones.

The Pectoral (Shoulder) Girdle:

- clavicle
- scapula
- humerus
- ulna and radious

The Clavicle (Collarbone):

- The anteriorly located clavicle is "S" shaped
- The medial end articulates with the sternum
- The lateral end articulates with the acromion of the scapula

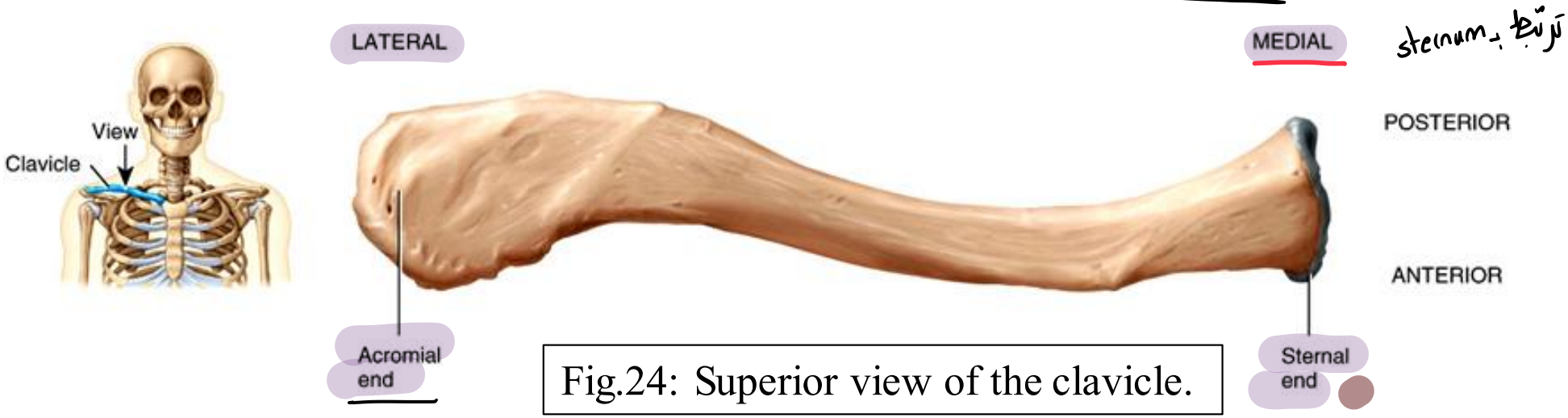


Fig.24: Superior view of the clavicle.

- Functions of the clavicle:

1. Keeps the limb away from the trunk.
2. Transmits force from the upper limb to the trunk.
3. The only bony attachment of upper limb with the trunk. Therefore, if the clavicle is fractured, the limb will fall (Dropped limb).

Identify the bones that form the pectoral girdle.

A) Scapulae and clavicles

B) Radii and ulnae

C) Coxal bones

D) Tibiae and fibulae

The Scapula (Shoulder blade):

- Triangular in shape and located on the posterior aspect of the rib cage level with the 2nd to 7th ribs.
- 2 surfaces: anterior (costal) surface featuring the subscapular fossa. Posterior surface divided by the spine into upper supraspinous fossa and lower infraspinous fossa.
- 3 border and 3 angles. The lateral angle presents the glenoid cavity for articulation with the head of the humerus.
- 3 processes:

1. Spine - a large process on the posterior surface of the scapula that ends laterally as the acromion.
2. Acromion - the flattened lateral end of the spine of the scapula. Articulates with the clavicle.
3. Coracoid process - a protruding projection on lateral end of the superior border.

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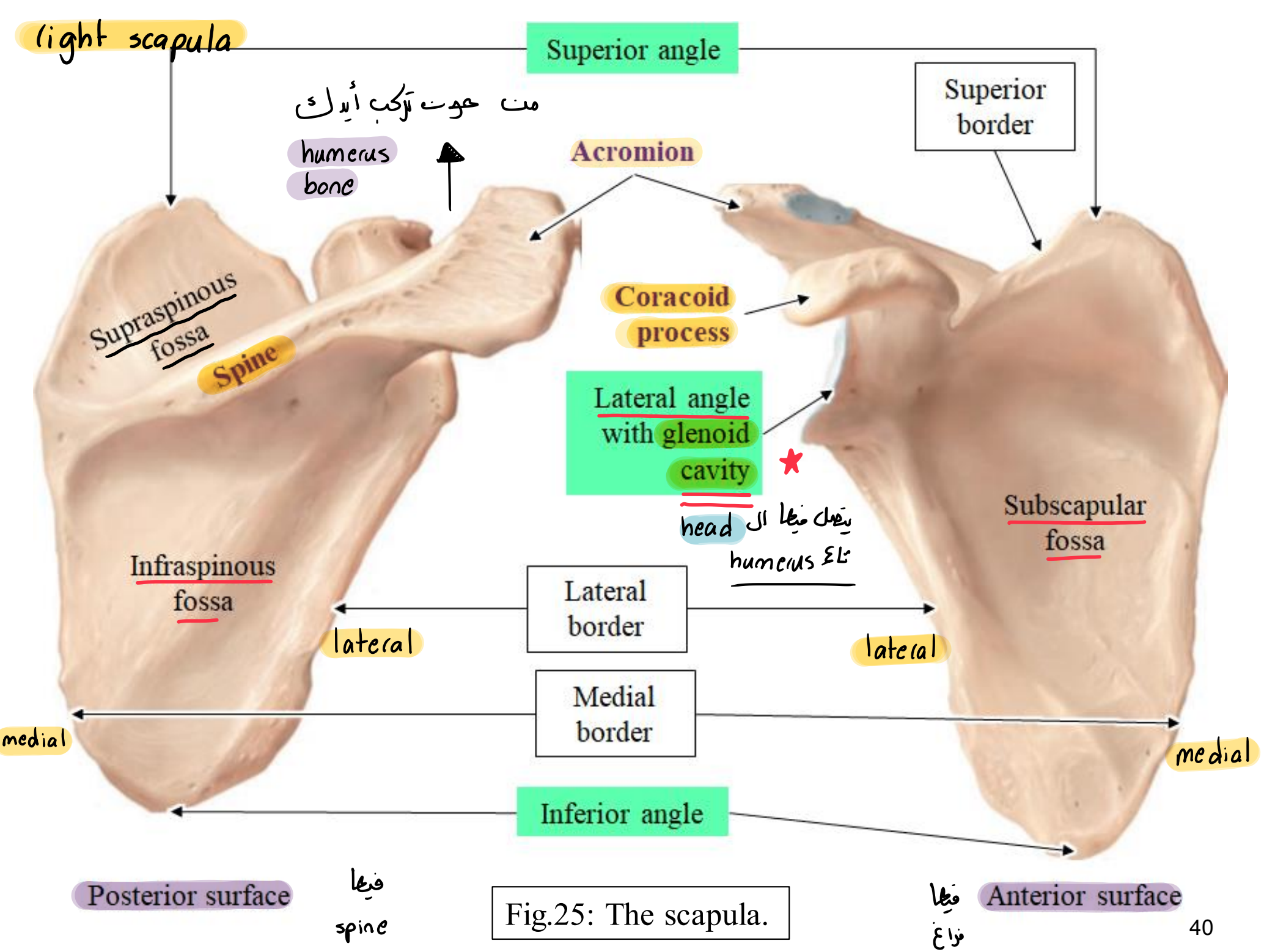

Fig.25: The scapula.

22. Where in the skeleton is the scapula located?

A. in the axial skeleton
B. in the appendicular skeleton
C. in the carpal region
D. in the shoulder girdle

Answer is D: The scapula (shoulder blade) is part of the shoulder girdle. It is also part of the appendicular skeleton, but choice D is the more specific answer.

The head of the humerus articulates with the glenoid cavity of the:

- A) femur
- B) radius
- C) os coxa
- D) scapula

The Humerus:

- Longest and largest bone of the upper limb. Formed of an upper end, a shaft, and a lower end.

- **The proximal end** features:
  - Rounded **head** that articulates with the glenoid cavity of the scapula to form the shoulder joint.
  - The **anatomical neck**.
  - Distal to the neck, we have the **greater and lesser tubercles**. Between these tubercles, we have the **intertubercular (bicipital) groove** for the tendon of the long head of the biceps muscle.
  - The **surgical neck** (the most common site of humerus fracture) separates the upper part from the shaft.

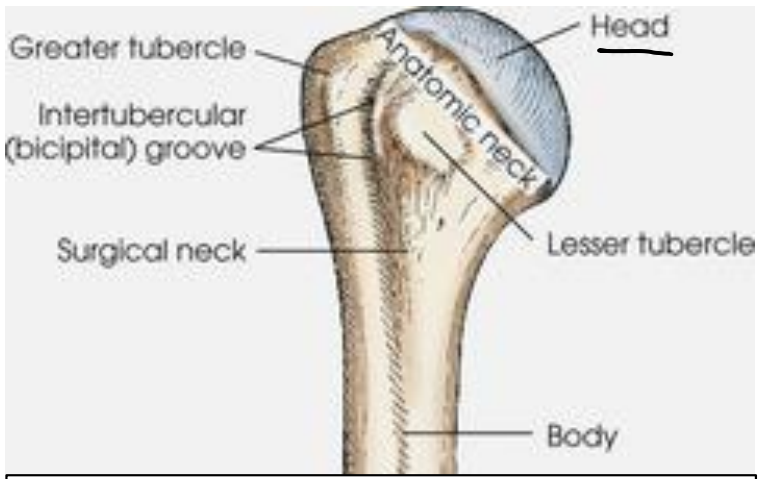

Fig.26: The proximal end of the humerus.

- **The shaft**: to which muscles are attached and several nerves are related.
- **The distal end** features the round **capitulum** which articulates with the head of the radius and the spool-shaped **trochlea** which articulates with the ulna. Also we have two **epicondyles** for muscle attachment. The medial epicondyle is more prominent.

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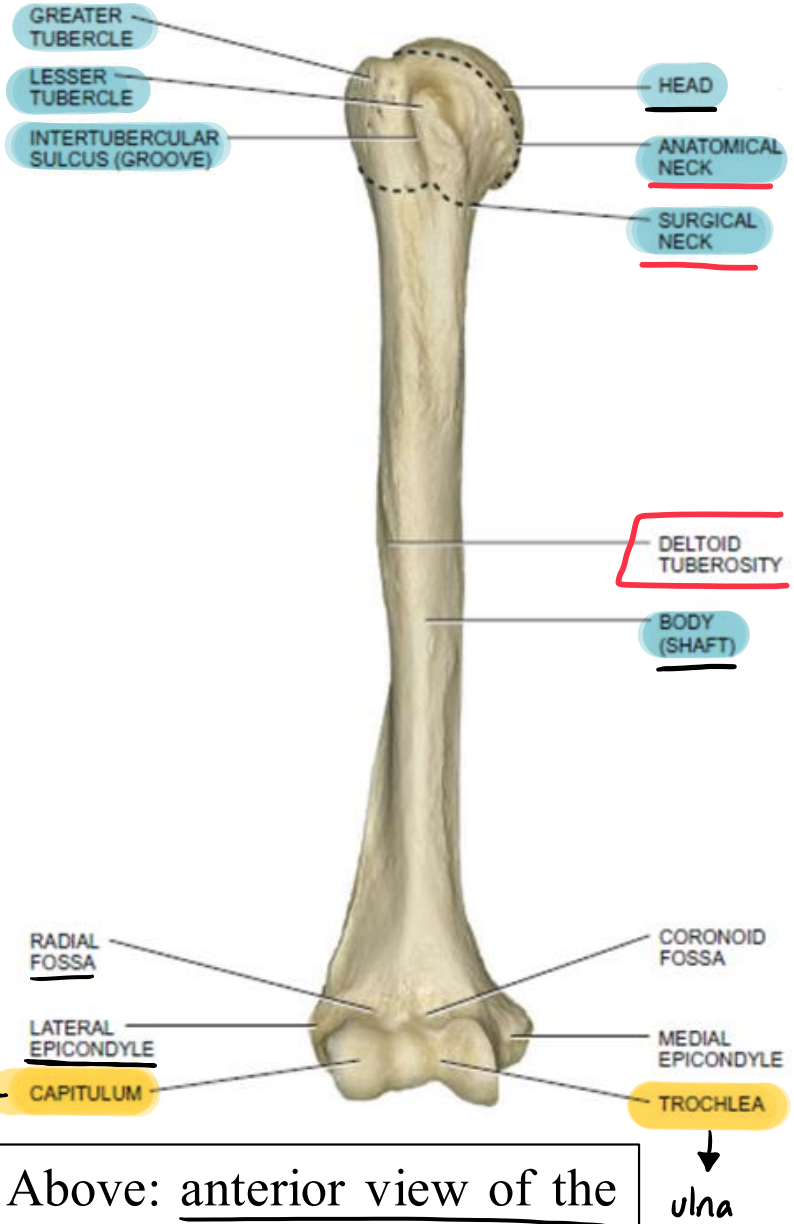

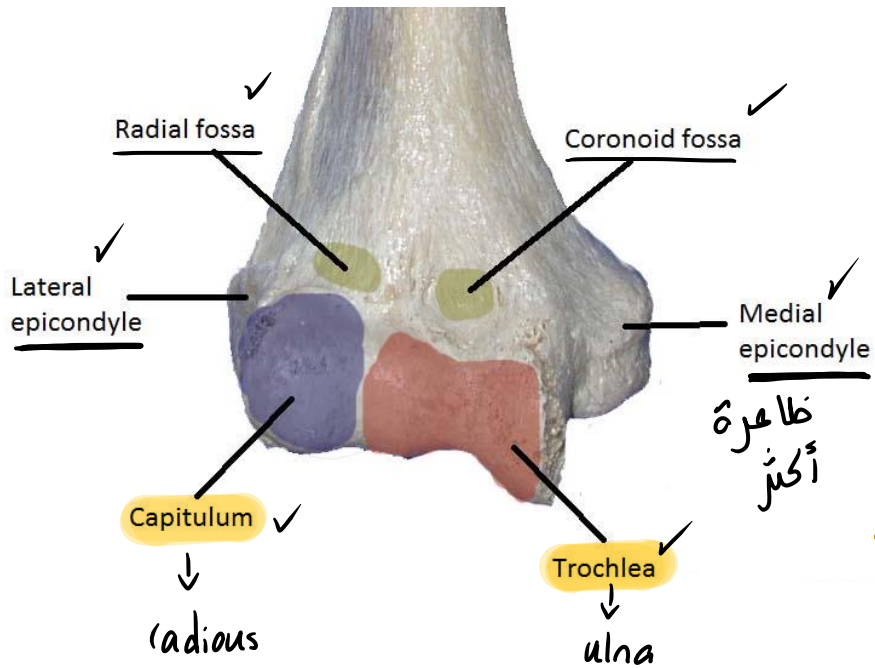

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Fig.27: Above: anterior view of the humerus. To the left: the distal end of the humerus.

The Ulna and Radius:

Feature	Ulna	Radius
Position	• Medial	• Lateral
Proximal end	• Ulnar notch • Olecranon process • Coronoid process • Articulates with trochlea	• Disc-shaped head • Articulates with capitulum
Shaft	• Triangular	• Triangular • Radial tuberosity for tendon of biceps
Interosseous border	• Lateral	• Medial
Distal end	• Head of ulna • Posteriorly located Styloid process	• Laterally located Styloid process
Wrist joint	• Not involved	• Involved

The depression on the posterior side of the humerus for the ulna when the elbow is extended is the:

- A) capitulum
- B) head
- C) olecranon fossa
- D) trochlea

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C

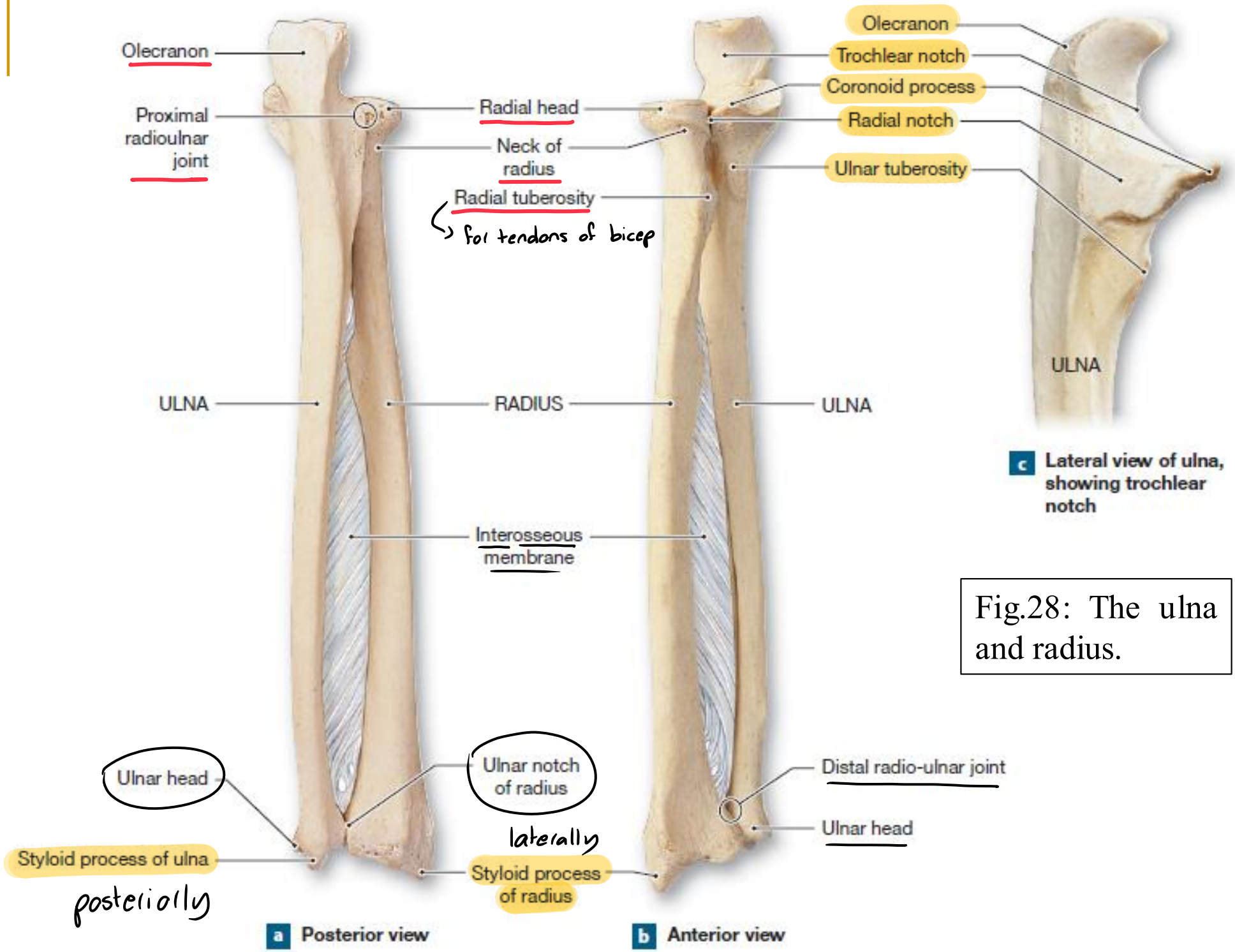
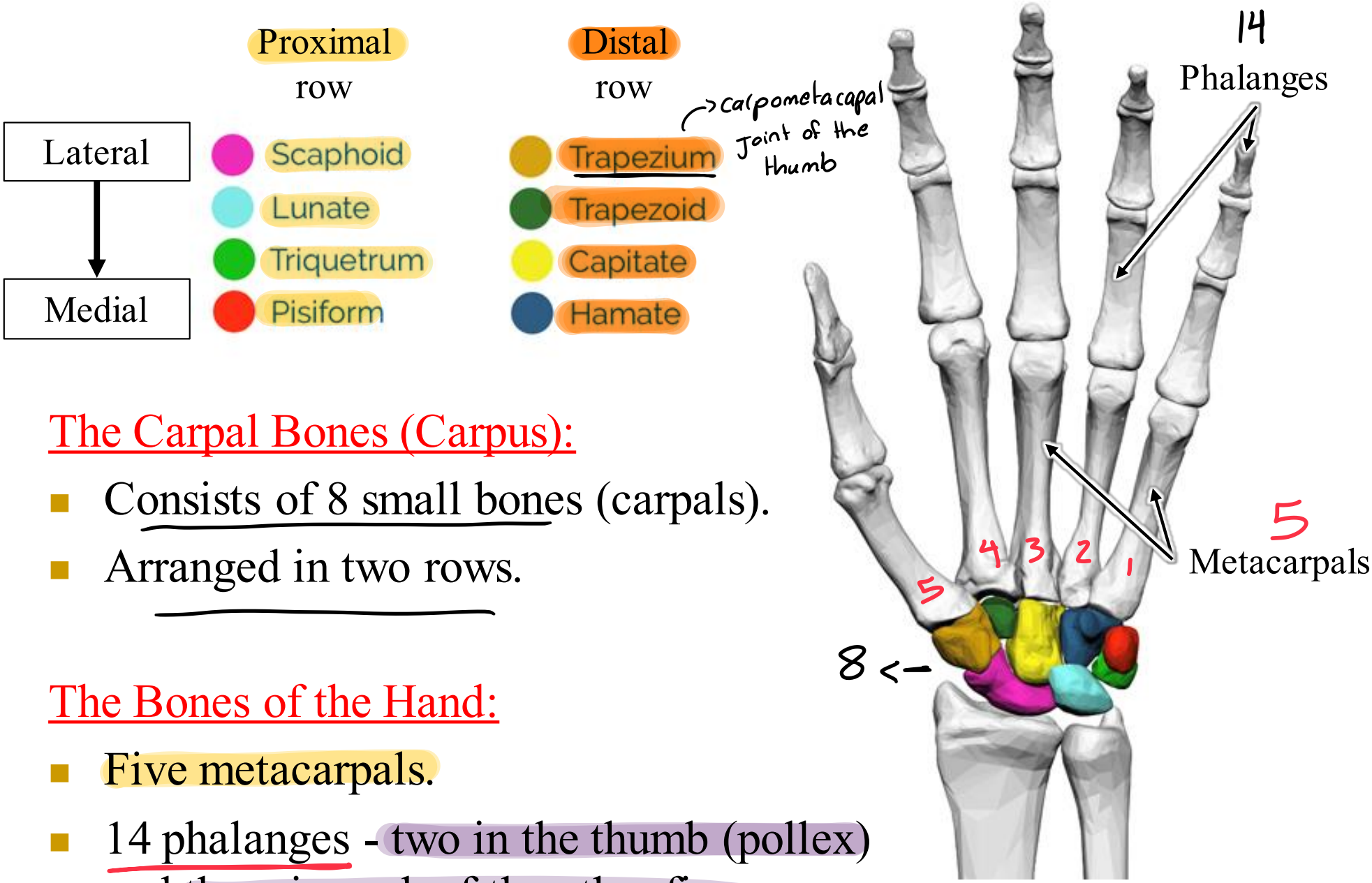


Fig.28: The ulna and radius.



The Carpal Bones (Carpus):

- Consists of 8 small bones (carpals).
- Arranged in two rows.

The Bones of the Hand:

- Five metacarpals.
- 14 phalanges - two in the thumb (pollex) and three in each of the other fingers.

Fig.29: The bones of the wrist and hand.

The Lower Limb

- Each lower limb has 31 bones
- Two separate regions

1. The *pelvic girdle* witch attaches lower limbs to trunk → 1 hip bone on each side
2. The *free part (30 bones)*:

- 1 Femur (thigh)
- 1 Patella
- 1 Tibia + 1 Fibula (leg)
- 7 Tarsal bones
- 5 Metatarsals and 14 Phalanges (foot)

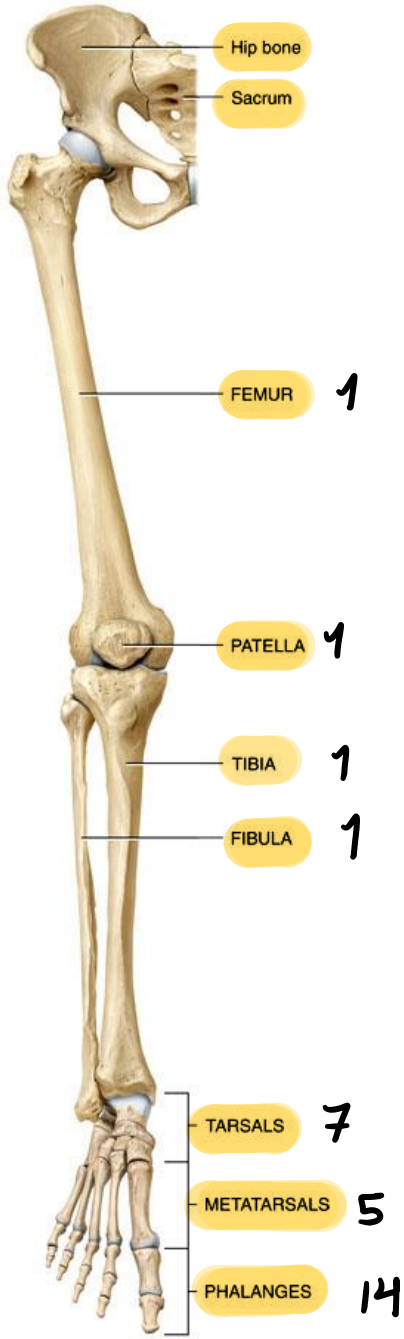


Fig.30: Anterior view of the lower limb bones.

The Hip (Coxal) Bone:

- Each hip bone consists of three bones that fuse together: ilium, pubis, and ischium
- The two hip bones are joined anteriorly at the pubic symphysis and they're joined posteriorly to the sacrum at the sacroiliac joints

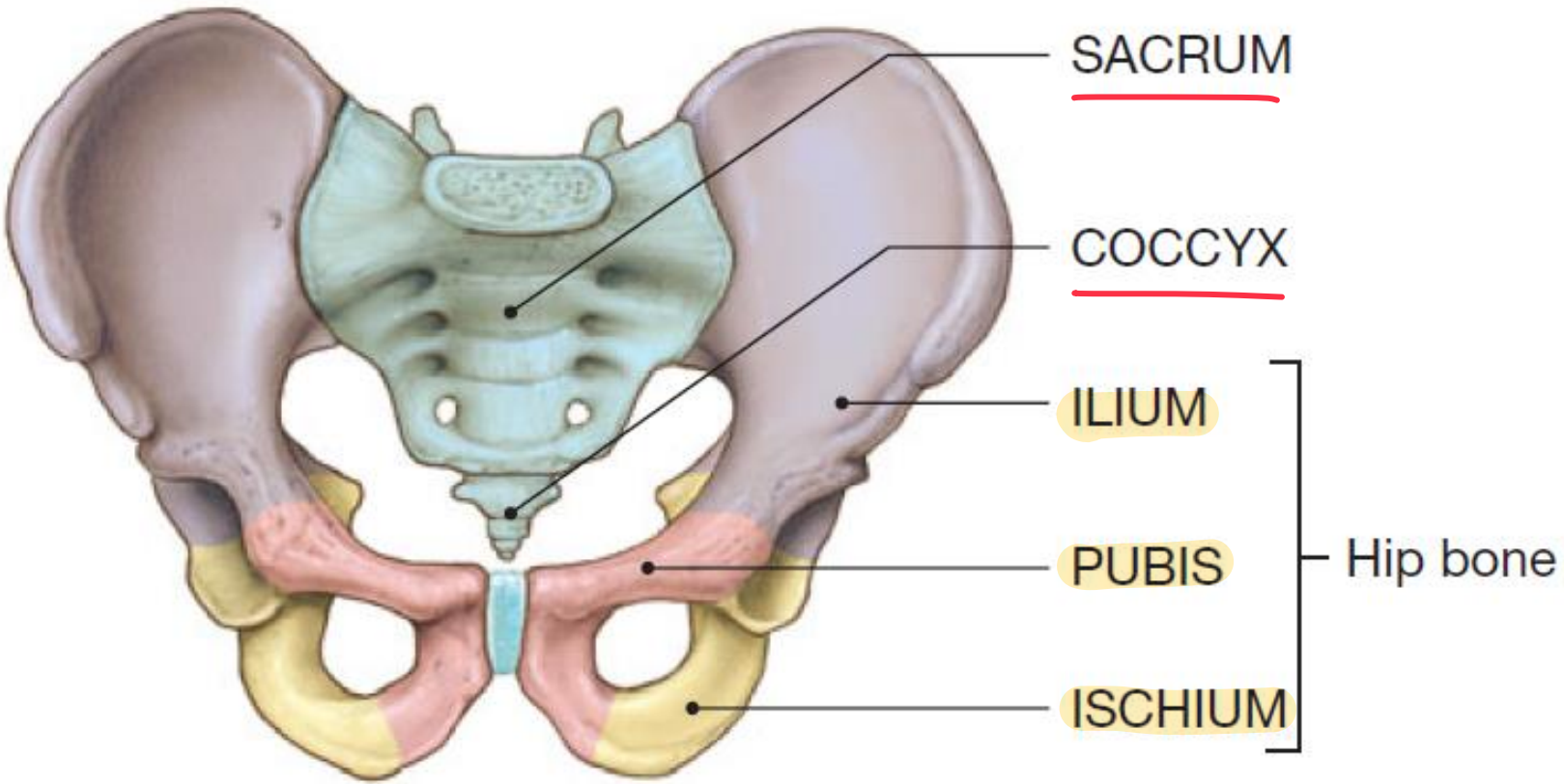


Fig.31: Anterior view of the pelvic girdle.

Identify a bone of the appendicular skeleton.

A) cranium

B) ribs

C) sternum

D) coxal bone

D

Identify the three regions of the coxal bones.

- A) Acetabulum, ilum and pubis
- B) Acetabulum, ischium and pubis
- C) Ilium, ischium and scarum
- D) Ilium, ischium and pubis

D

The Ilium:

- Largest and most superior of the three hip bones.
- Superior border - iliac crest. Possess a tubercle
- Has four prominent projections: the superior and inferior anterior and posterior iliac spines
- Greater sciatic notch is located between the posterior inferior iliac spine and the ischial spine. Through it pass the sciatic nerve

The Pubis:

- Pubis - inferior and anterior part of the hip bone
- The two pubic bones meet at the pubic symphysis. The angle below this joint is called the pubic arch

The Ischium:

- Ischium - inferior and posterior part of the hip bone
- Most prominent feature is the ischial tuberosity, it is the part that meets the chair when you are sitting
- Ischial spine – a prominent projection. Below the spine we have the lesser sciatic notch

- The 3 bones fuse at and participate in the formation of the acetabulum which is the site of articulation with the head of femur.
- The obturator foramen is bounded by the pubis and ischium. It's the largest foramen in the body.

- Differences exist between the male and female pelvis. The features of the female pelvis permit easier process of child birth.

The depression of the coxal bones where the head of the femur articulates with the coxal bone is called the:

- A) acetabulum
- B) obturator foramen
- C) sciatic notch
- D) pubic symphysis

A

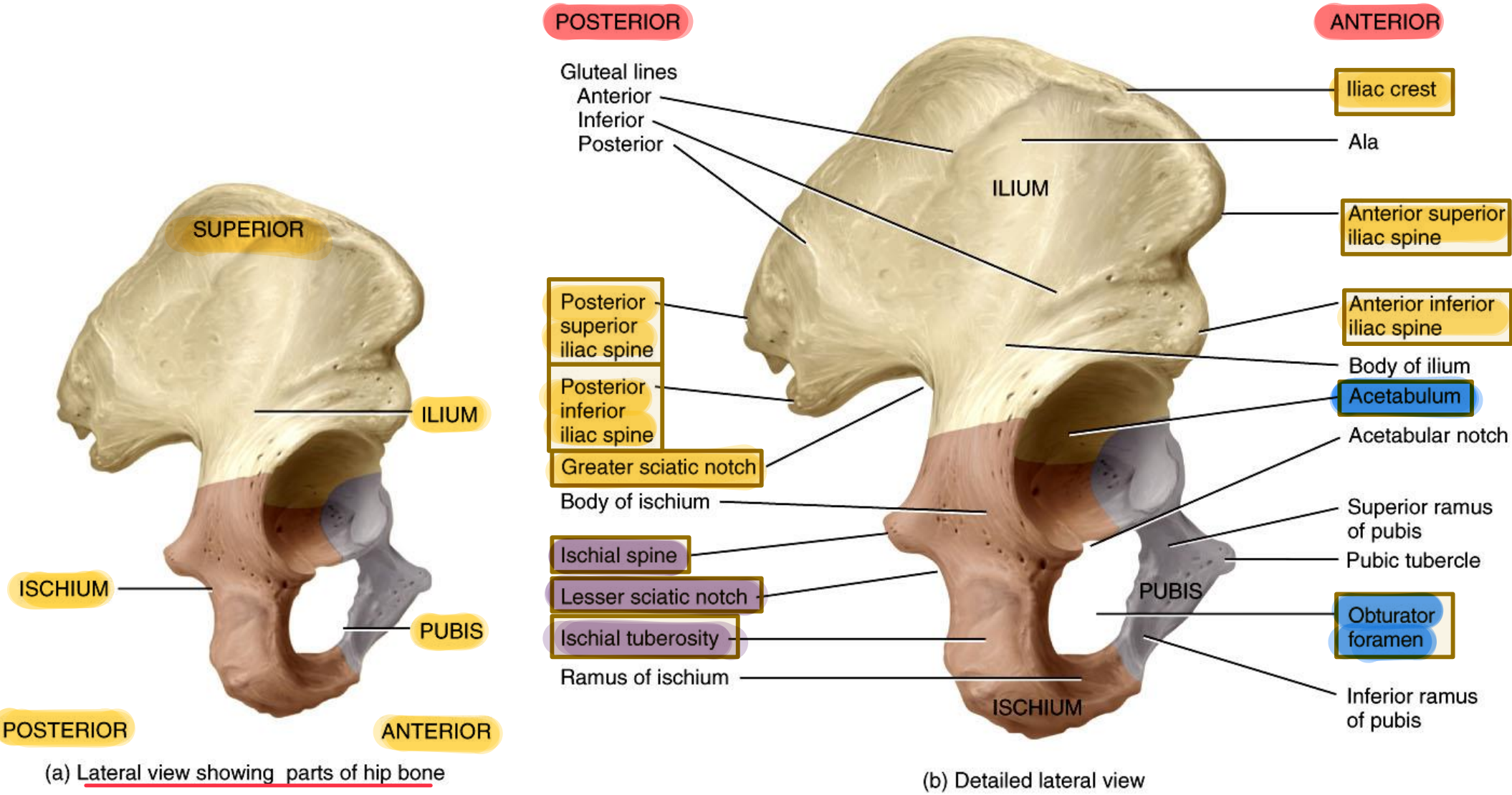


Fig.32: Features of the three pelvic bones.

The Femur:

- Femur - longest, heaviest, and strongest bone in the body
- **Proximal end**: Features a **head** witch articulates with the acetabulum to form the hip joint. The head has a small depression called the **fovea capitis** for attachment of a ligament. Distal to the head is the **neck** and distal to it are the **greater and lesser trochanters**.

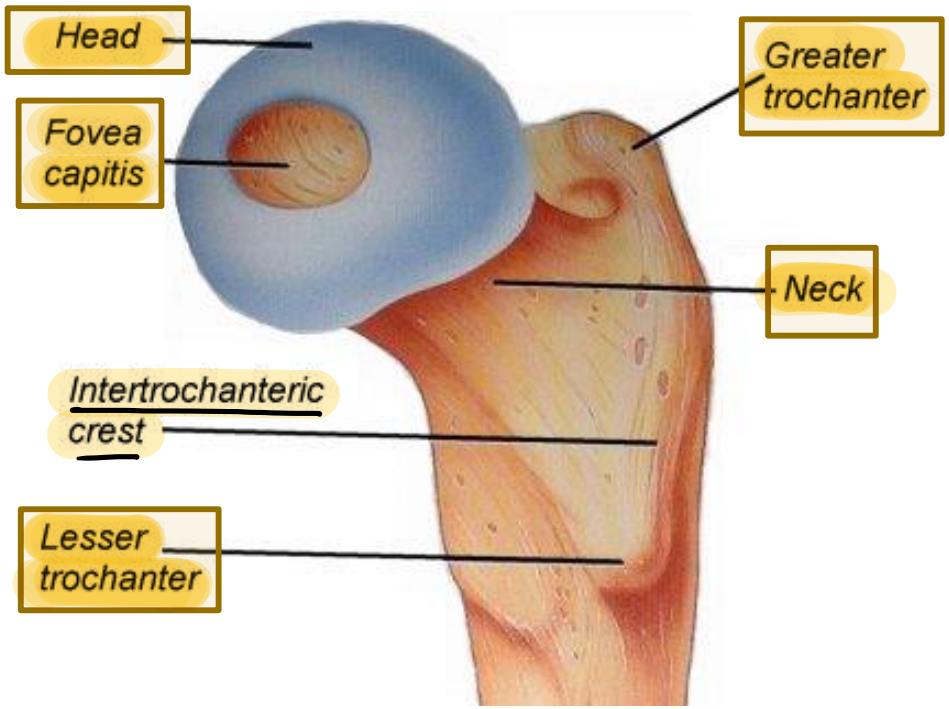
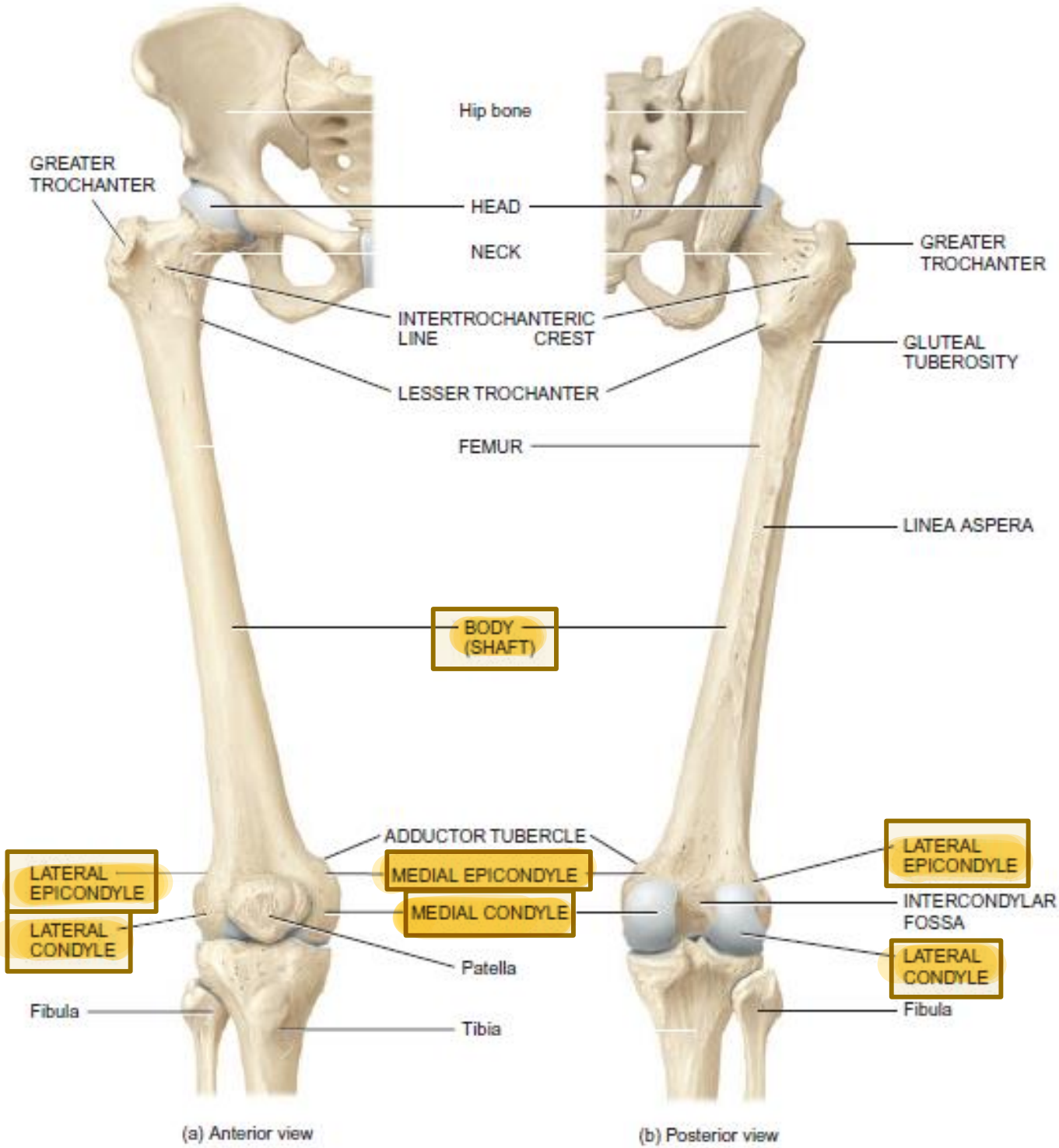


Fig.33: The proximal end of the femur.

- **Shaft**: for attachment of muscles.
- **Distal end**: Two **condyles** that articulate inferiorly with the tibia and anteriorly with the patella. Proximal to the condyles are the medial and lateral **epicondyles** for muscle attachment.

Function:

Fig.34: Features of the femur bone.



The Patella:

- Largest sesamoid bone in the body ✓
- Forms the patellofemoral joint
- Triangular in shape. The base is superior. The narrow apex is inferior
- Increases the leverage of the quadriceps femoris muscle

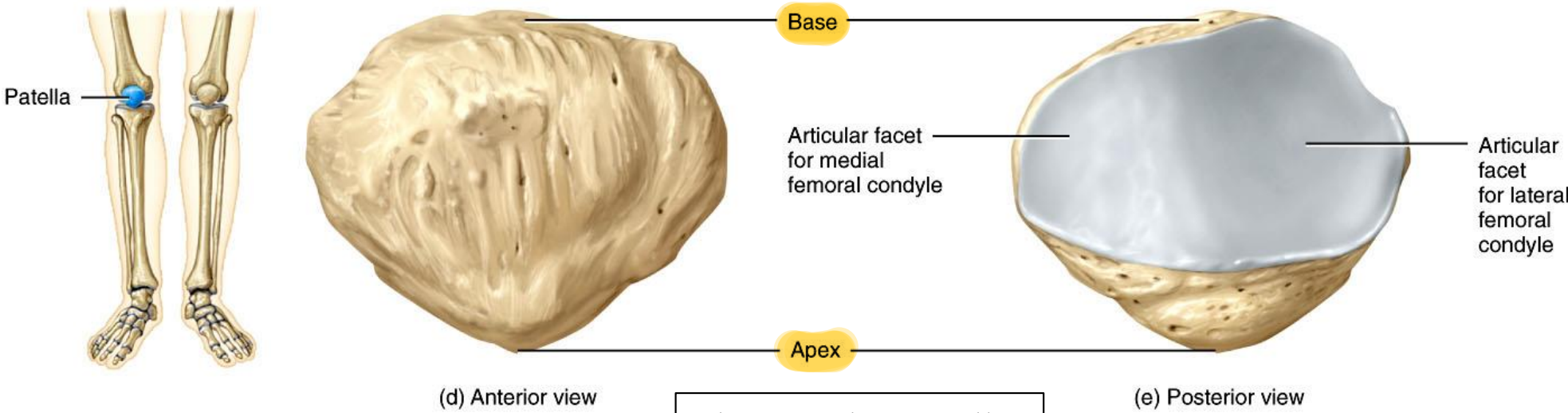


Fig.35: The patella.

medial

The Tibia (Shin Bone):

https://youtu.be/uUb2pyzOWHg?si=bkGwg3IDXauheX5G

- The larger, medial weight-bearing bone of the leg
- **Proximal end**: The **lateral and medial condyles** on the superior surface which articulates with the condyles of the femur to form the knee joint.
- **Shaft**: Exhibits the **tibial tuberosity** for attachment of the patellar ligament. The lateral border of the shaft is the sharp **interosseous border**.
- **Distal end**: It articulates distally with the talus at the ankle joint. Features the **medial malleolus**.

The Fibula: (lateral)

- The smaller, laterally placed bone of the leg
- Non-weight bearing. Serve for muscle attachment
- Shaft – medial interosseous border
- Distal end, articulates with the tibia and the talus. Features the lateral malleolus.

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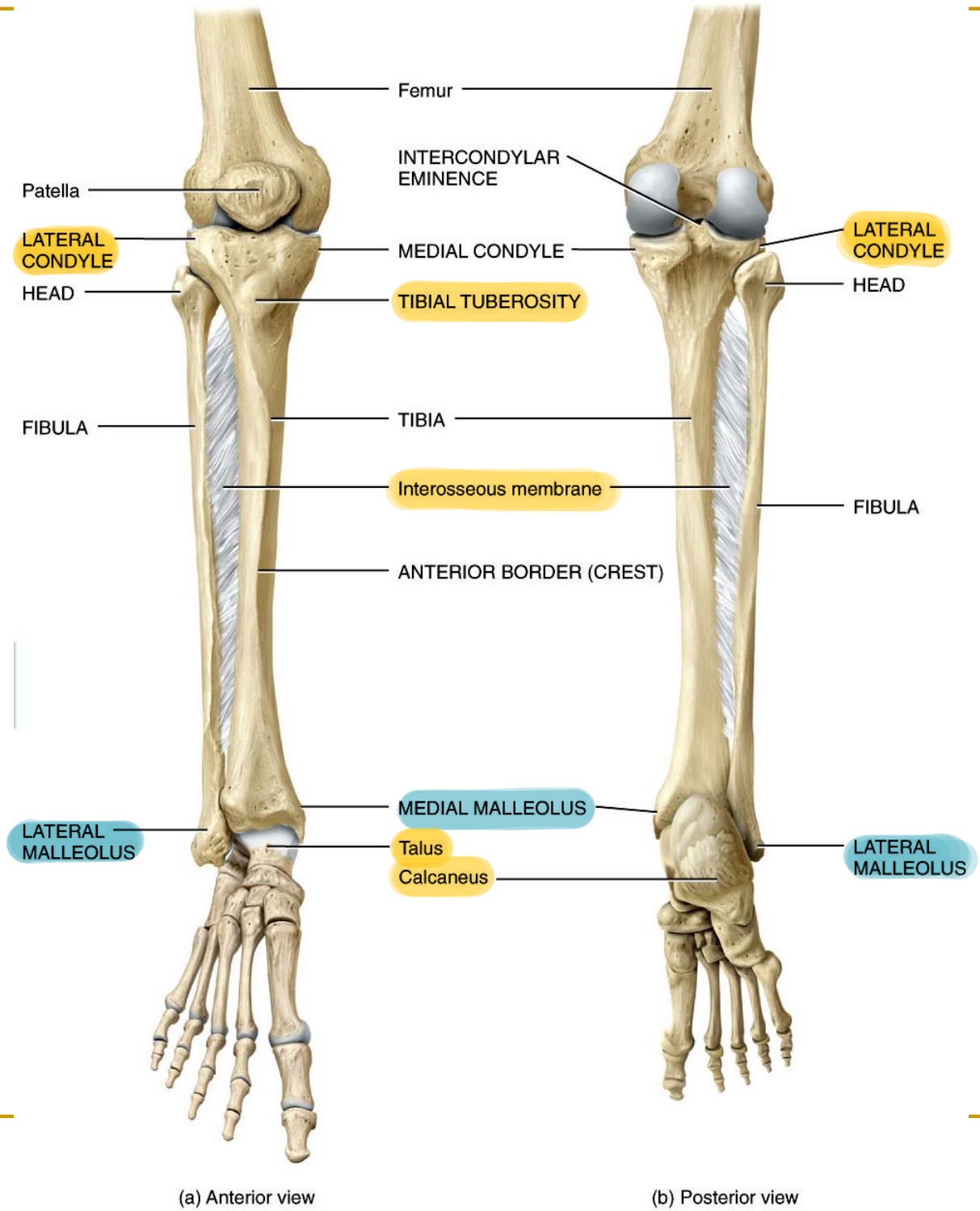


Fig.36: The tibia and fibula.

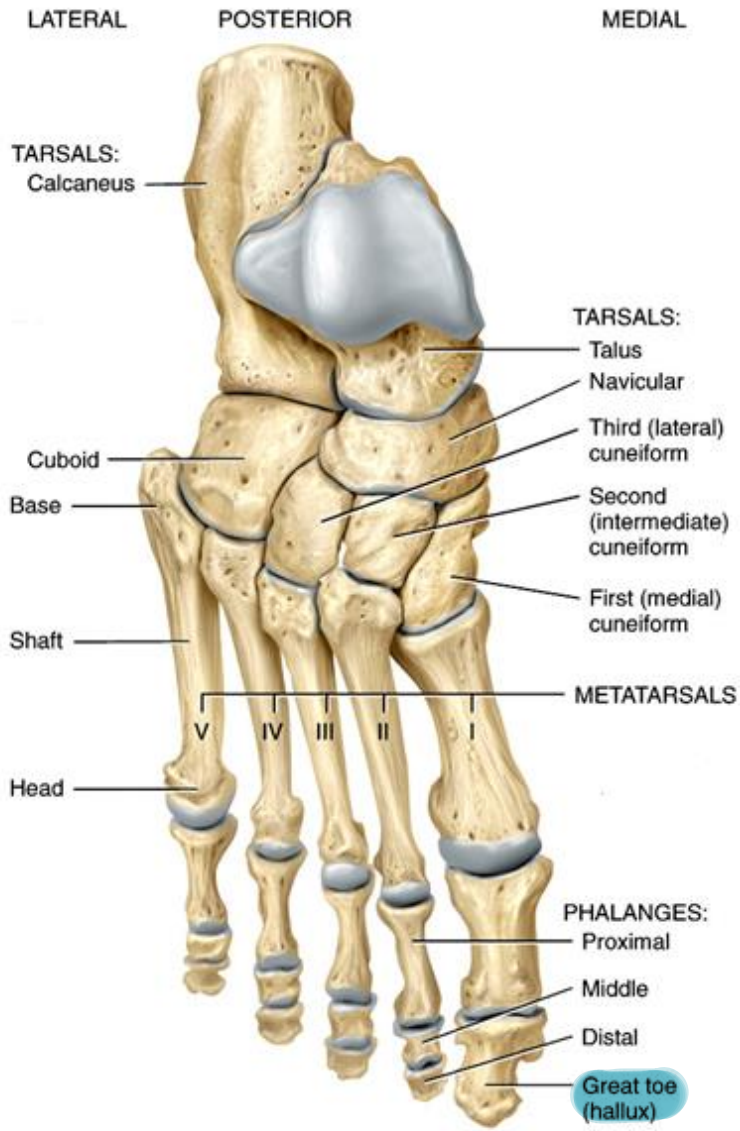
66. The tibia articulates distally with which one of the following?

A. tarsals
B. metatarsals
C. phalanges
D. femur

Answer is A: Distal refers to the end that is further away from the trunk. Hence the ankle bones (tarsals) is the correct choice.

The Skeleton of the Foot:

- Seven tarsal bones - talus (articulates with tibia and fibula), calcaneus (the heel bone, the largest and strongest tarsal bone), navicular, cuboid and three cuneiforms
- Five metatarsals (5)
- 14 phalanges - two in the big toe (hallux) and three in each of the other toes
- Two longitudinal and one transverse arches support the weight of the body and assist in walking. When the arches decrease, we'll have a flat foot.



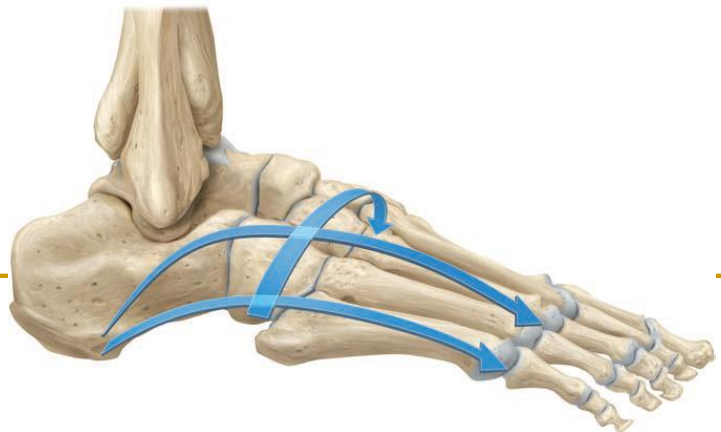


Fig.37: Above: bones of the ankle and foot. Left: arches of the foot.

The heel bone is the:

- A) calcaneus
- B) fibula
- C) patella
- D) talus

37. The appendicular skeleton includes all of the following **EXCEPT** one. Which one?

A. the pectoral girdle
B. the thoracic cage
C. the phalanges
D. the lower limbs

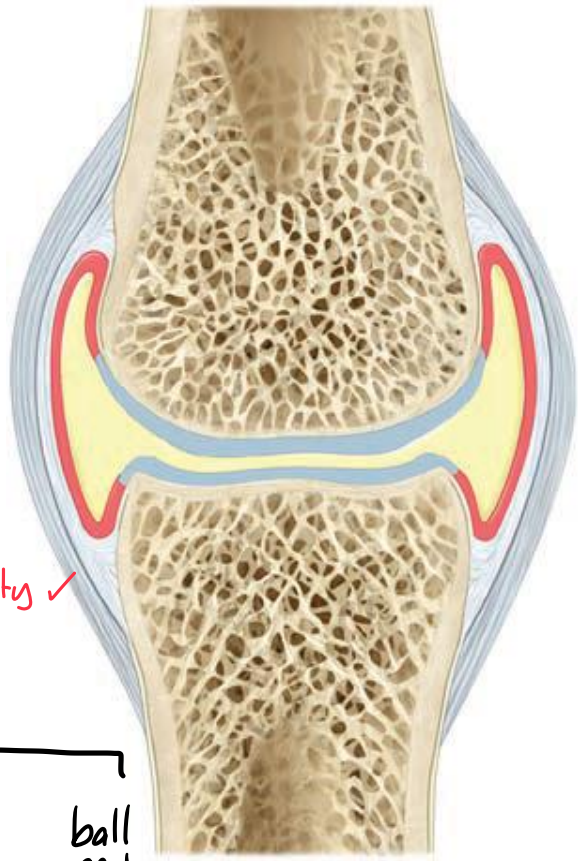
Answer is B: The thoracic cage (the ribs) are part of the axial skeleton.

19. One of the following lists contains only bones in the appendicular skeleton. Which one?

A. patella, ethmoid, femur, coccyx, tibia
B. clavicle, fibula, metatarsal, phalange, radius
C. humerus, scapula, occipital, metacarpal, sternum
D. ulna, radius, phalange, mandible, coxal

Answer is B: The coccyx, occipital, sternum, mandible are parts of the axial skeleton.

Joints

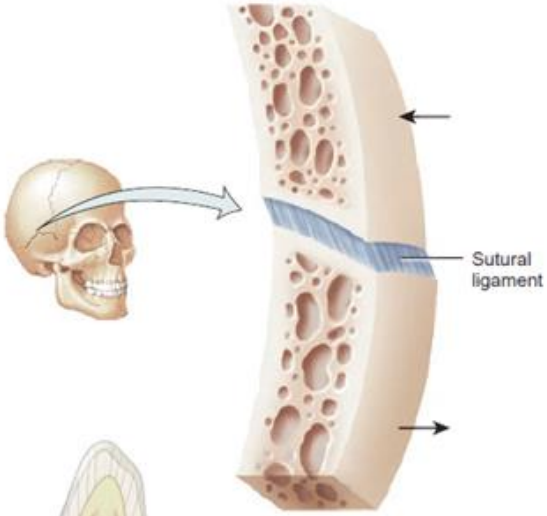


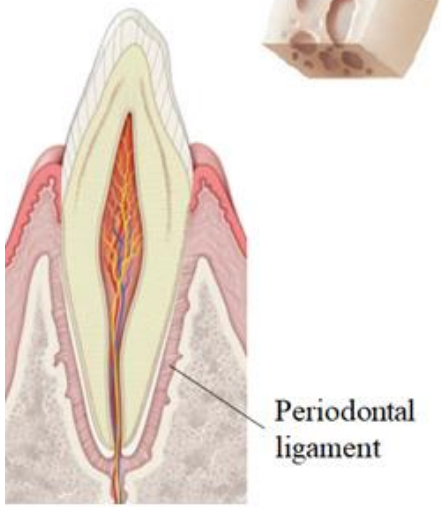
- Fibrous — no joint cavity
  - suture
  - gomphoses
- Cartilaginous — no joint cavity
  - symphyses
- Synovial — joint cavity ✓
  - planer
  - hinge
  - pivot
  - condyloid
  - saddle
  - ball and socket

Joints are sites where two or more bones meet

Fibrous Joints:

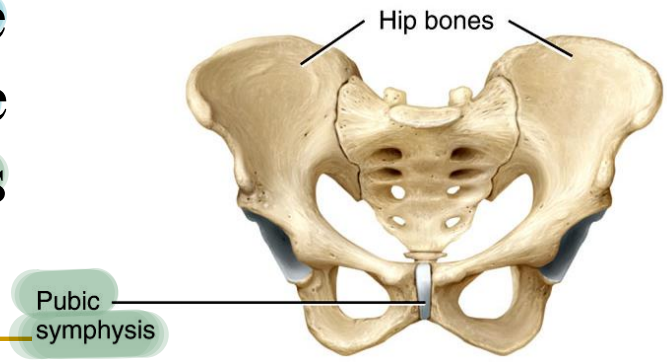
- Bones are held together by dense collagenous irregular connective tissue with no cavity. Example: (1) Sutures between most skull bones and (2) Gomphoses in which a cone-shaped peg fits into a socket (like joints between teeth and their sockets).





Cartilaginous Joints:

- Bones are held together by cartilage with no cavity. Symphyses are joints in which articulating bones are covered by hyaline cartilage with a disc of fibrocartilage between the bones. Example: symphysis pubis and the intervertebral joints.



A suture is an example of a _____ joint.

- A) synovial
- B) fibrous
- C) cartilagenous

Synovial Joints:

https://youtu.be/JO_N1apvidE?si=dbOlgVbl_jf--cRY

1) A ***synovial cavity*** allows the joint to be freely movable.
2) Articular surfaces of bones are covered by hyaline ***articular cartilage***.
3) Surrounded by ***articular capsule*** which is formed of an outer fibrous capsule and an inner synovial membrane.
4) The cavity contains ***synovial fluid*** secreted by the synovial membrane. This fluid (1) lubricates the joint, (2) absorbs shocks, and (3) maintain the cartilage.

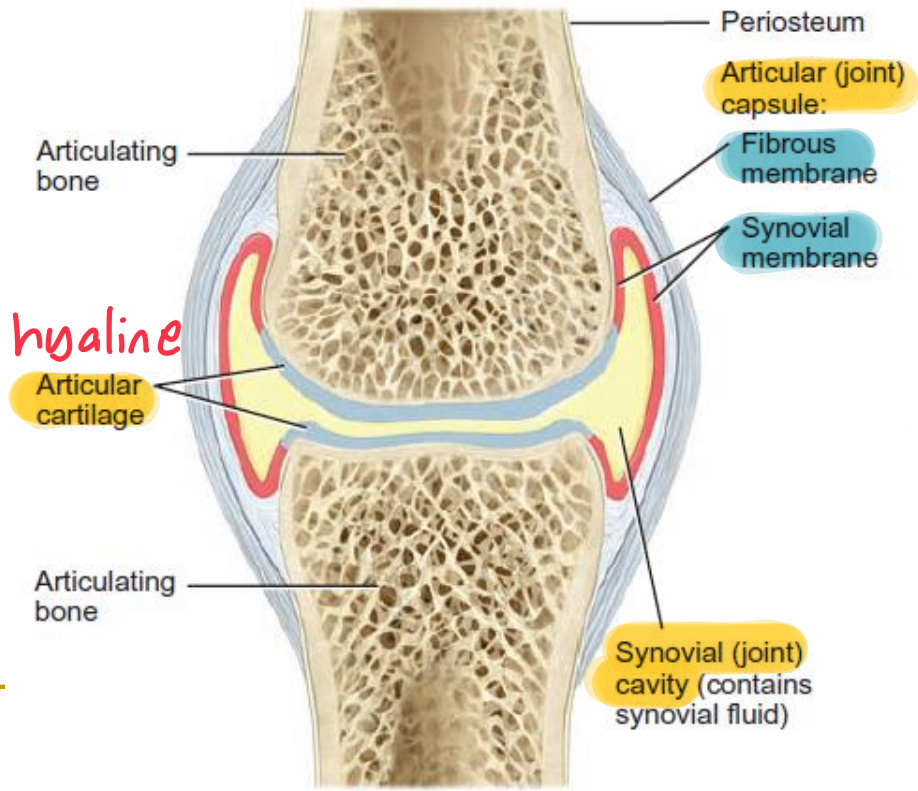


Fig.38: Features of synovial joints.

60. What is the role of hyaline cartilage in the body?

A. it attaches muscle to bone.
B. it reinforces joints by tying one bone to another.
C. it covers articulating bone surfaces.
D. it produces synovial fluid.

Answer is C: Hyaline cartilage is very smooth, and by covering the articulating surfaces of bones, ensures that the joint moves without noticeable friction.

5) ***Ligaments and articular discs***

6) ***Nerve and Blood Supply***

- Branches from different arteries anastomose around a joint to ensure sufficient blood supply to the joint.

تتشابك

7) ***Bursae and Tendon Sheaths***

- Bursae
  - Sac-like structures containing fluid similar to synovial fluid
  - Located between tendons, ligaments and bones
  - Cushion the movement of these body parts

تخفيف

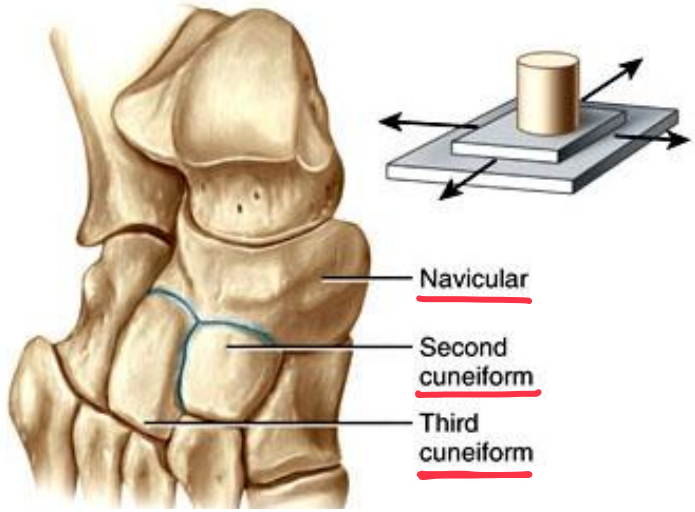
- Tendon sheaths
  - Tube-like bursae that wrap around tendons
  - Reduce friction at joints

Types Synovial Joints:

- Synovial joints are classified according to type of movement and the shape of the articulating bones into:

1) Planar Joints

- Primarily permit gliding movements.
- Intercarpal joints.



2) Hinge Joints

- Produce an opening and closing motion like that of a hinged door.
- Permit only flexion and extension.
- Knee, elbow, and the interphalangeal joints.

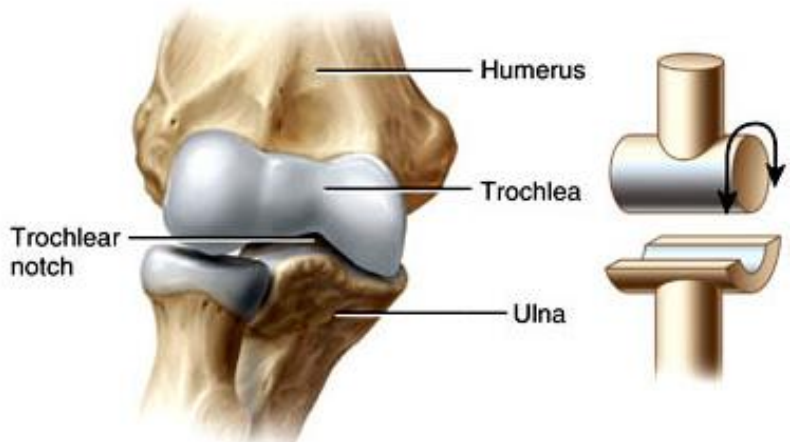


Fig.39: Planar (top) and hinge (bottom) joints.

The knee and elbow are _____ joints.

A) hinge

B) ball and socket

C) saddle

D) gliding

3) Pivot Joints

- Surface of one bone articulates with a ring formed partly by another bone.
- Only rotation can occur
- Altlantoaxial and radioulnar joints

4) Condyloid Joints

- Oval projection of one bone fits into the oval-shaped depression of another bone.
- Flexion, extension, abduction and adduction are allowed
- Wrist

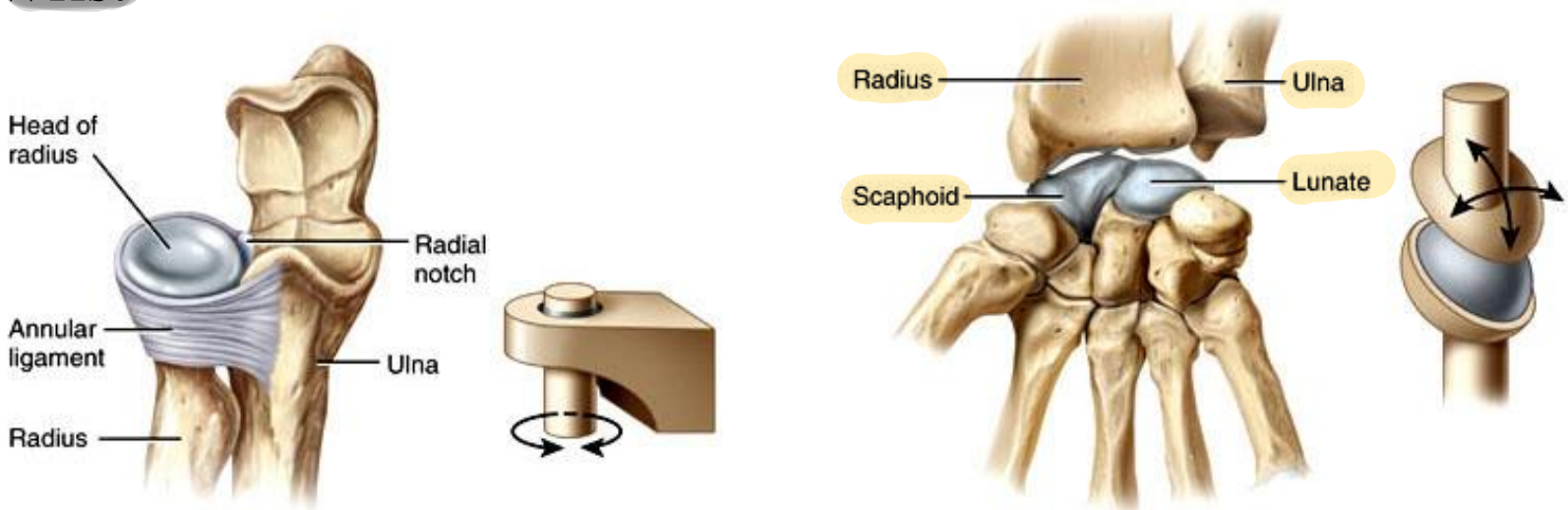


Fig.40: Pivot (left) and condyloid (right) joints.

76. What is a distinguishing feature of synovial joints?

A. there is fluid between the articulating bones
B. they are immovable joints
C. the articulating bones are held together by tendons
D. they involve a “ball and socket” articulation

Answer is A: The fluid is synovial fluid. Ball & socket joints are synovial, but are only one type of synovial joint.

5) Saddle Joints

- Articular surface of one bone is saddle-shaped, and the articular surface of the other bone fits into the "saddle"
- Flexion, extension, abduction and adduction
- Carpometacapal joint of the thumb (trapezium)

6) Ball-and-Socket Joints

- Ball-like part of one bone fitting into a cup-like depression of another bone
- Flexion, extension, abduction, adduction, circumduction and rotation are allowed
- Shoulder and hip

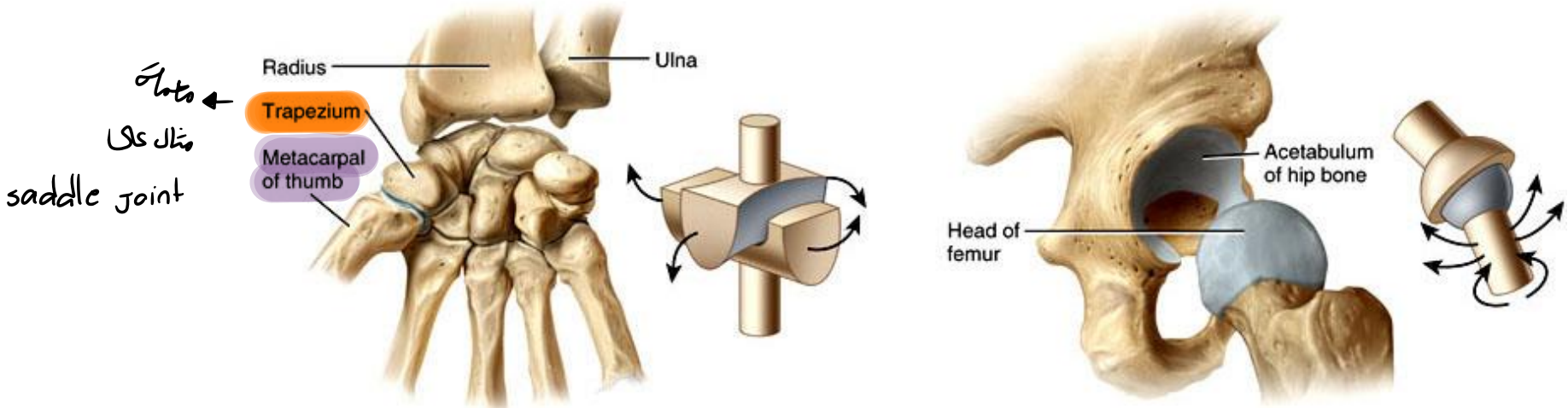


Fig.41: Saddle (left) and ball-and-socket (right) joints.

(a) Pivot joint
(between C1 and
C2 vertebrae)

(f) Ball-and-socket joint
(hip joint)

(b) Hinge joint
(elbow)

(e) Condyloid joint
(between radius and
carpal bones of wrist)

(c) Saddle joint
(between trapezium
carpal bone and 1st
metacarpal bone)

(d) Plane joint
(between tarsal bones)

The joint between the carpal and first metacarpal of the thumb is a _____ joint.

- A) hinge
- B) condyloid
- C) saddle
- D) gliding

C

The Shoulder (Glenohumeral) Joint:

- Synovial ball-and-socket joint formed by the head of the humerus and glenoid cavity of the scapula
- **Movements**: Flexion, extension, abduction, adduction, circumduction, and medial and lateral rotation.

مجال حركة واسع على حساب الثبات stability

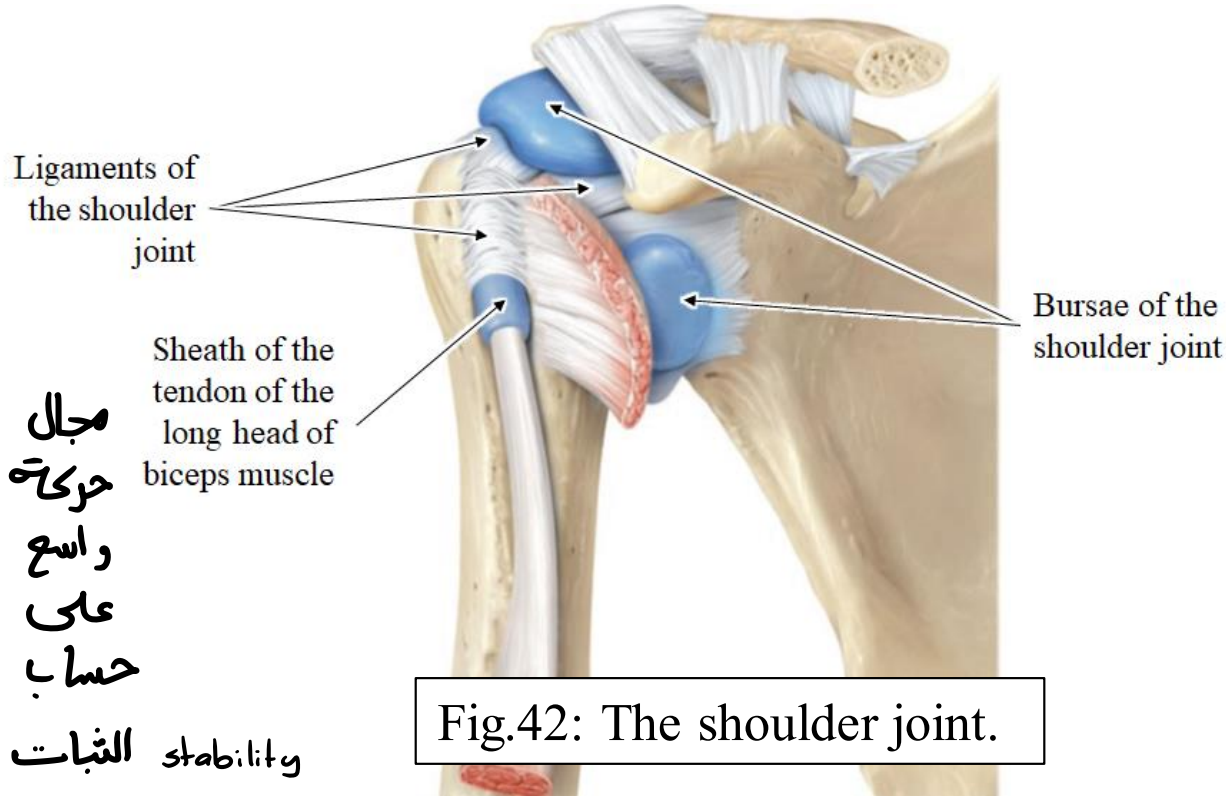


Fig.42: The shoulder joint.

- ***More freedom of movement than any other joint of the body which comes at the expense of stability***
- **Rotator Cuff**: a group of muscles that surrounds and stabilizes the shoulder joint. They keep the head of humerus in position.

The Hip (Coxal) Joint:

- Synovial ball-and-socket joint formed by the head of the femur and the acetabulum of the hip bone.
- A very stable joint on the expense of decreasing range of movement.
- Movements: Flexion, extension, abduction, adduction, circumduction, and medial and lateral rotation.

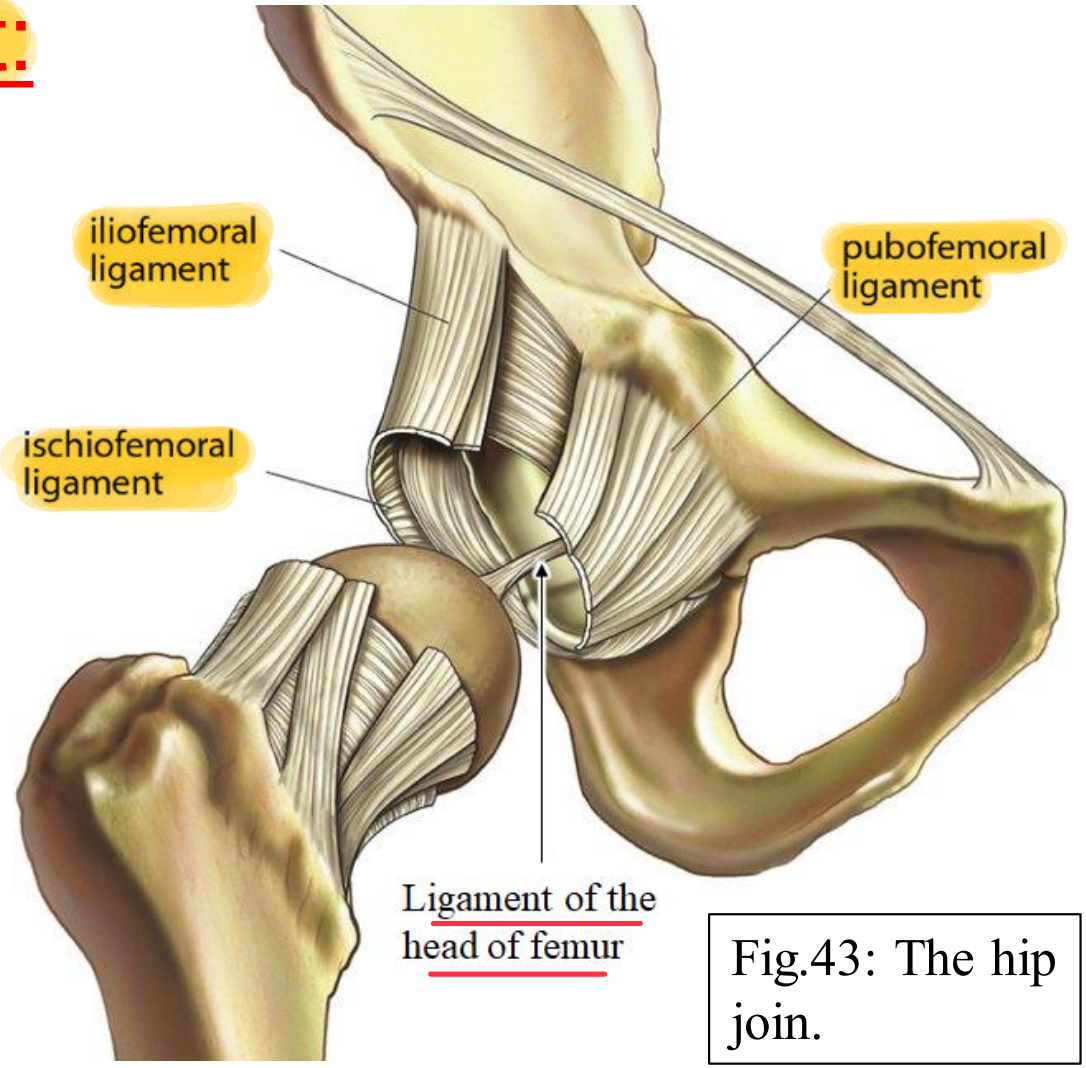


Fig.43: The hip join.

- Ligaments outside the joint help stabilize it. The *ligament of the head of femur* is found within the joint and keep the head of the femur in its place inside the acetabulum.

The Knee Joint:

- Synovial modified-hinge joint formed by the femur, tibia and patella.
- Movements: Flexion, extension, and slight medial and lateral rotation of the leg when flexed.
- Ligaments outside and inside the joint help stabilize it.
- Menisci: Two fibrocartilage discs between the tibial and femoral condyles help compensate for the irregular shapes of the bones.

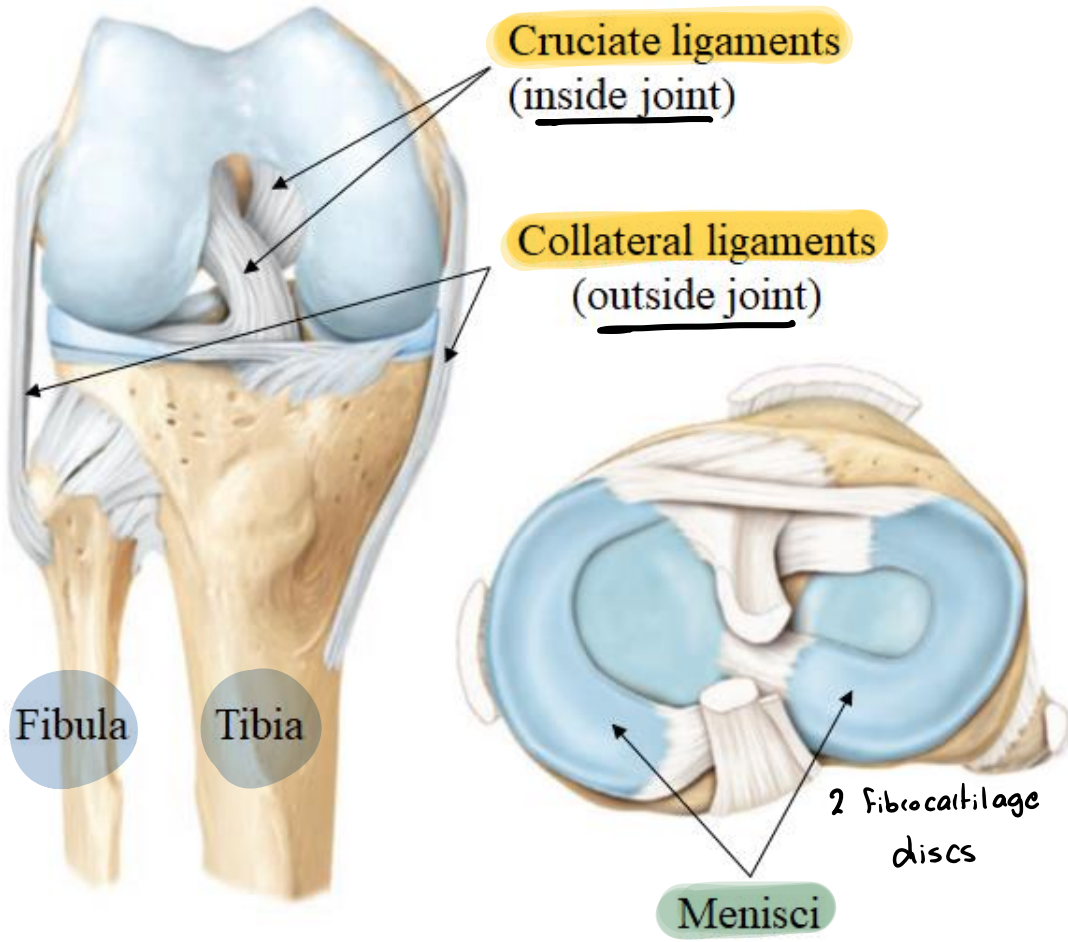


Fig.44: Knee joint: ligaments and menisci.