CHAPTER VI

SKELETAL SYSTEM

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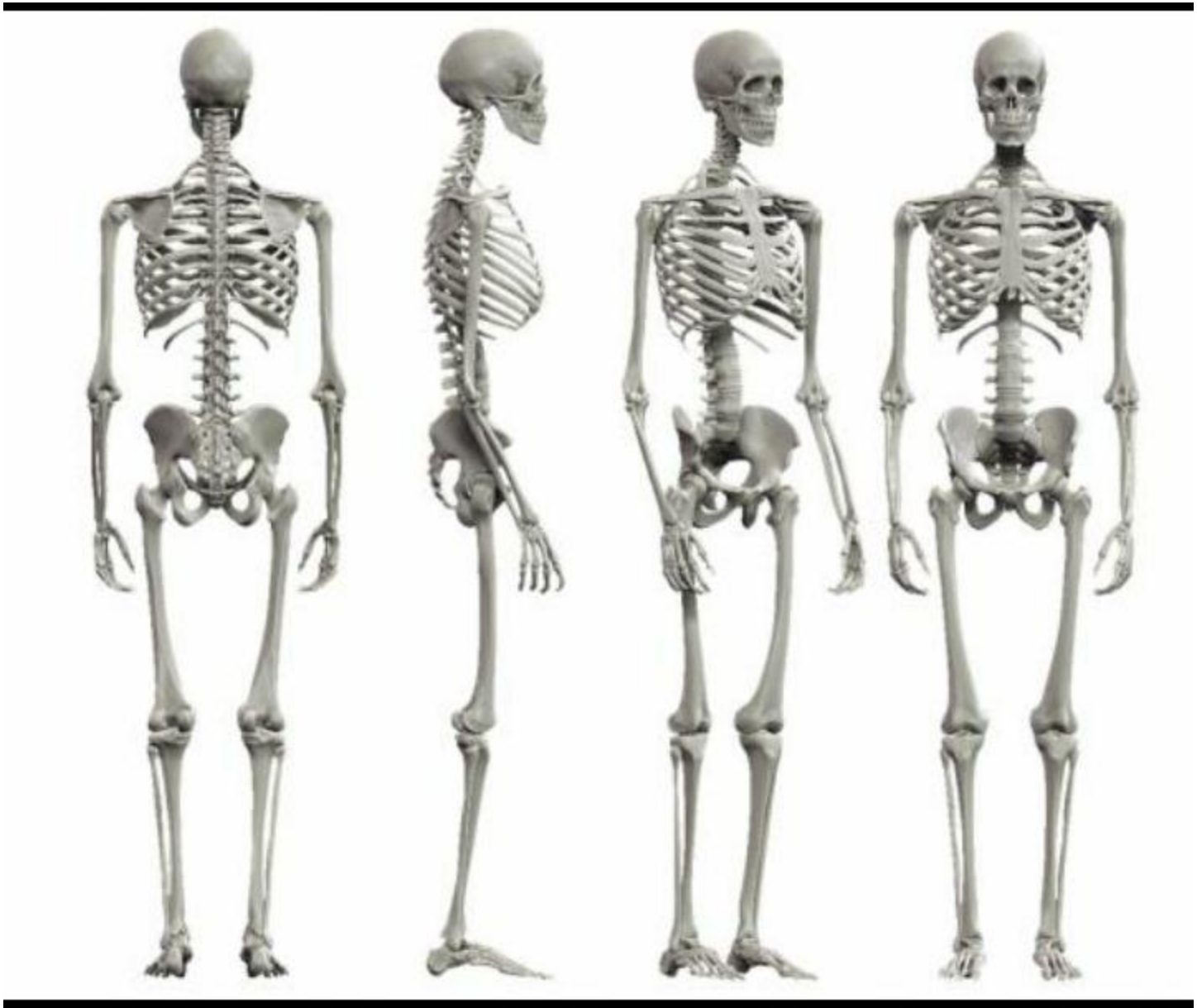
Assistant Lecturer

7. 2 . 2019

Skeletal System



Skeleton of rabbit

- Endoskeleton

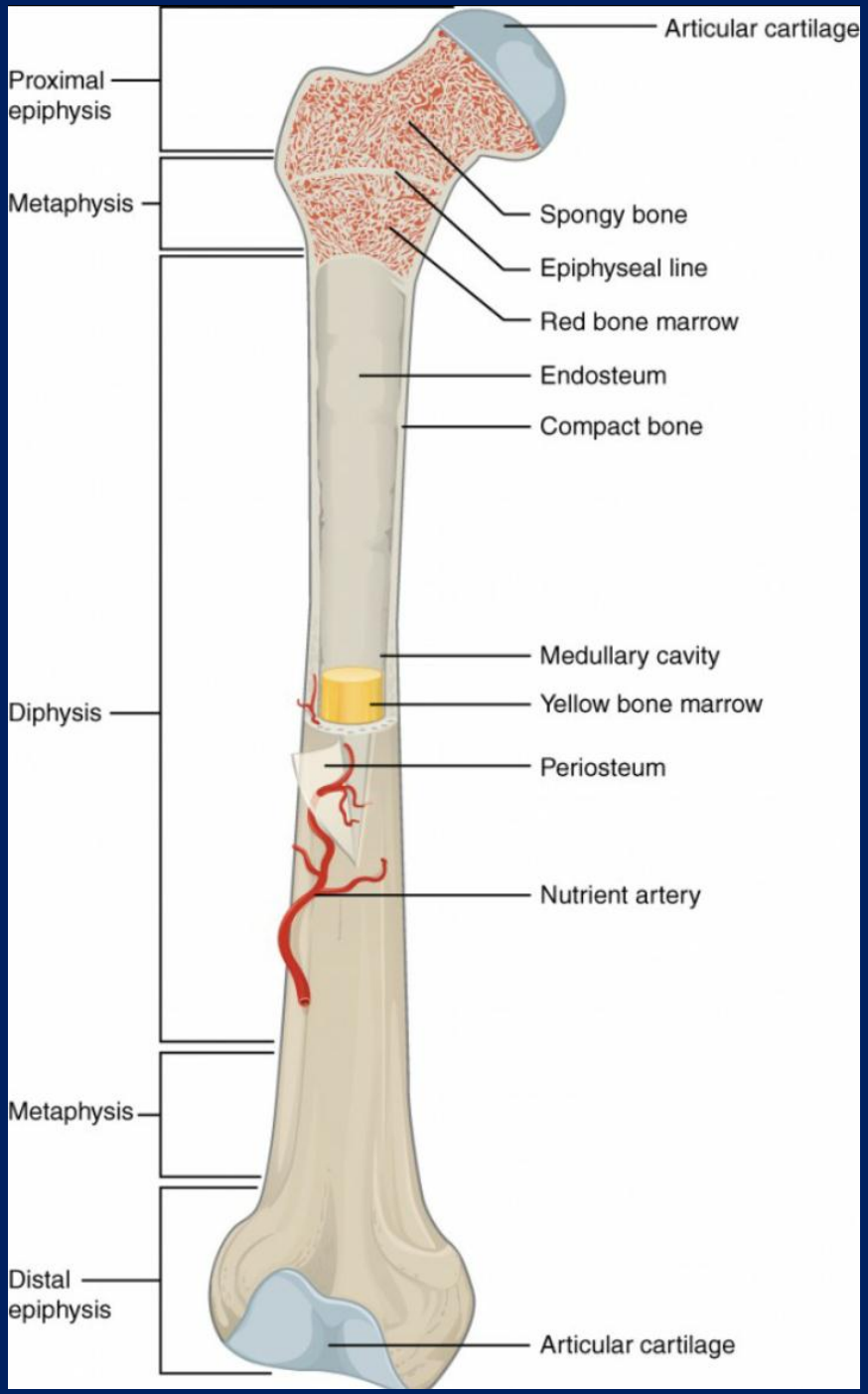
within + skeleton

- Exoskeleton

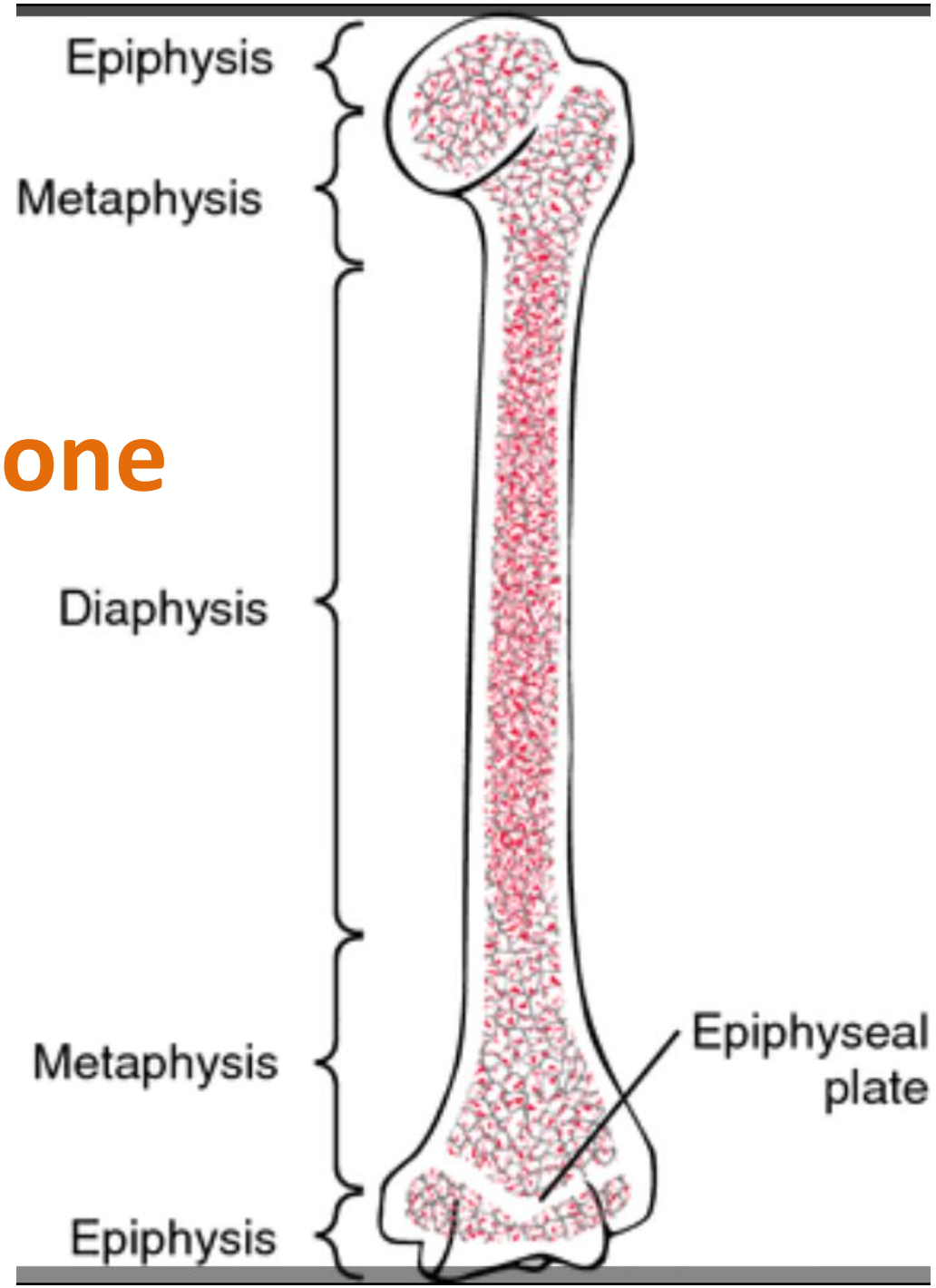
outside + skeleton

A typical long bone

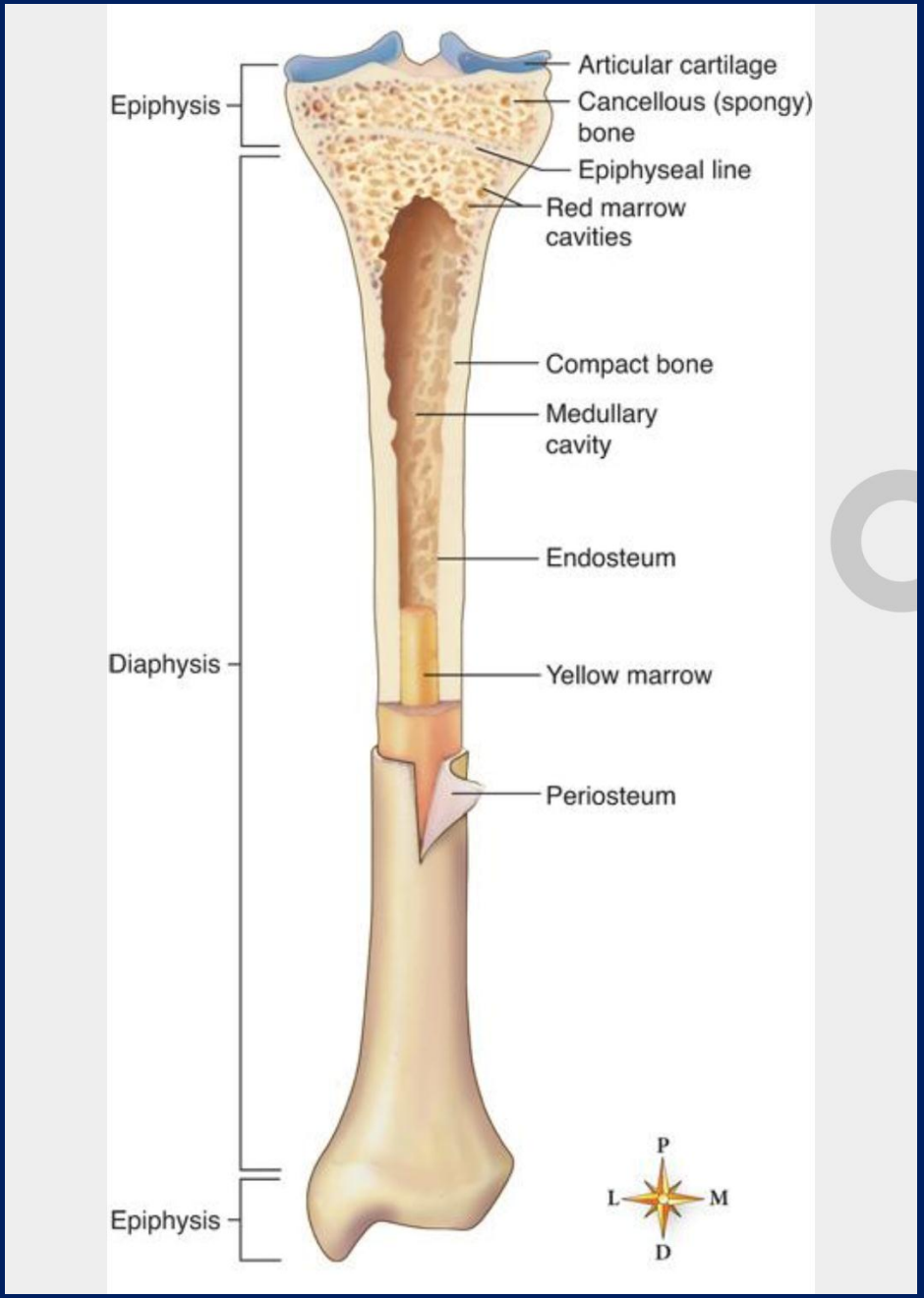
(Femur)

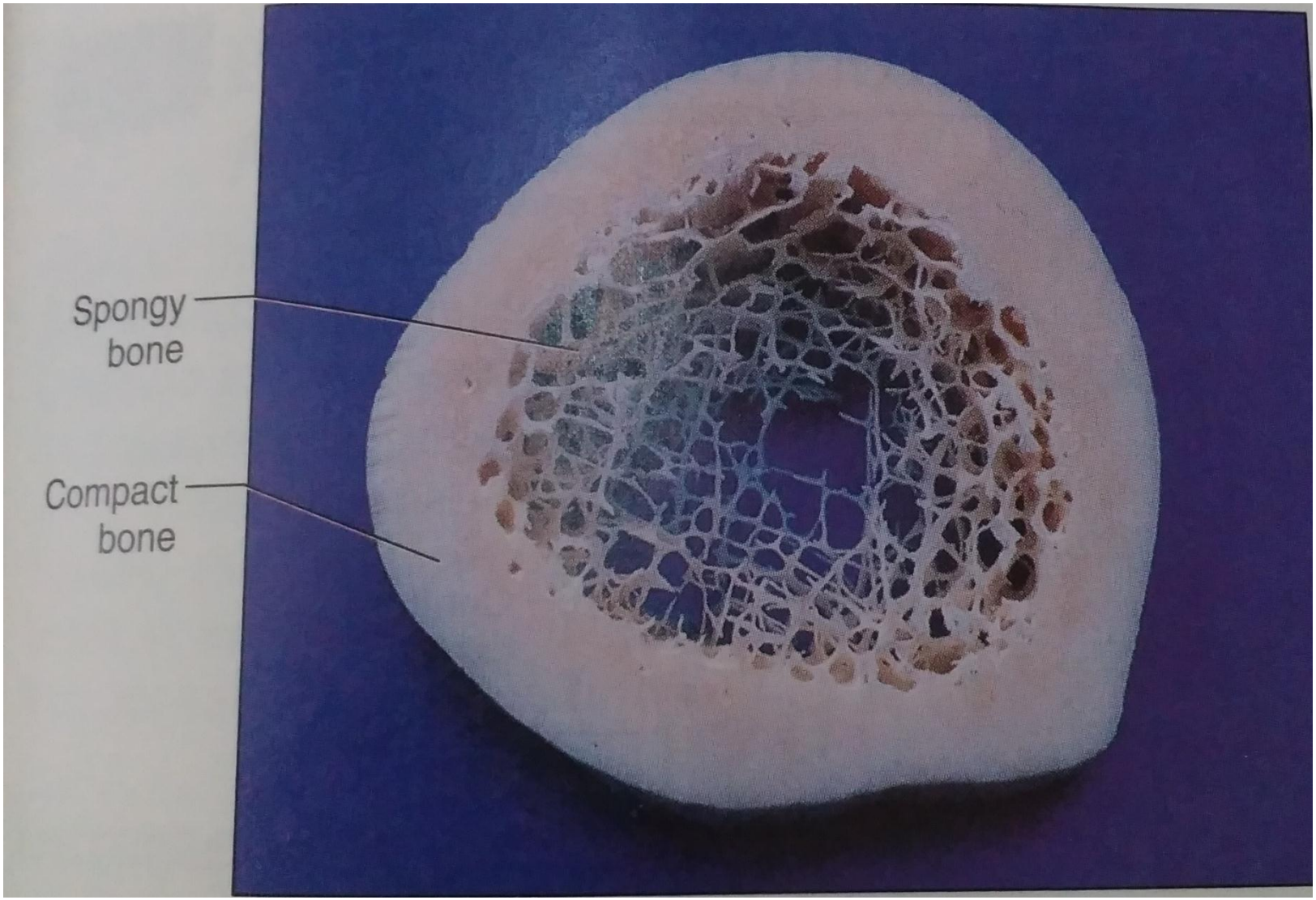


A typical long bone

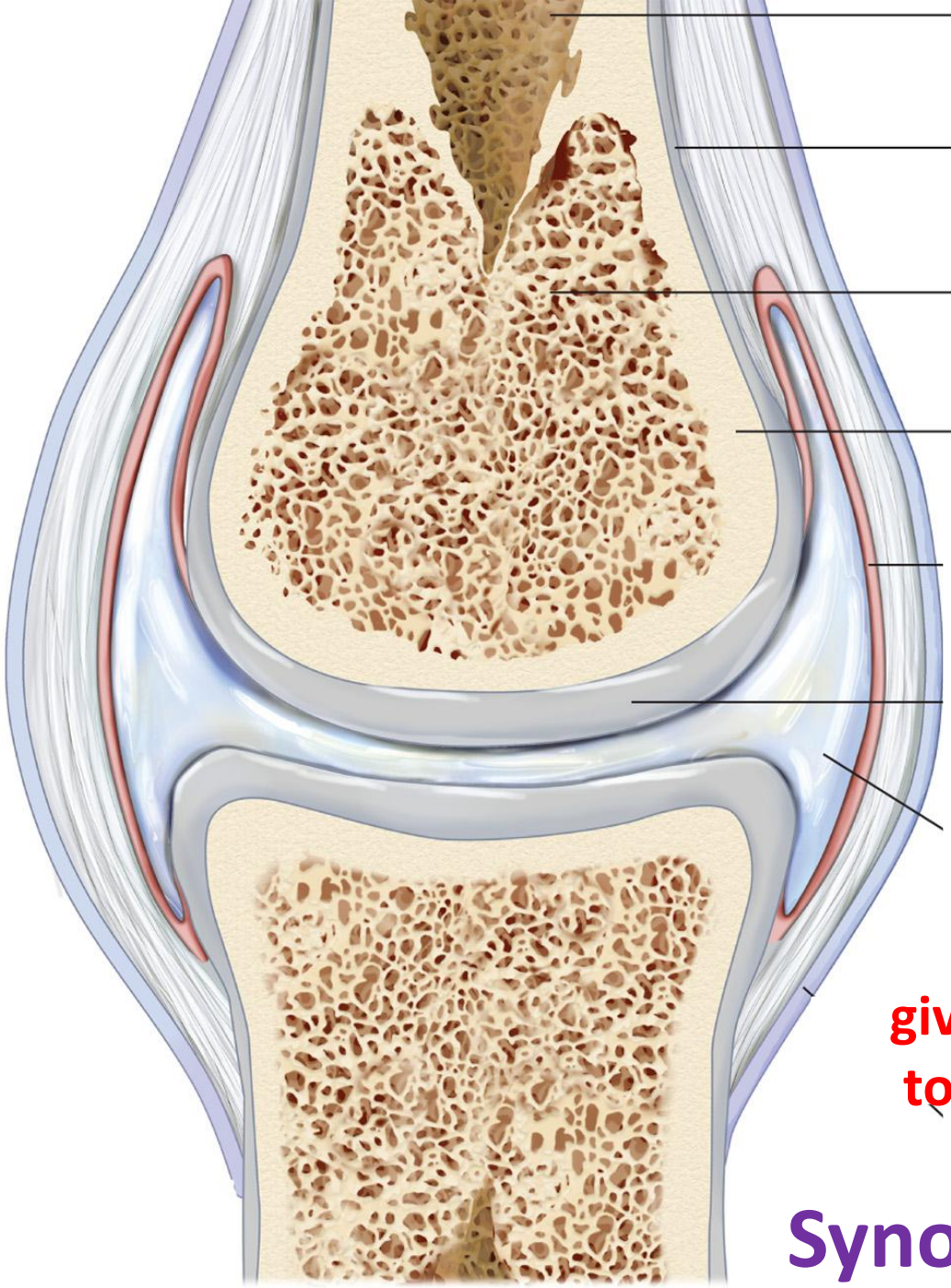


A long bone


Articular cartilage
Cancellous (spongy) bone
Epiphyseal line
Red marrow cavities
Compact bone
Medullary cavity
Endosteum
Yellow marrow
Periosteum
Epiphysis
Diaphysis
Epiphysis
P
L
M
D

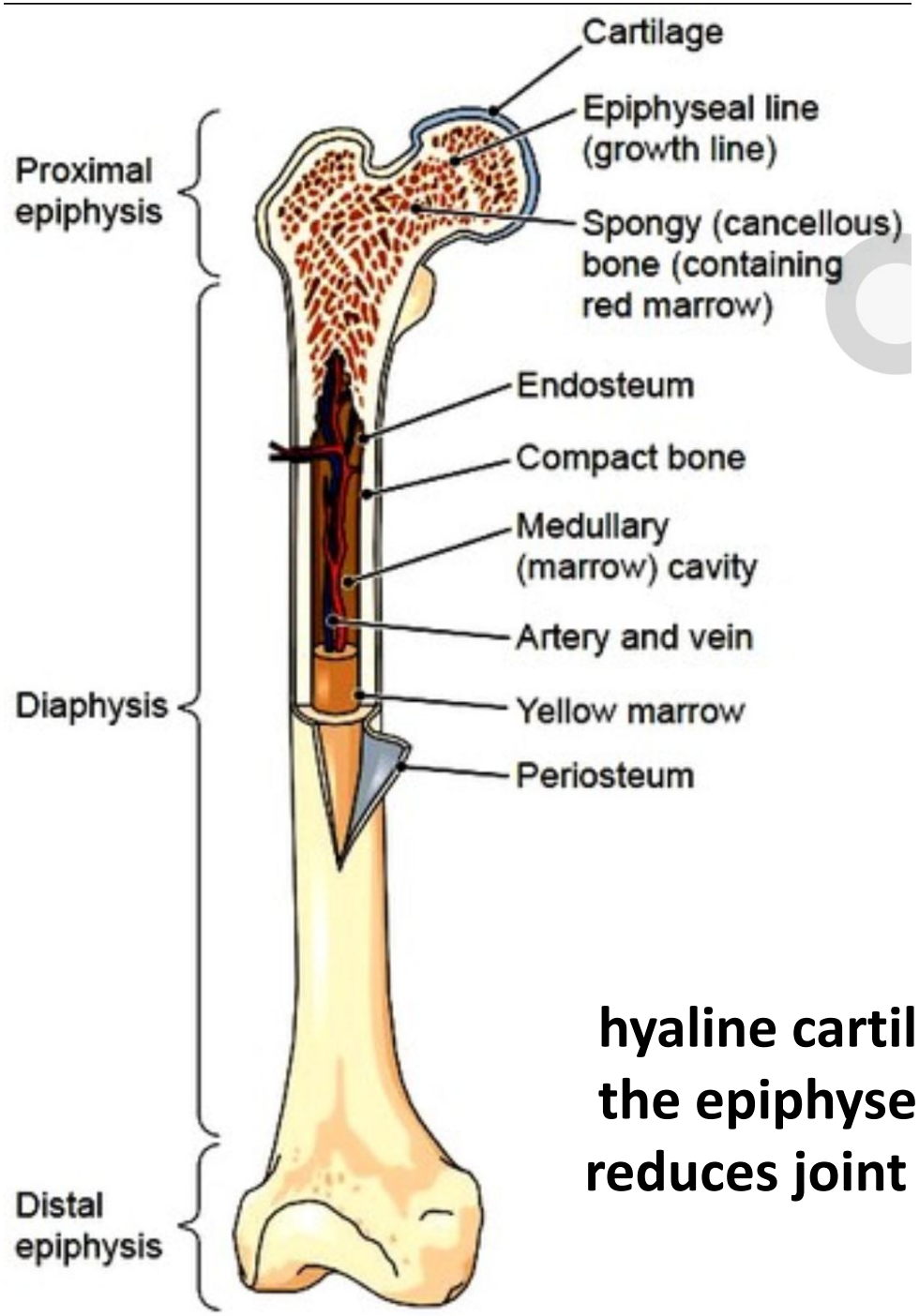


Concentrates most materials around the periphery

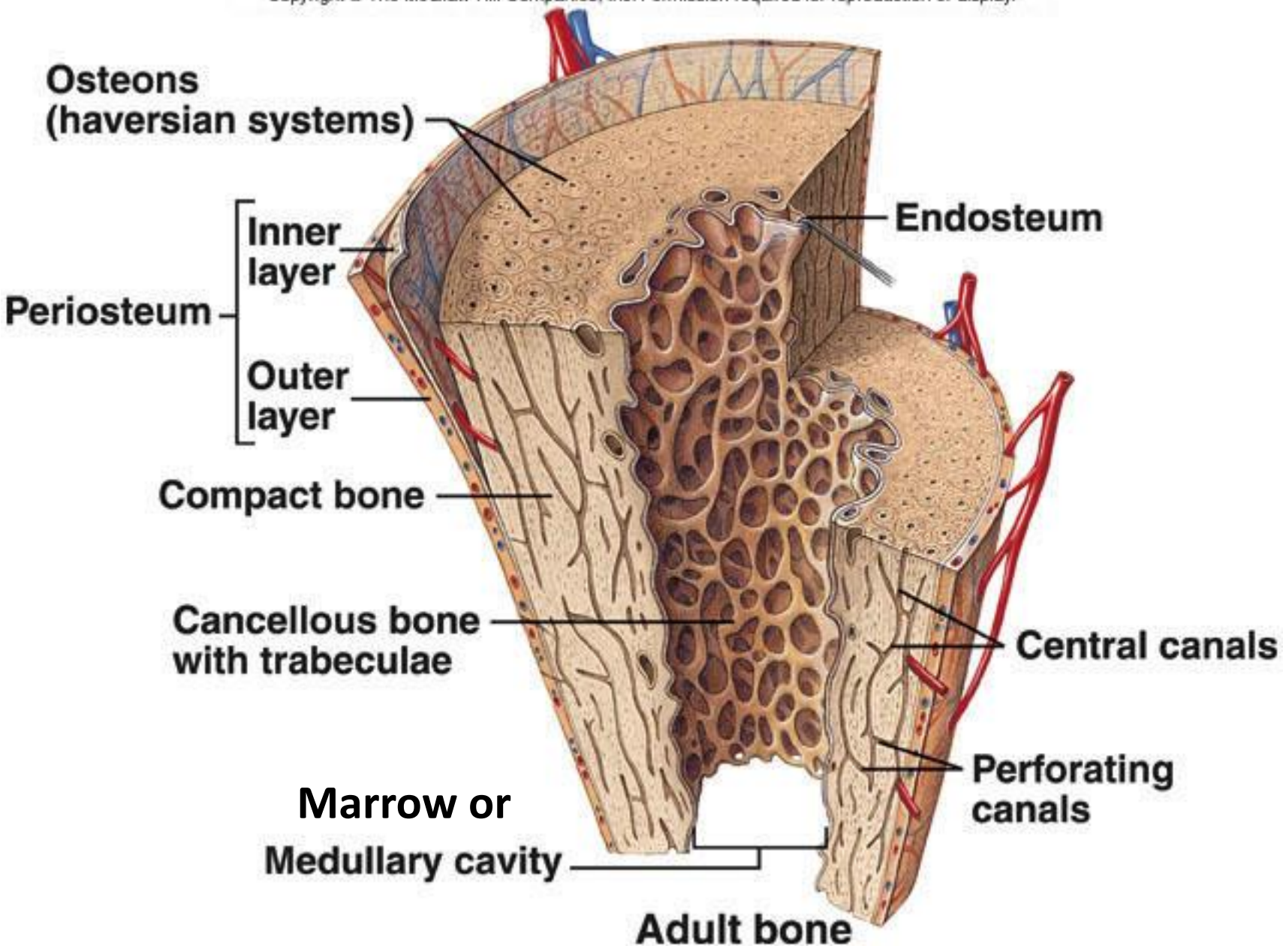


giving maximum resistance to bending movements

Synovial joint



hyaline cartilage covers the epiphyses , reduces joint friction



Structure of the periosteum

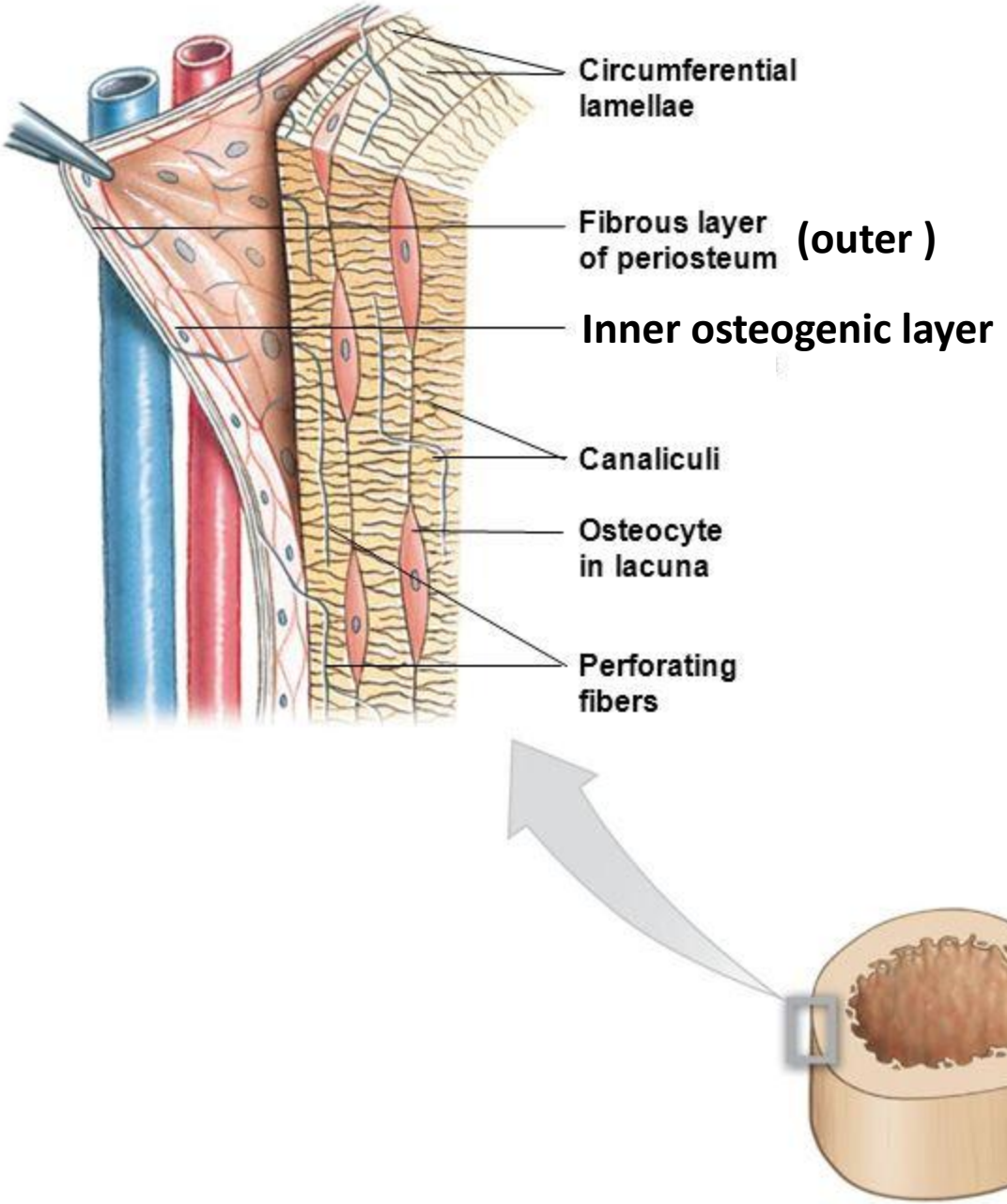
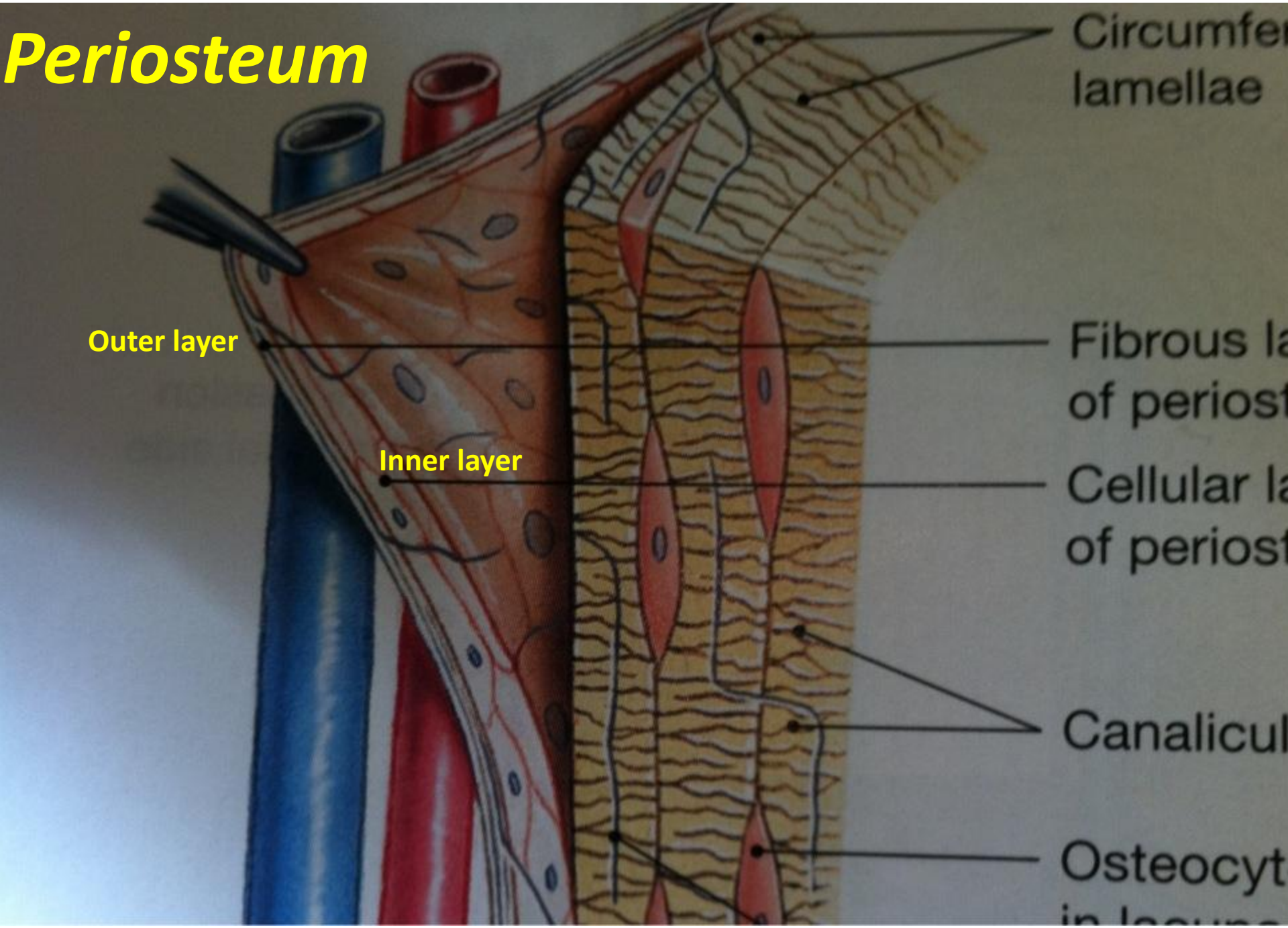
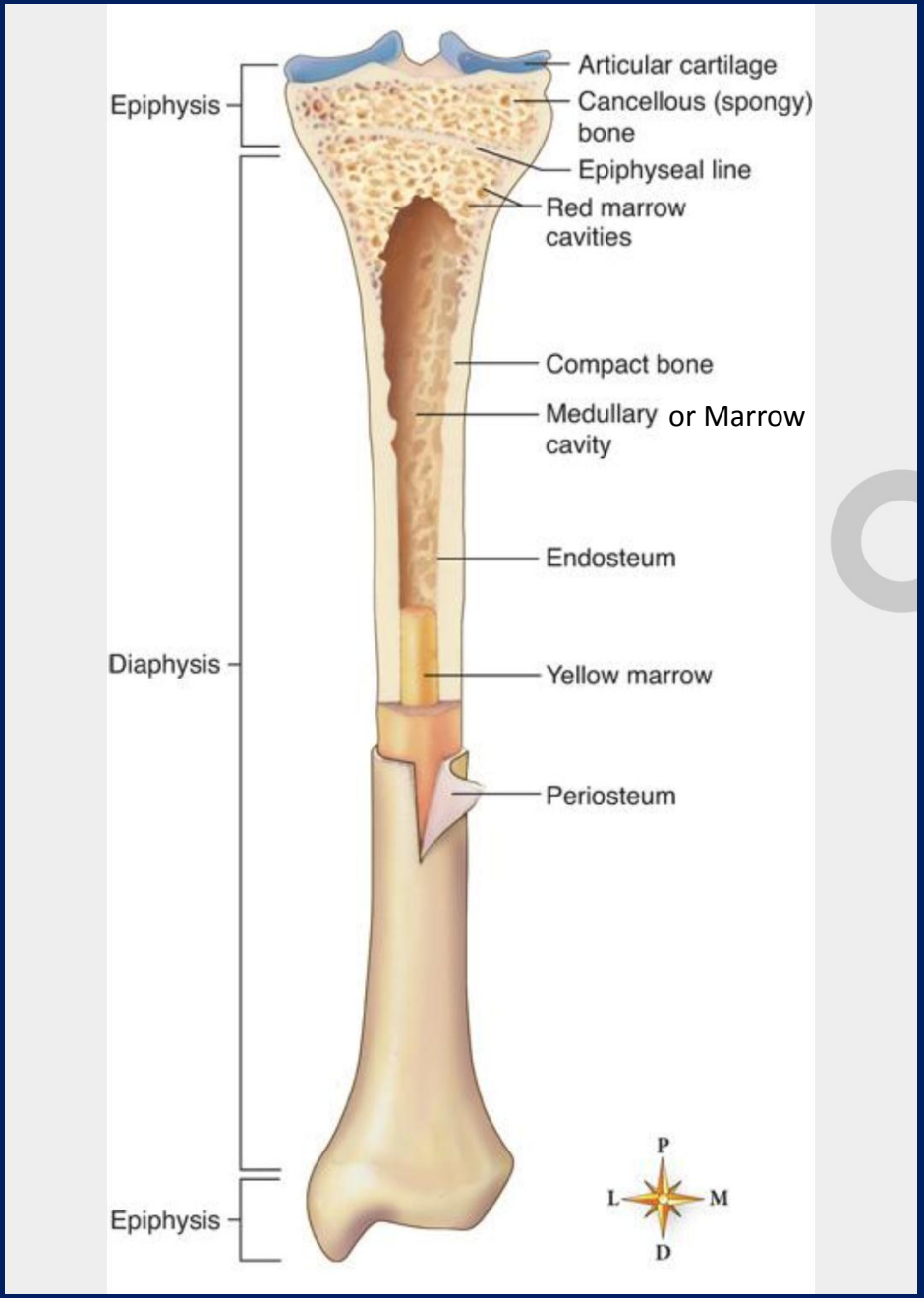


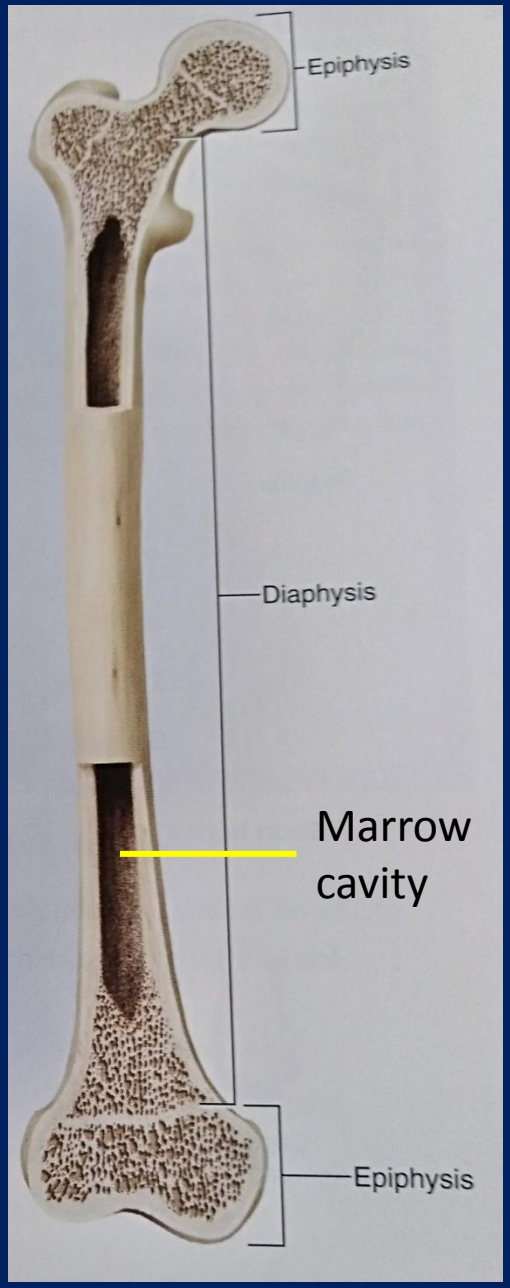
Figure 6.5 3

Periosteum


Outer layer
Inner layer
Circumfer
lamellae
Fibrous la
of periost
Cellular la
of periost
Canalicul
Osteocyt

A long bone


Articular cartilage
Epiphysis
Cancellous (spongy) bone
Epiphyseal line
Red marrow cavities
Compact bone
Medullary or Marrow cavity
Endosteum
Diaphysis
Yellow marrow
Periosteum
Epiphysis
P
L
M
D



A long bone(Dried)

The skeleton of a mammal

The internal structure of rabbit includes the structure and arrangement of its bony framework ,which is known as **its skeleton**.

Functions of the skeleton

(Five main purposes)

(1) Support

(2) Protection

(3) Muscle attachment

(4) Movement or Locomotion

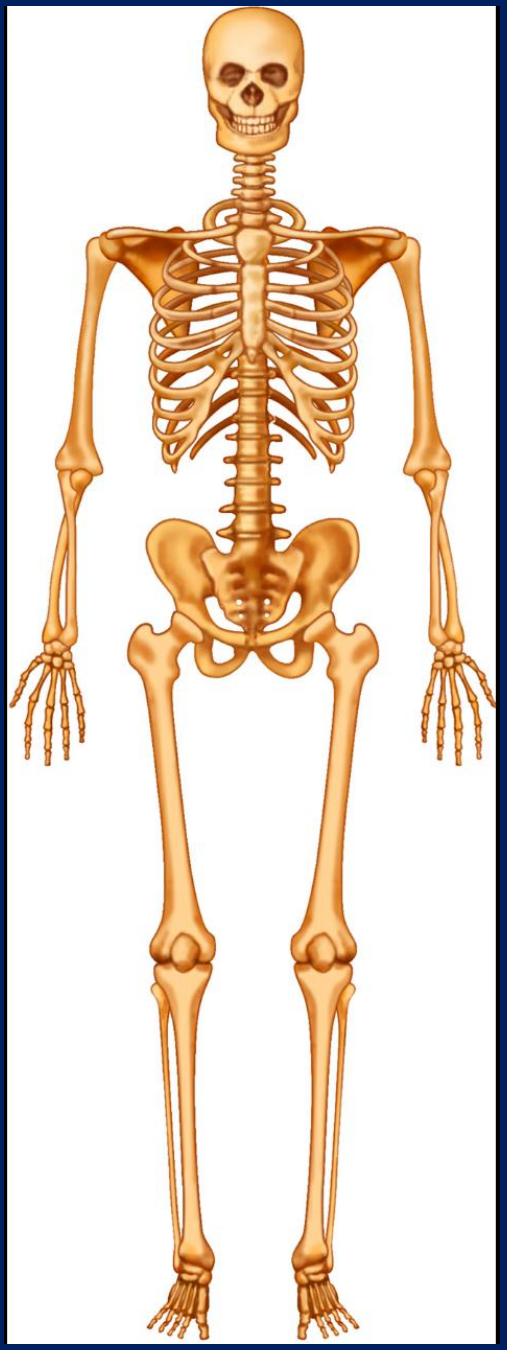
(5) Production of blood corpuscles

(1) Support

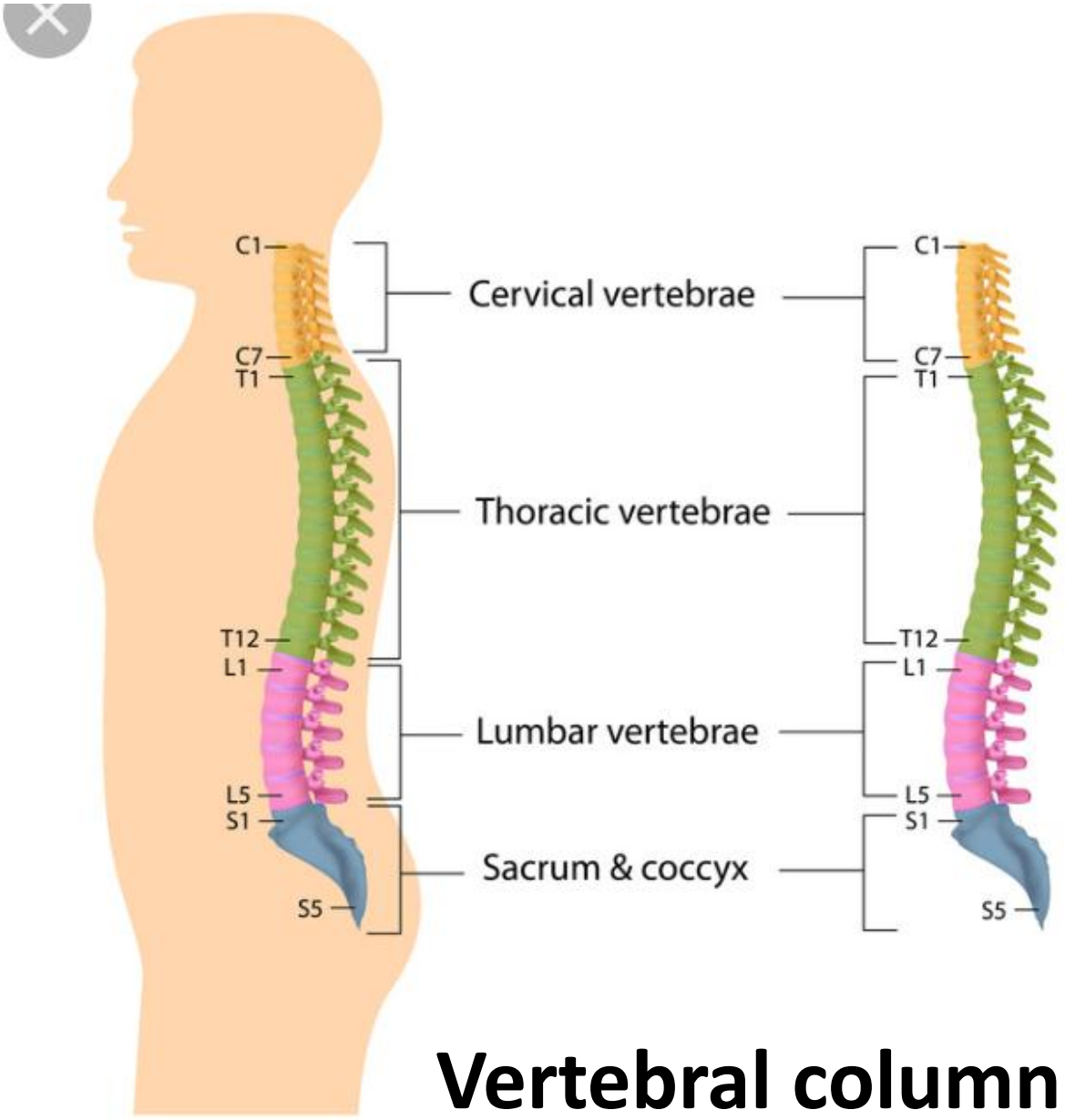
The rigid skeleton **forms a frame work** for the support of the body .

1. Support

-raises the body
above the ground

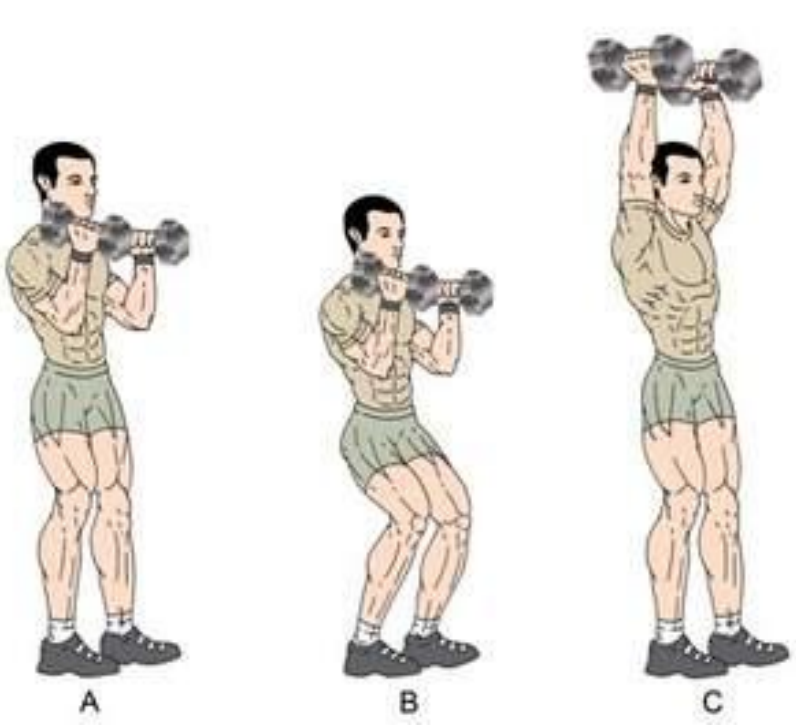


-becomes a rigid axis to support the heavy head



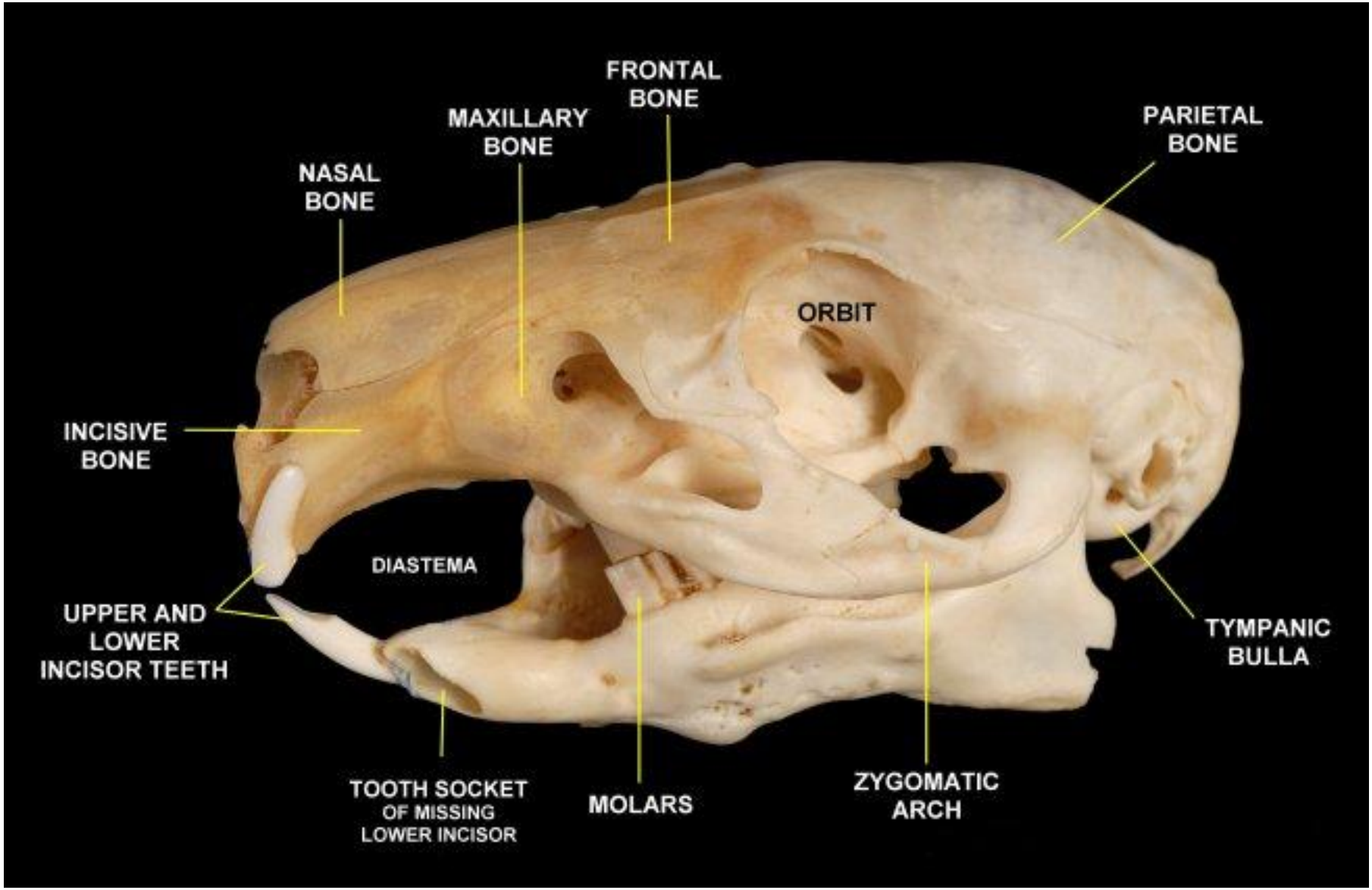
Vertebral column of man


bodylastics

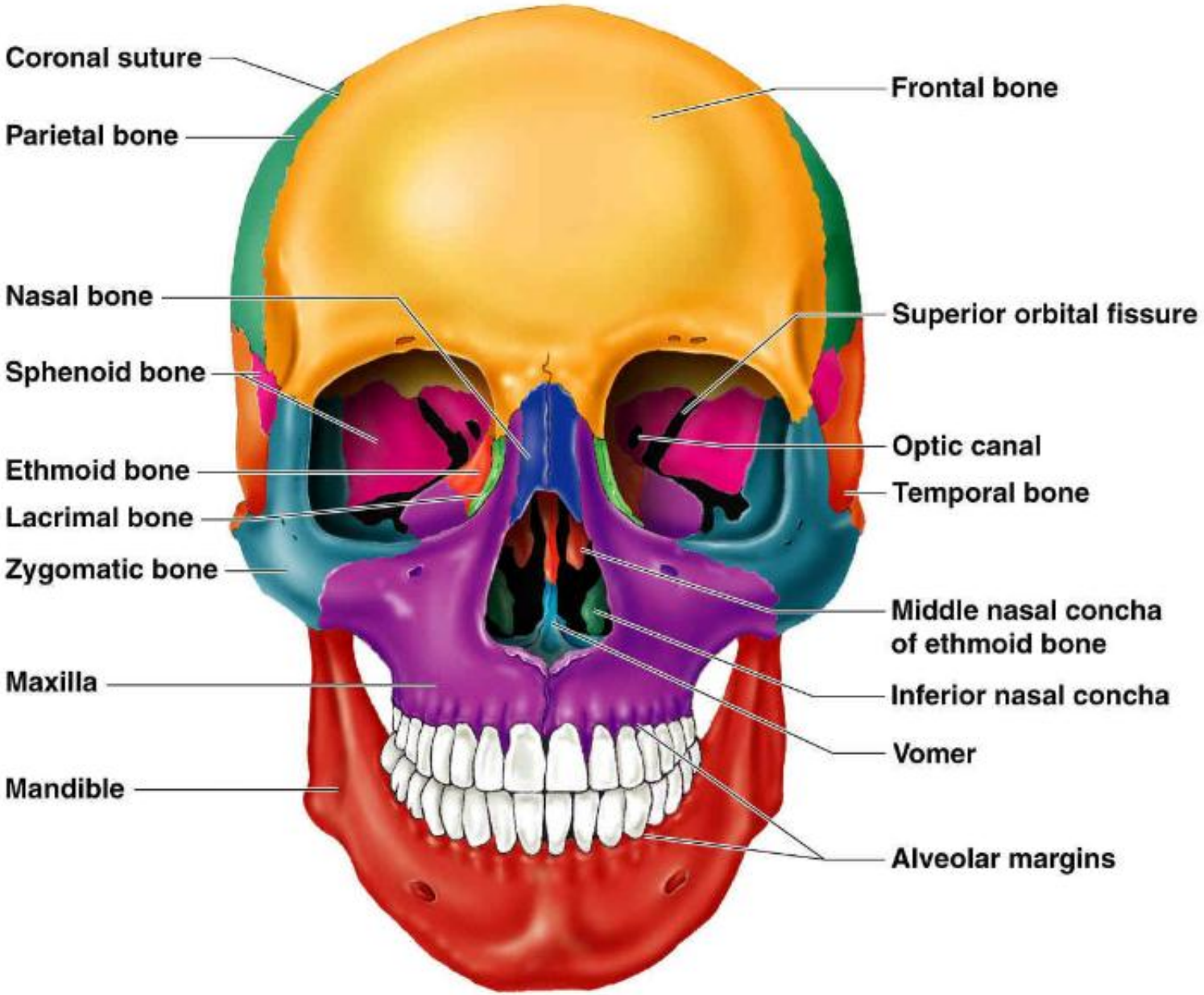


Vertebral column becomes rigid axis to resist the pushed exercised by the limbs

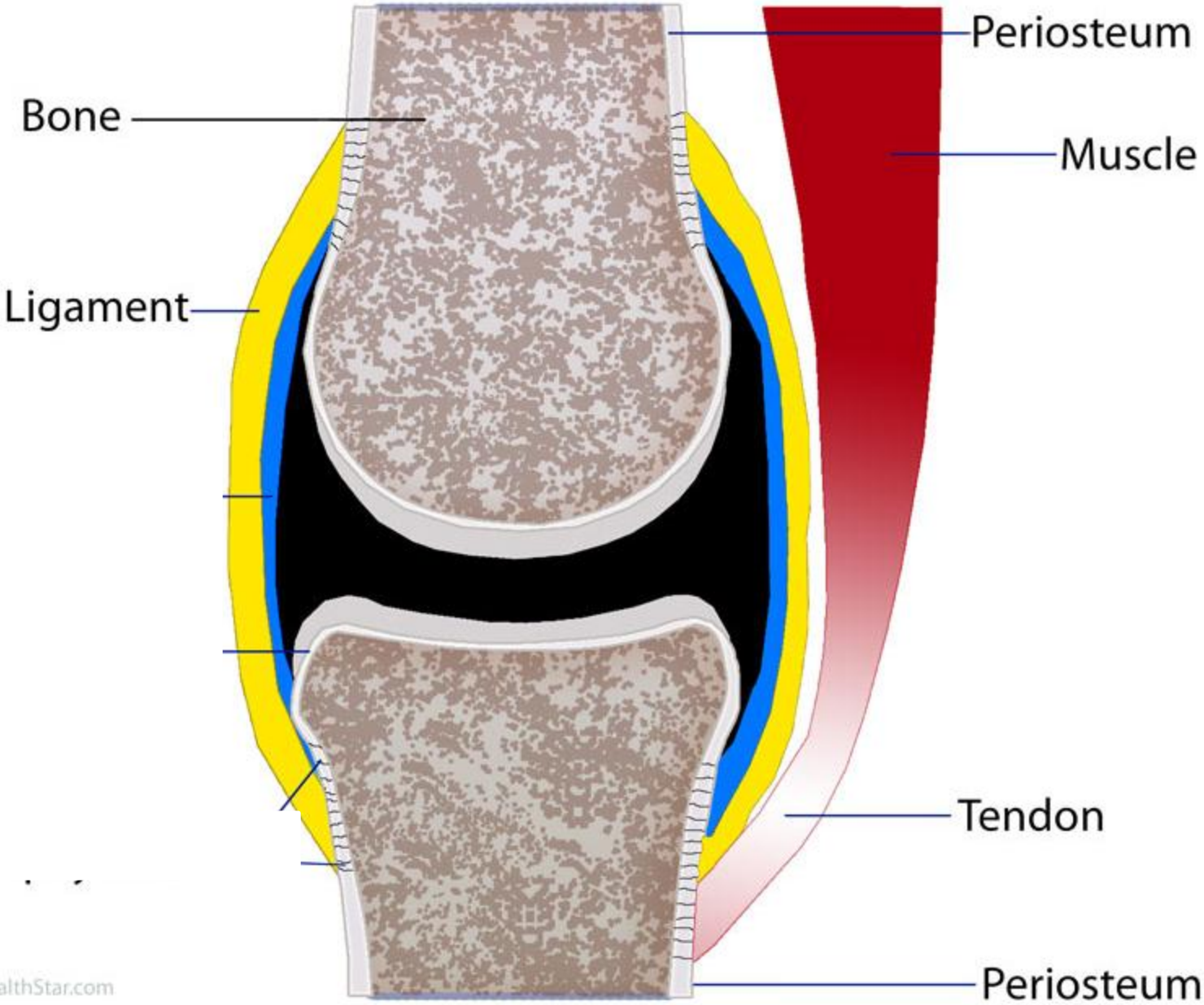
2 .Protection

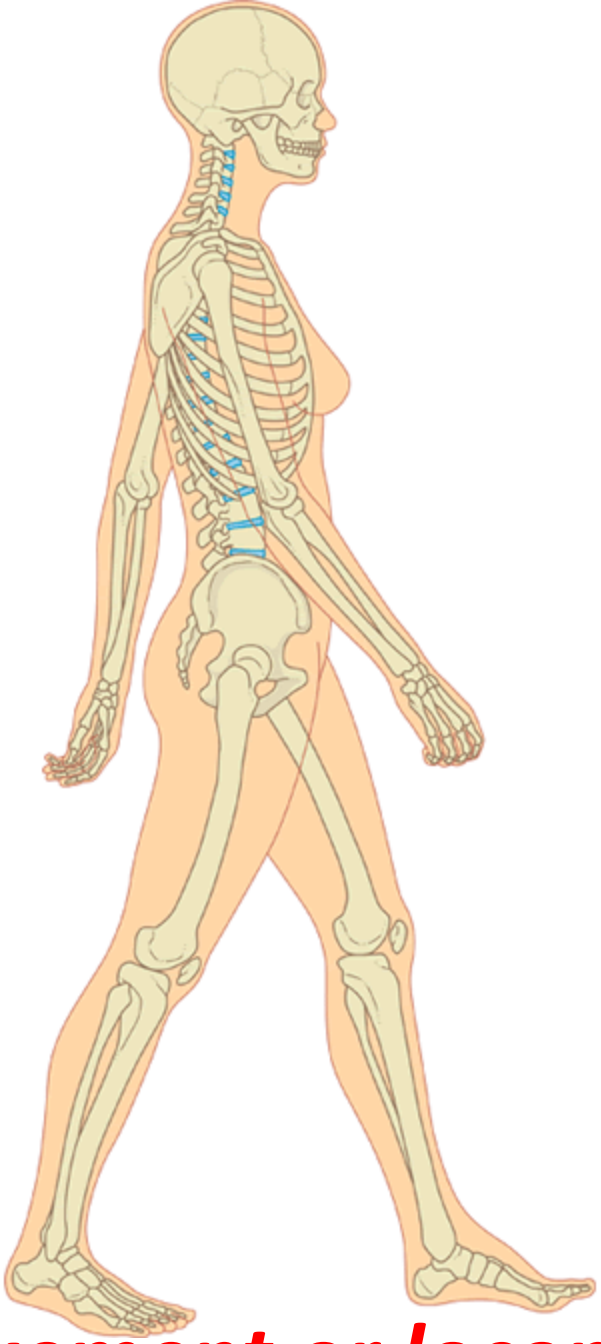


Skull of rabbit


Coronal suture
Parietal bone
Nasal bone
Sphenoid bone
Ethmoid bone
Lacrimal bone
Zygomatic bone
Maxilla
Mandible
Frontal bone
Superior orbital fissure
Optic canal
Temporal bone
Middle nasal concha of ethmoid bone
Inferior nasal concha
Vomer
Alveolar margins

3 .Muscle attachment





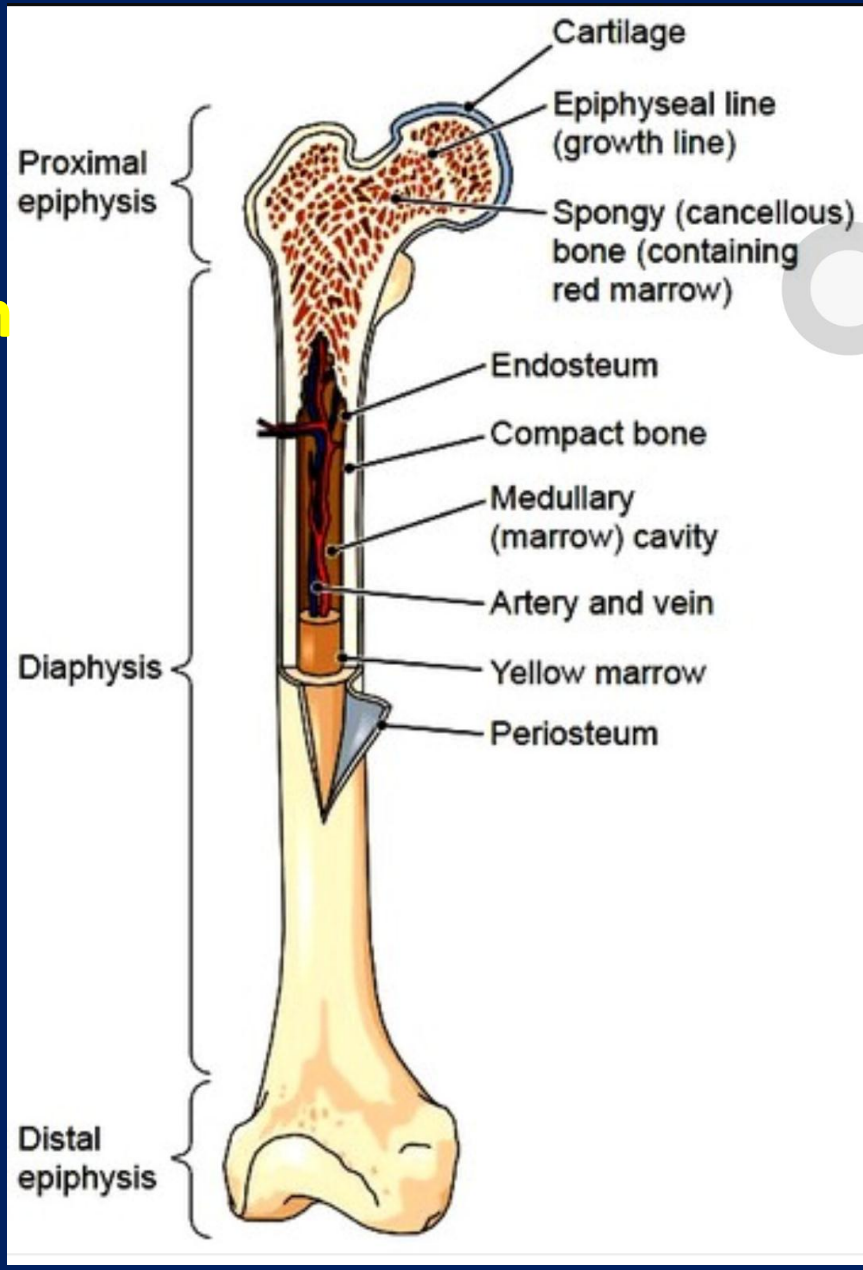
4 . Movement or locomotion

(5)Production of blood corpuscles

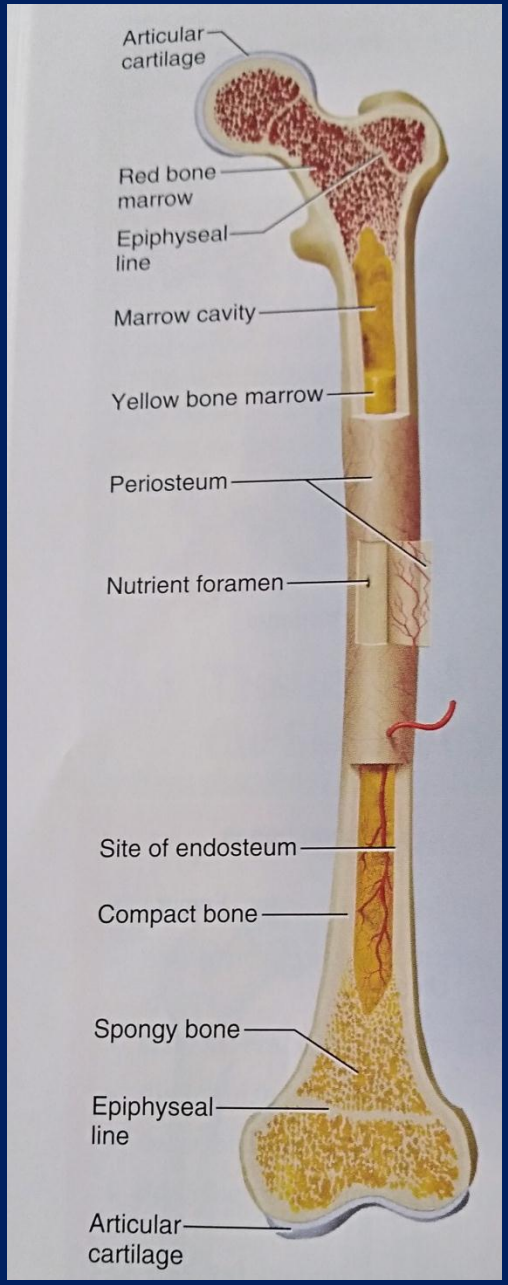
The long bones of vertebrates **contain red marrow** .In amphibians ,reptiles ,and birds the bone marrow **forms all kinds of corpuscles**

5 . Production of blood corpuscles

In mammals the red marrow form erythrocytes, blood platelets and granulocytes only , other white corpuscles are formed in the lymphatic tissue



5 . Production of blood corpuscles



The endoskeleton of rabbit

- divided into two main parts

(1) Axial skeleton

(2) Appendicular skeleton

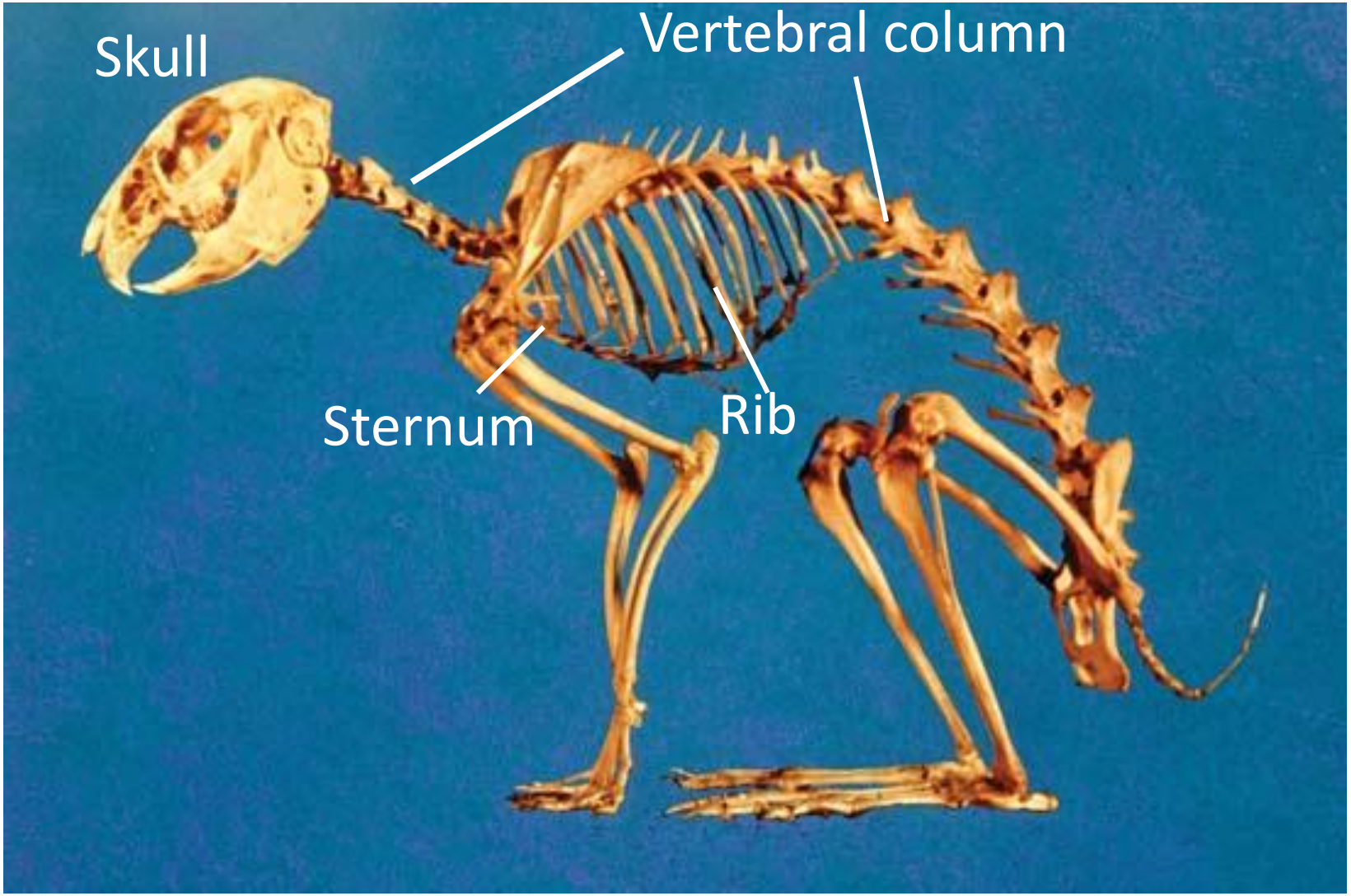
Endoskeleton of rabbit

Axial skeleton

Appendicular skeleton

The Axial Skeleton

- skull
- vertebral column (backbone)
- sternum (breastbone)
- ribs



Axial skeleton of rabbit

The vertebrae in the vertebral column

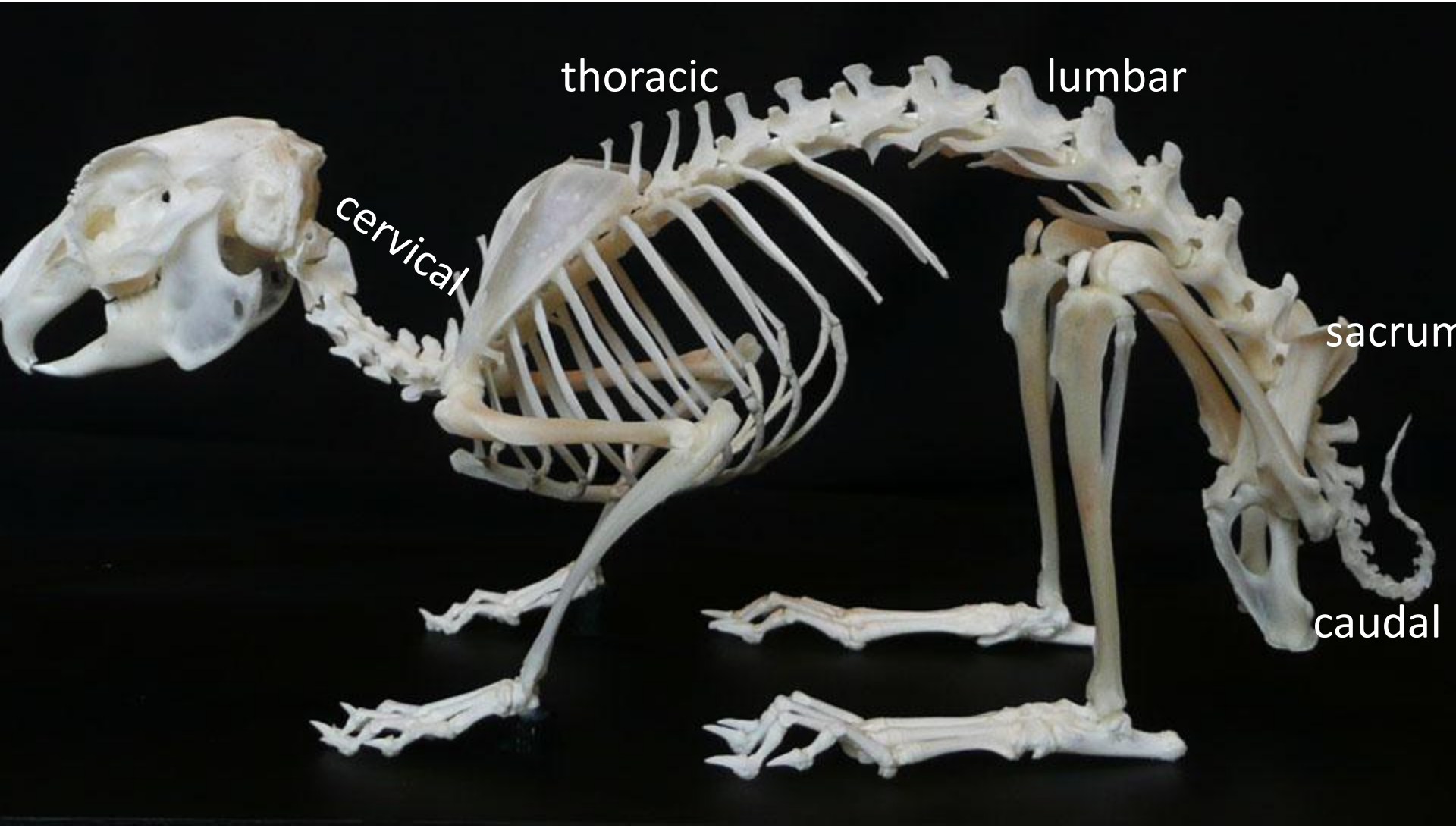
(I) cervical

(ii) thoracic

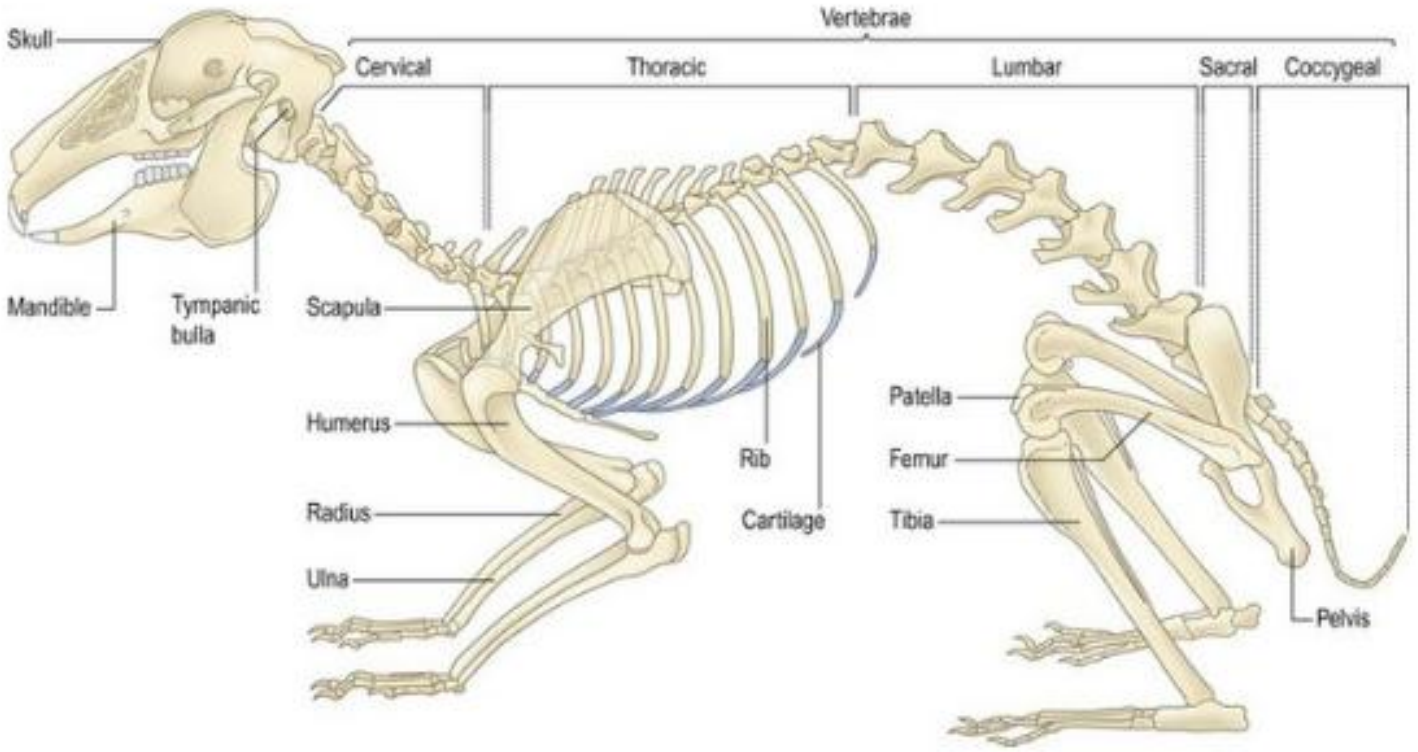
(iii) lumbar

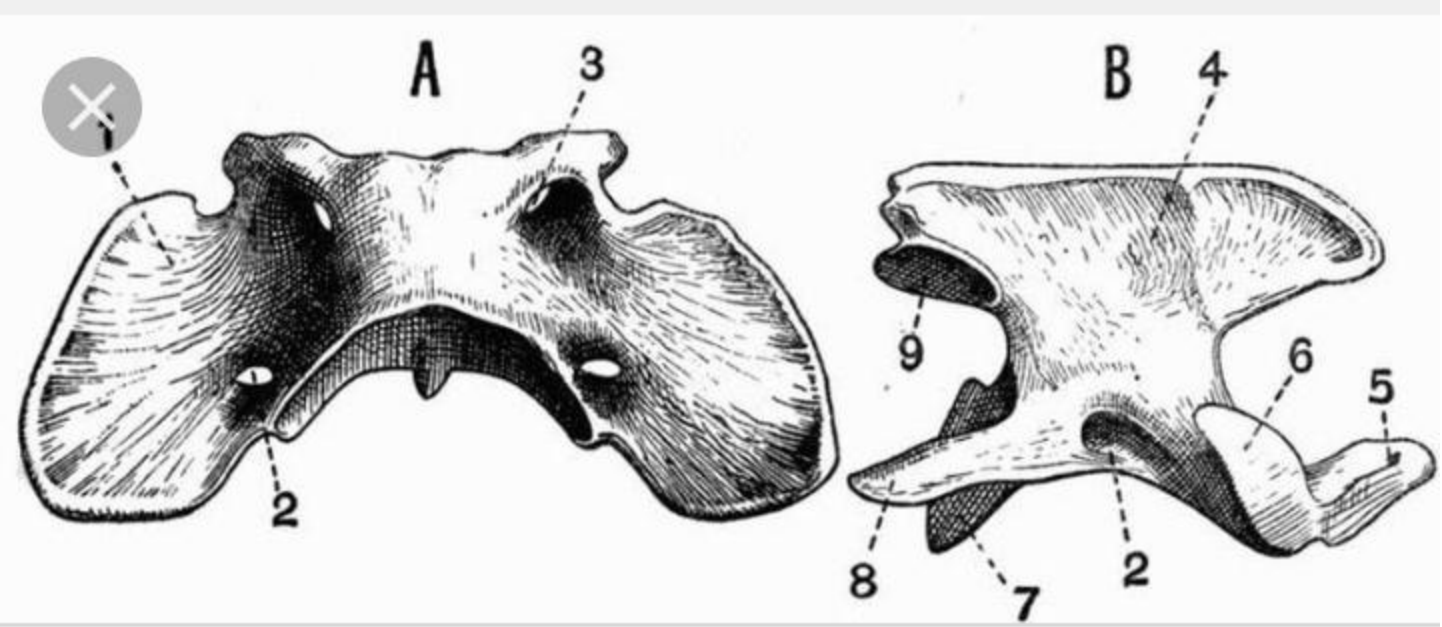
(iv) sacral

(v) caudal



Vertebral column of rabbit

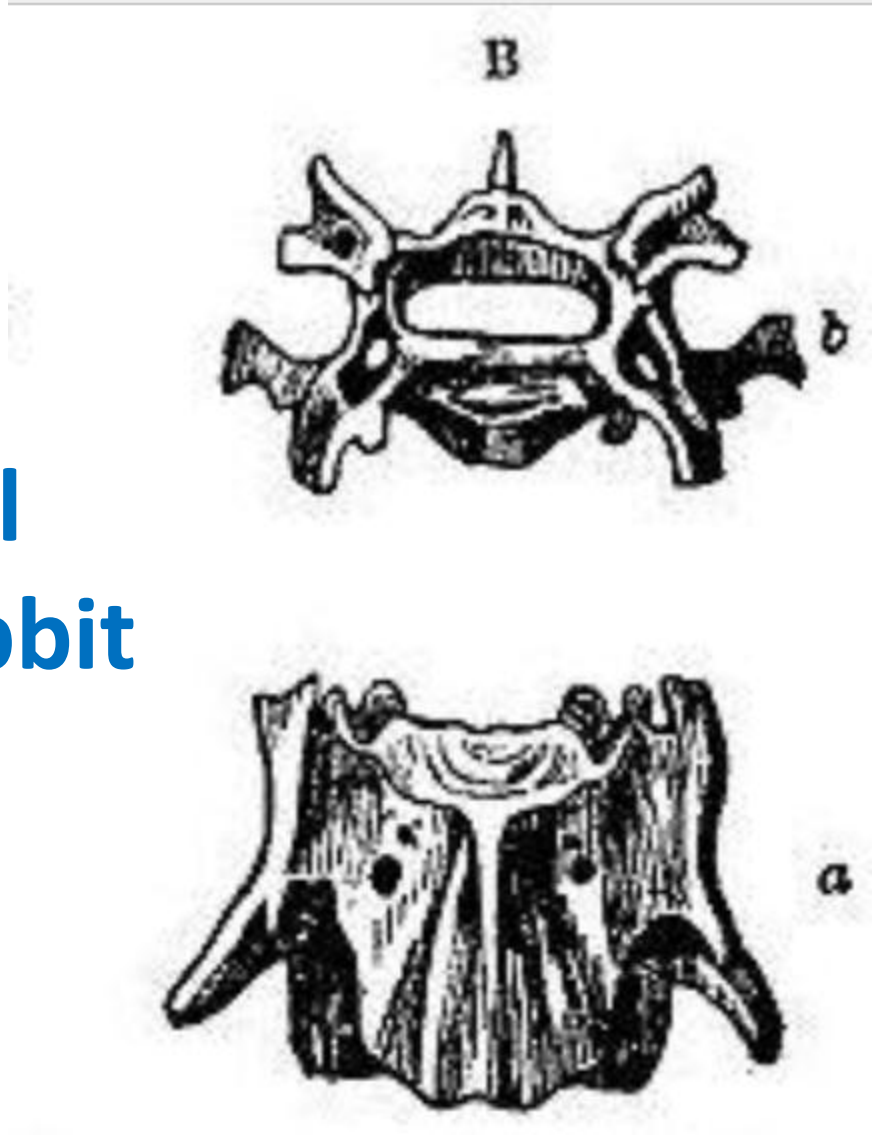

Vertebrae
Skull
Cervical
Thoracic
Lumbar
Sacral
Coccygeal
Mandible
Tympanic bulla
Scapula
Humerus
Radius
Ulna
Rib
Cartilage
Patella
Femur
Tibia
Pelvis



Atlas of rabbit
(first cervical vertebra)

Axis of rabbit
(second cervical vertebra)

Typical cervical vertebra of rabbit



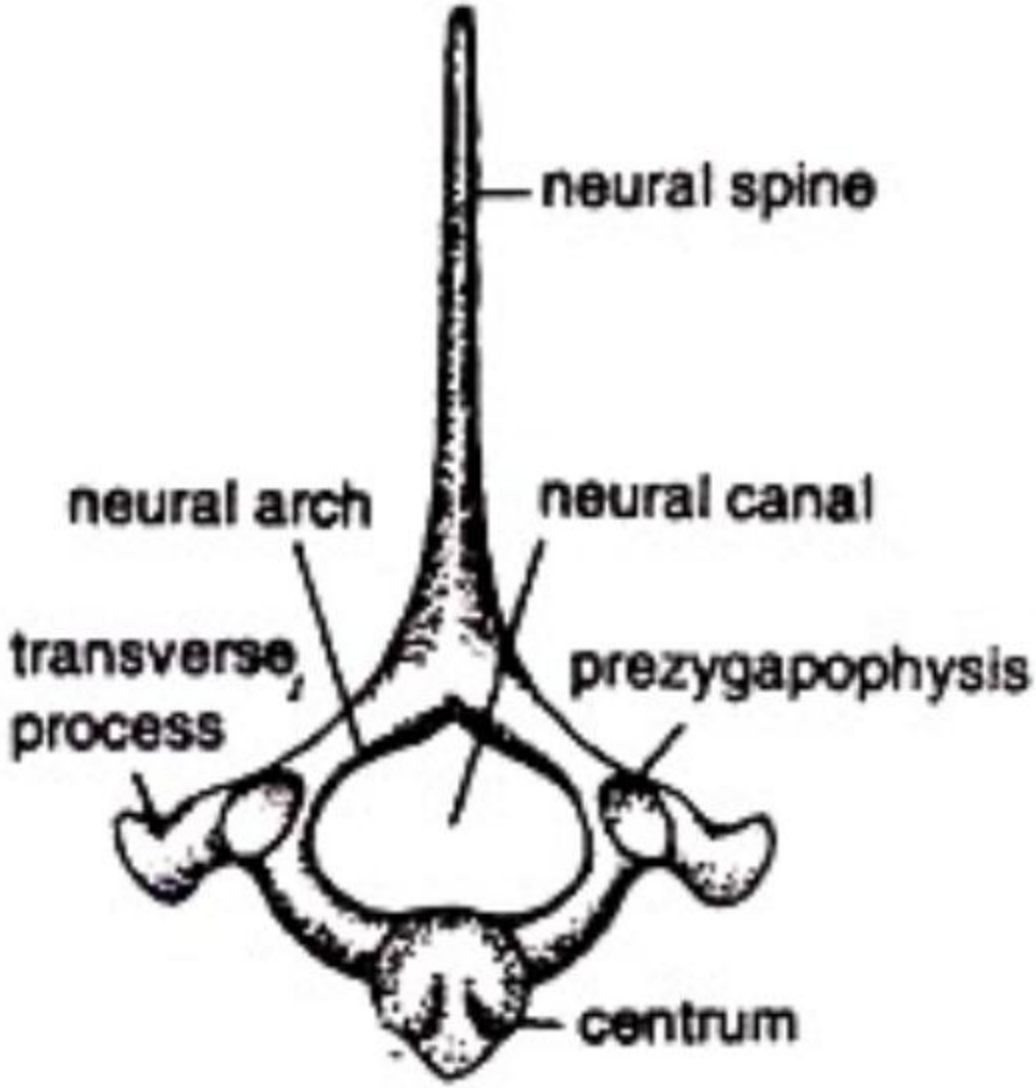
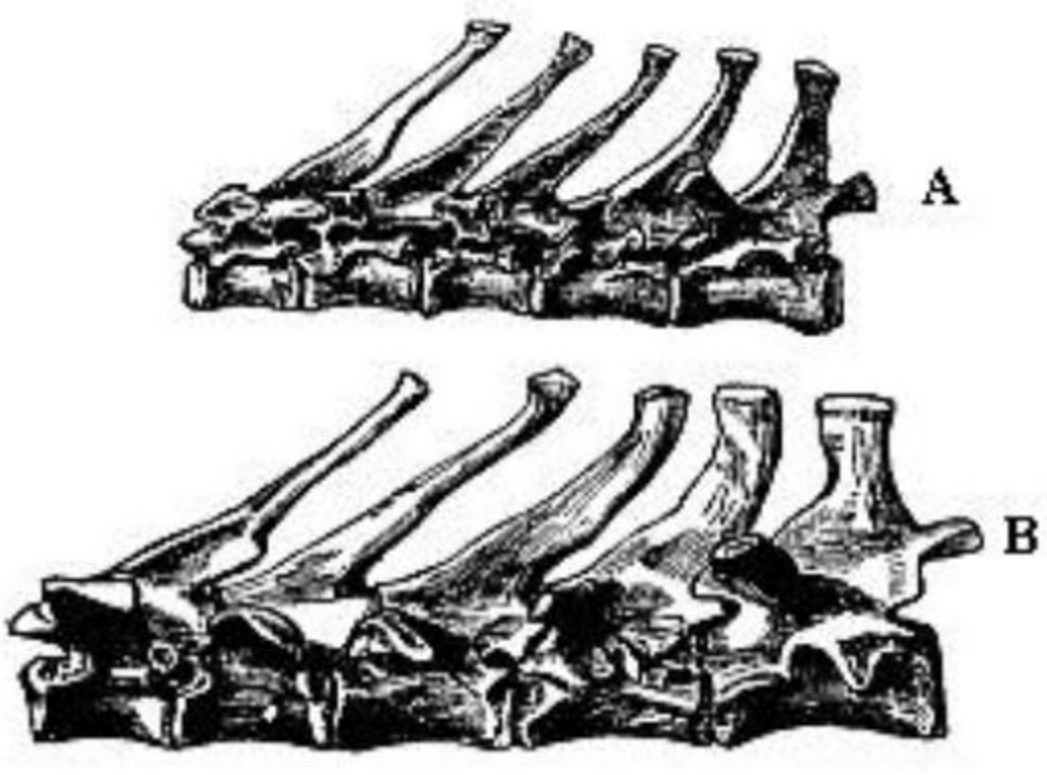
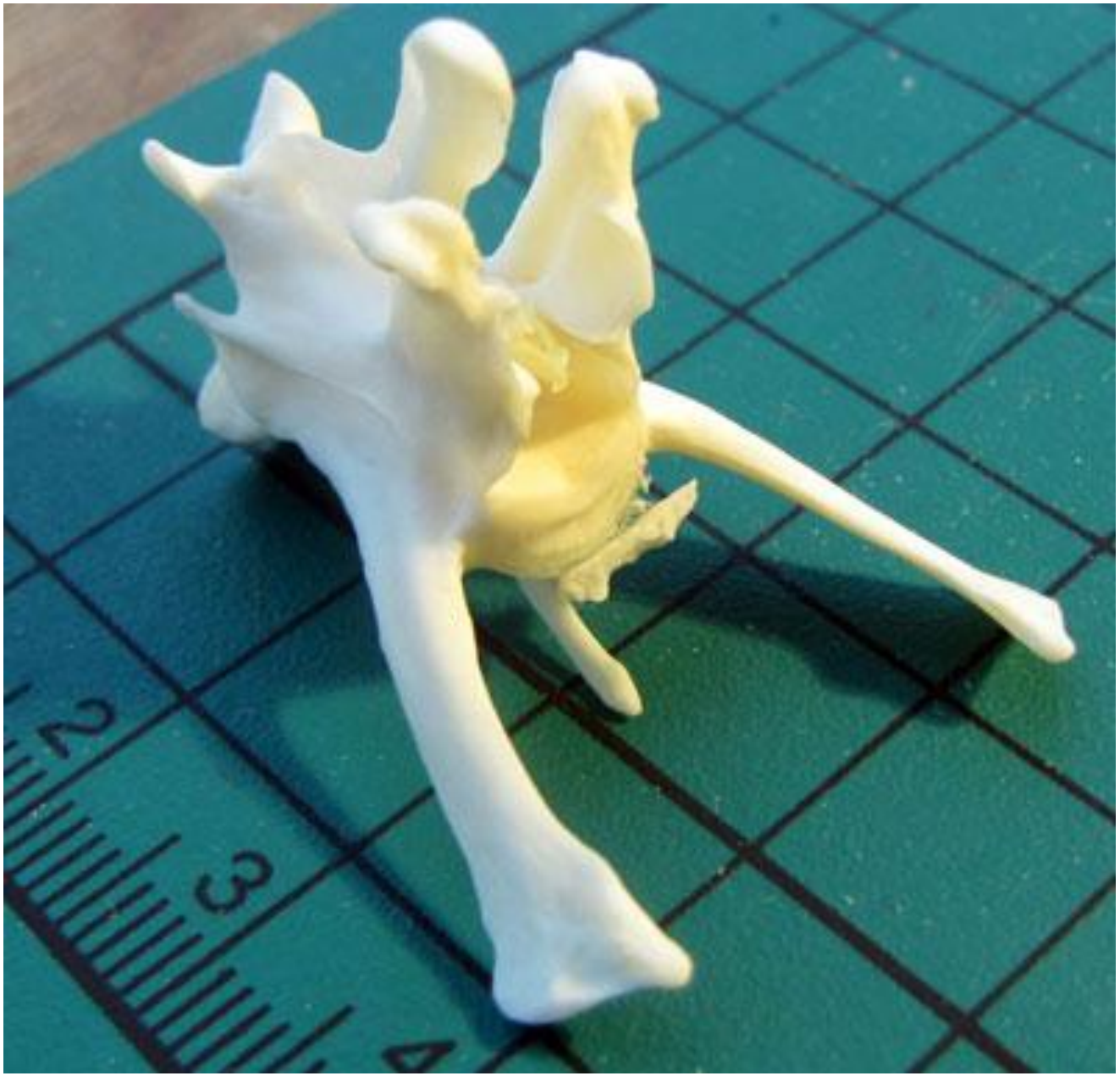


Fig. 42.45 : Cavia sp. Anterior thoracic vertebra.
Anterior view

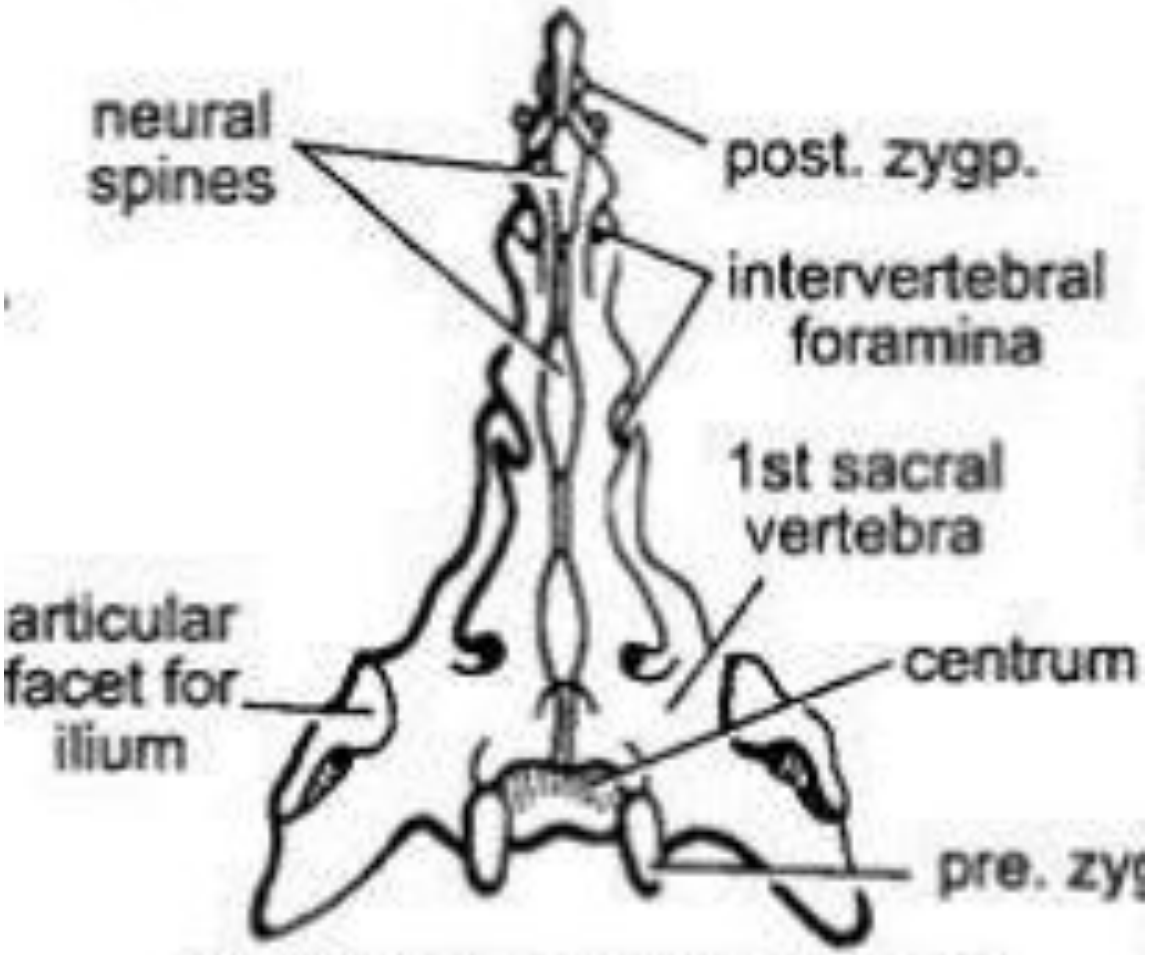


Thoracic vertebrae of rabbit



Lumbar vertebra of rabbit

Sacrum of rabbit



12. SACRUM (Dorsal view)

13. Rabbit. Vertebrae.

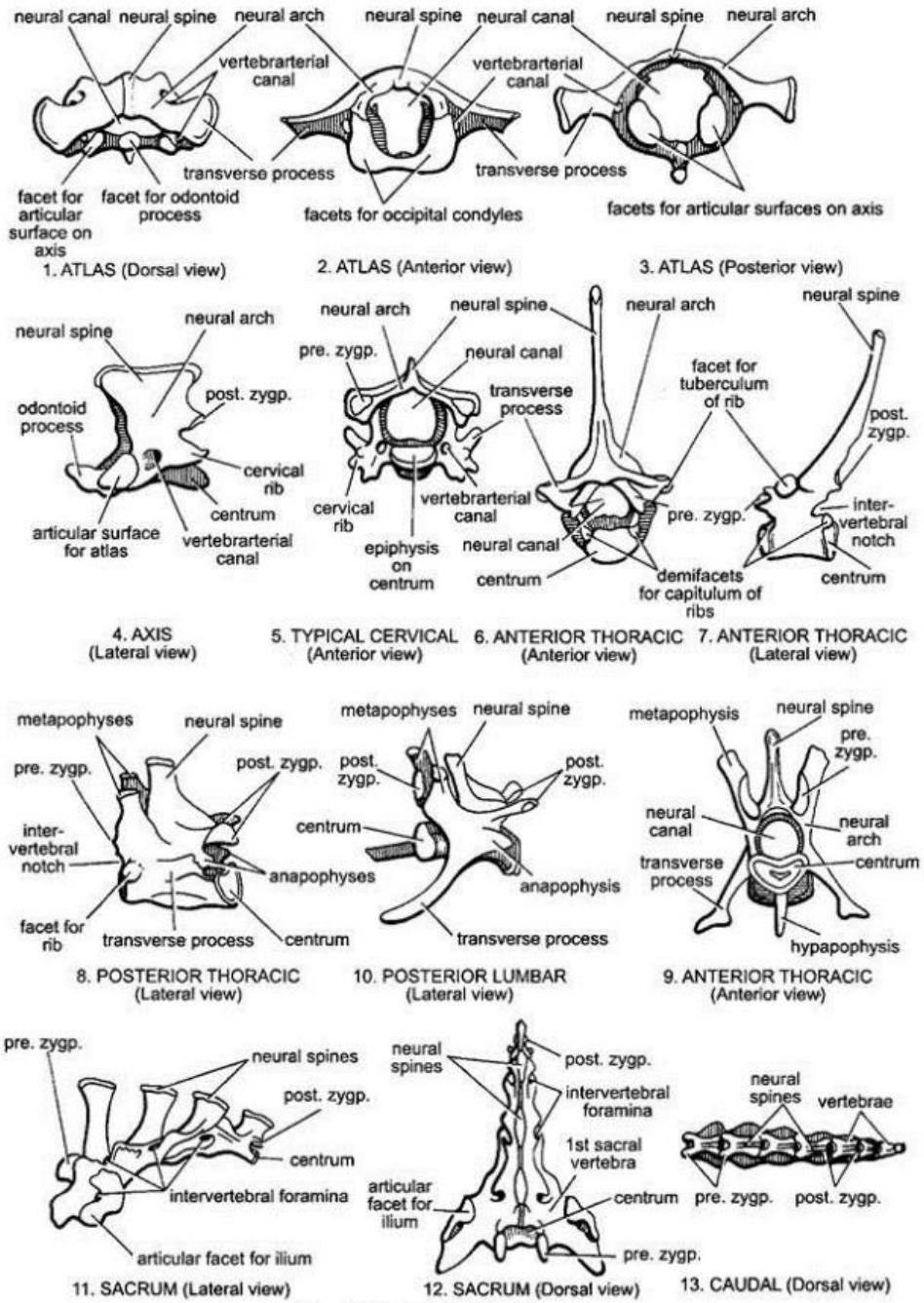
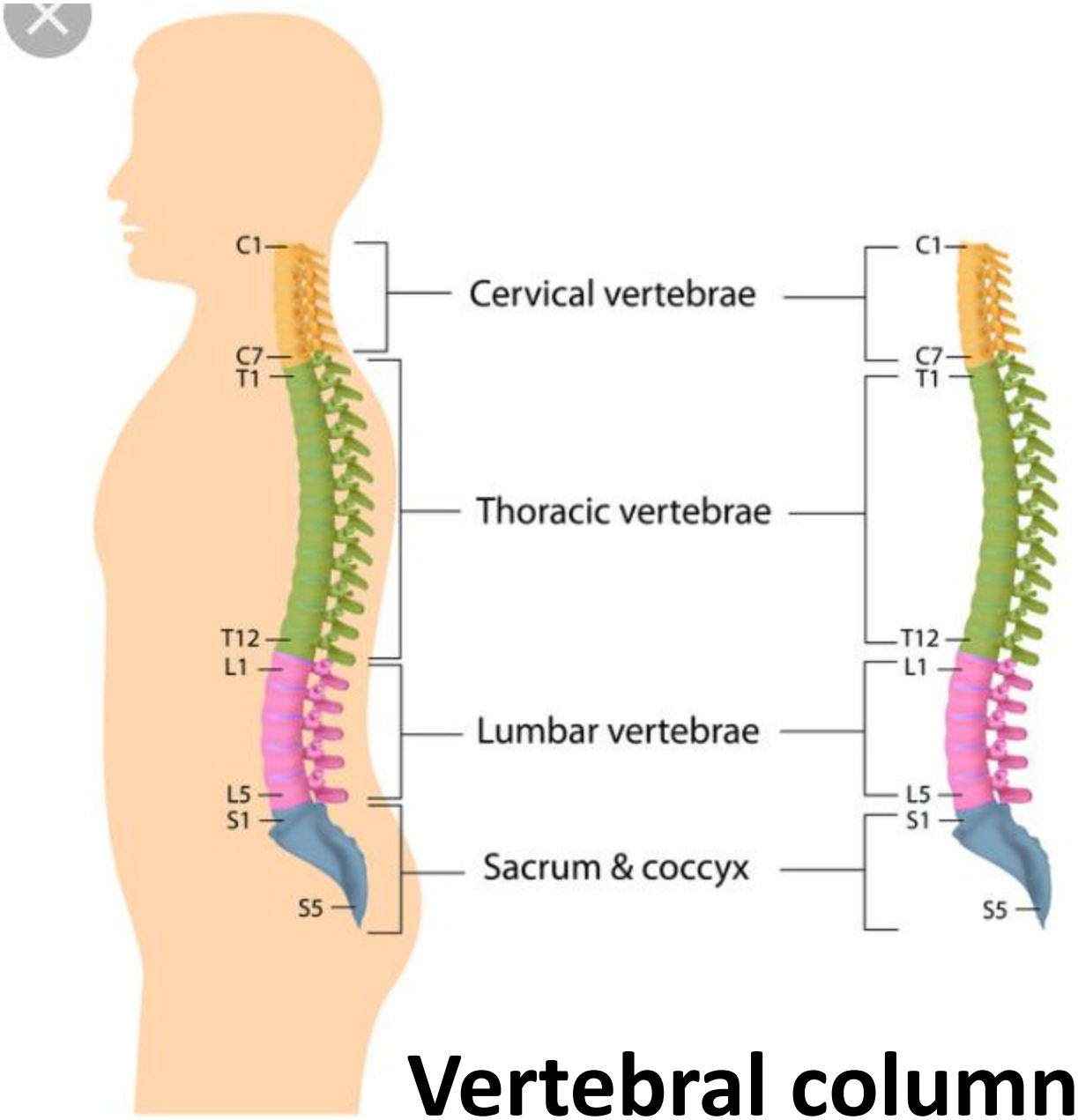
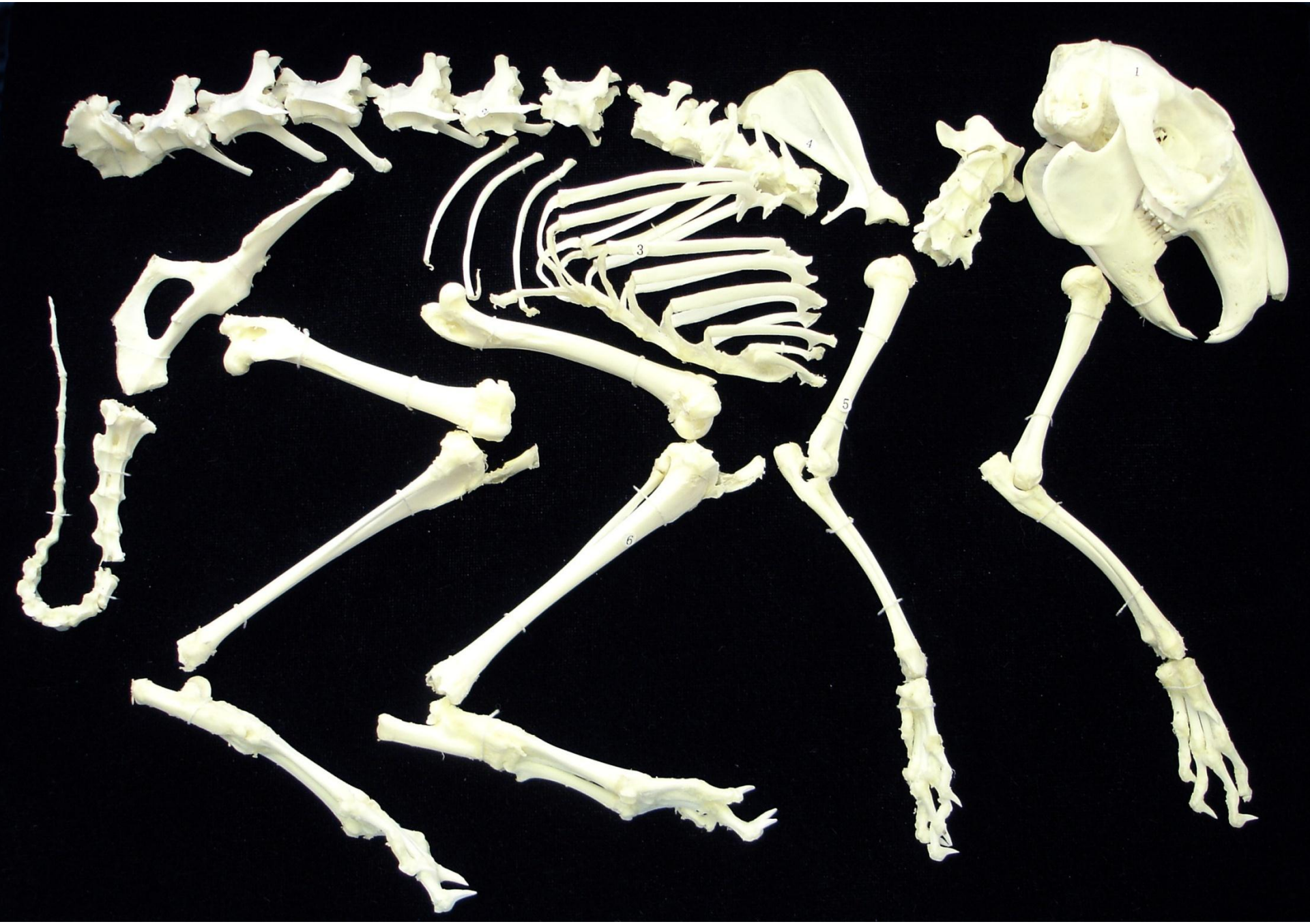
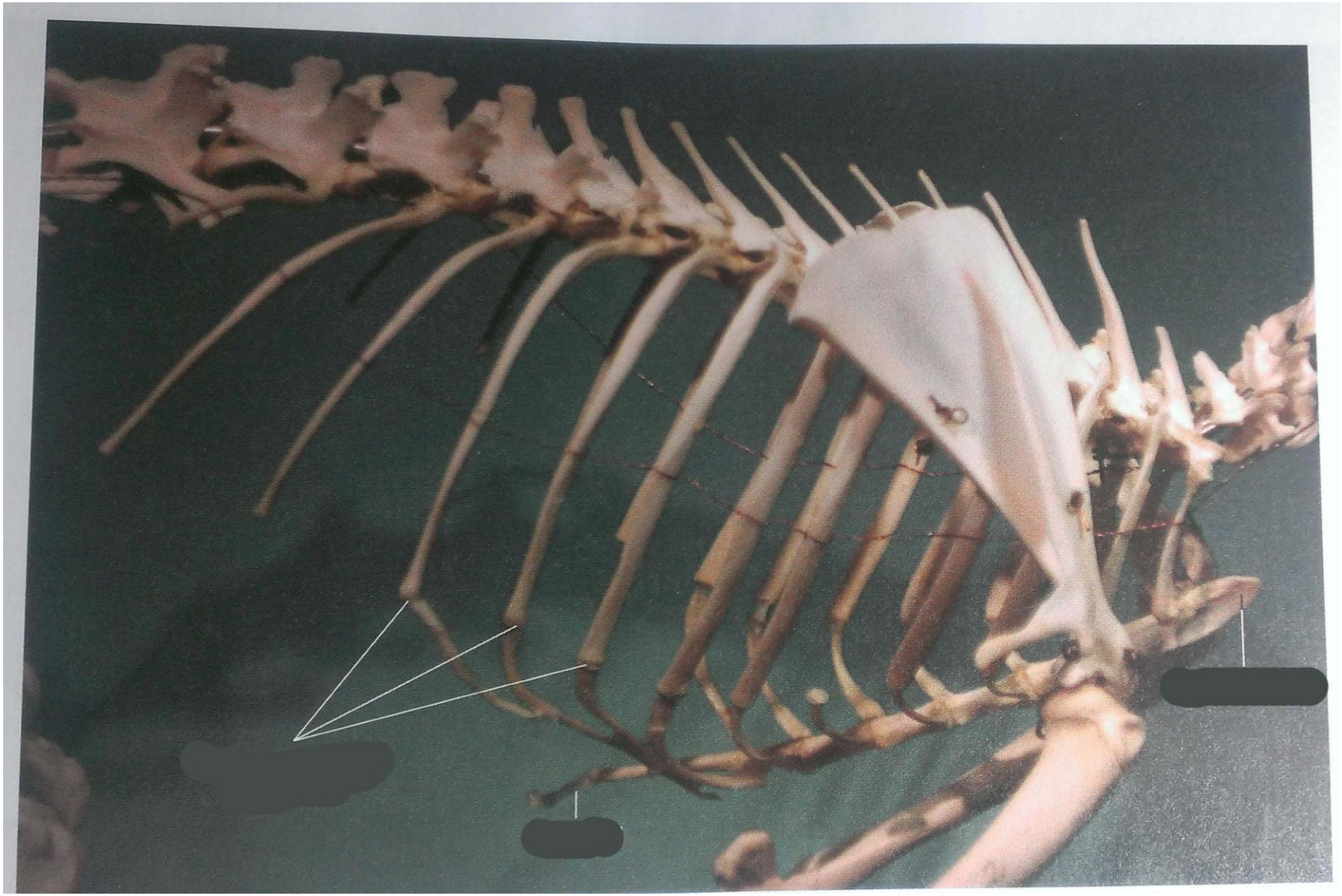


Fig. 29.13. Rabbit. Vertebrae.

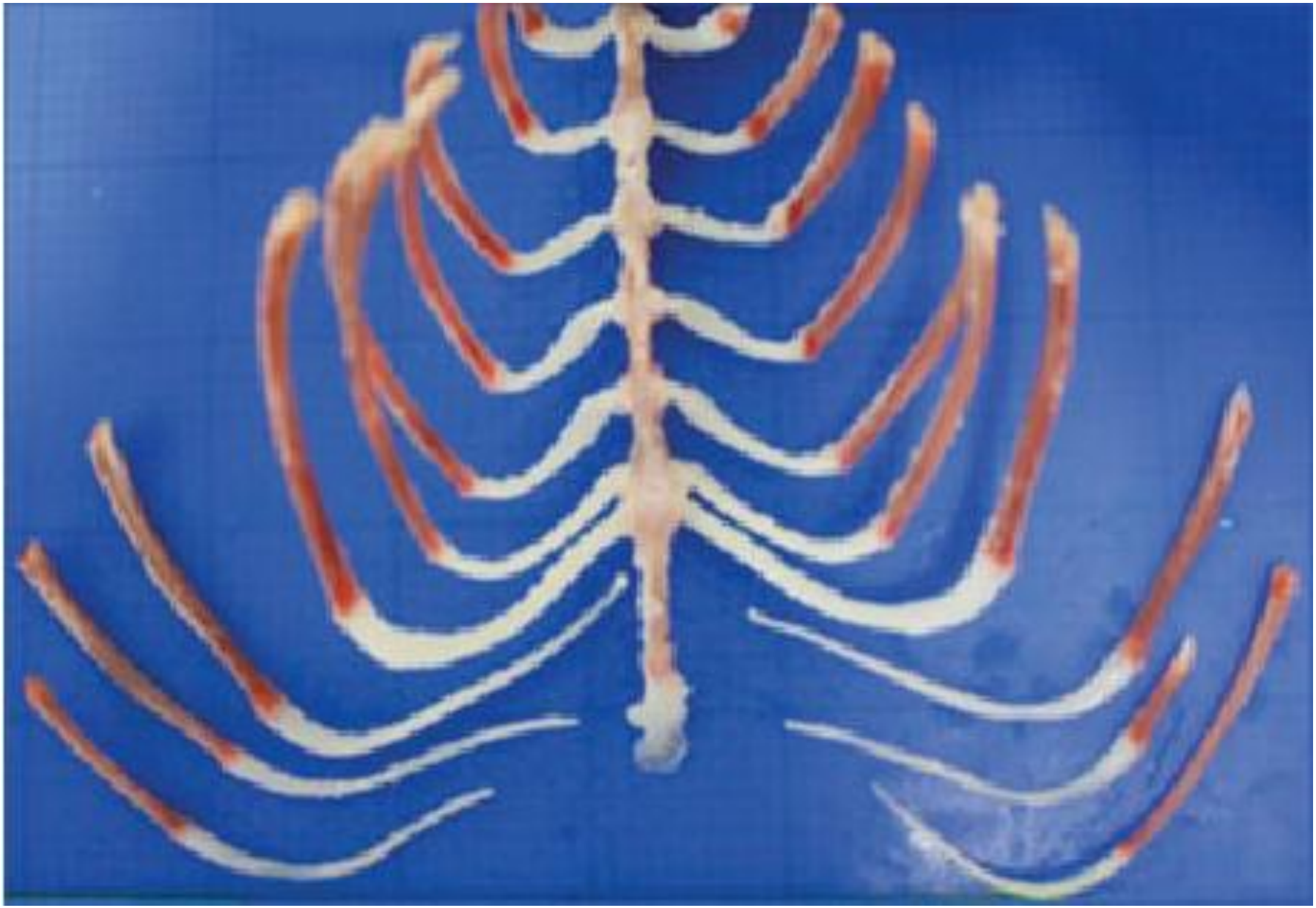


Vertebral column of man


1
2
3
4
5
6



Twelve pairs of ribs attached to the vertebral column at the back and the breastbone in front .



Ribs and sternum of rabbit

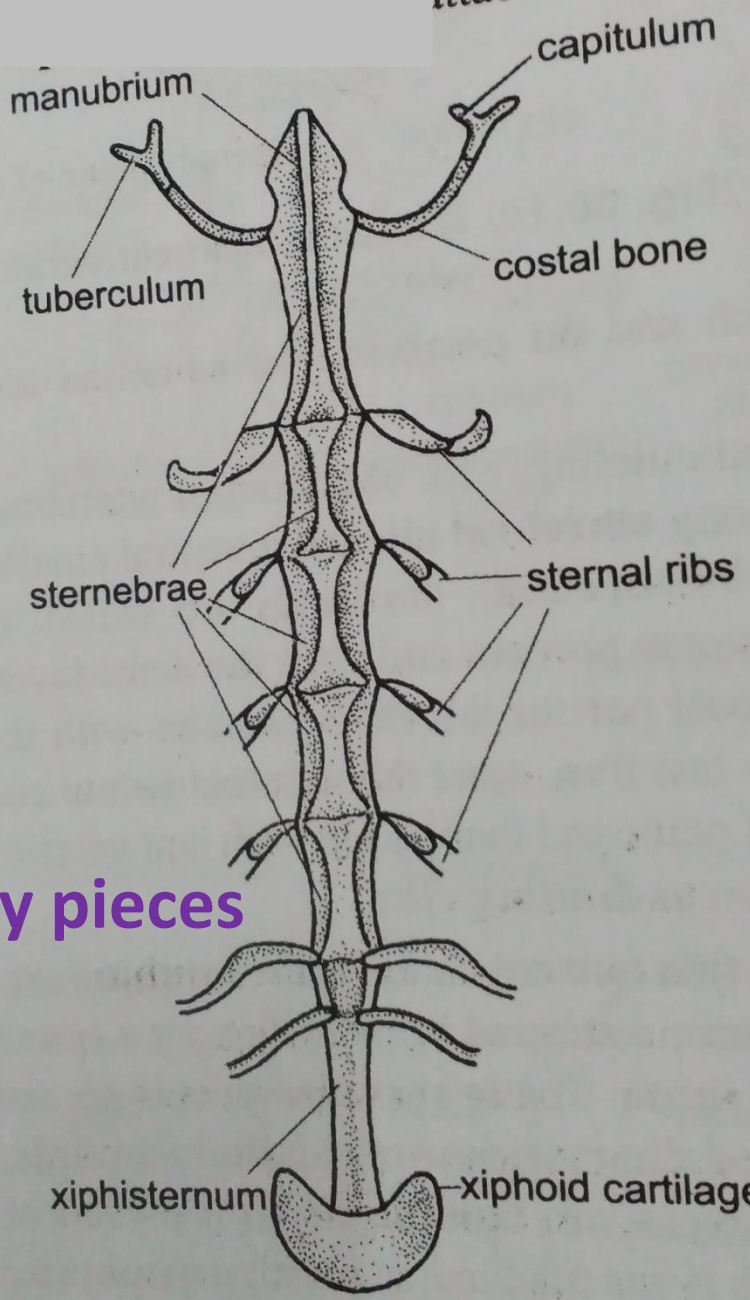
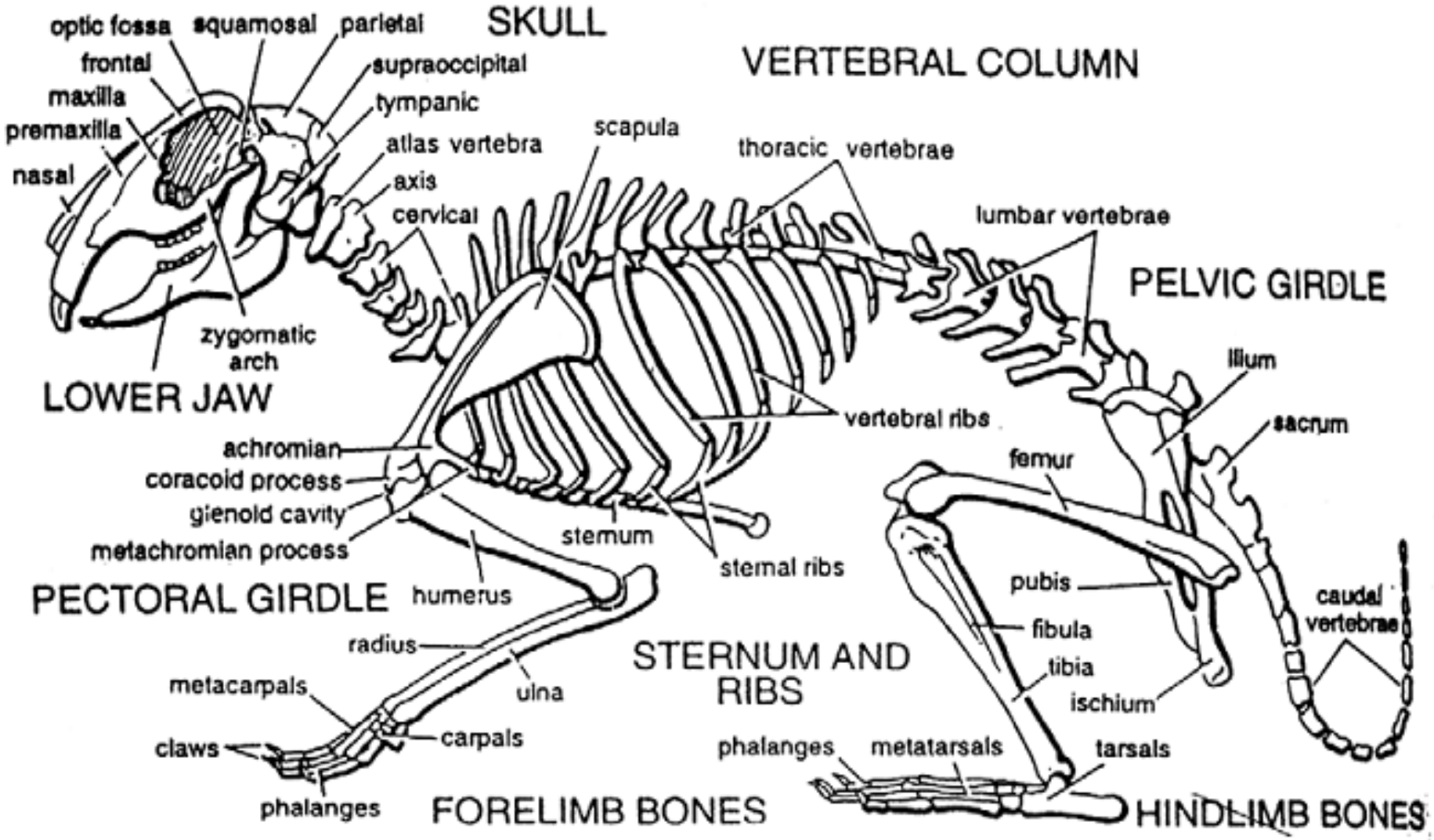
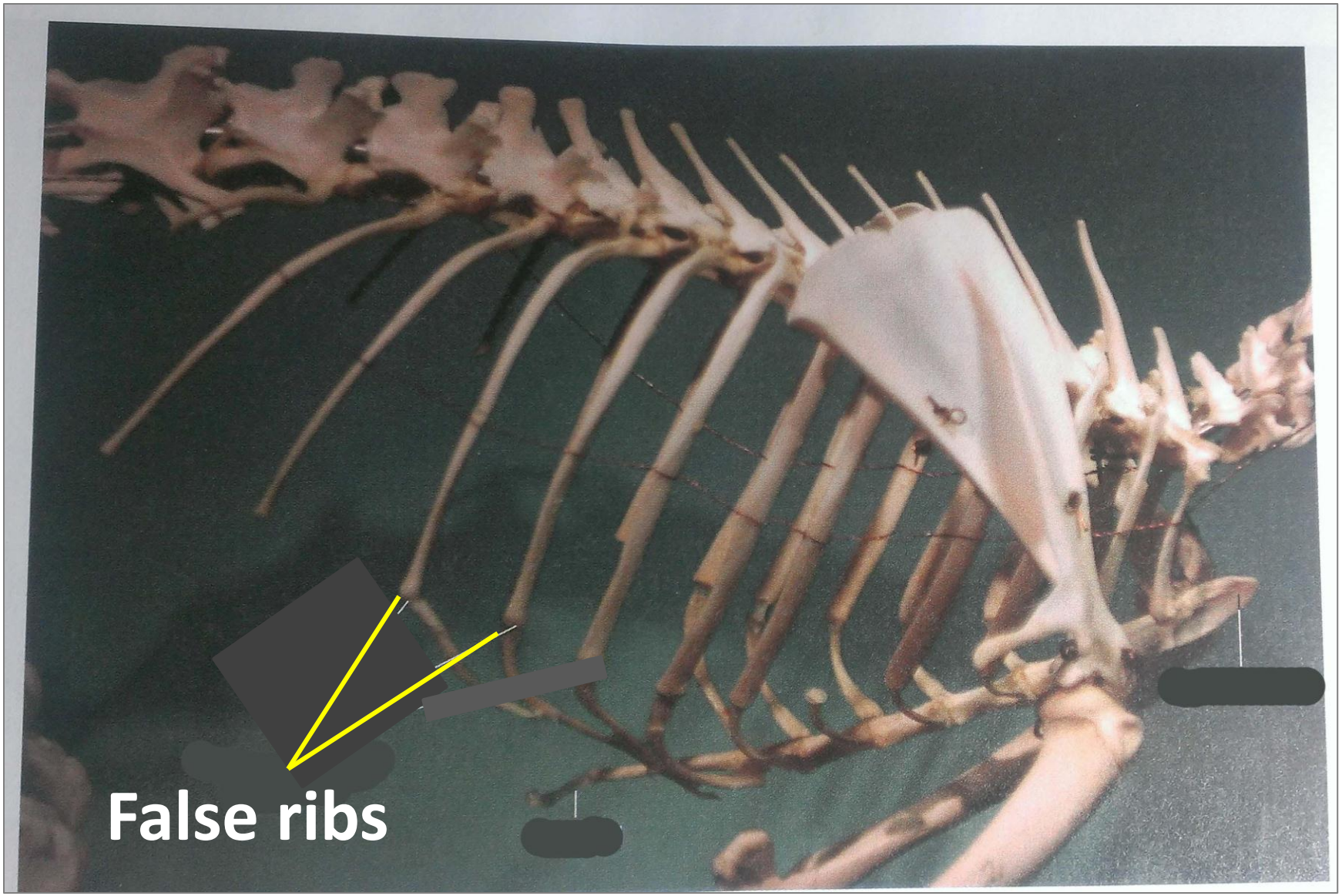


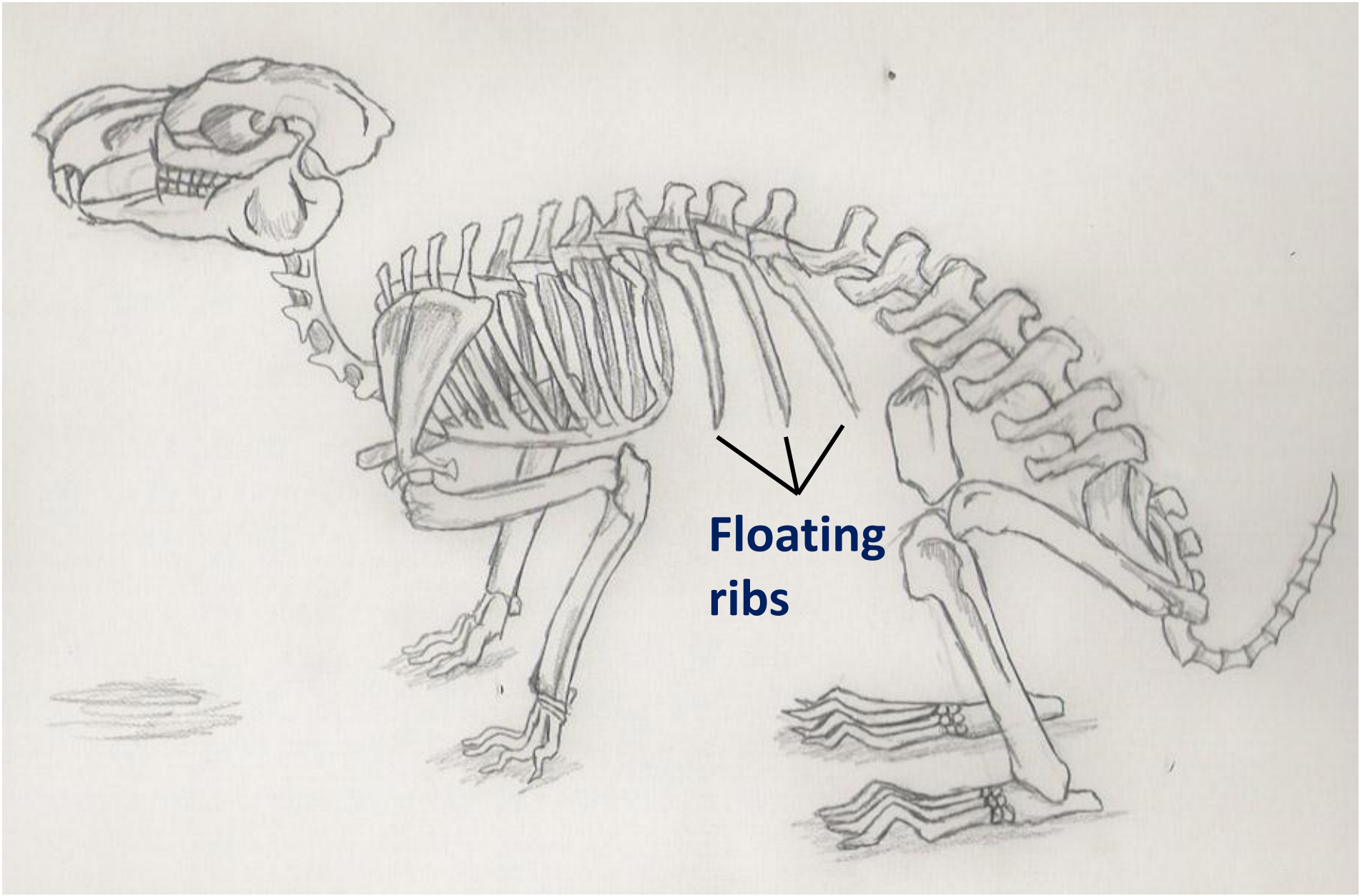
Fig. 29.15. Rabbit. Sternum.

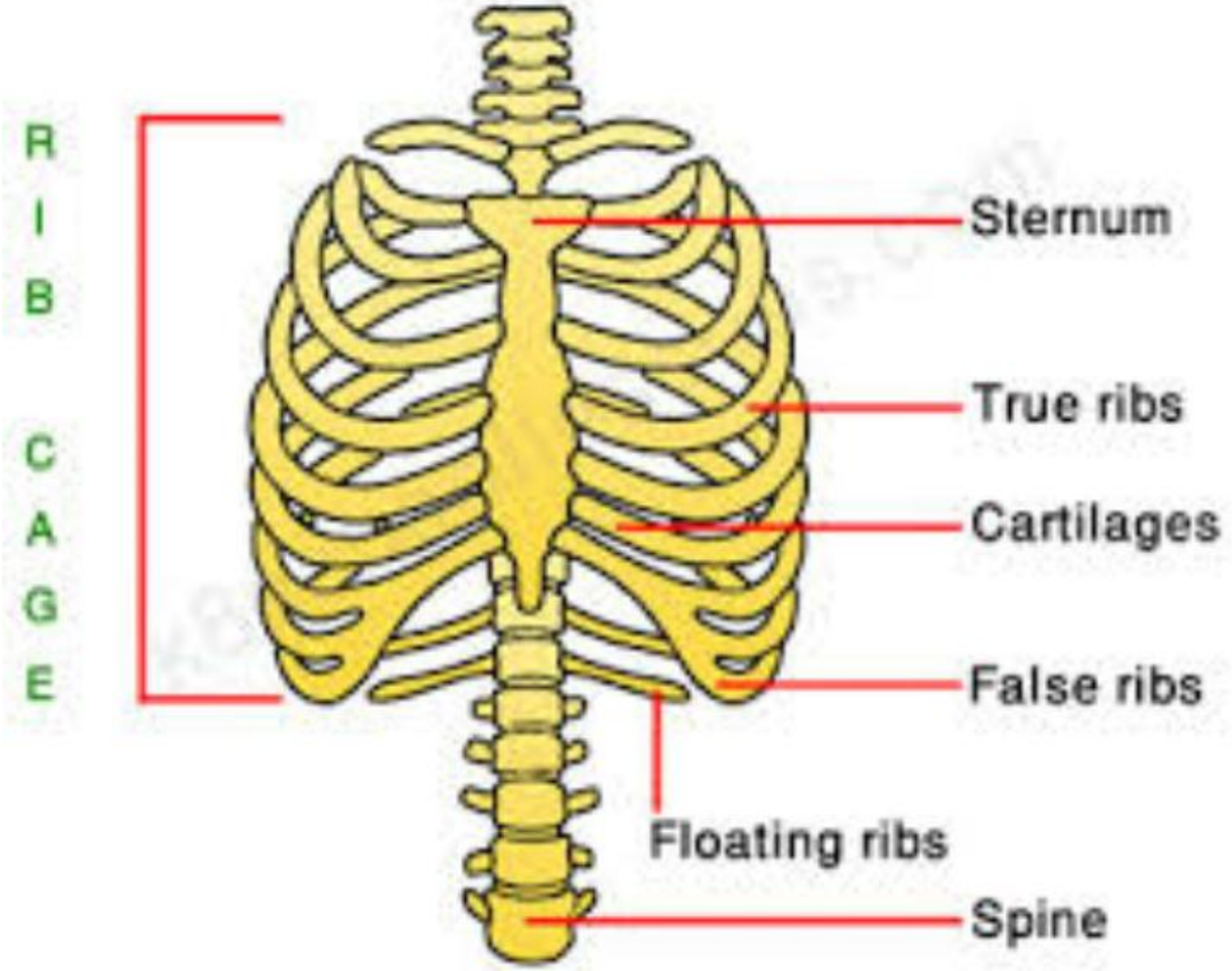
Seven bony pieces



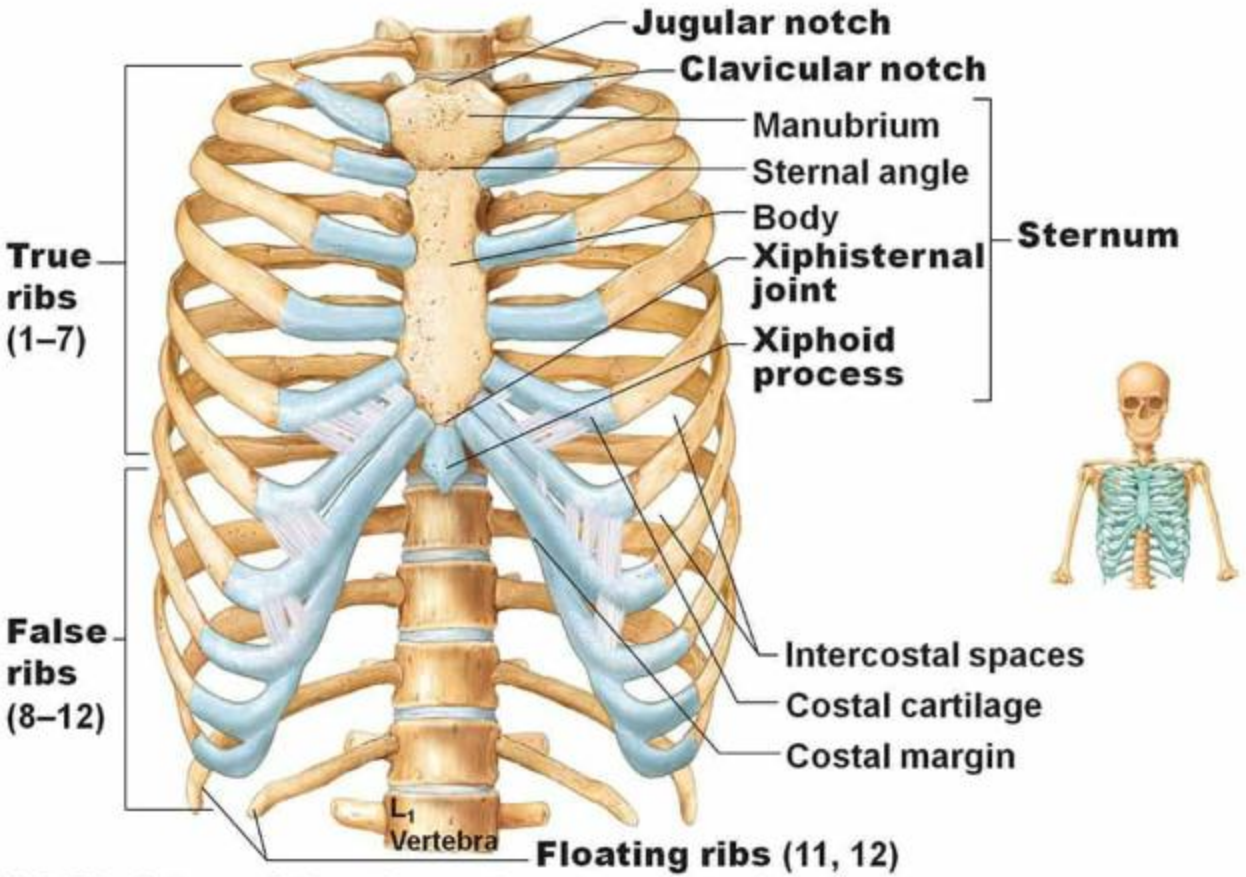
RABBIT SKELETON


False ribs


Floating
ribs


RIB CAGE
Sternum
True ribs
Cartilages
False ribs
Floating ribs
Spine

Thoracic Cage



(a) Skeleton of the thoracic cage, anterior view

image via: studyblue.com

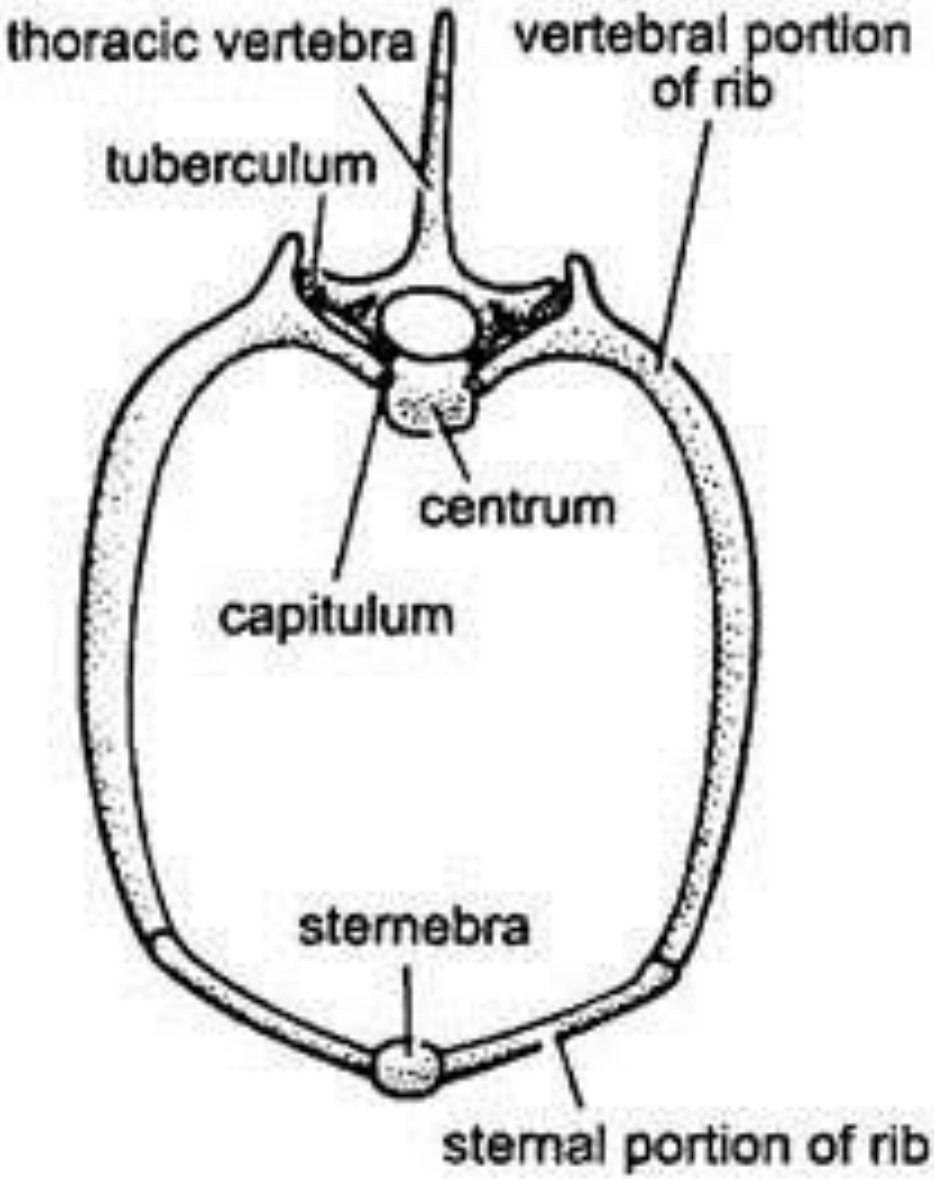
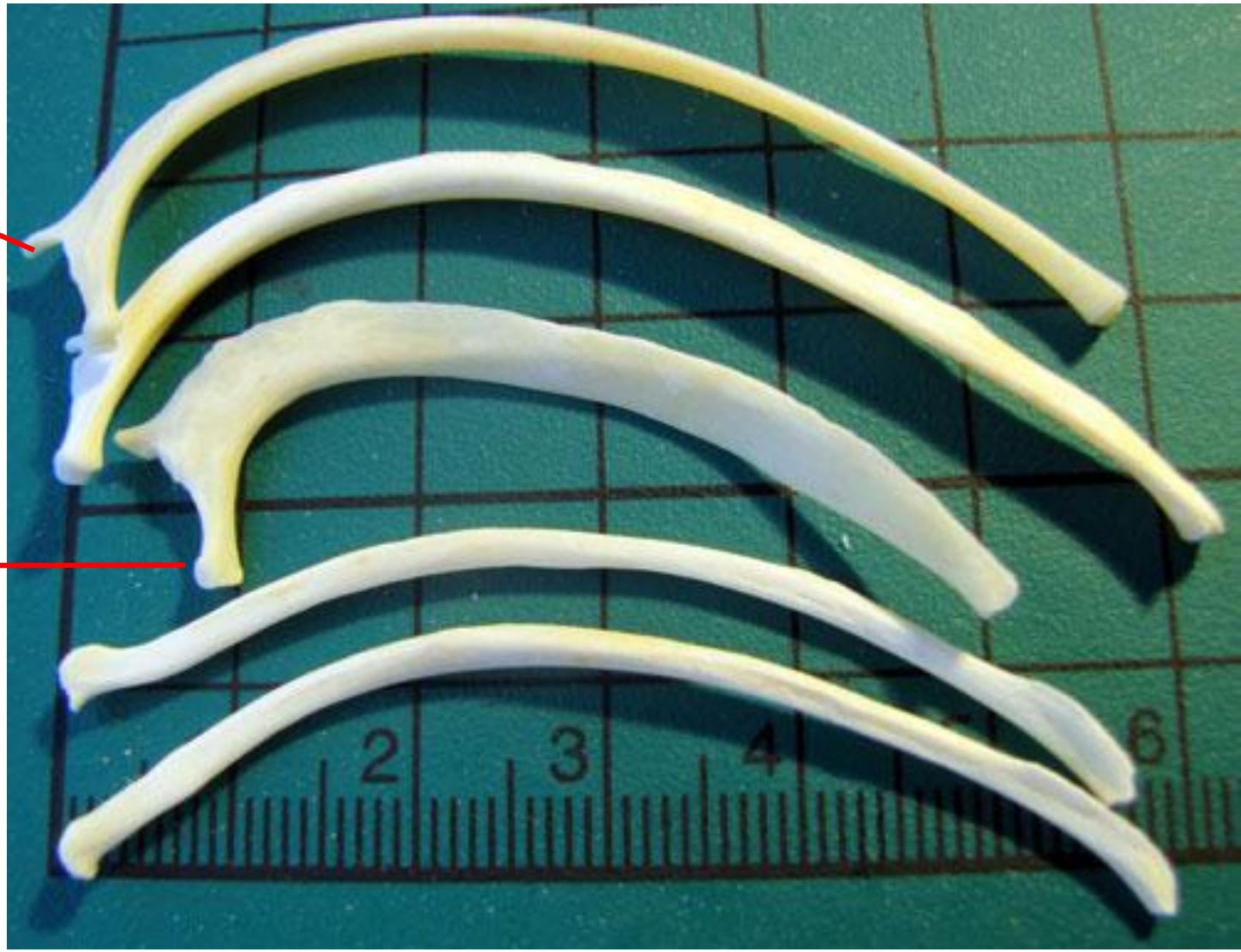
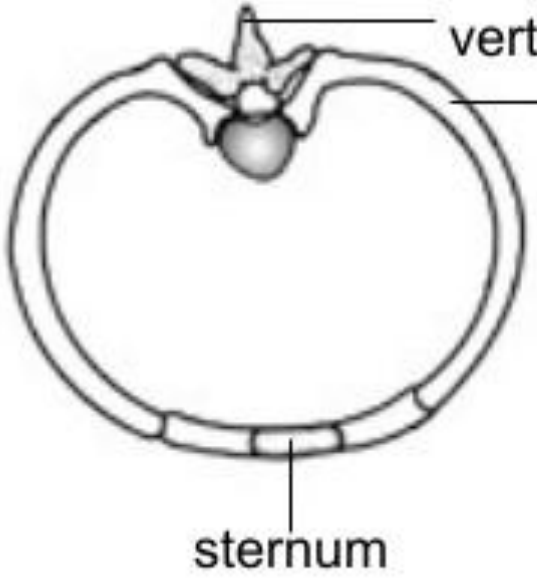
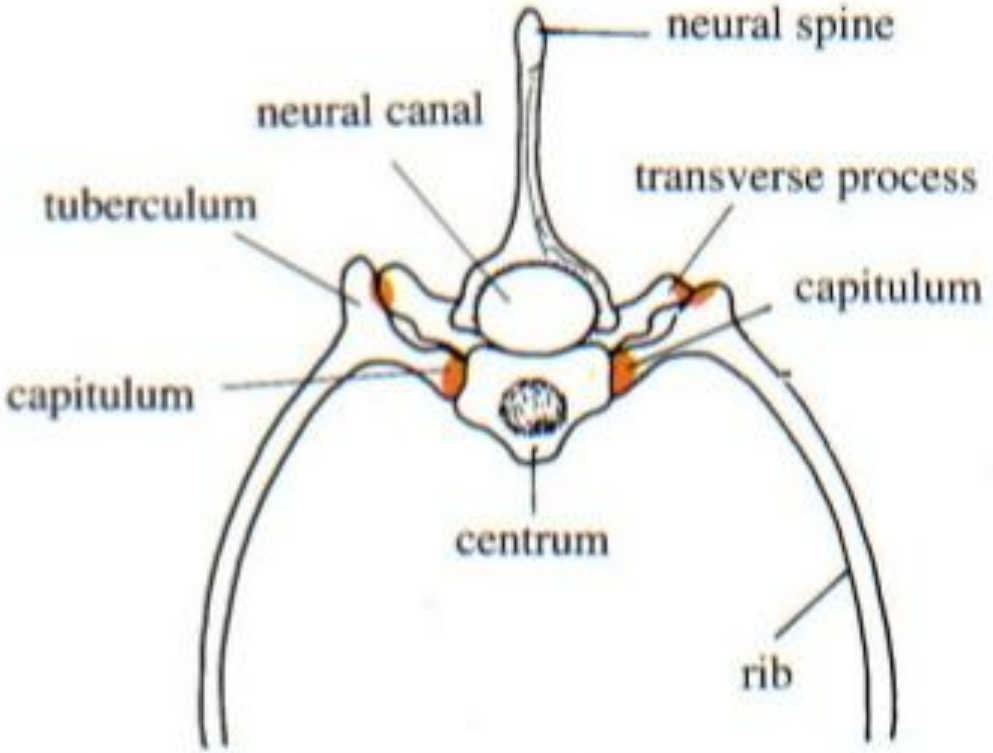


Fig. 29.14. Rabbit. A thoracic vertebra with its ribs.



Ribs of rabbit





A pair of ribs articulates with each vertebra.The tuberculum articulates with the facet on the tranverse process and the capitulum articulates with the capitular facet.

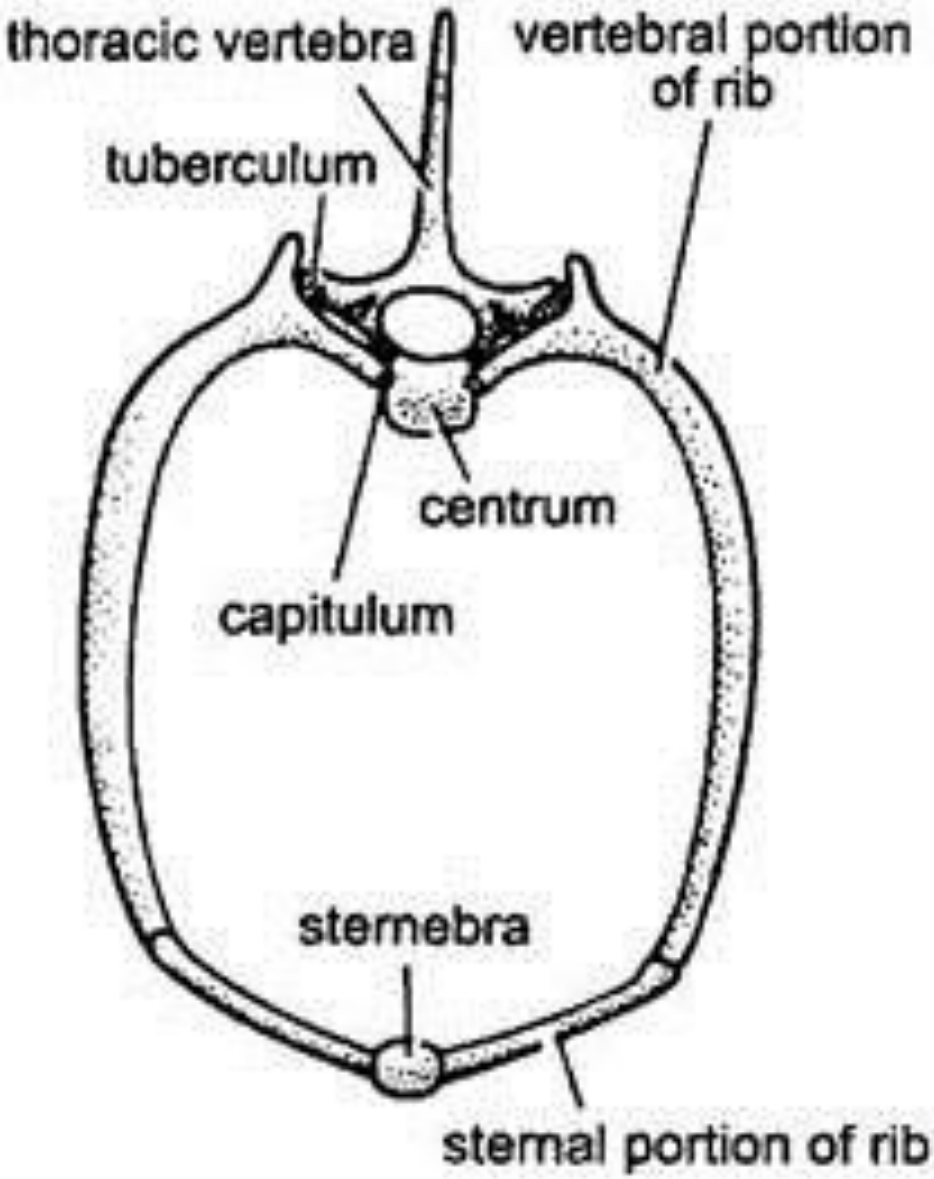
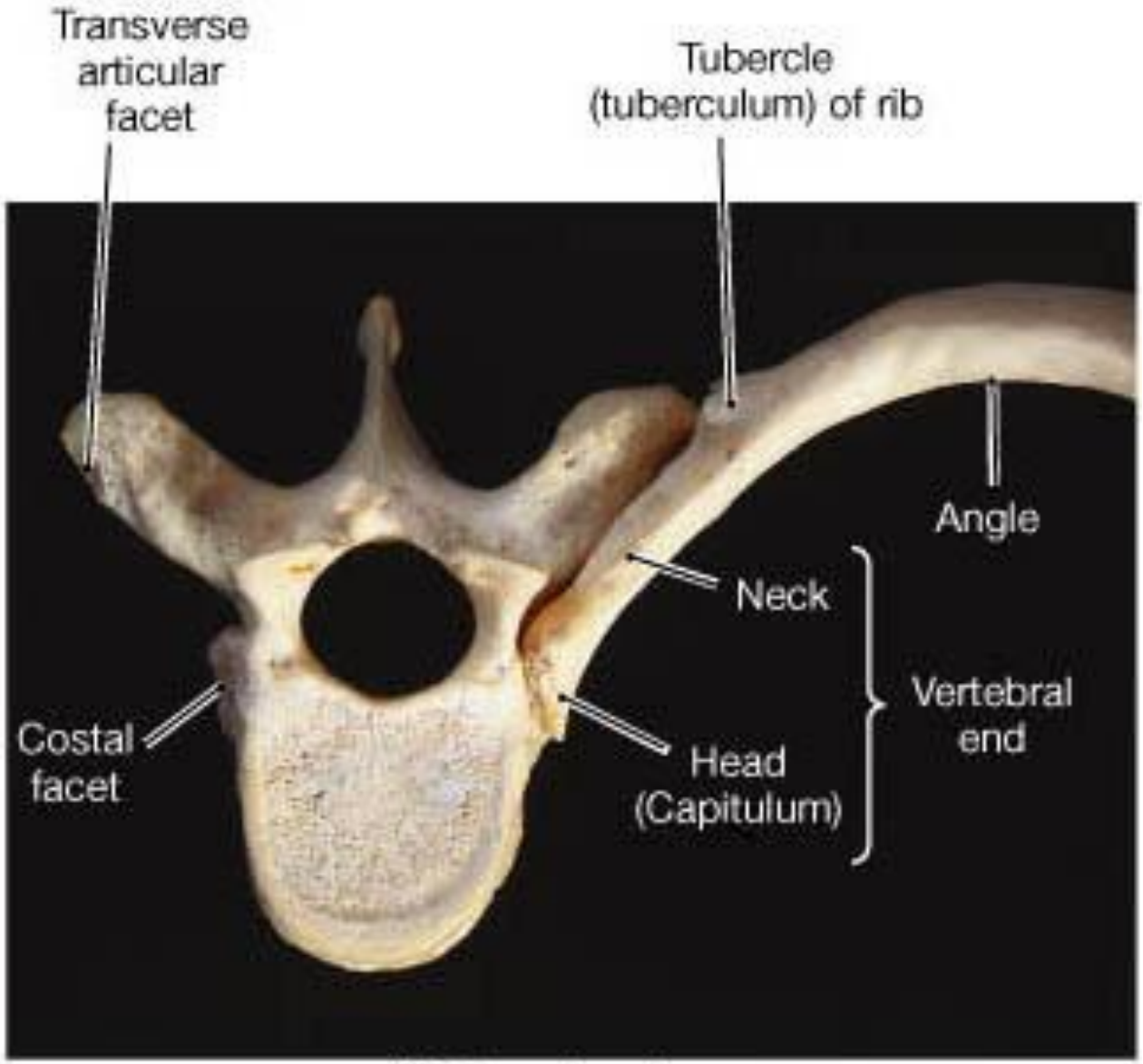
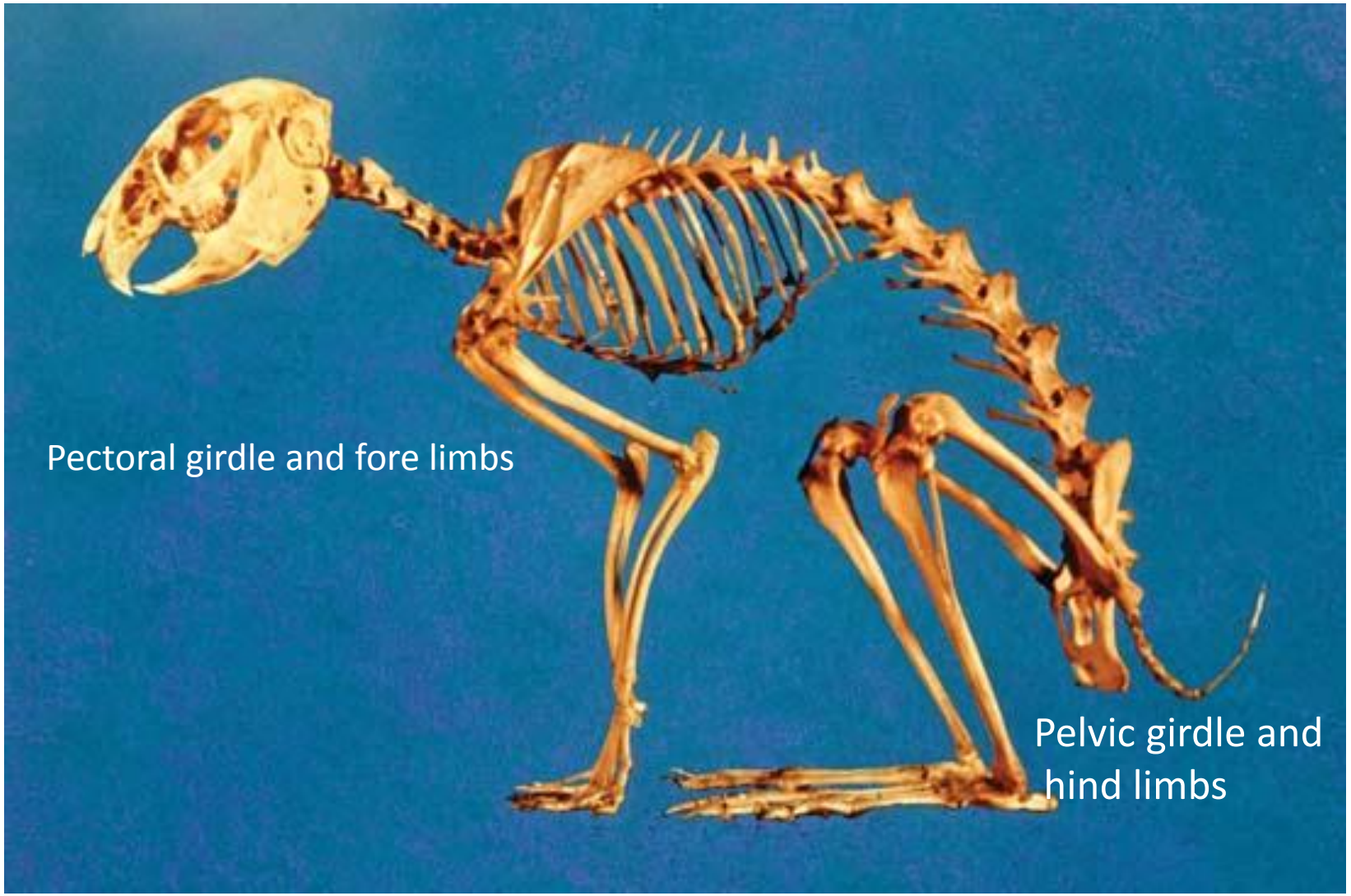


Fig. 29.14. Rabbit. A thoracic vertebra with its ribs.



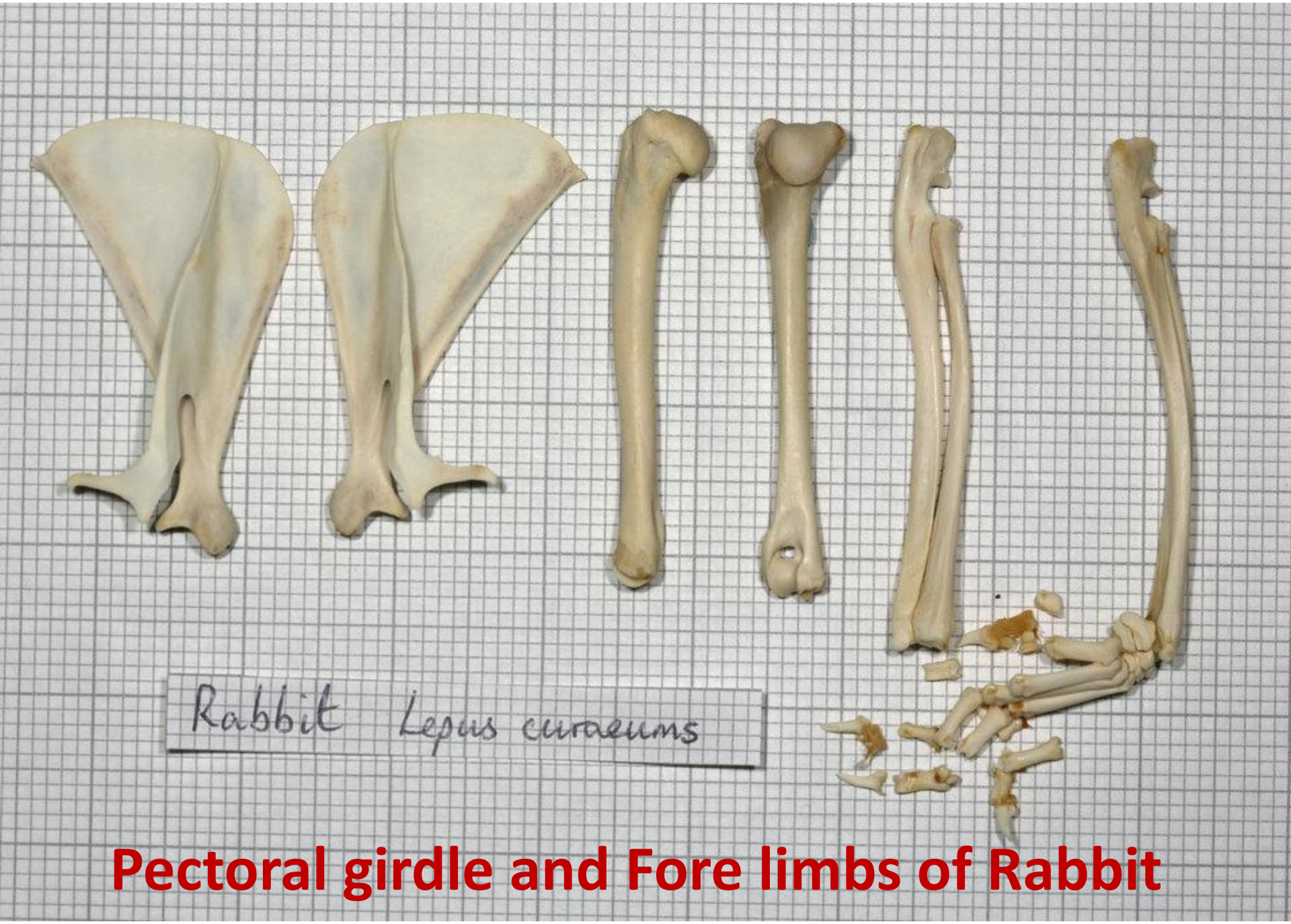
(b) Superior view

Vertebra and rib of human

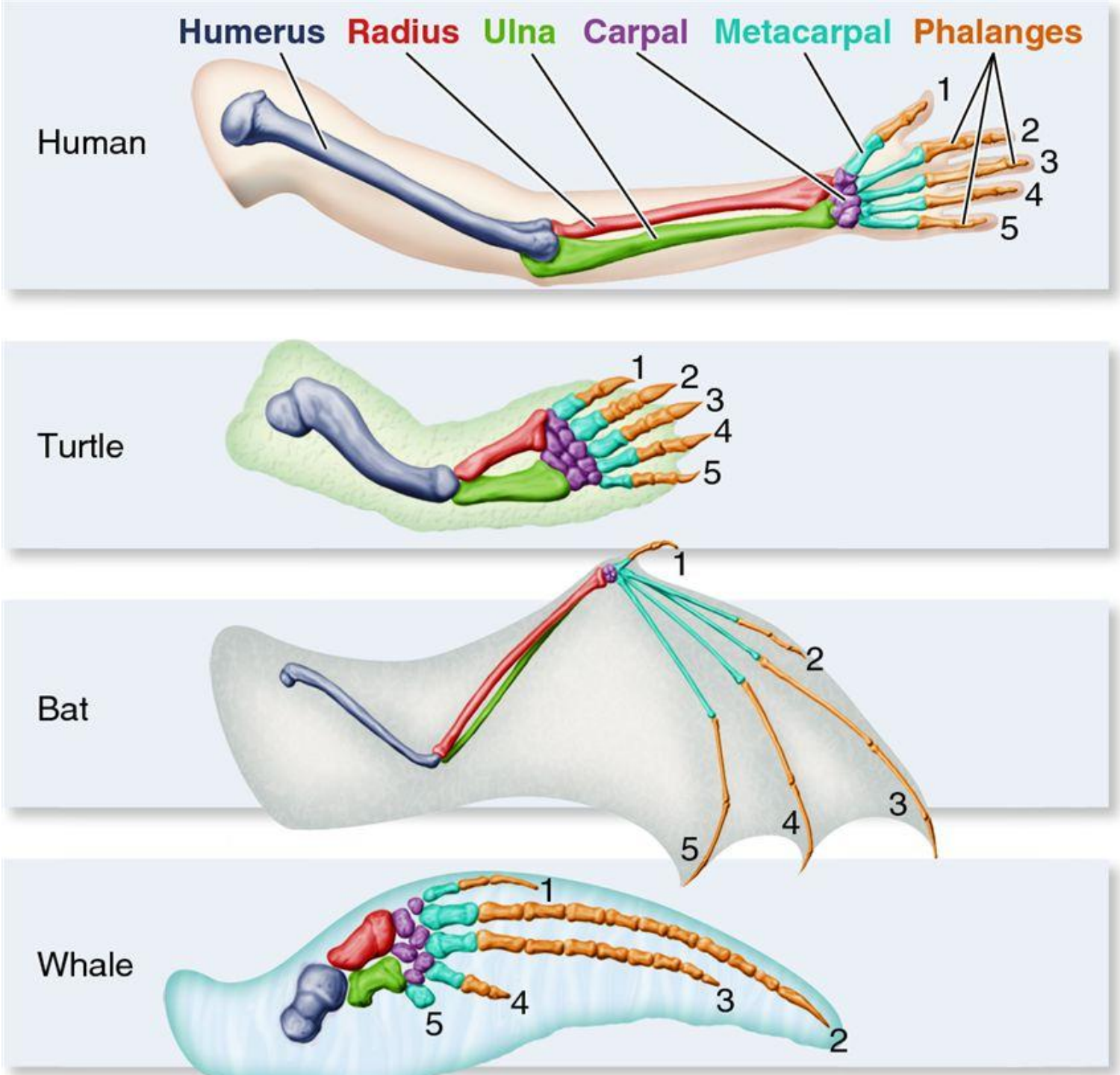


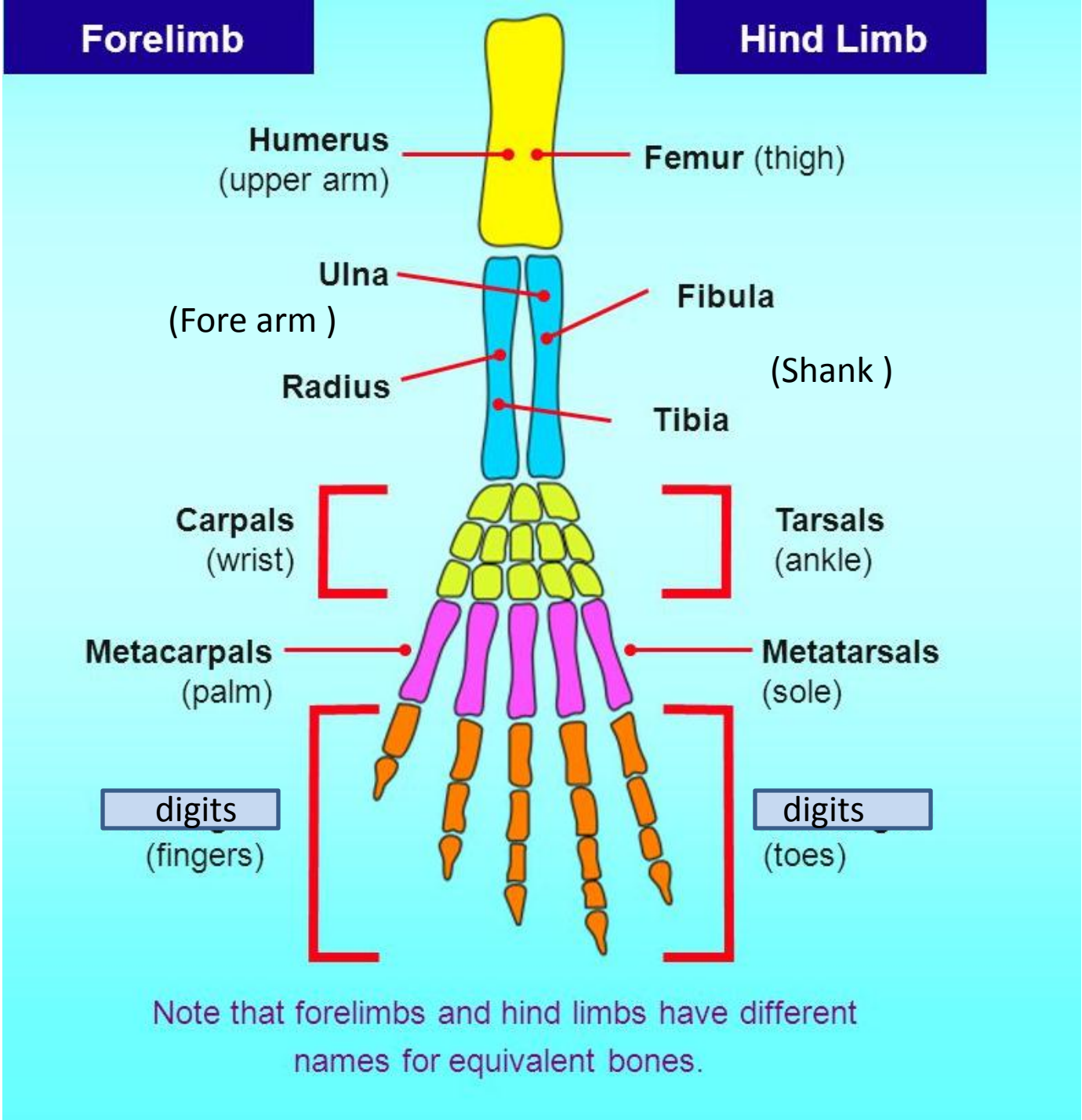
Appendicular skeleton of rabbit

Appendicular skeleton of rabbit

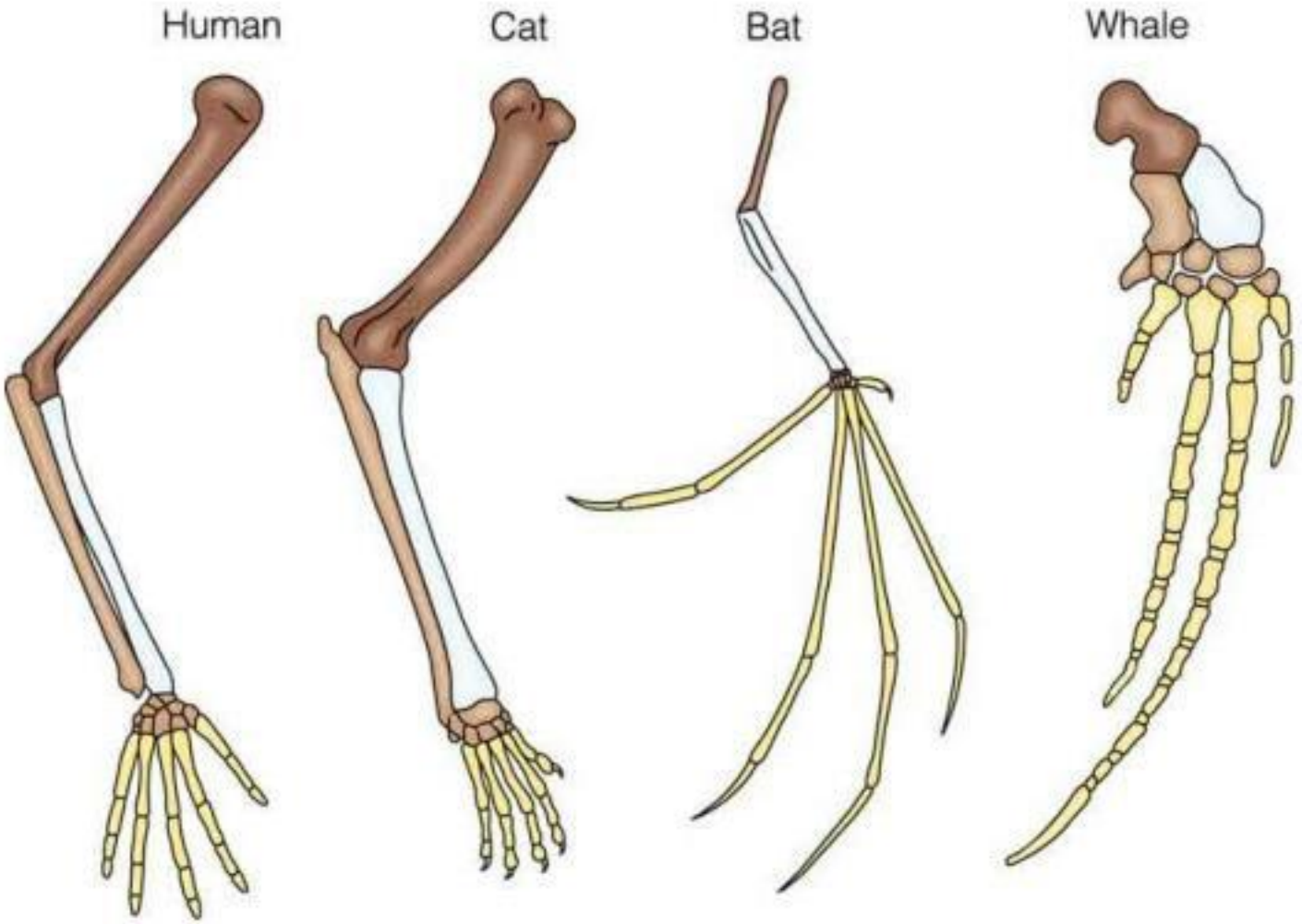


Pectoral girdle and Fore limbs of Rabbit

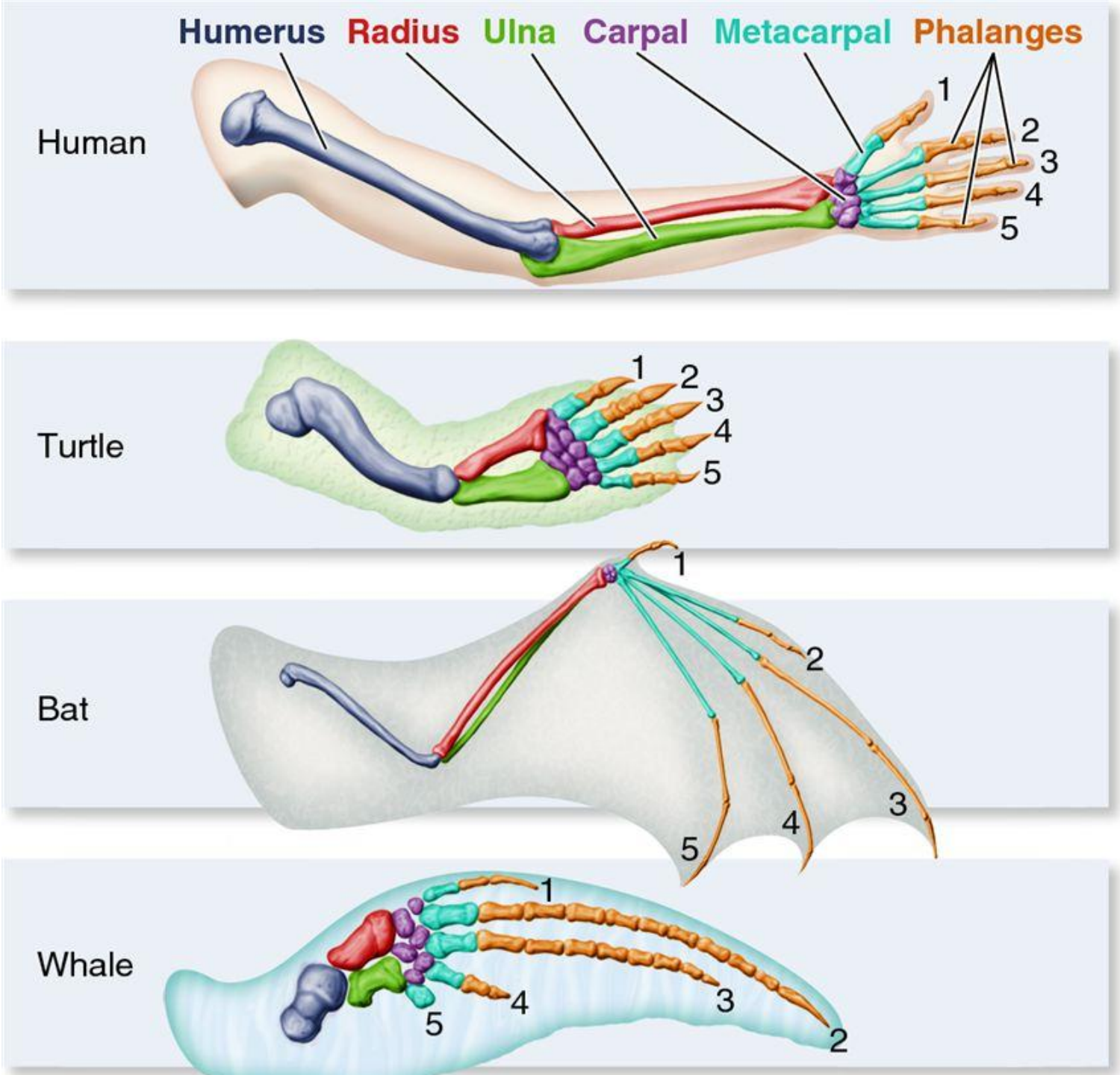

Humerus
Radius
Ulna
Carpal
Metacarpal
Phalanges
Human
1
2
3
4
5
Turtle
1
2
3
4
5
Bat
1
2
3
4
5
Whale
1
2
3
4
5


Forelimb
Hind Limb
Humerus
(upper arm)
Femur (thigh)
Ulna
(Fore arm)
Fibula
(Shank)
Radius
Tibia
Carpals
(wrist)
Tarsals
(ankle)
Metacarpals
(palm)
Metatarsals
(sole)
digits
(fingers)
digits
(toes)
Note that forelimbs and hind limbs have different
names for equivalent bones.

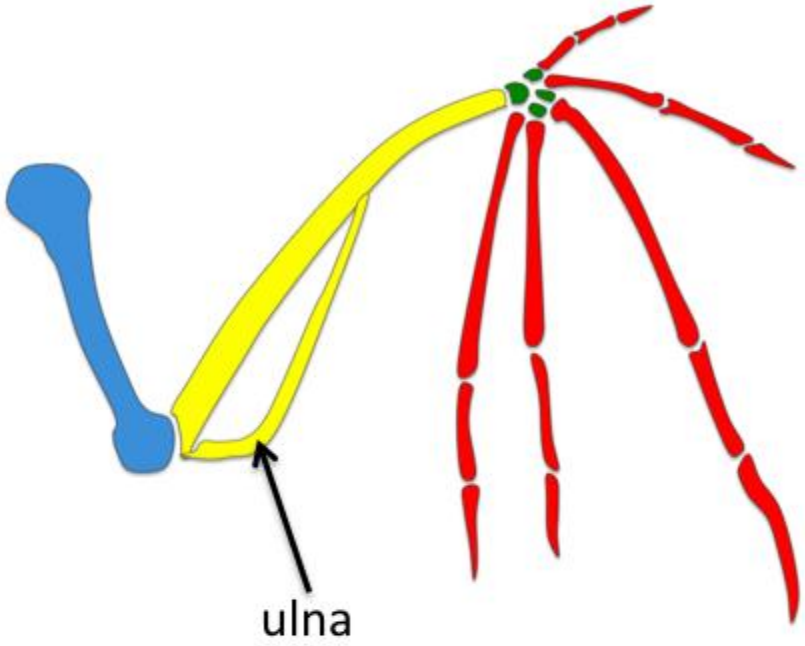
Pentadactyl (5-digit) Limbs



- Nearly all vertebrates have a pentadactyl limb
- Structure is similar in all, despite different uses for the limb

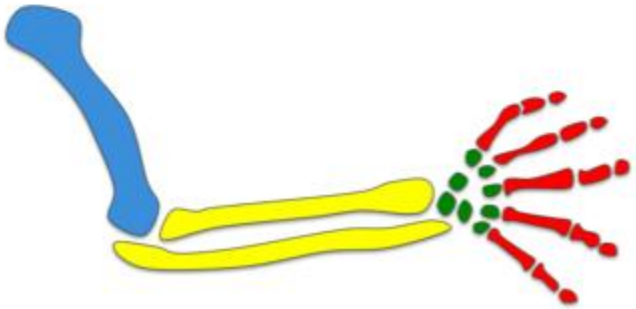

Humerus
Radius
Ulna
Carpal
Metacarpal
Phalanges
Human
1
2
3
4
5
Turtle
1
2
3
4
5
Bat
1
2
3
4
5
Whale
1
2
3
4
5

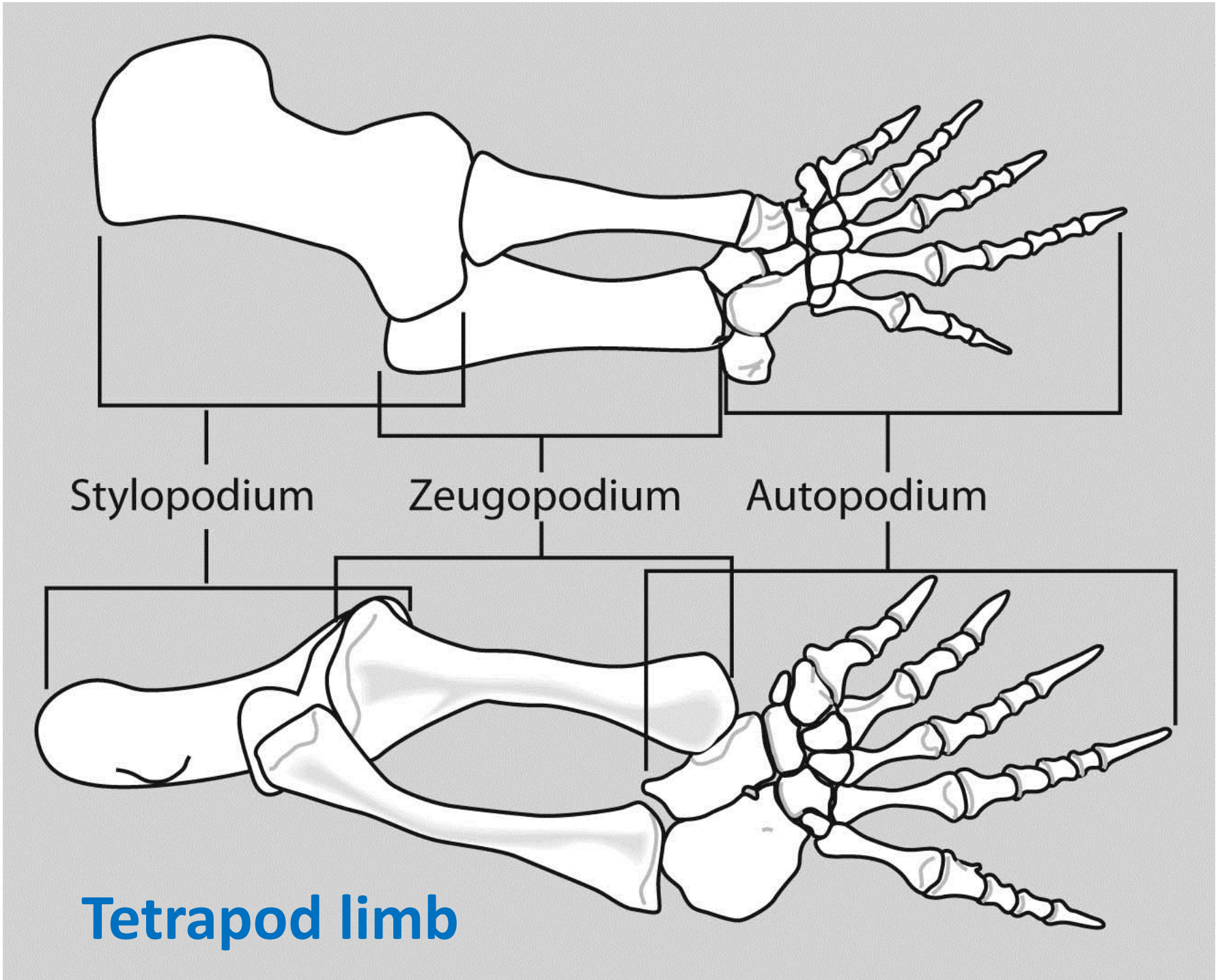
bat skeletal forelimb



stylopod
zeugopod
autopod

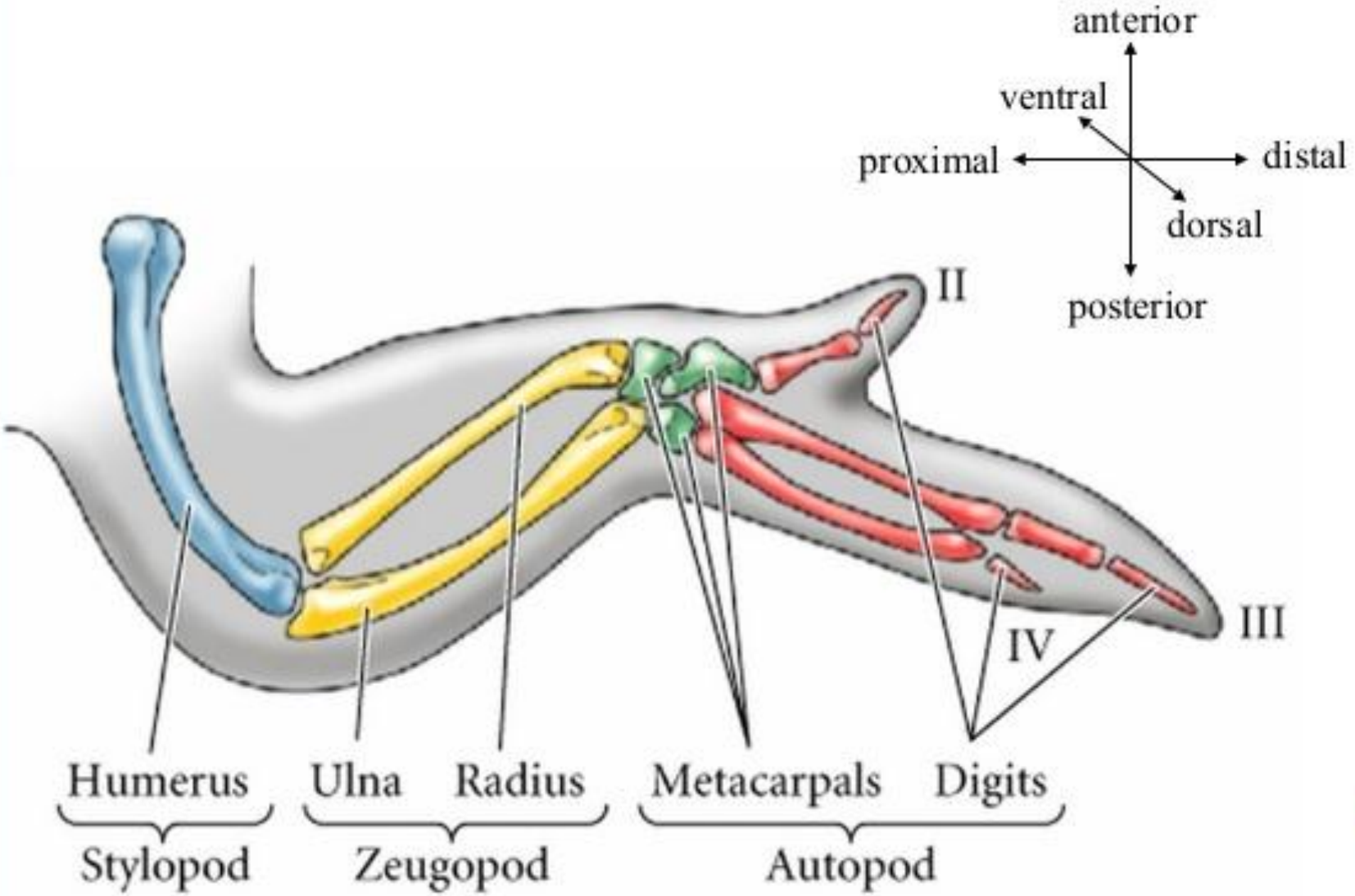
mouse skeletal forelimb

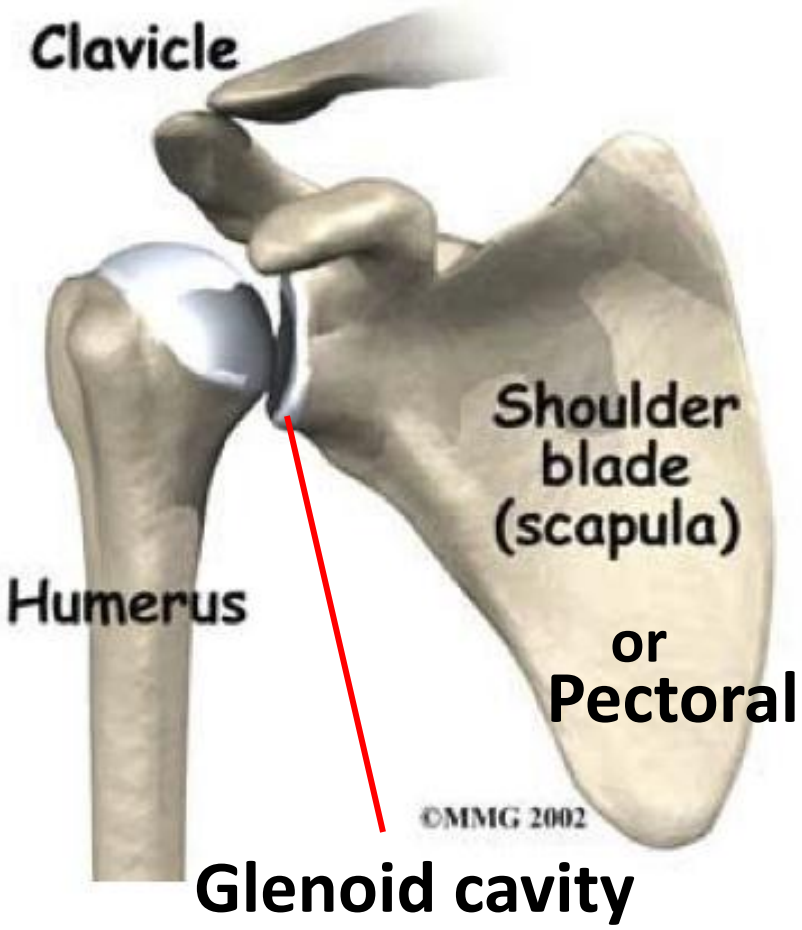


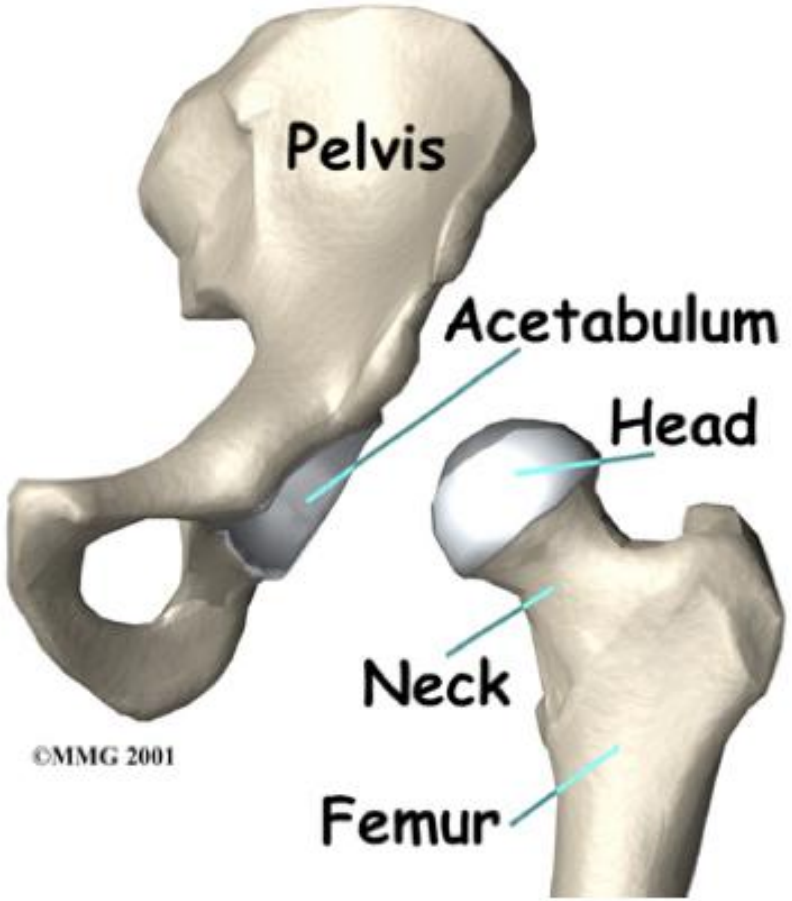


Tetrapod limb

TETRAPOD LIMB



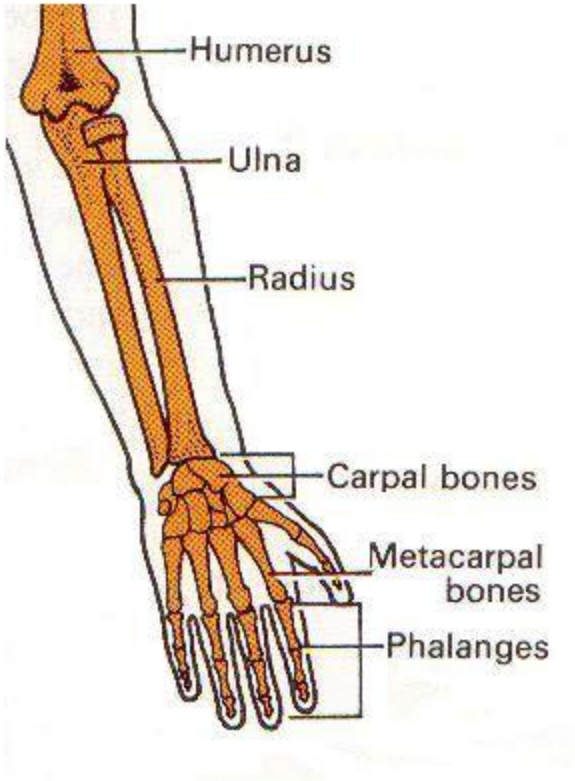


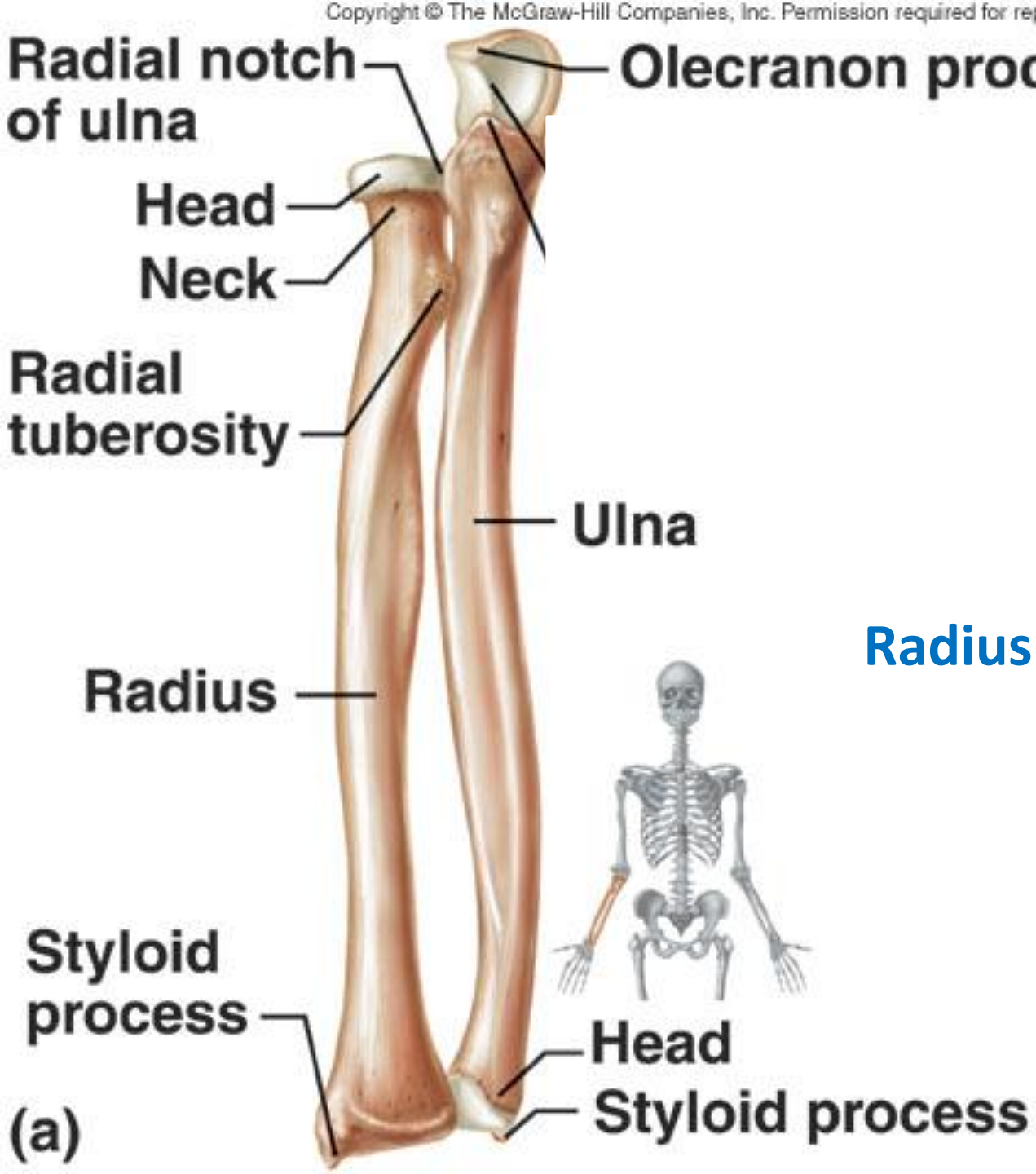


Ball and socket joints

Forearm

- Consists of two long bones
  - **Ulna** (medial)
  - **Radius** (lateral)

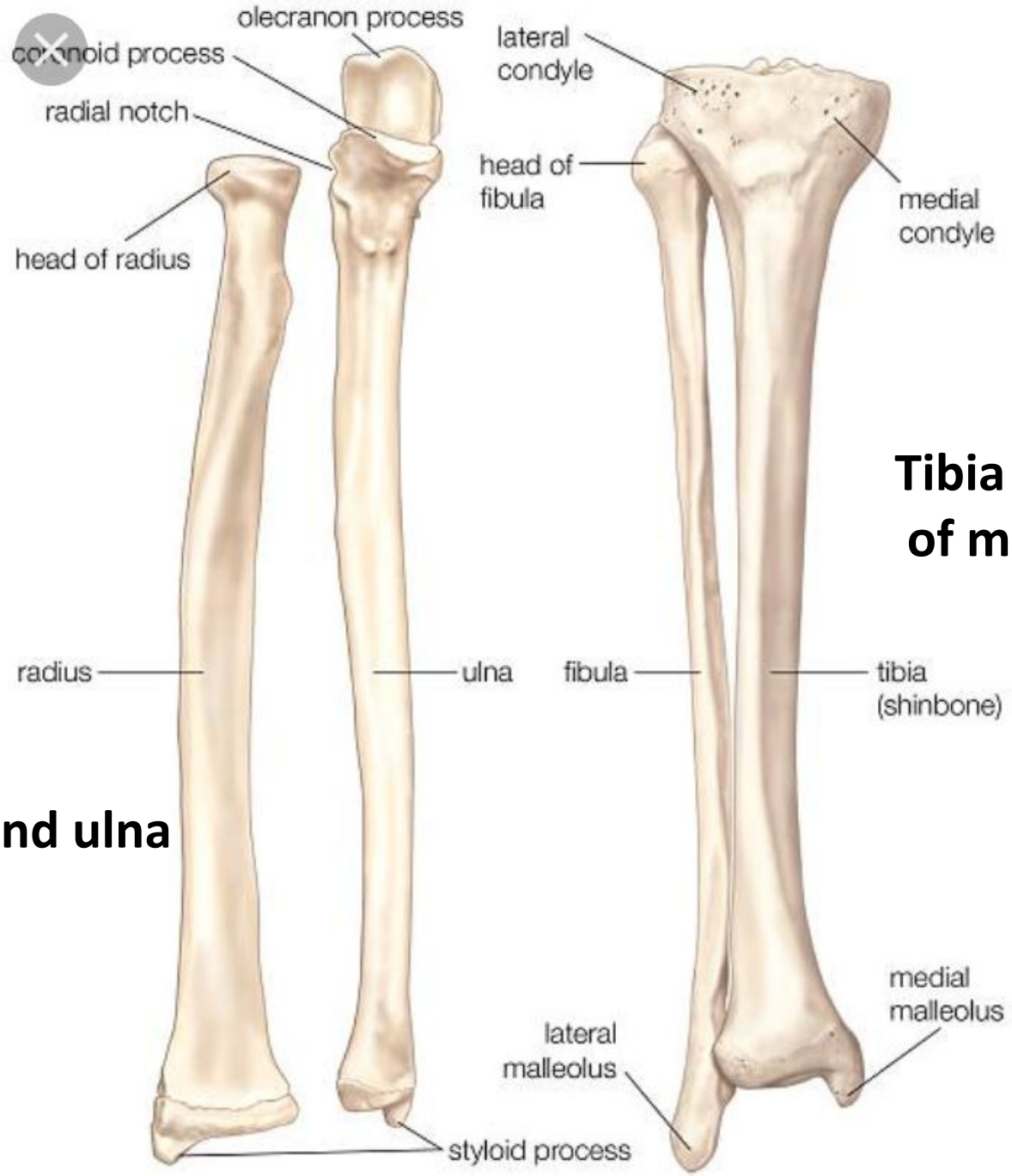




Radius and ulna of human

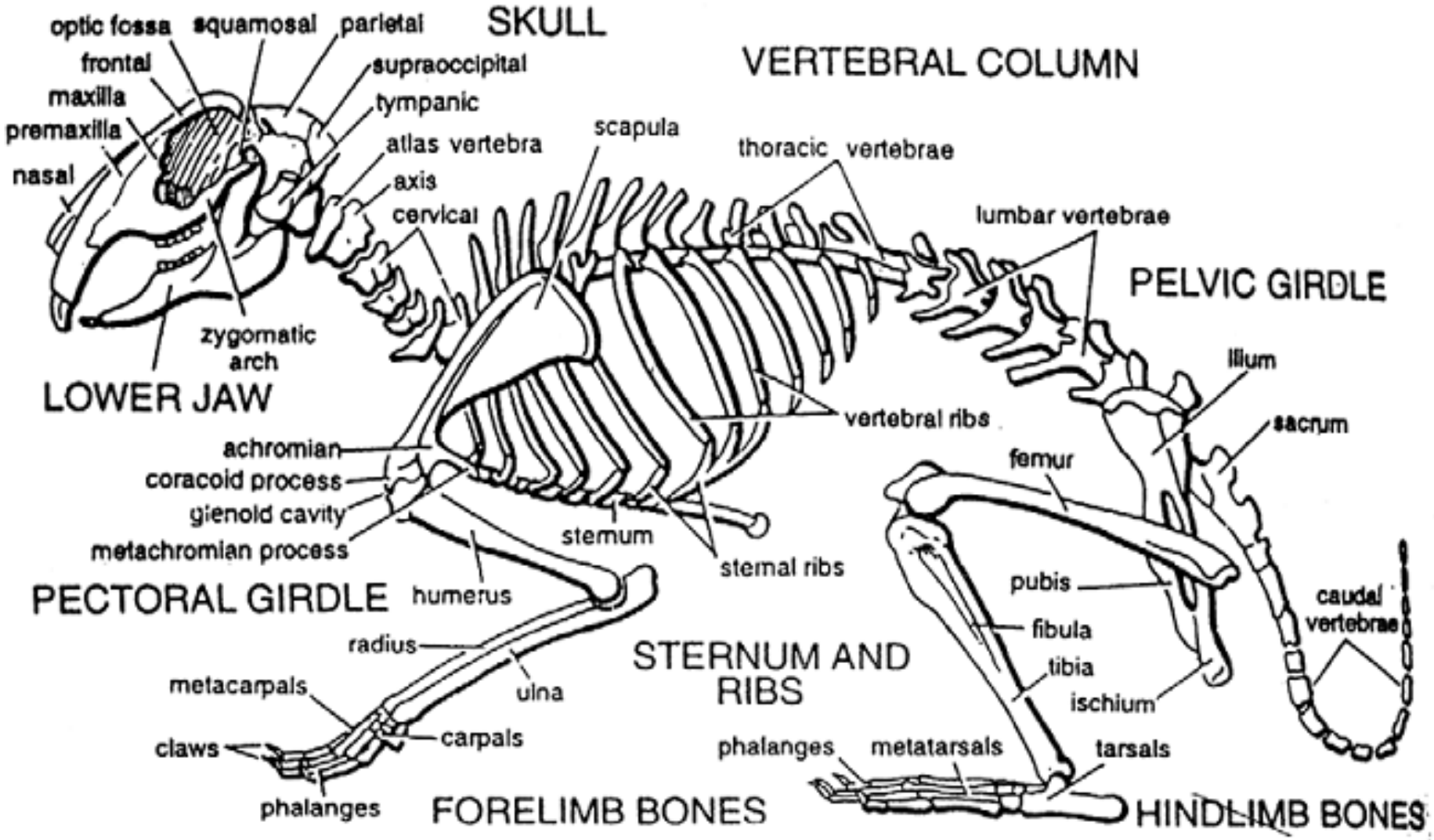
Radius and Ulna of rabbit

Tibio fibula of rabbit



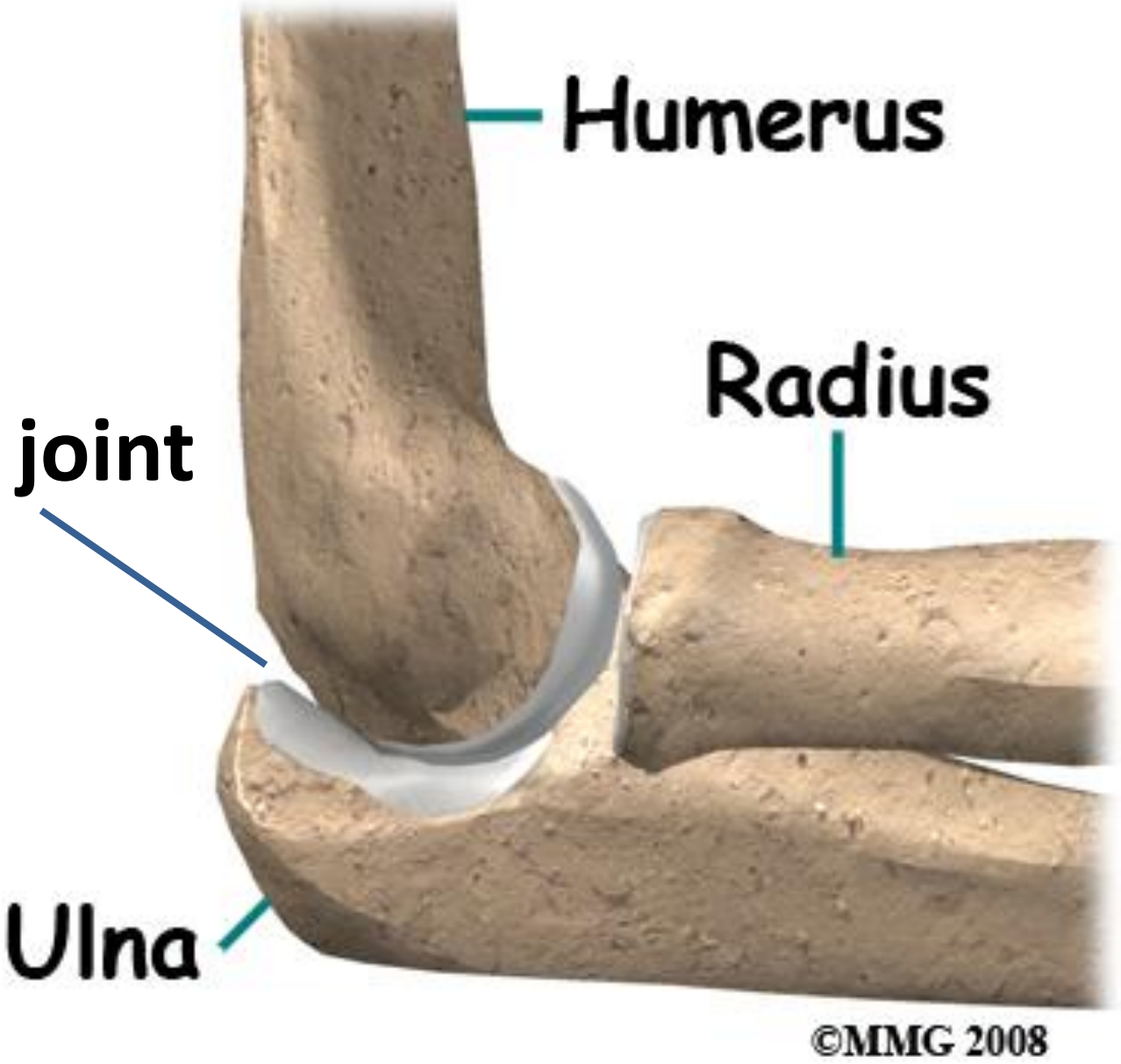
Radius and ulna of man

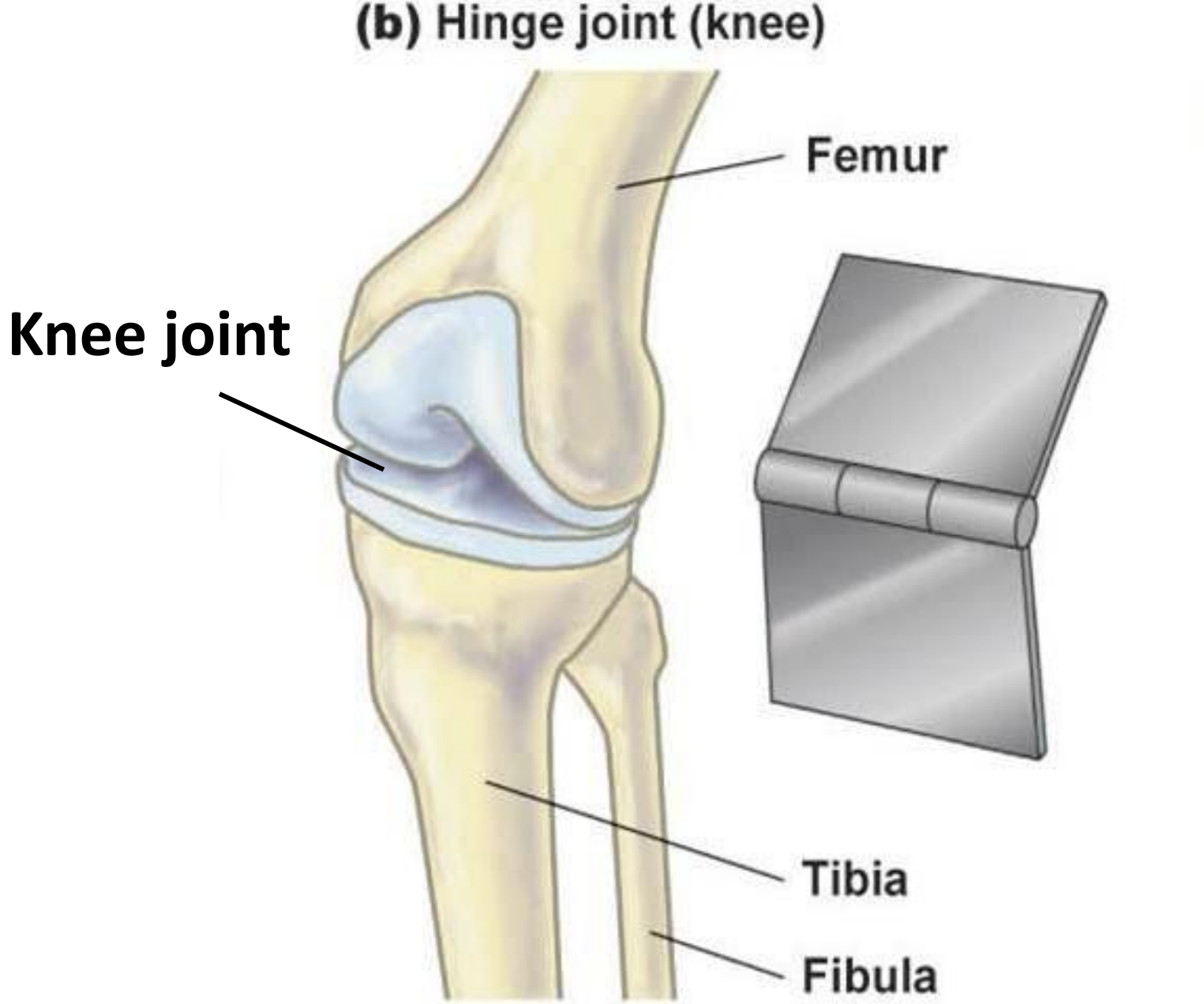
Tibia and fibula of man

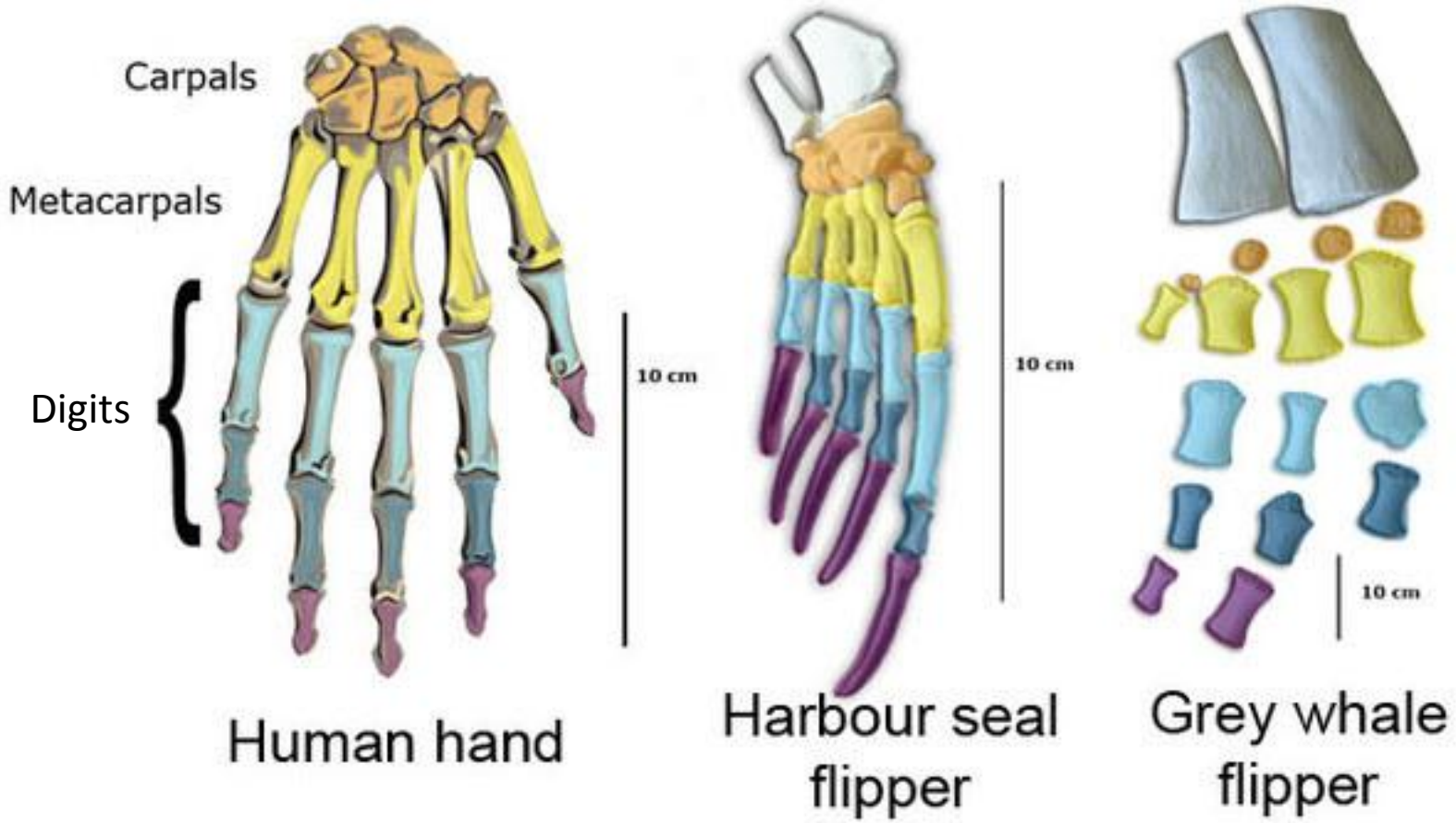


RABBIT SKELETON

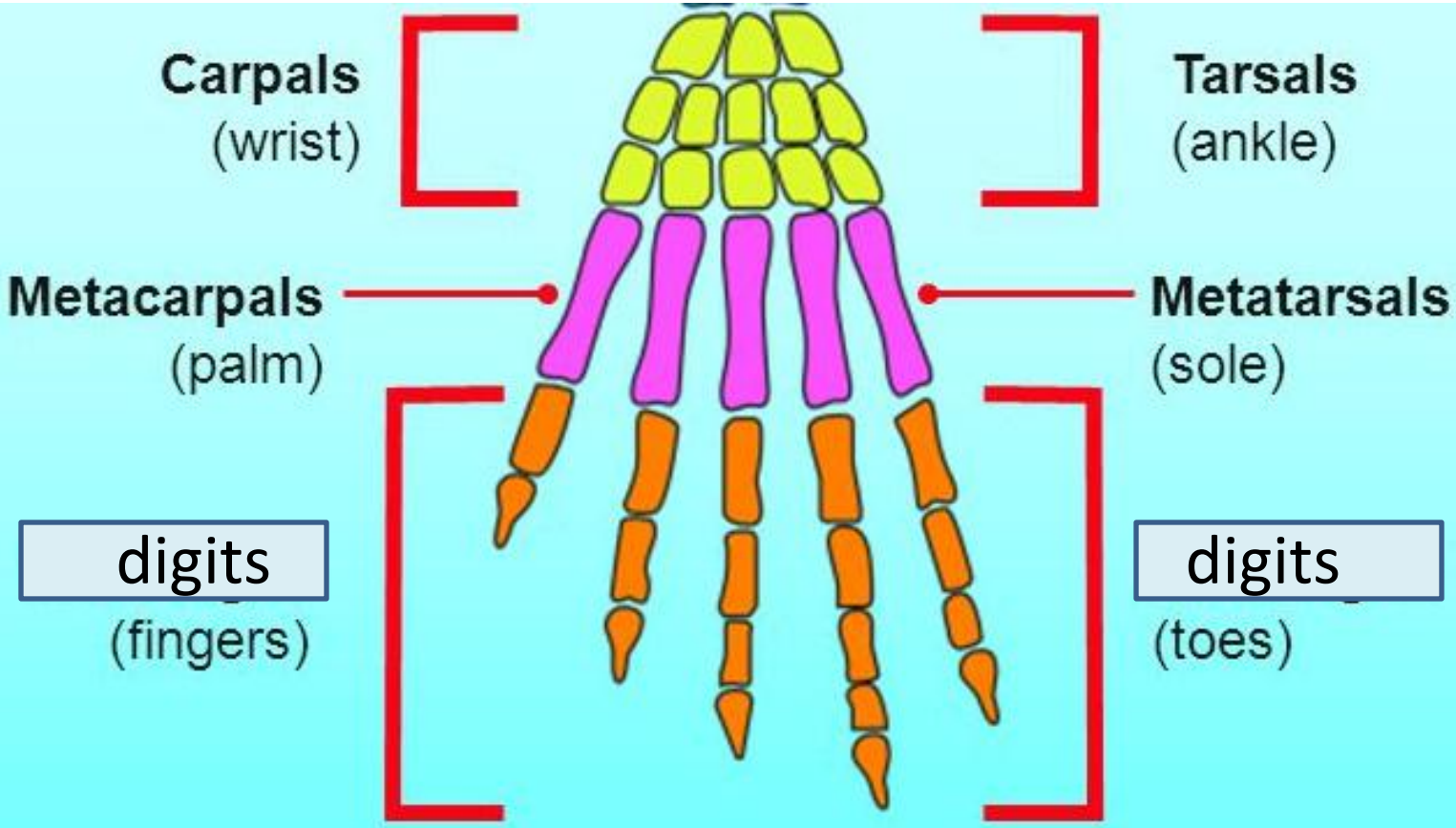
Elbow joint



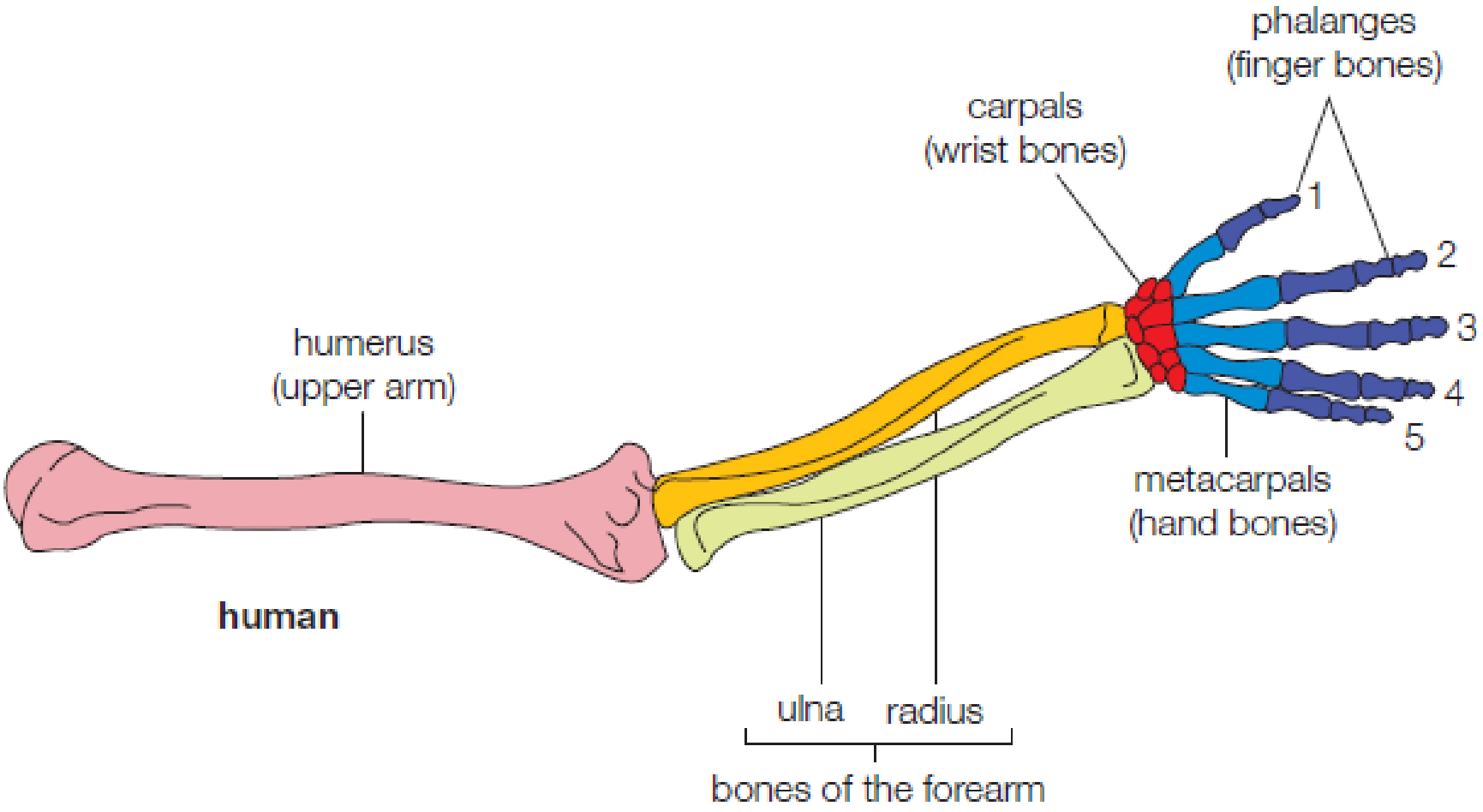

(b) Hinge joint (knee)
Femur
Knee joint
Tibia
Fibula


Carpals
Metacarpals
Digits
10 cm
Human hand
10 cm
Harbour seal flipper
10 cm
Grey whale flipper

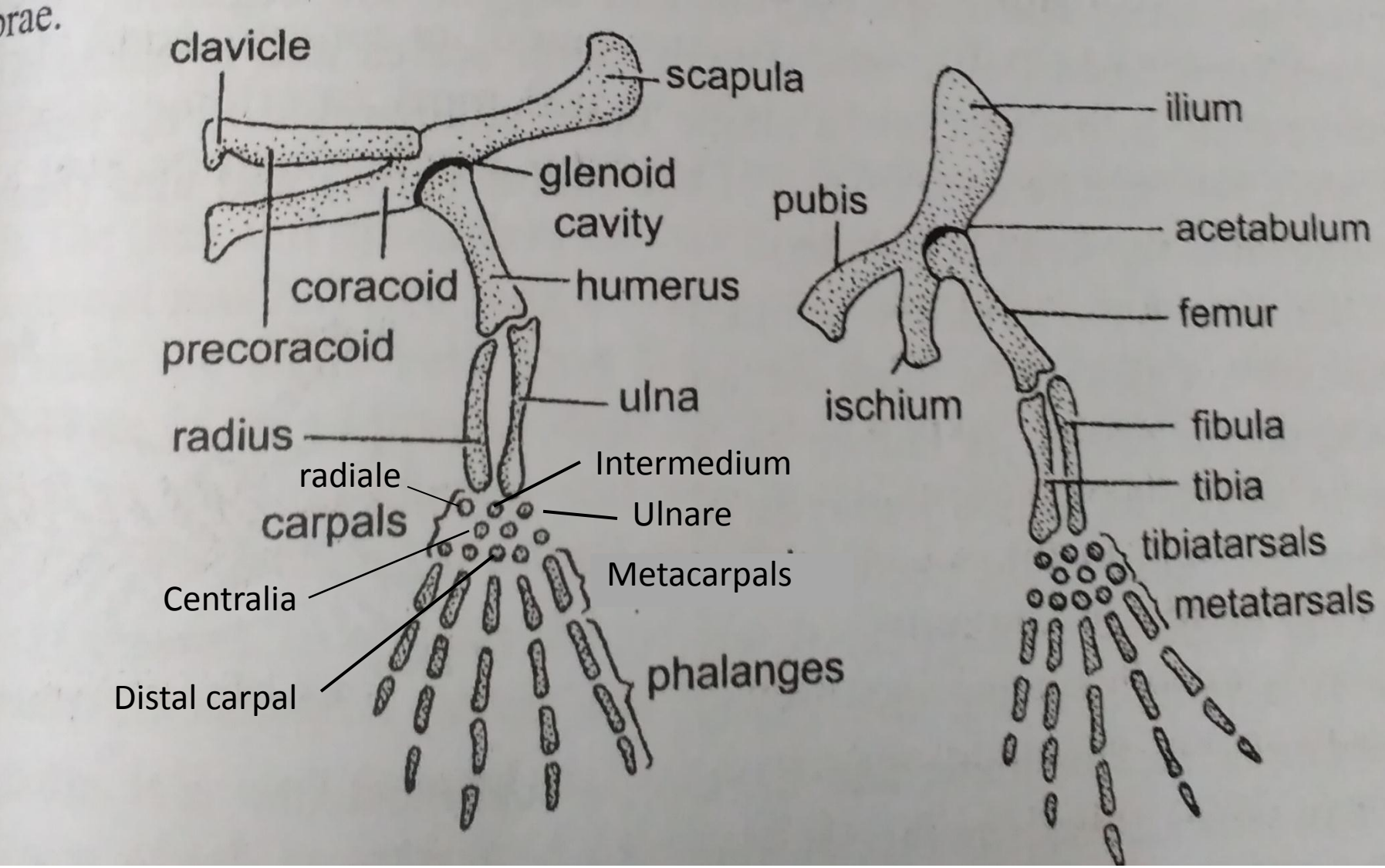
Autopodium


Carpals
(wrist)
Tarsals
(ankle)
Metacarpals
(palm)
Metatarsals
(sole)
digits
(fingers)
digits
(toes)
Note that forelimbs and hind limbs have different names for equivalent bones.

Autopodium

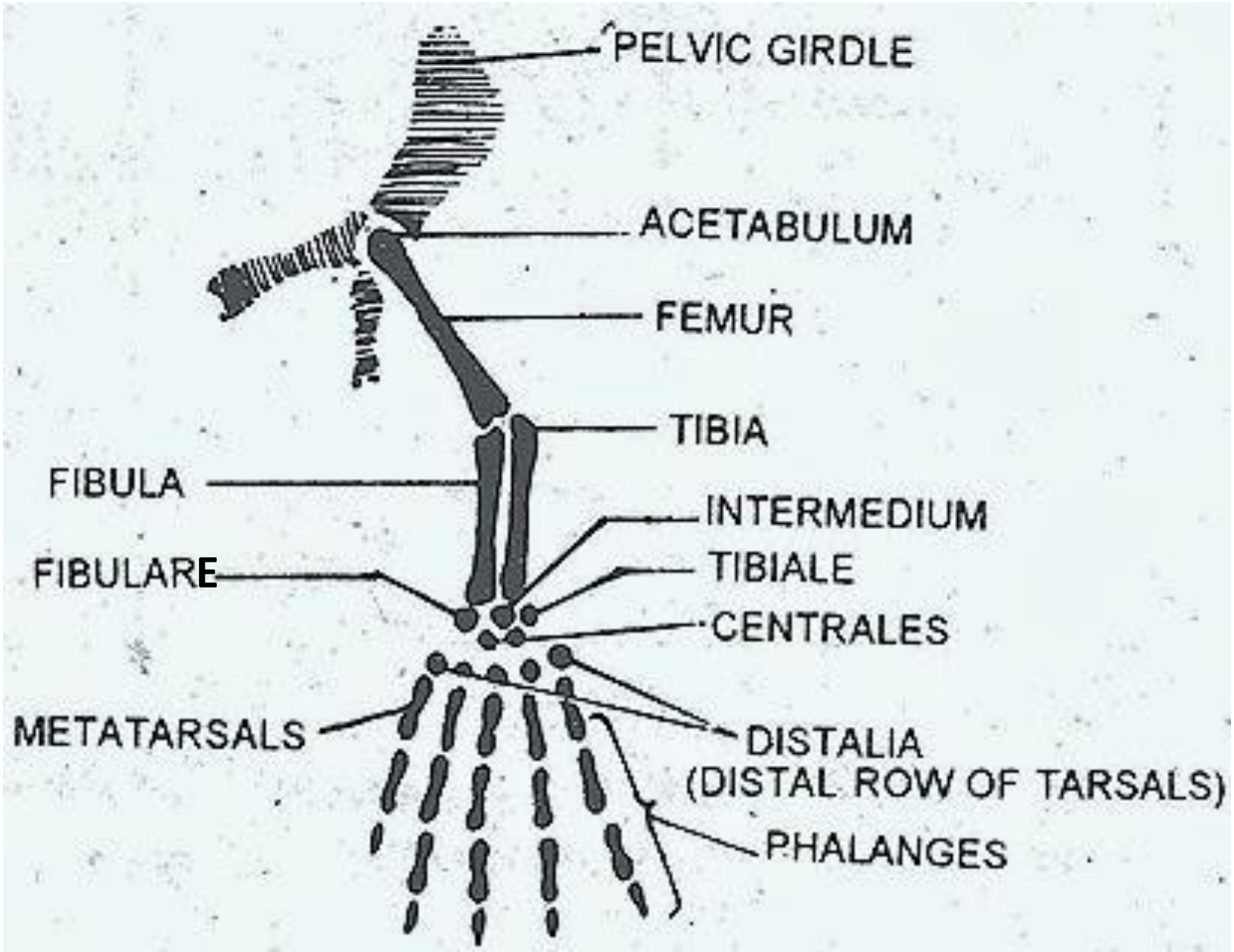

phalanges
(finger bones)
carpals
(wrist bones)
1
2
3
4
5
humerus
(upper arm)
metacarpals
(hand bones)
human
ulna
radius
bones of the forearm

Foot bones of human

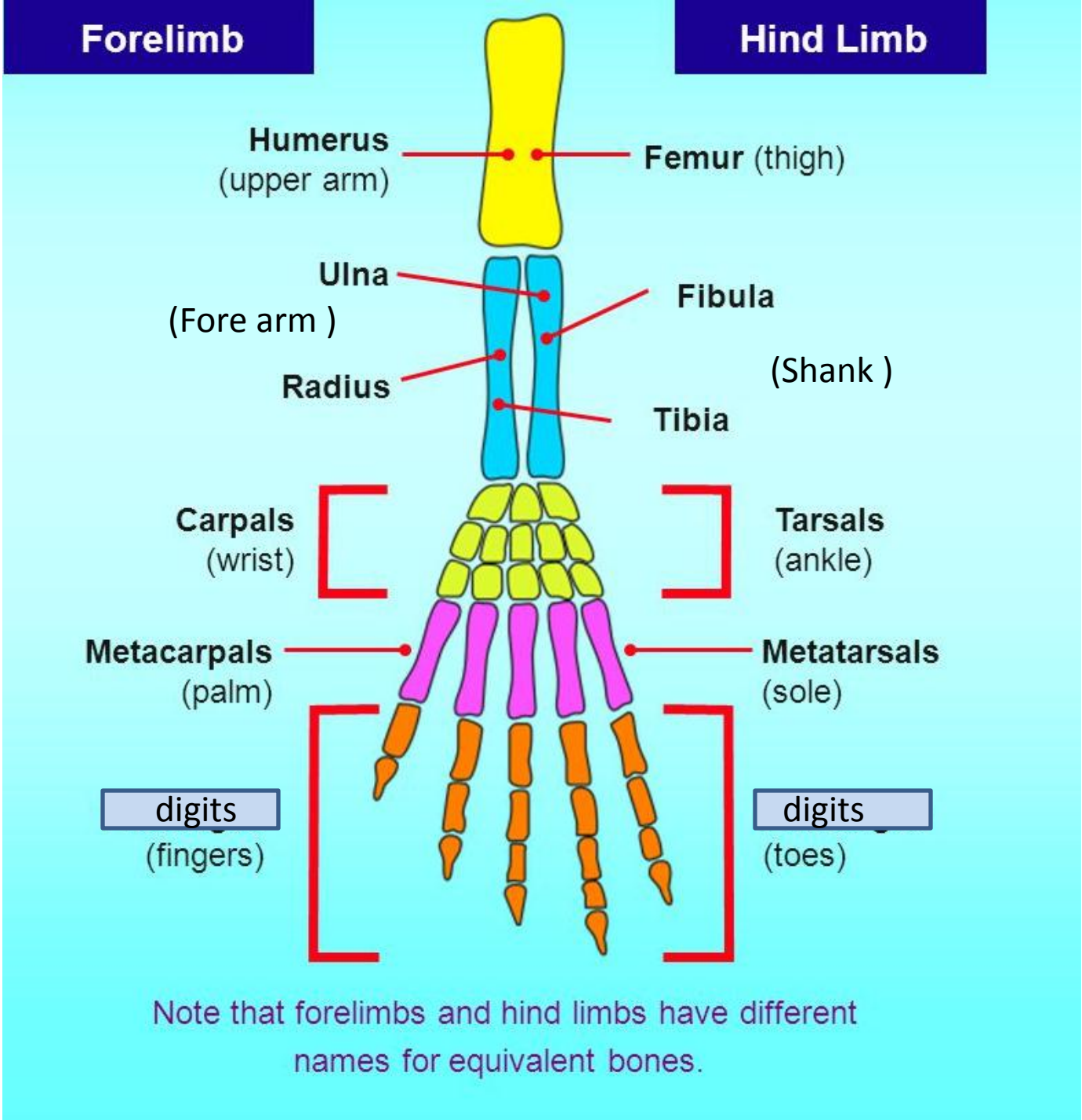


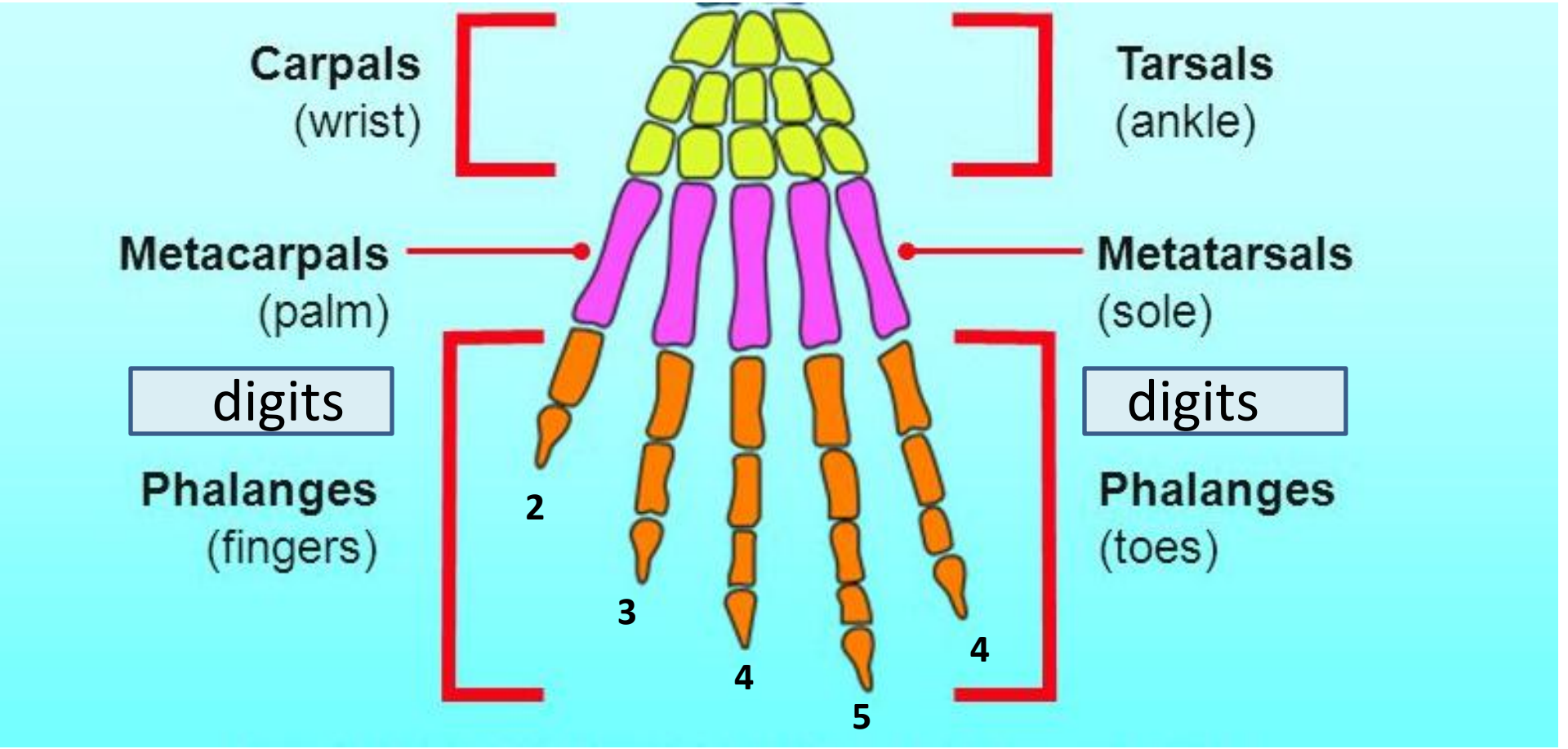
Pectoral girdle and fore limb of tetrapod

Pelvic girdle and hind limb of tetrapod

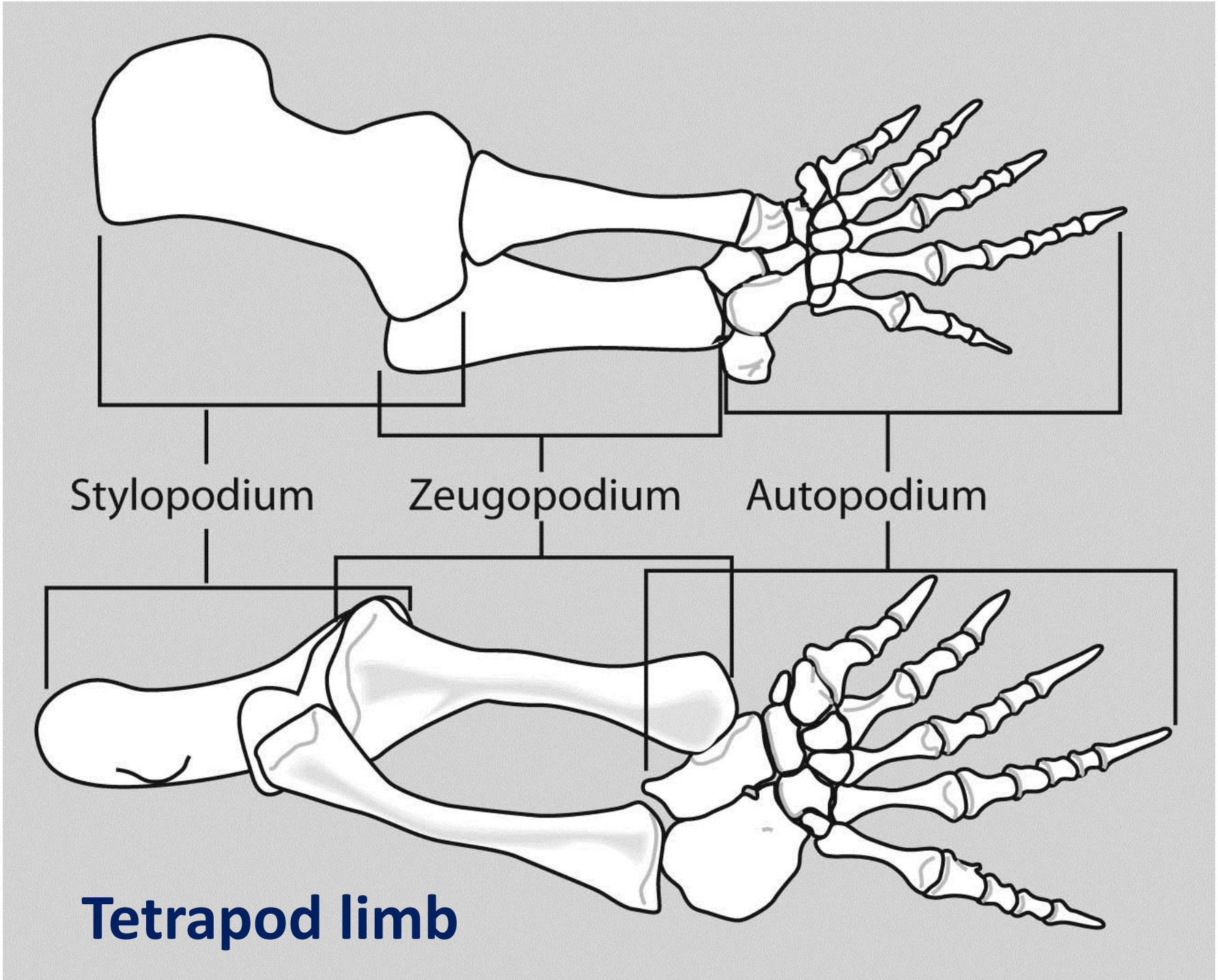


Hind limb bones of tetrapod


Forelimb
Hind Limb
Humerus
(upper arm)
Femur (thigh)
Ulna
(Fore arm)
Fibula
(Shank)
Radius
Tibia
Carpals
(wrist)
Tarsals
(ankle)
Metacarpals
(palm)
Metatarsals
(sole)
digits
(fingers)
digits
(toes)
Note that forelimbs and hind limbs have different
names for equivalent bones.


Carpals
(wrist)
Tarsals
(ankle)
Metacarpals
(palm)
Metatarsals
(sole)
digits
digits
Phalanges
(fingers)
Phalanges
(toes)
2
3
4
4
5

Autopodium



Tetrapod limb

Fig. 25.1. *Seymouria* (A cotylosaur). Anapsid.

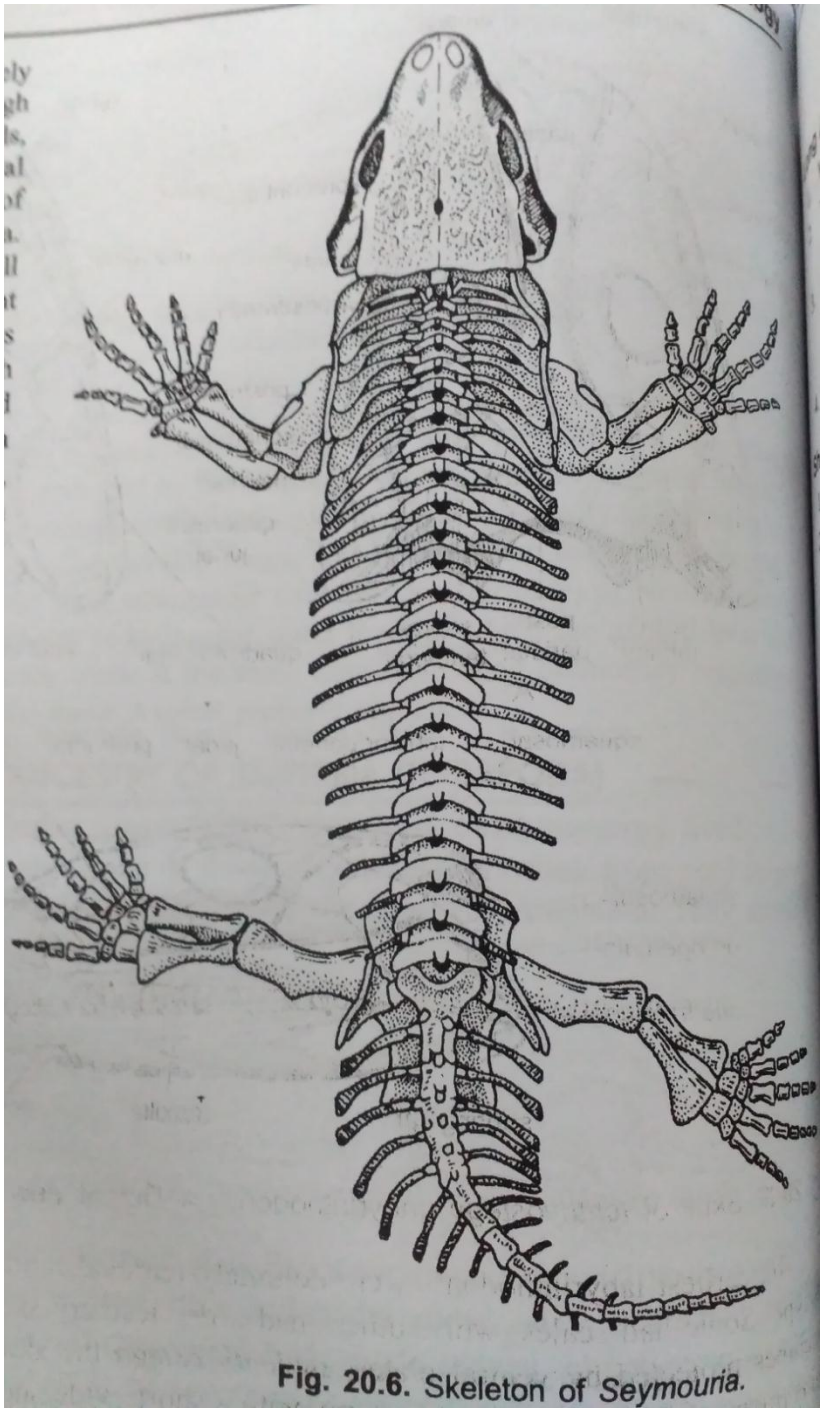
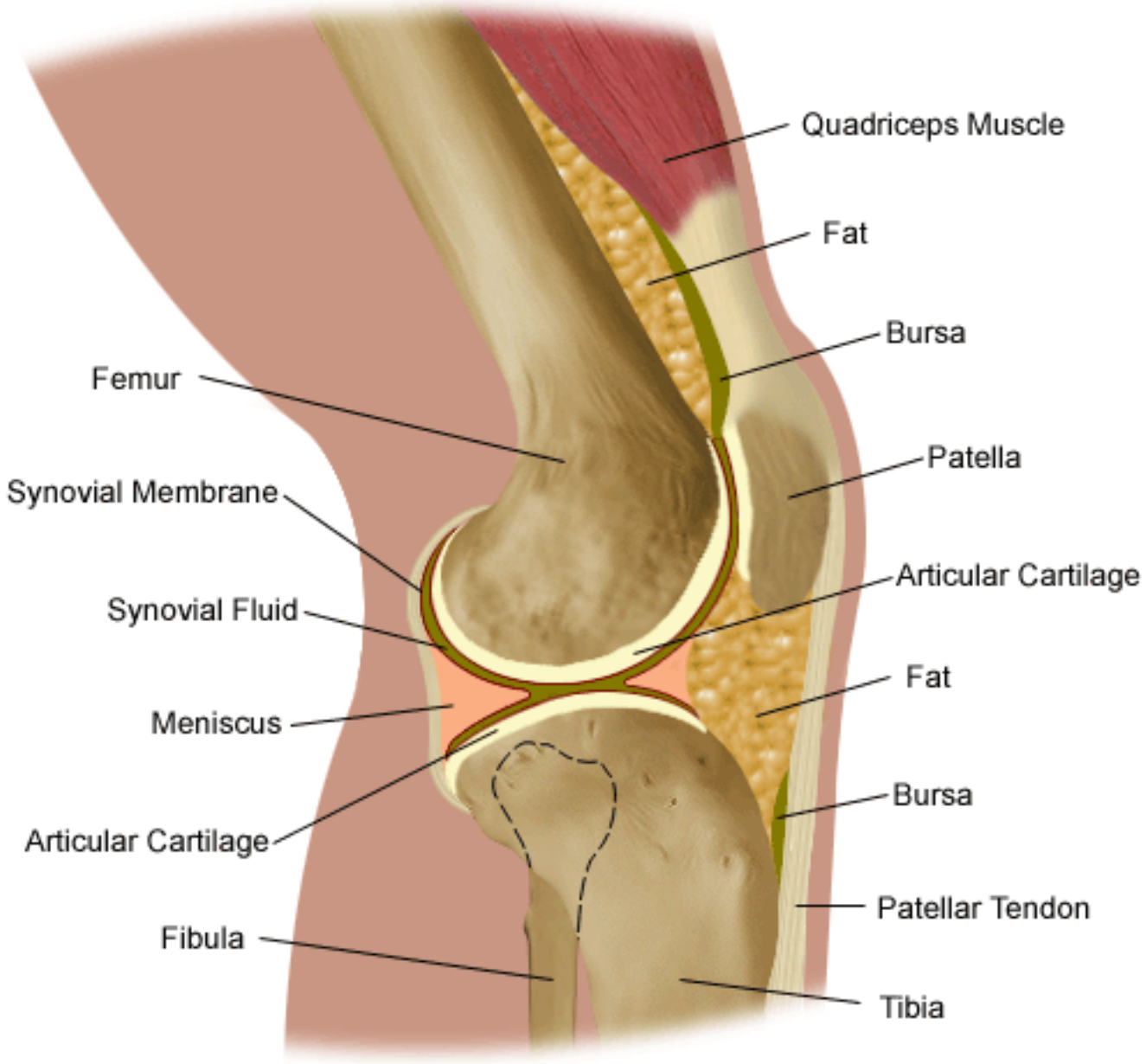


Fig. 20.6. Skeleton of *Seymouria*.

JOINTS

- is defined as **the spot** where two or more bones meet

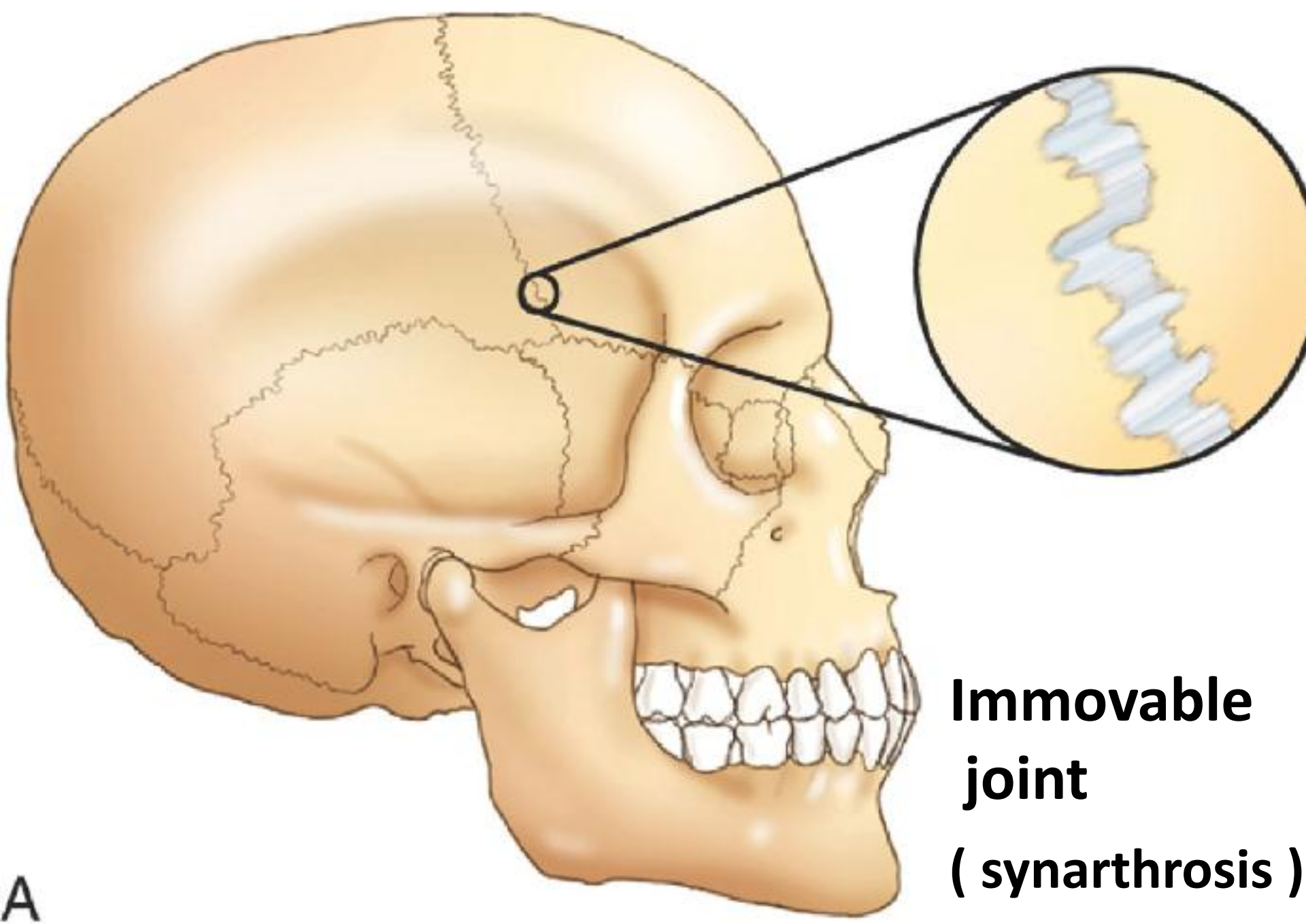
Anatomy of the Knee



Bones of the mammalian skeleton are joined to one another in different parts of the body **in order to allow movement of the body parts.**

There are **various types of joints** which permit **varying degrees of movement** .

However ,in some parts of the body such as the skull and pelvic girdle ,the bones are firmly attached to one another so that **movement of these bones is not possible .**

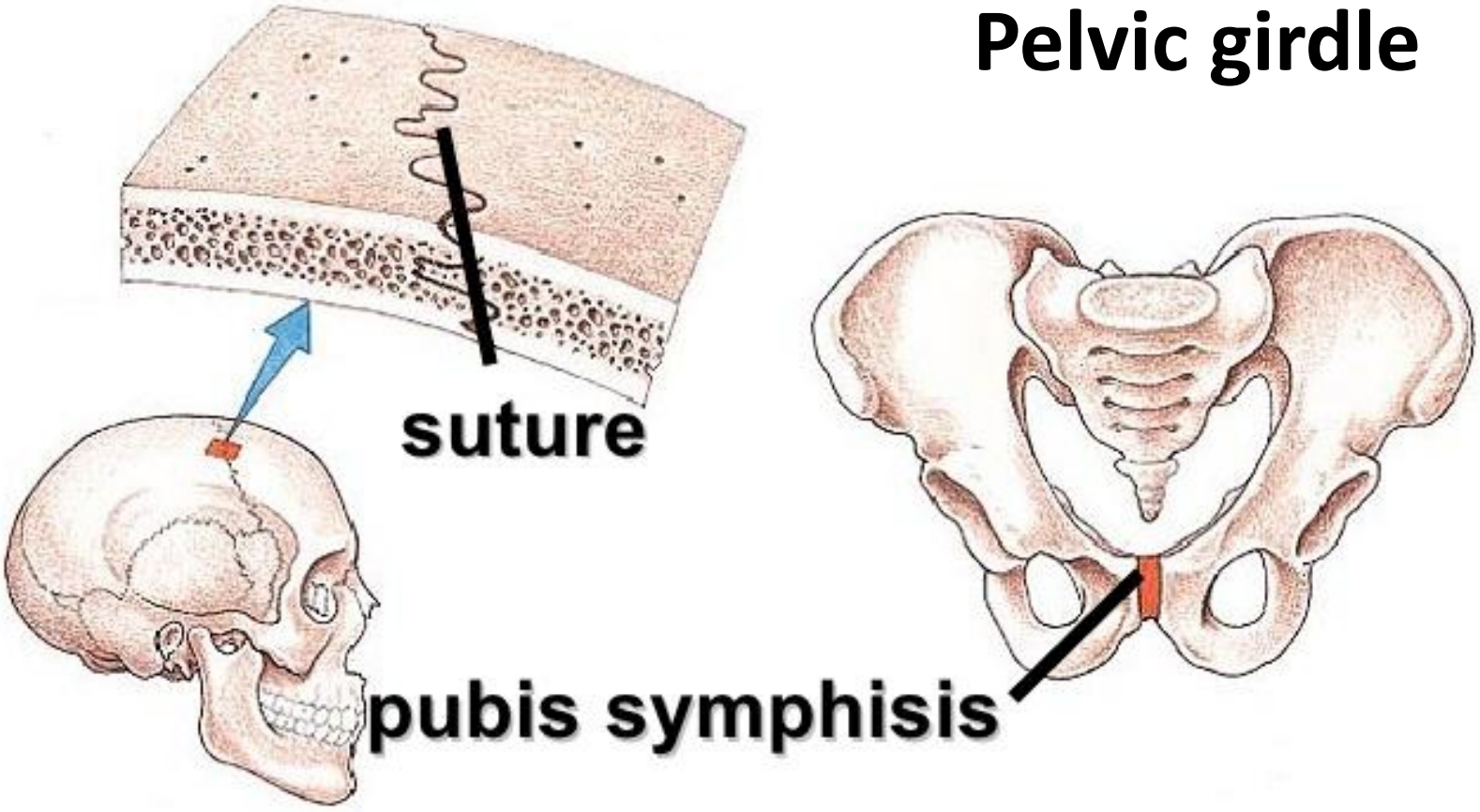


Immovable joint

(synarthrosis)

A

Immovable Joints (synarthrosis)

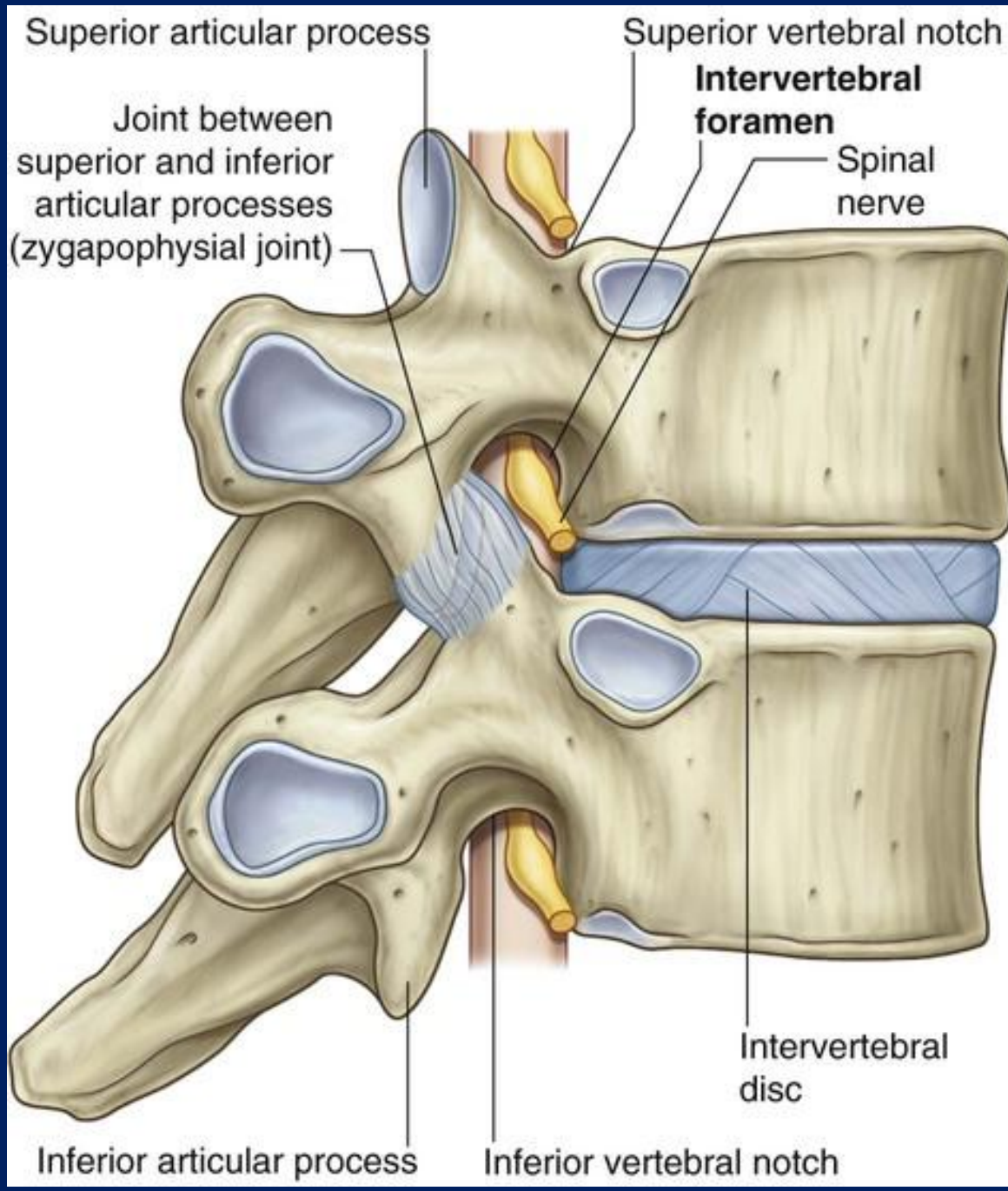


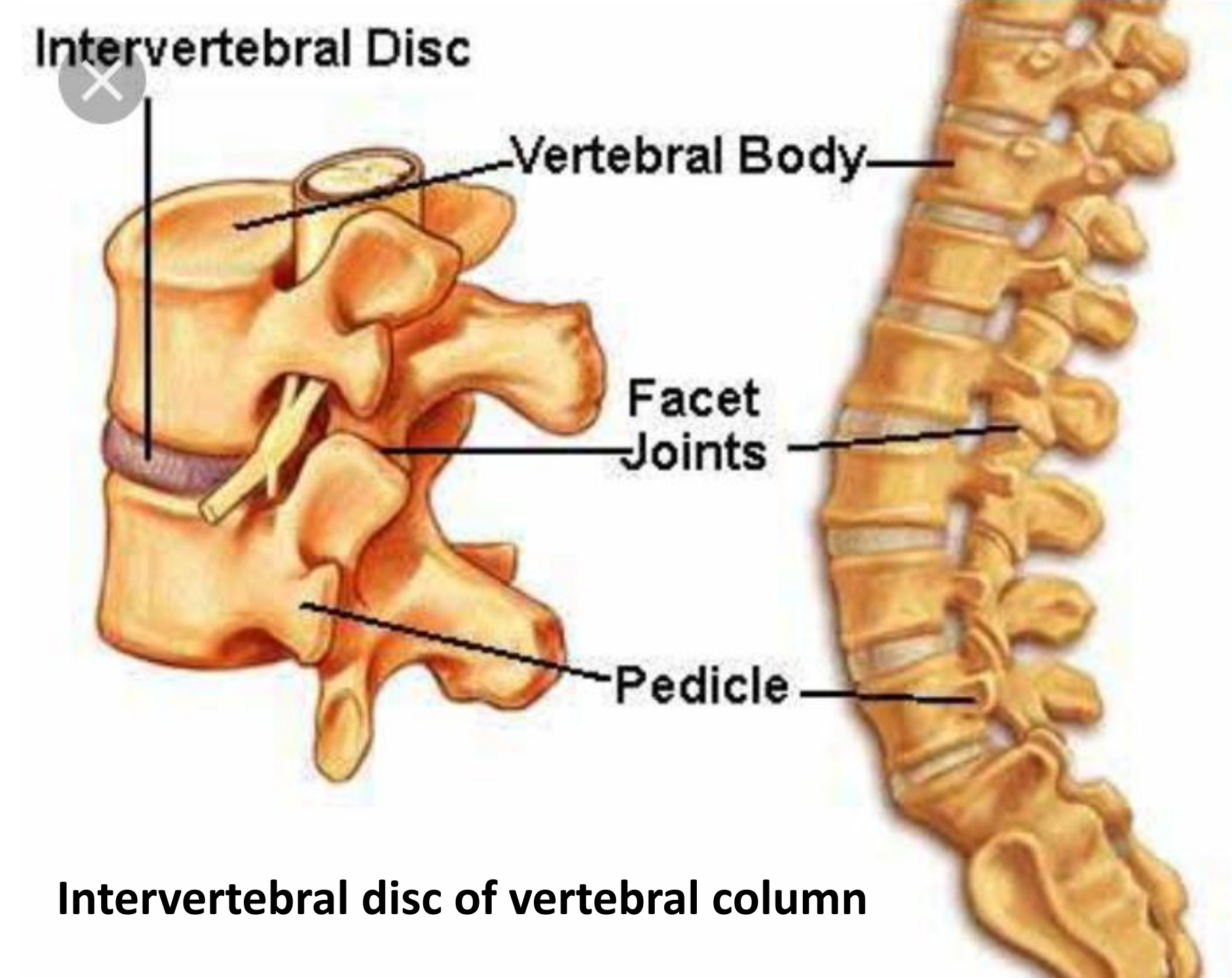
Pelvic girdle

Rabbit skull

Vertebrae of man

The vertebrae are joined by Ligaments and intervertebral disc which allow very little movement Between them .





Intervertebral disc of vertebral column

Joints

(1) Immovable joints or **synarthroses**

(2) Movable joints or **diarthroses**

There are four main kinds of moveable joints

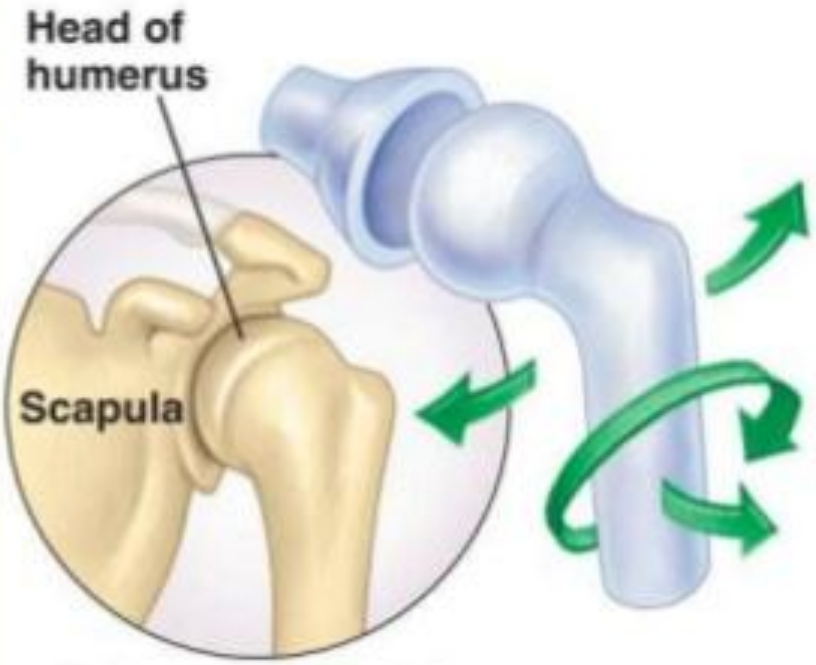
(1) Ball and socket joints

(2) Hinge joints

(3) Gliding joint

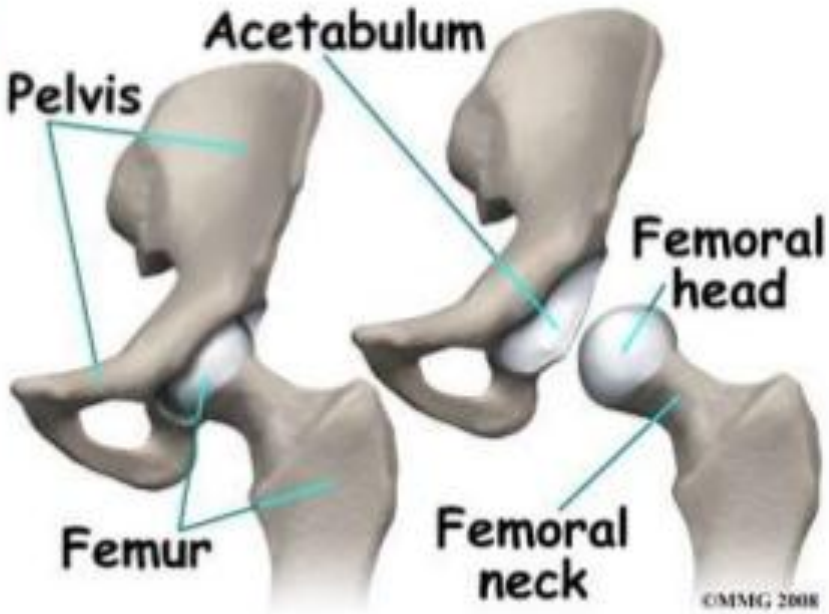
(4) Pivot joint

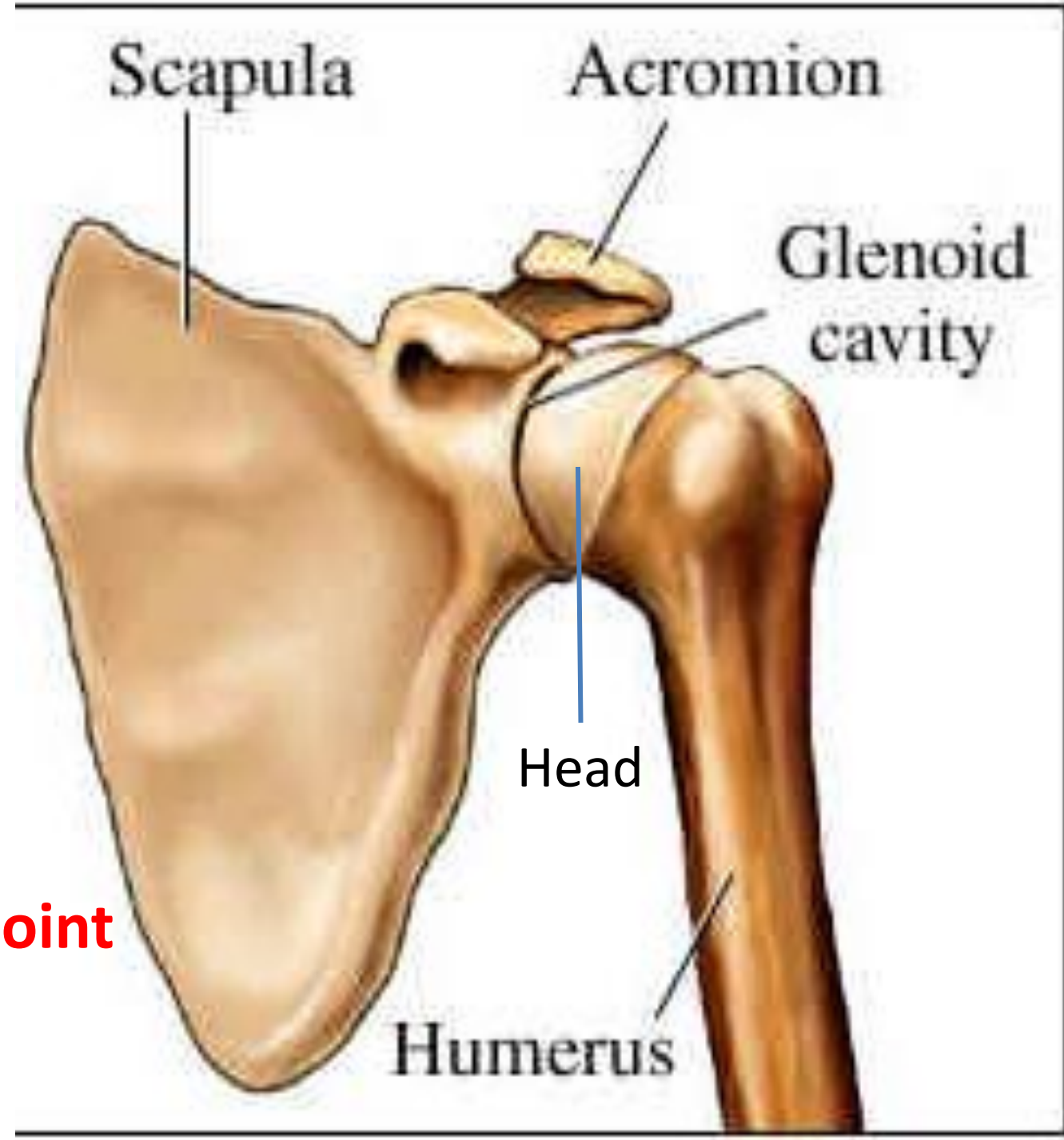
Ball and Socket Joints



Shoulder: Humerus and Scapula

Hip: Femur and Pelvis

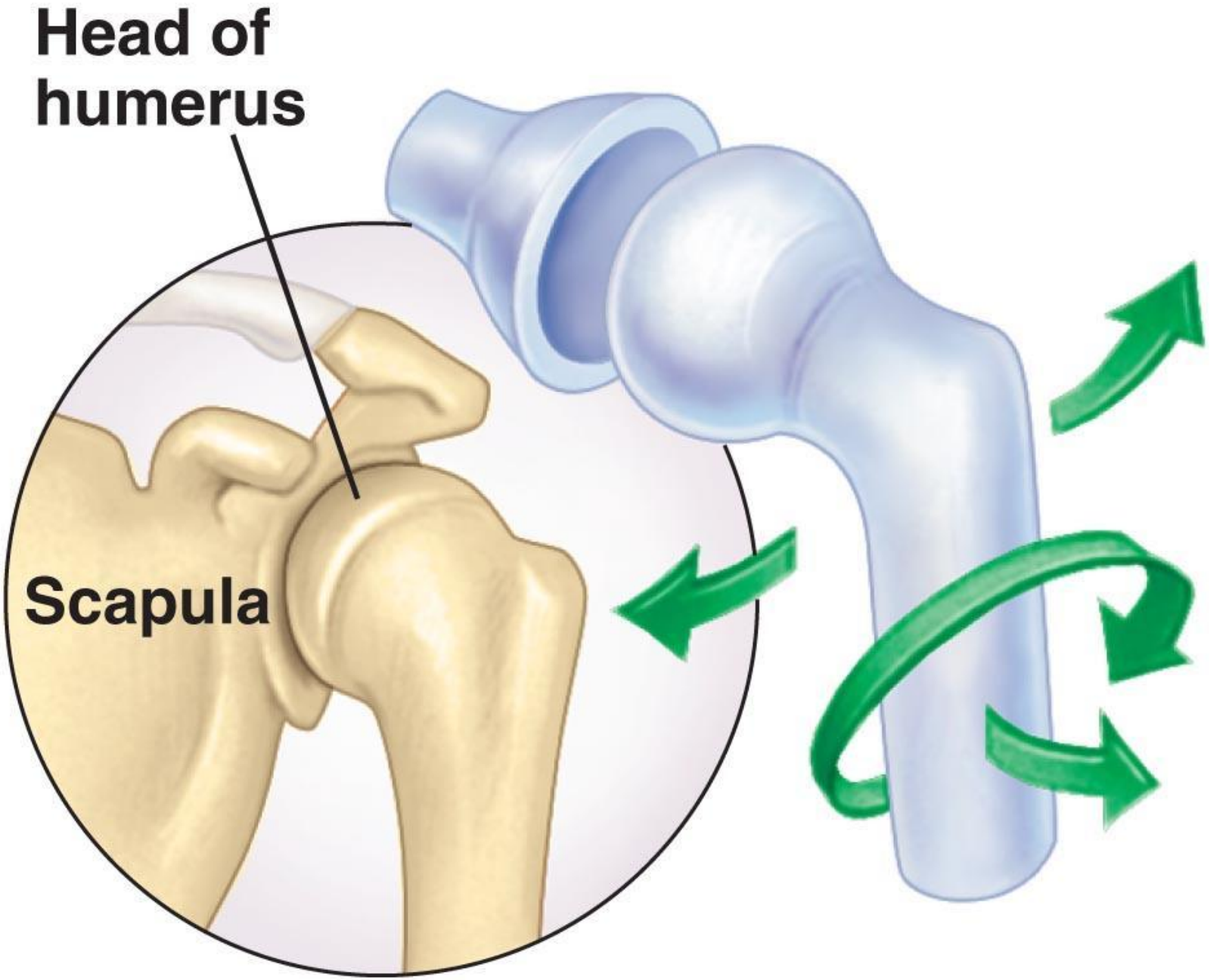




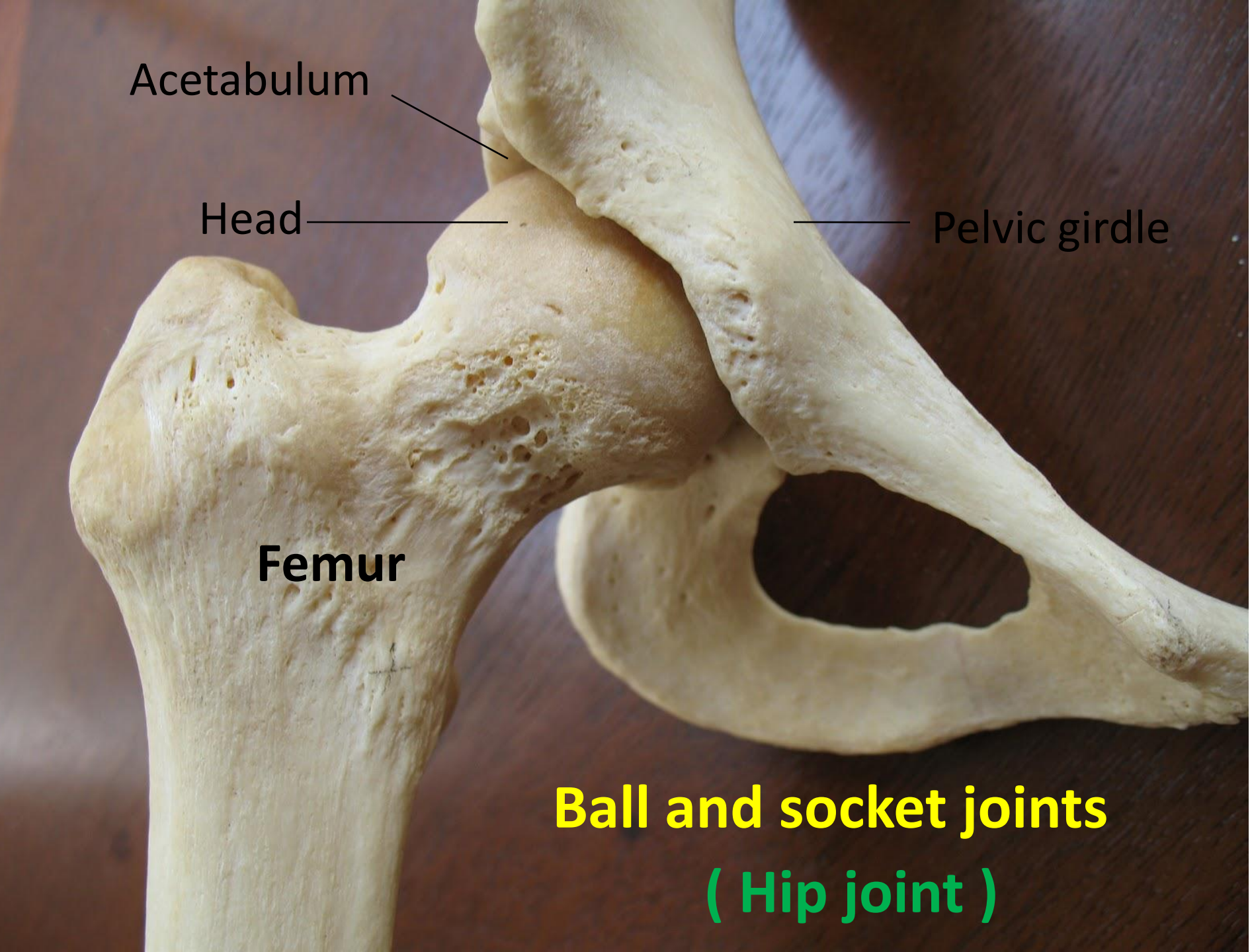
Ball and socket joint

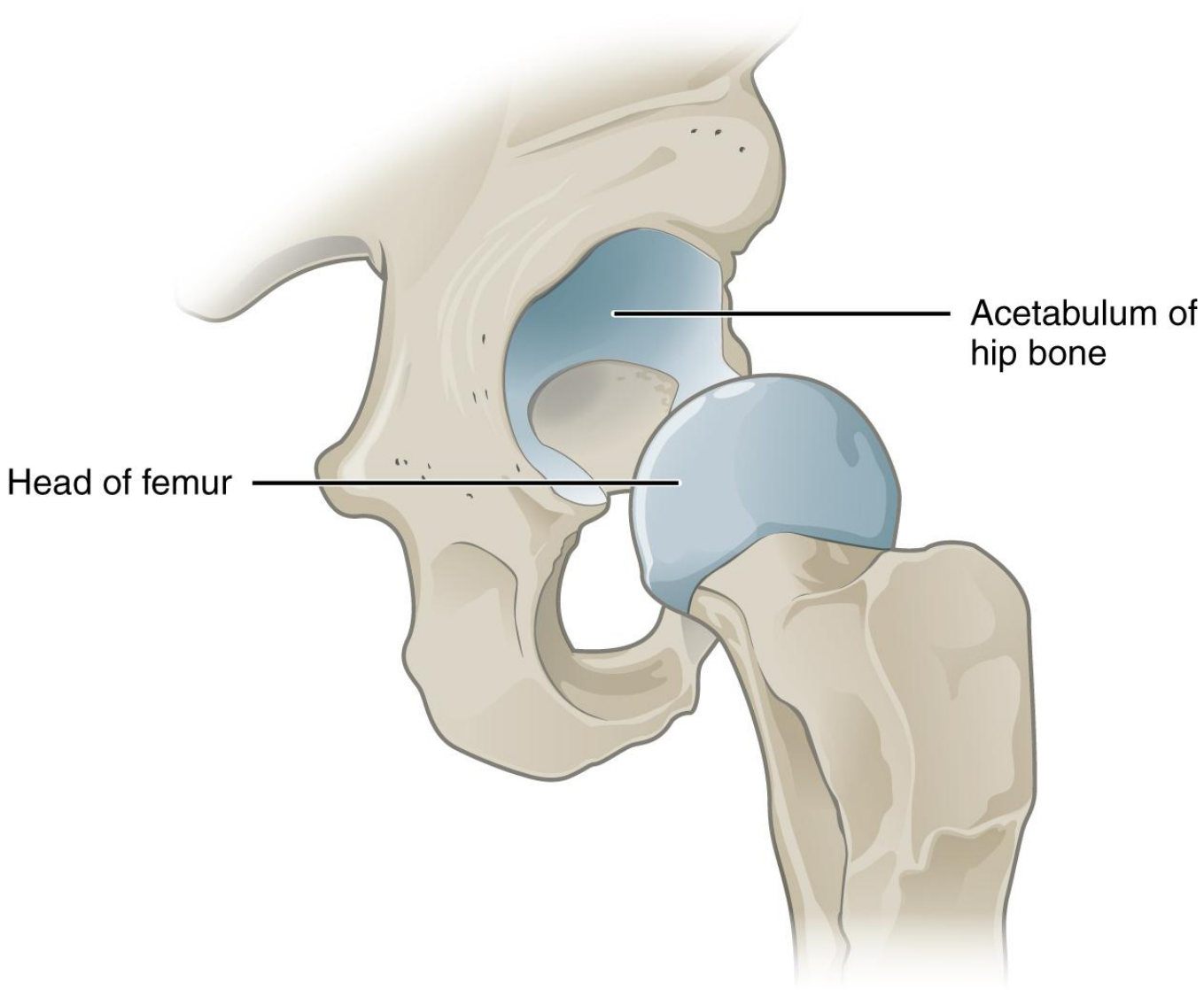
or

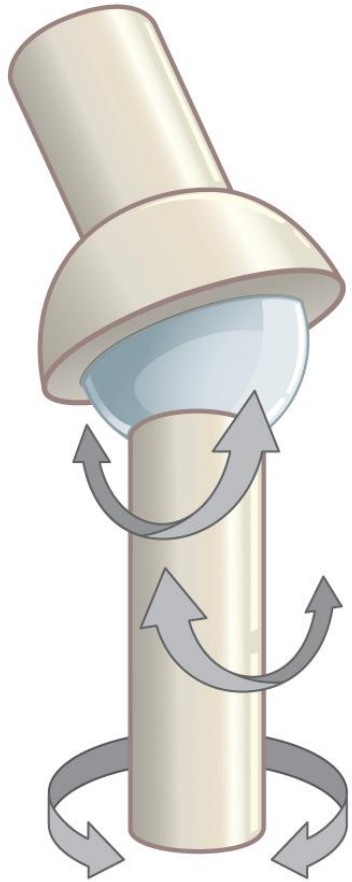
Shoulder joint

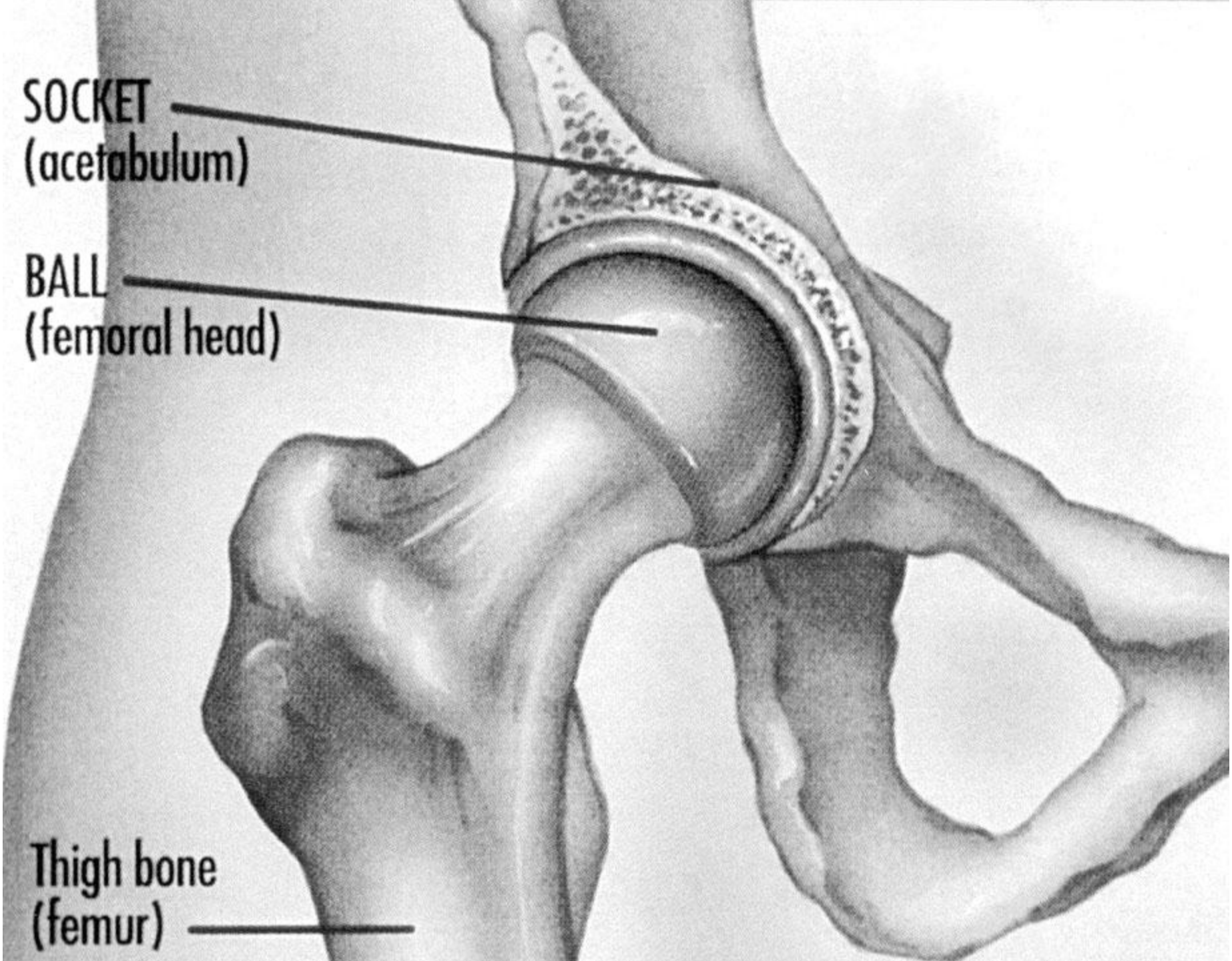


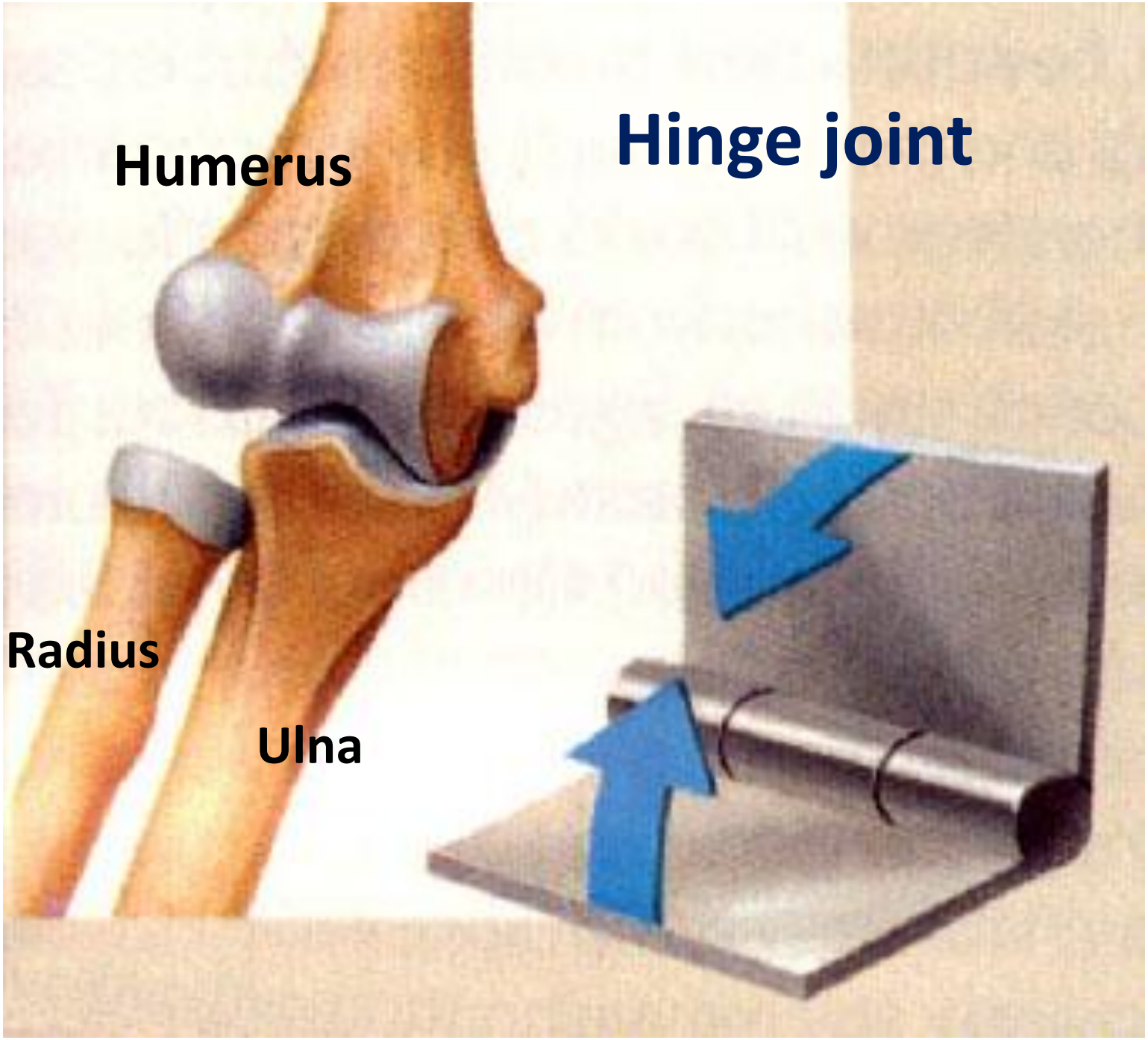
Ball-and-socket joint


Acetabulum
Head
Pelvic girdle
Femur
Ball and socket joints
(Hip joint)


Acetabulum of hip bone
Head of femur

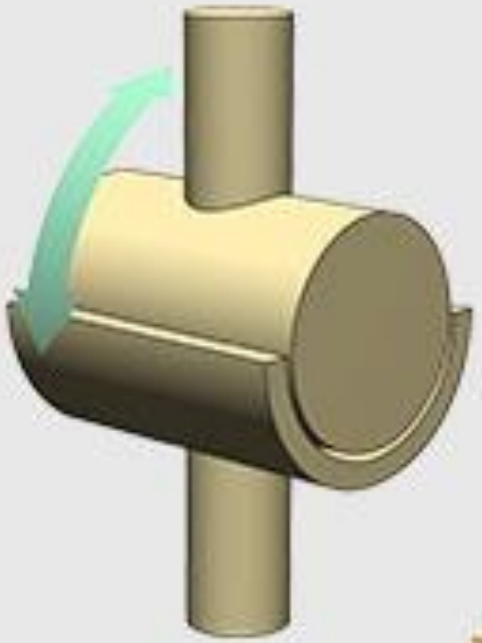


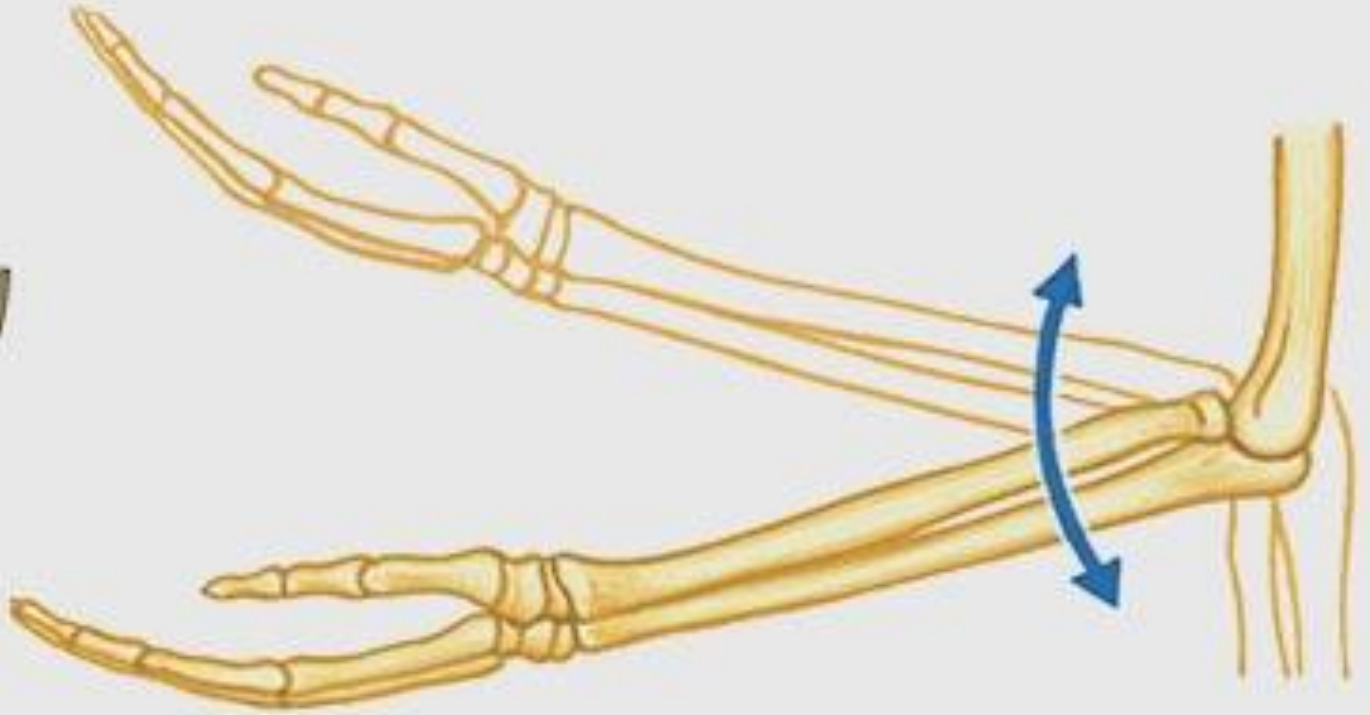

SOCKET
(acetabulum)
BALL
(femoral head)
Thigh bone
(femur)

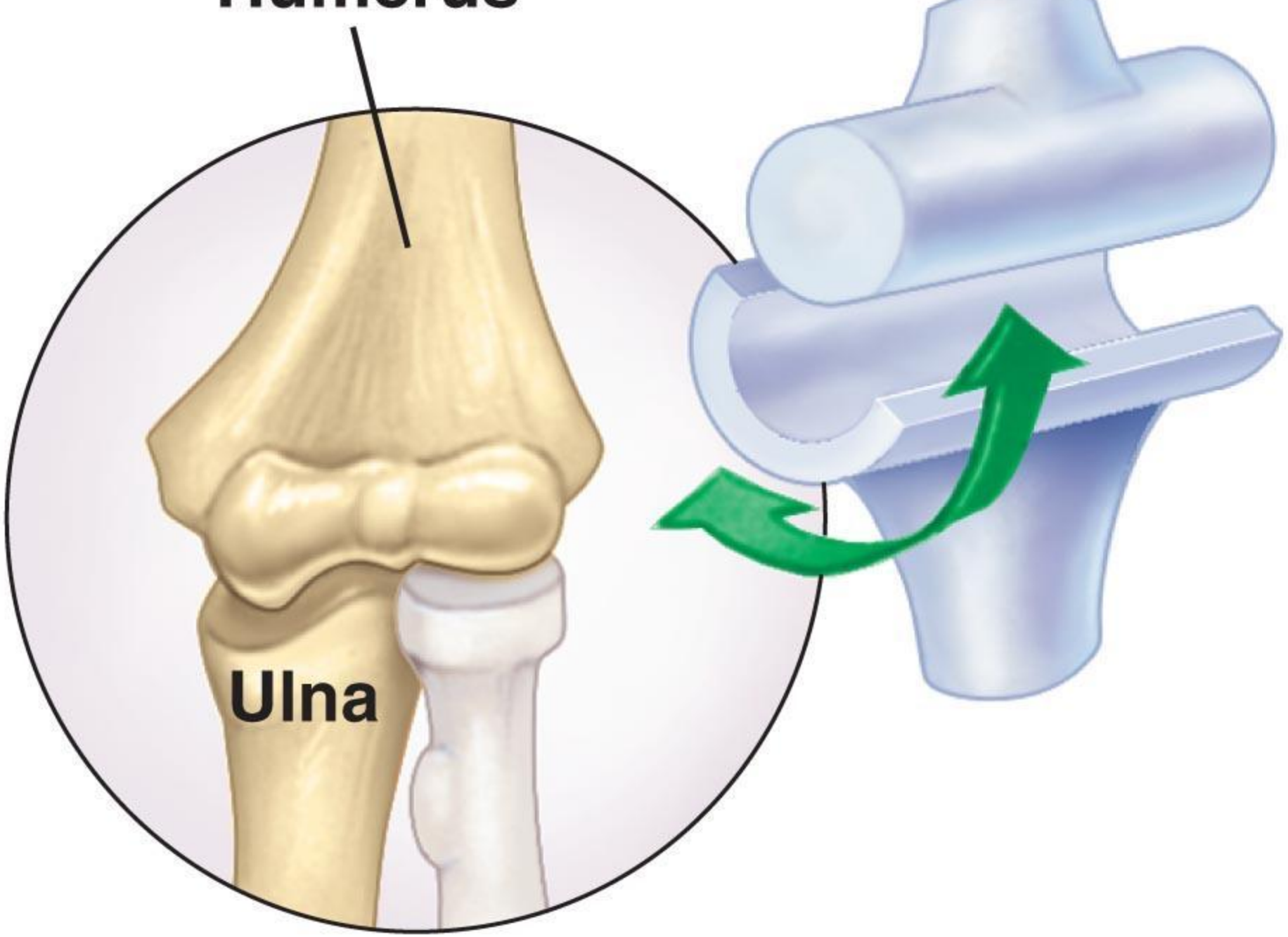

Humerus
Hinge joint
Radius
Ulna

Hinge Joint

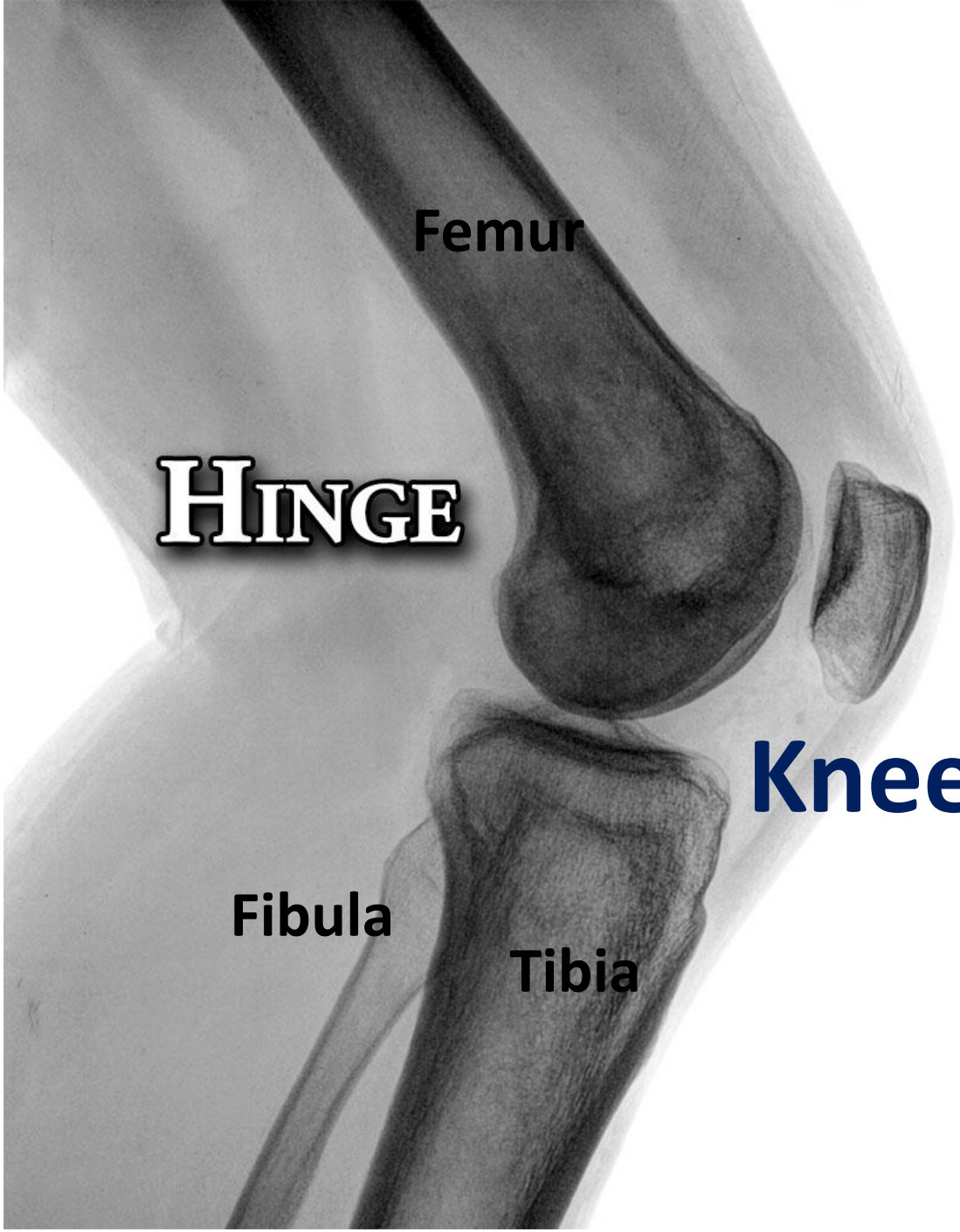
(Elbow joint)



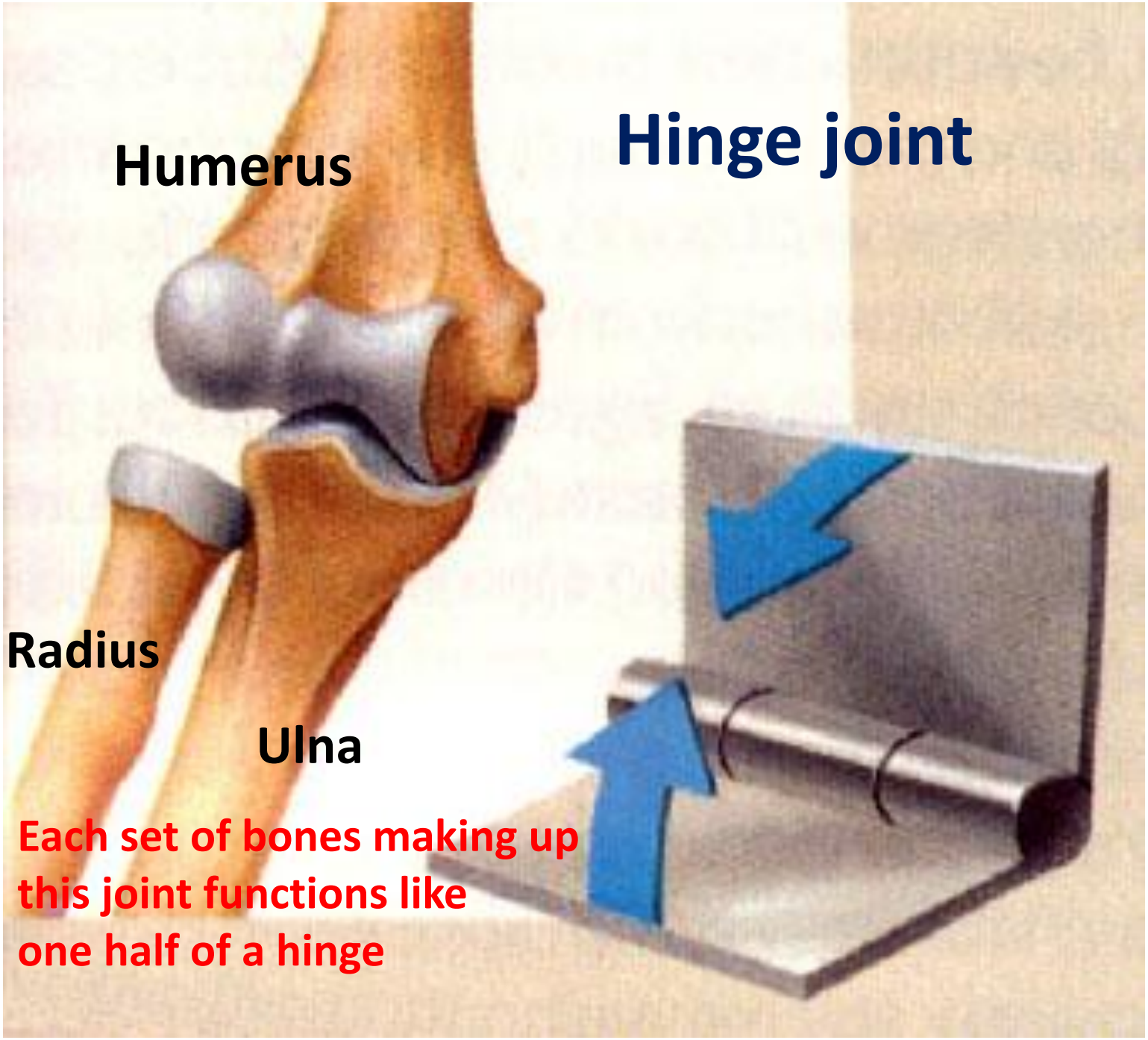




Hinge joint



Knee

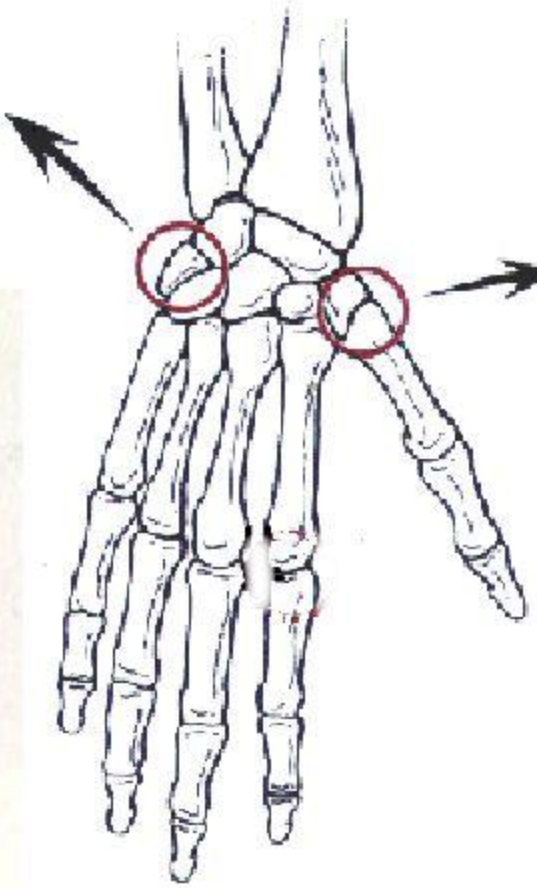

Humerus
Hinge joint
Radius
Ulna
Each set of bones making up
this joint functions like
one half of a hinge

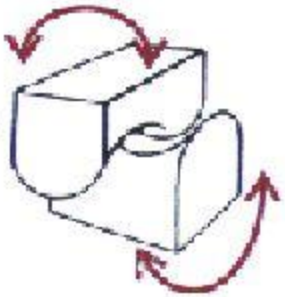
Skeletal System

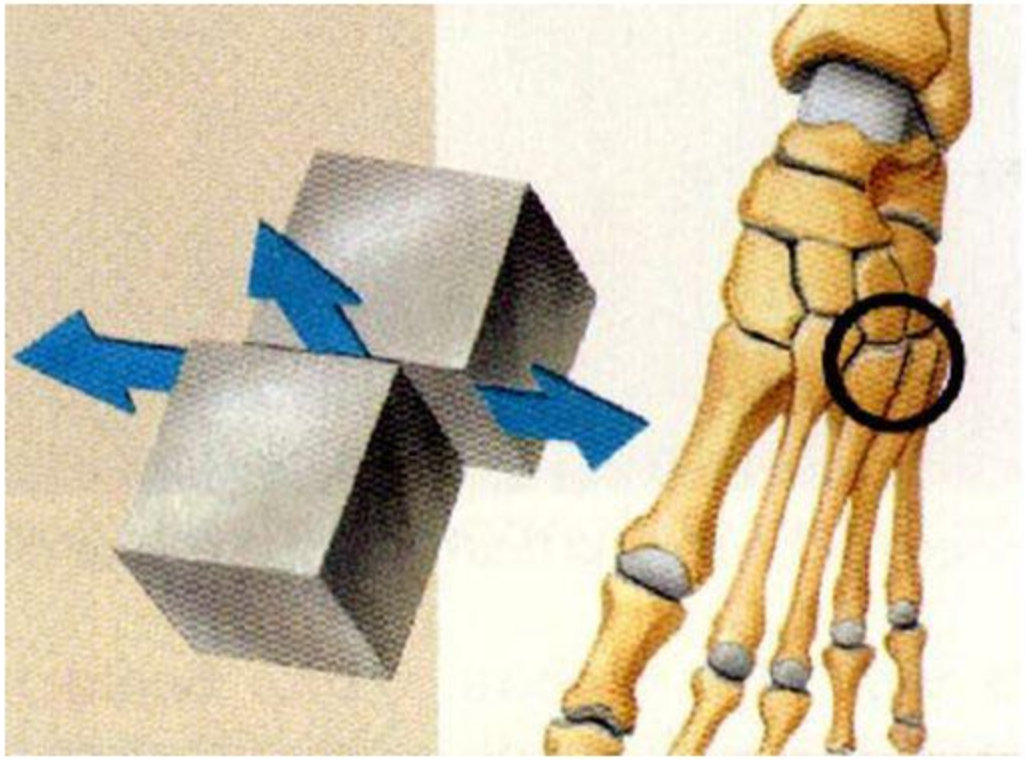
Gliding Joint

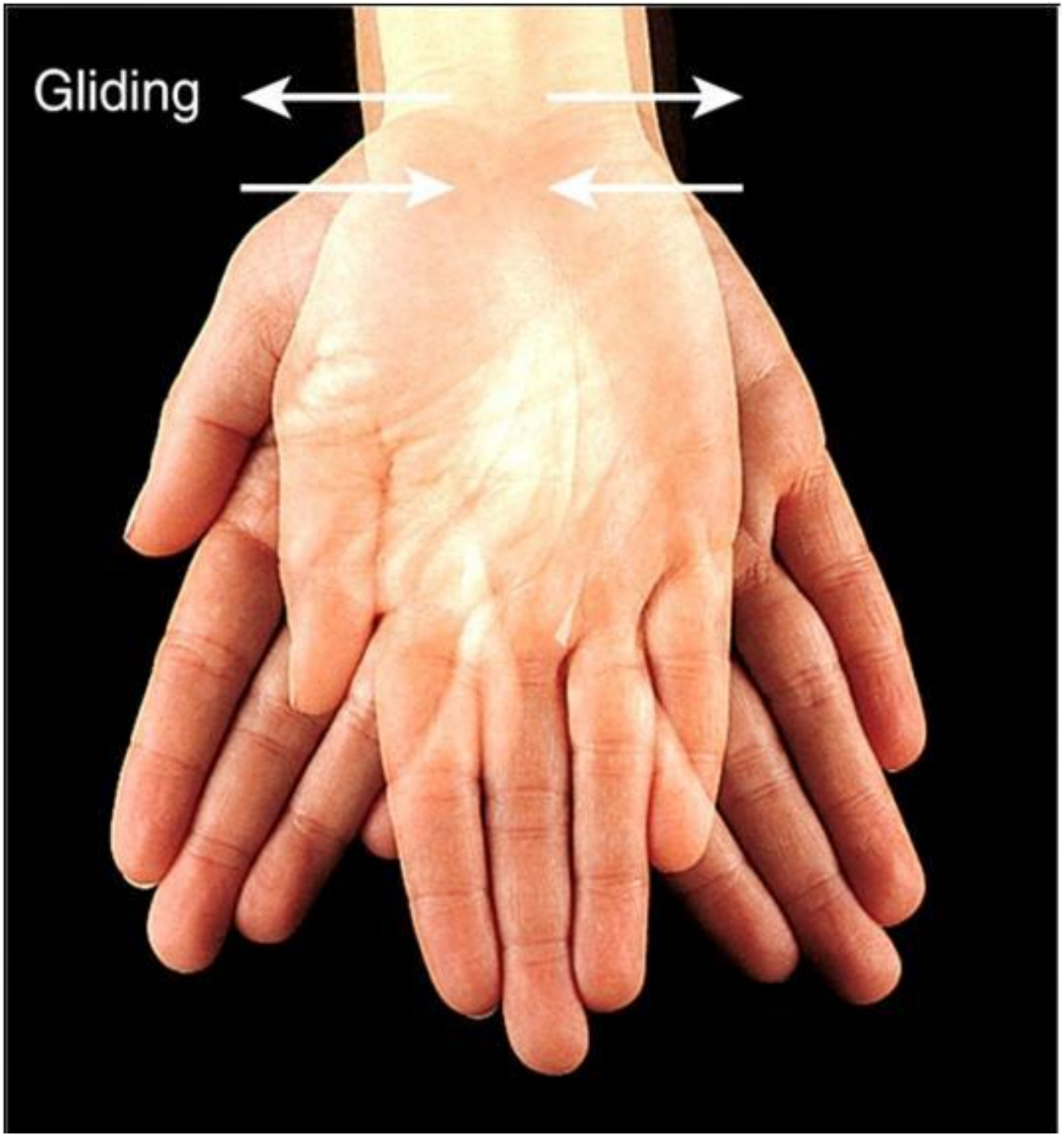
Gliding joint allows the bones to glide over each other.
Bones of the wrist and the ankle have gliding joints.

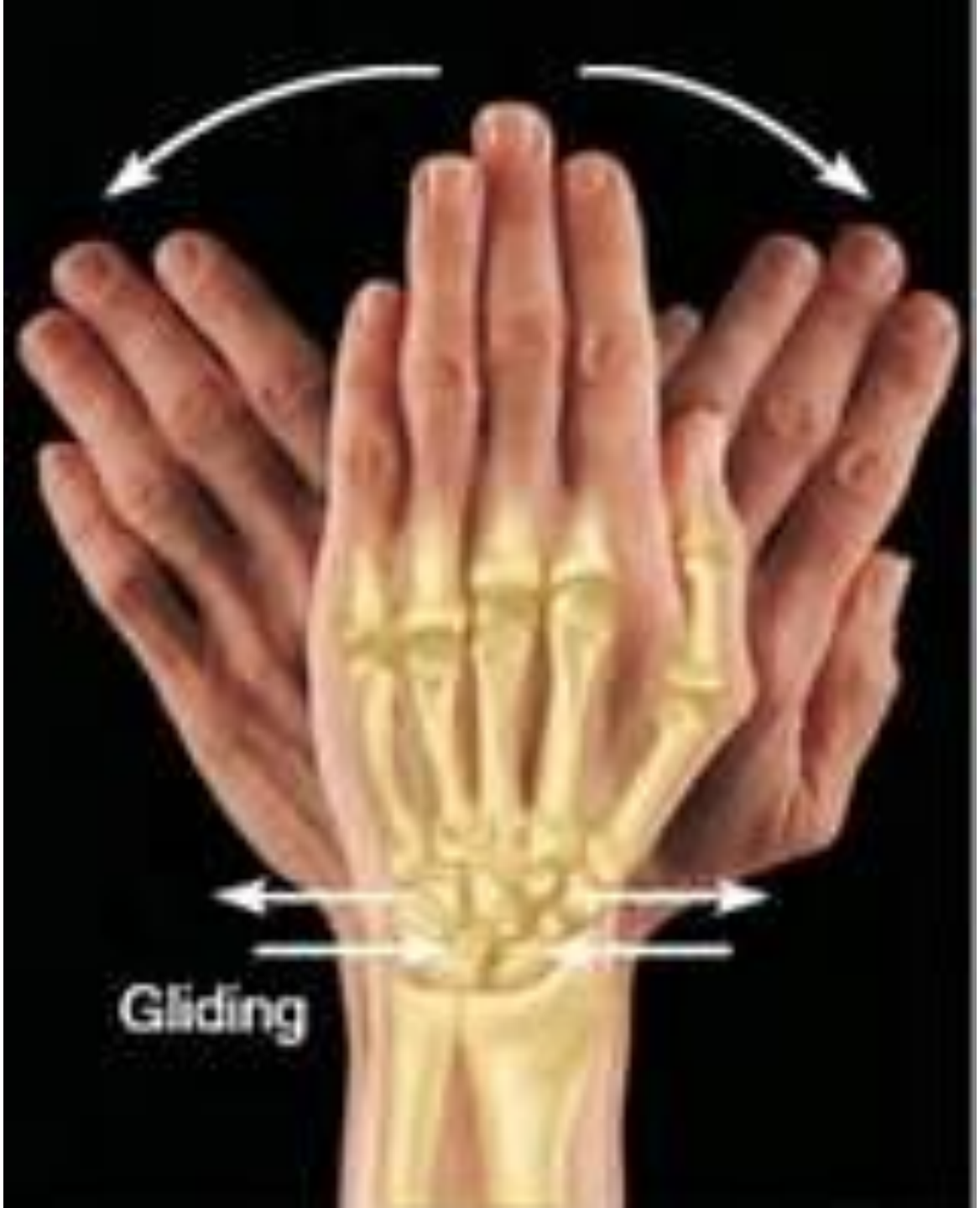
Gliding joint



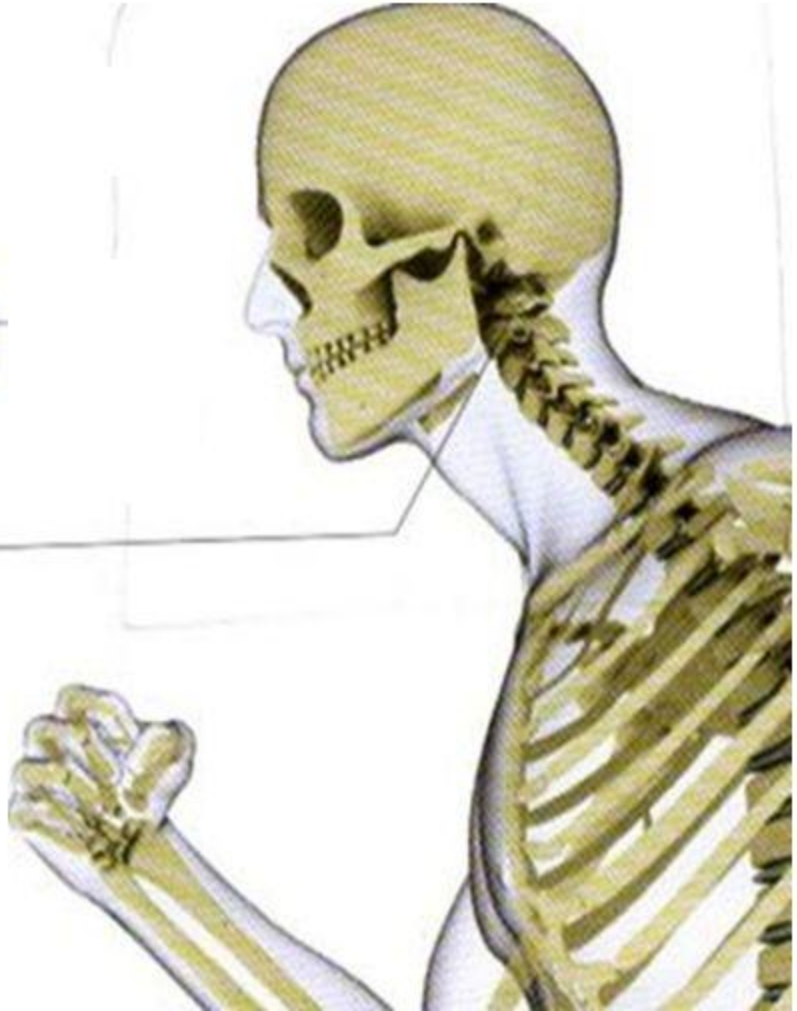


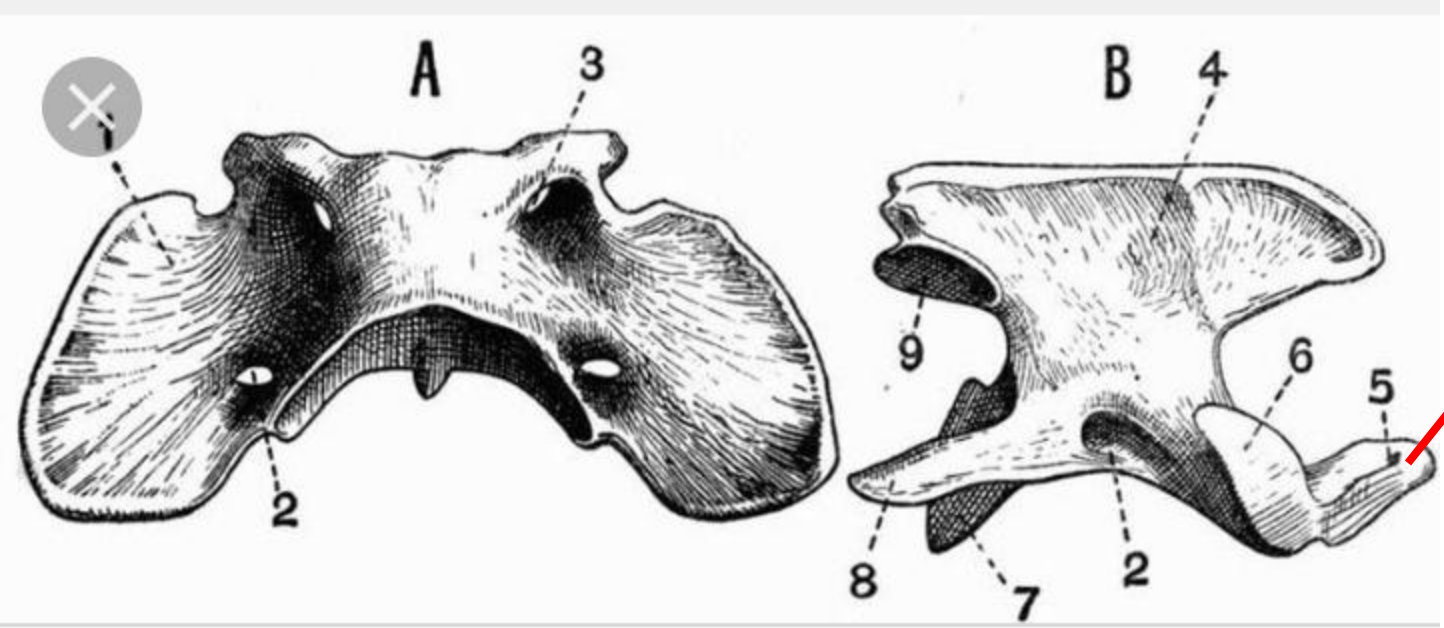



Gliding


Gliding

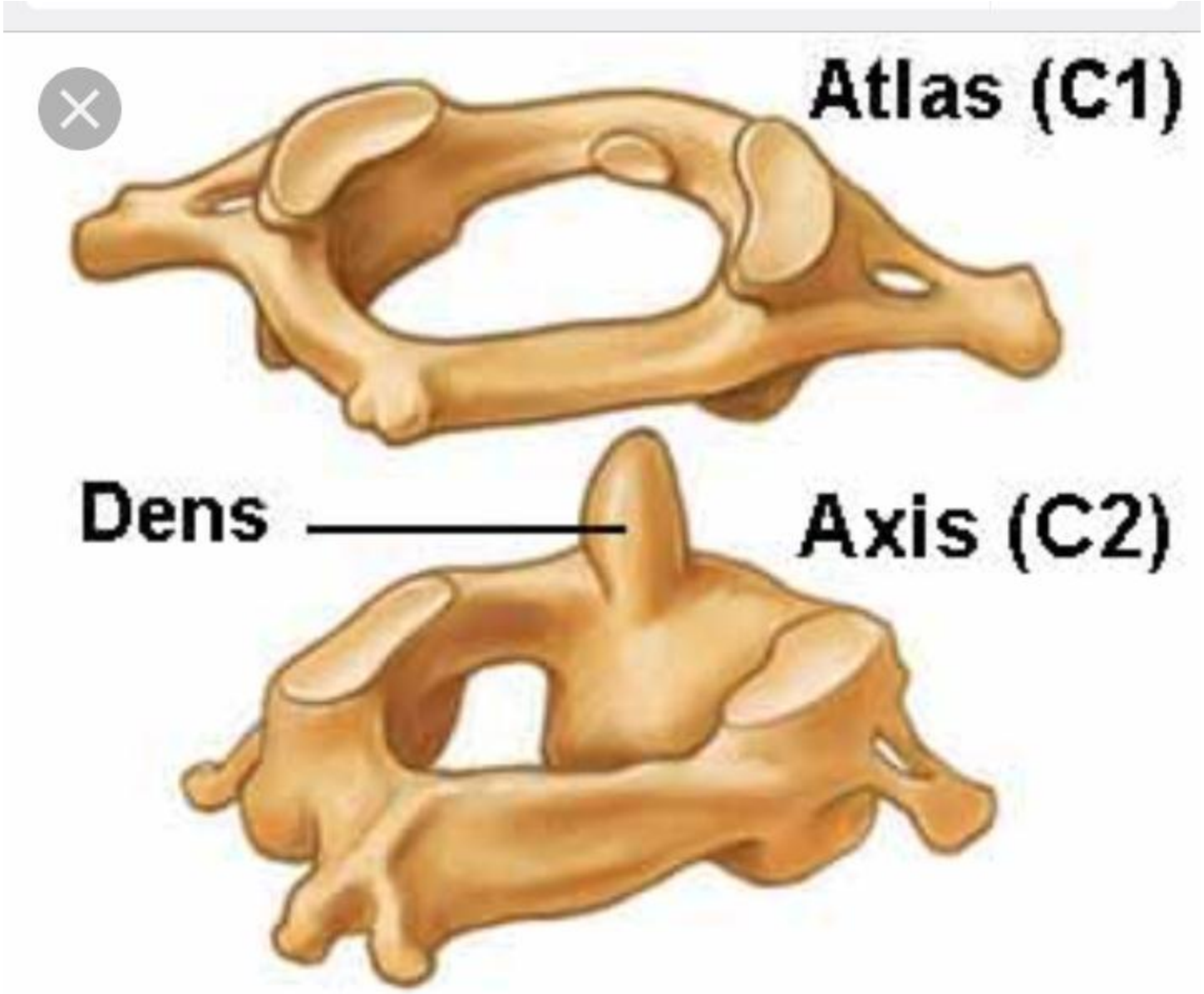
Pivot Joint





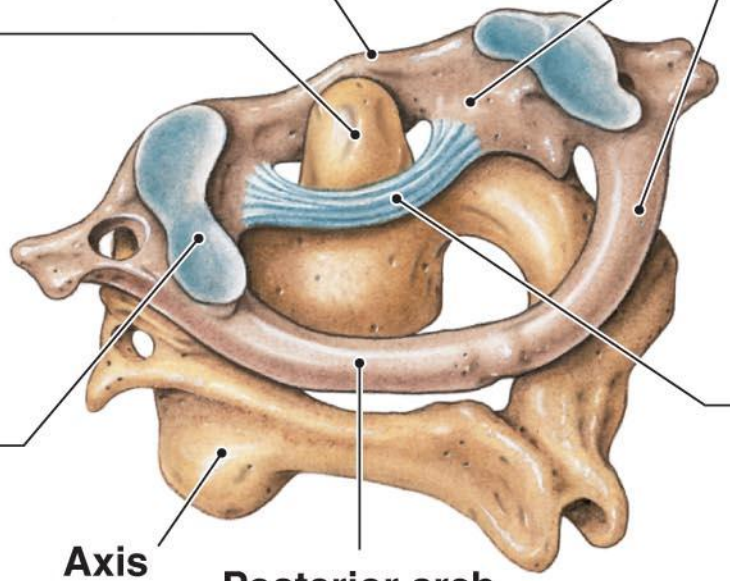
Atlas of rabbit
(first cervical vertebra)

Axis of rabbit
(second cervical vertebra)

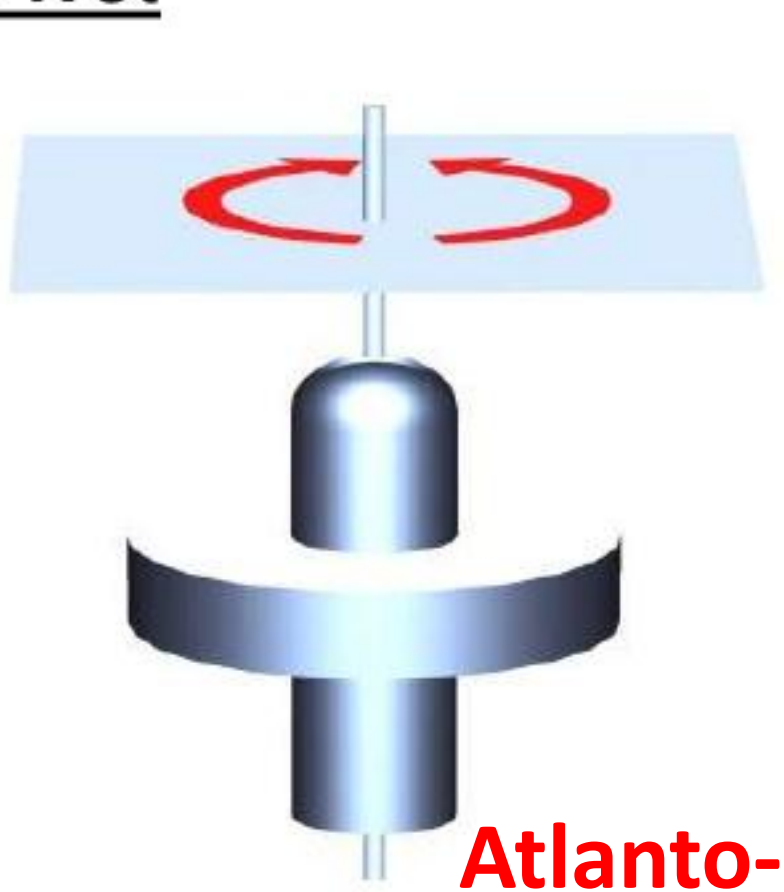


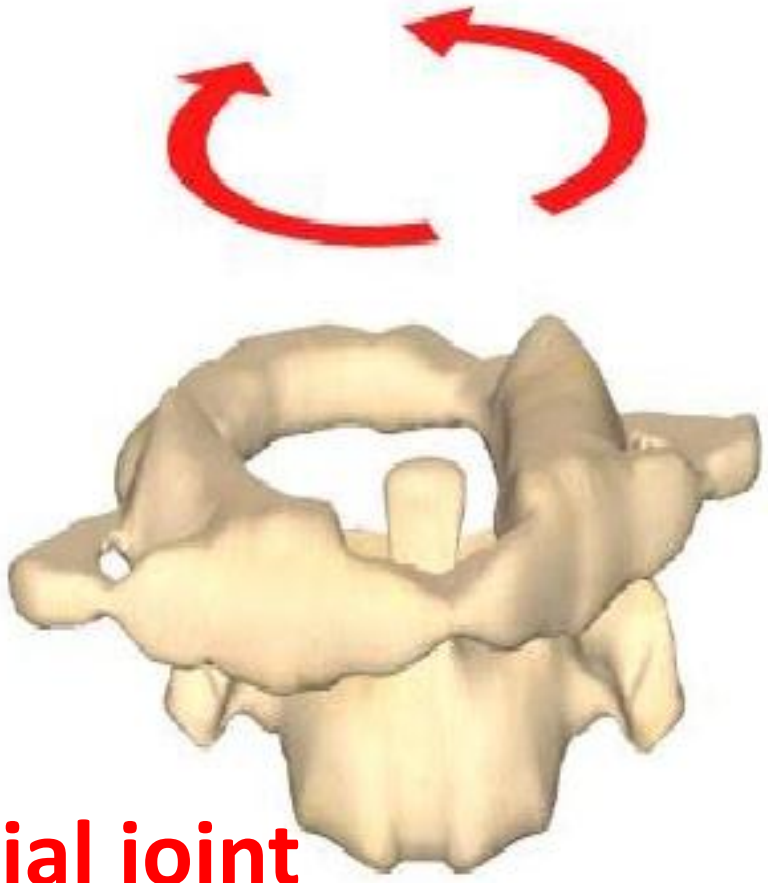
Cervical vertebrae of human

The first two cervical vertebrae: the atlas and the axis



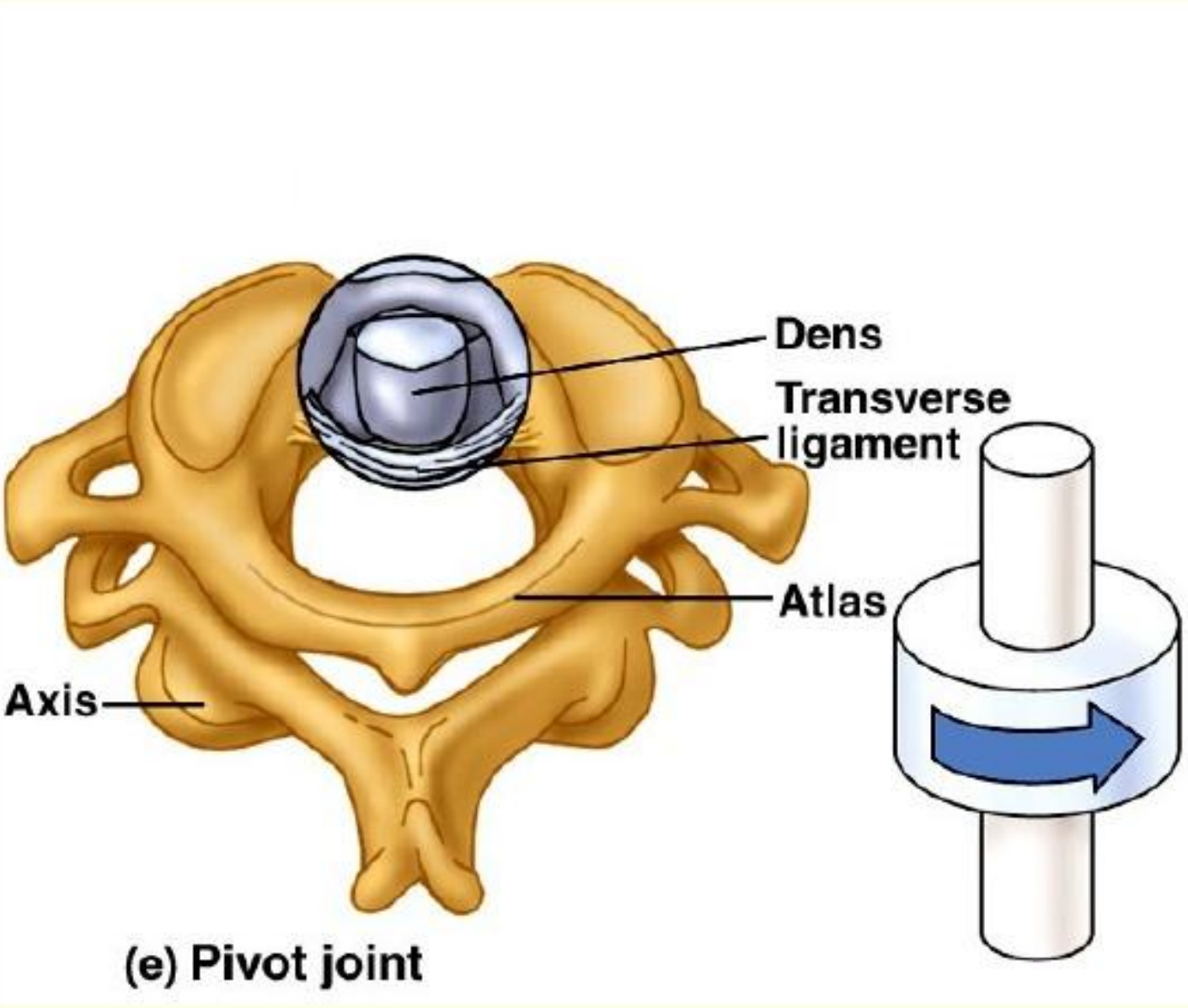
Pivot

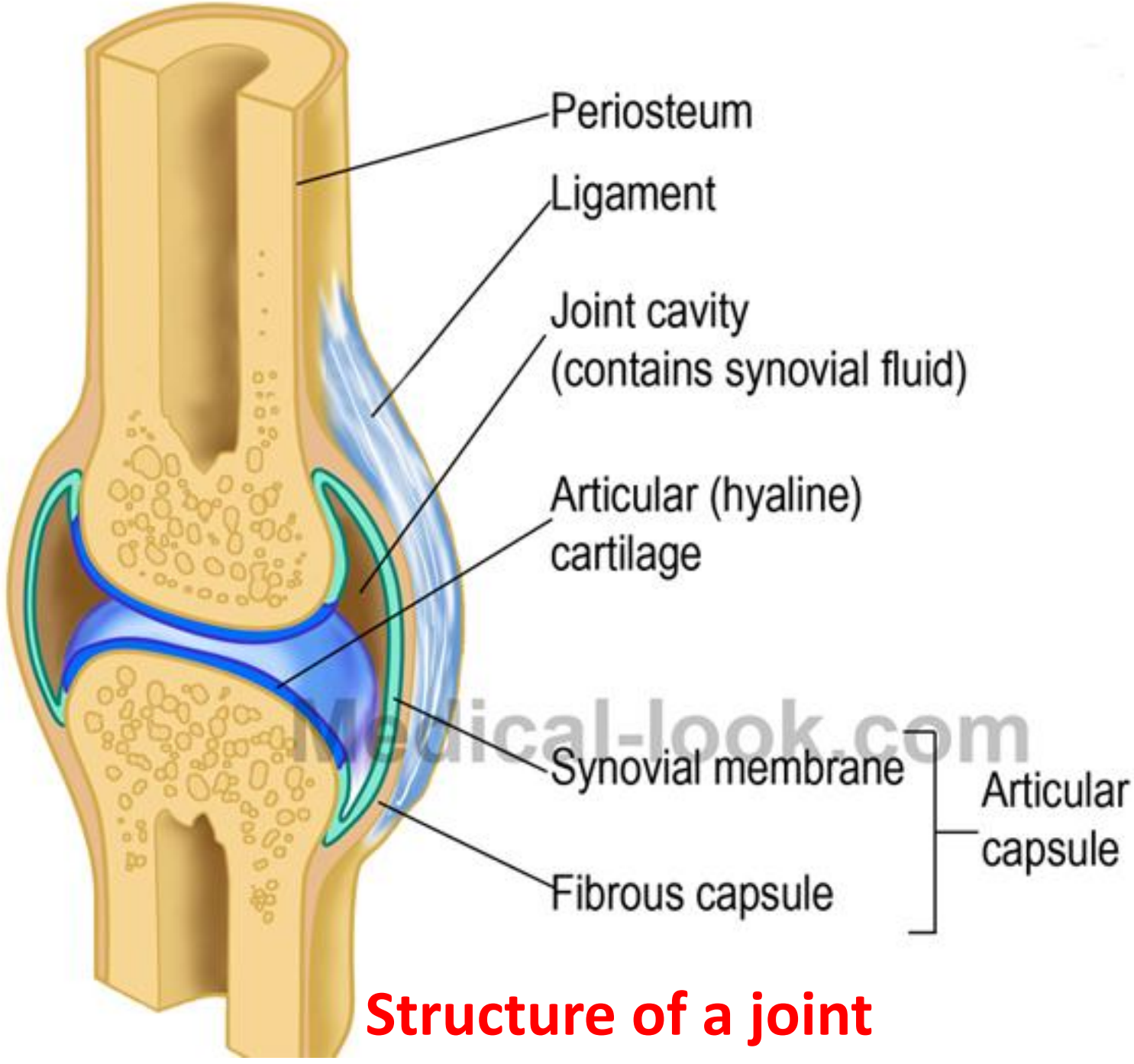




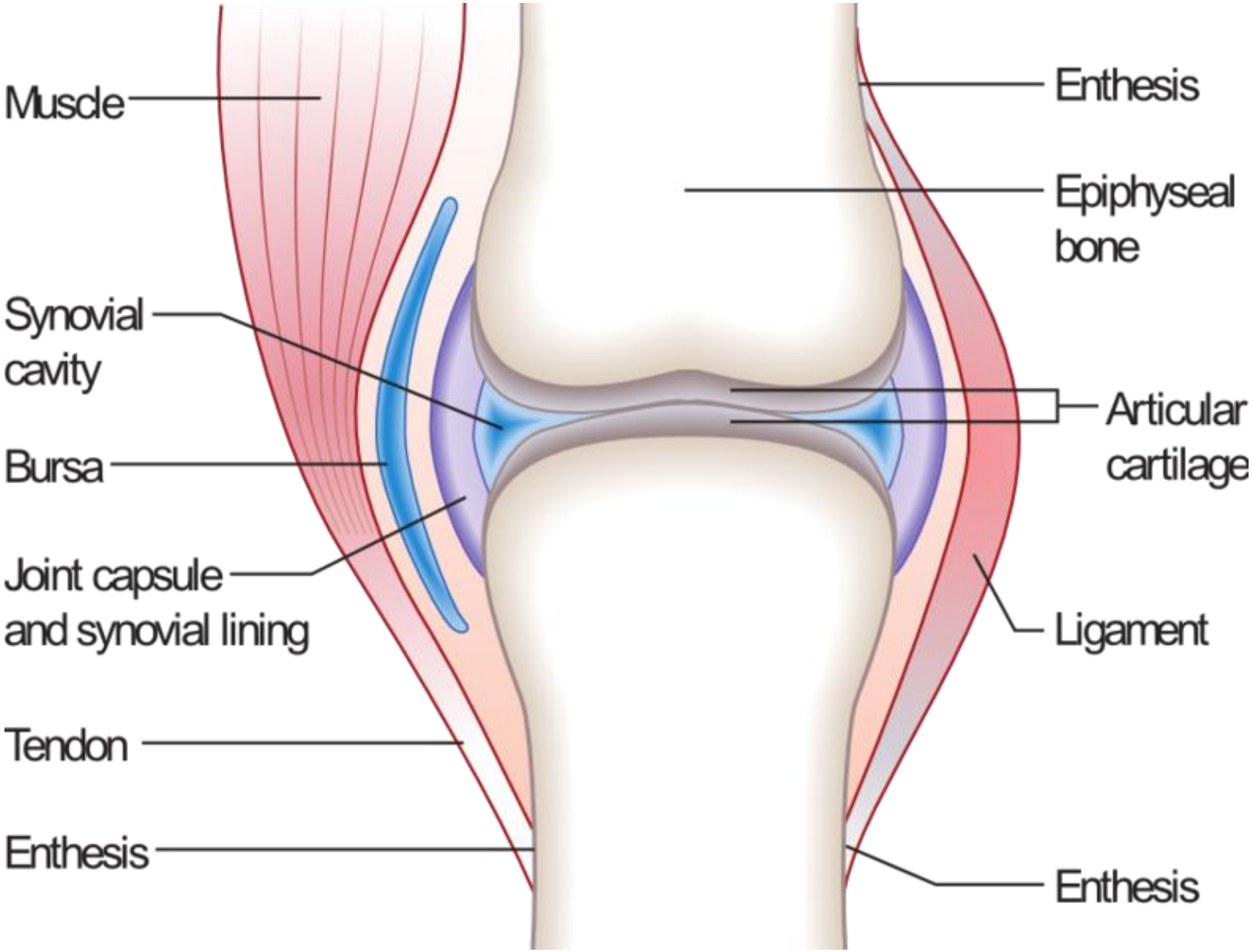
Atlanto-axial joint

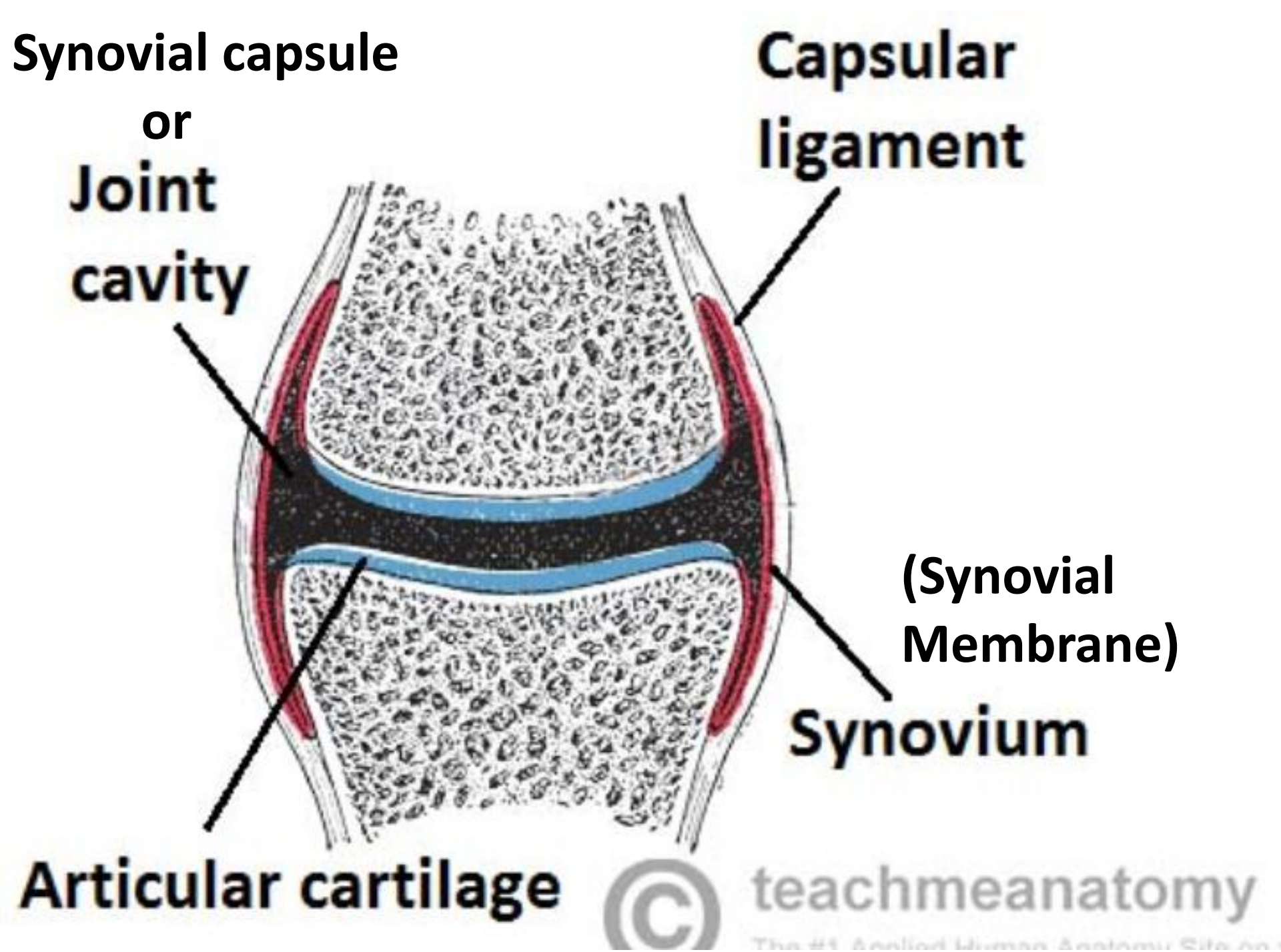
- **Pivot joint:** rotation around a central axis
- **Ex:** atlas/ axis joint



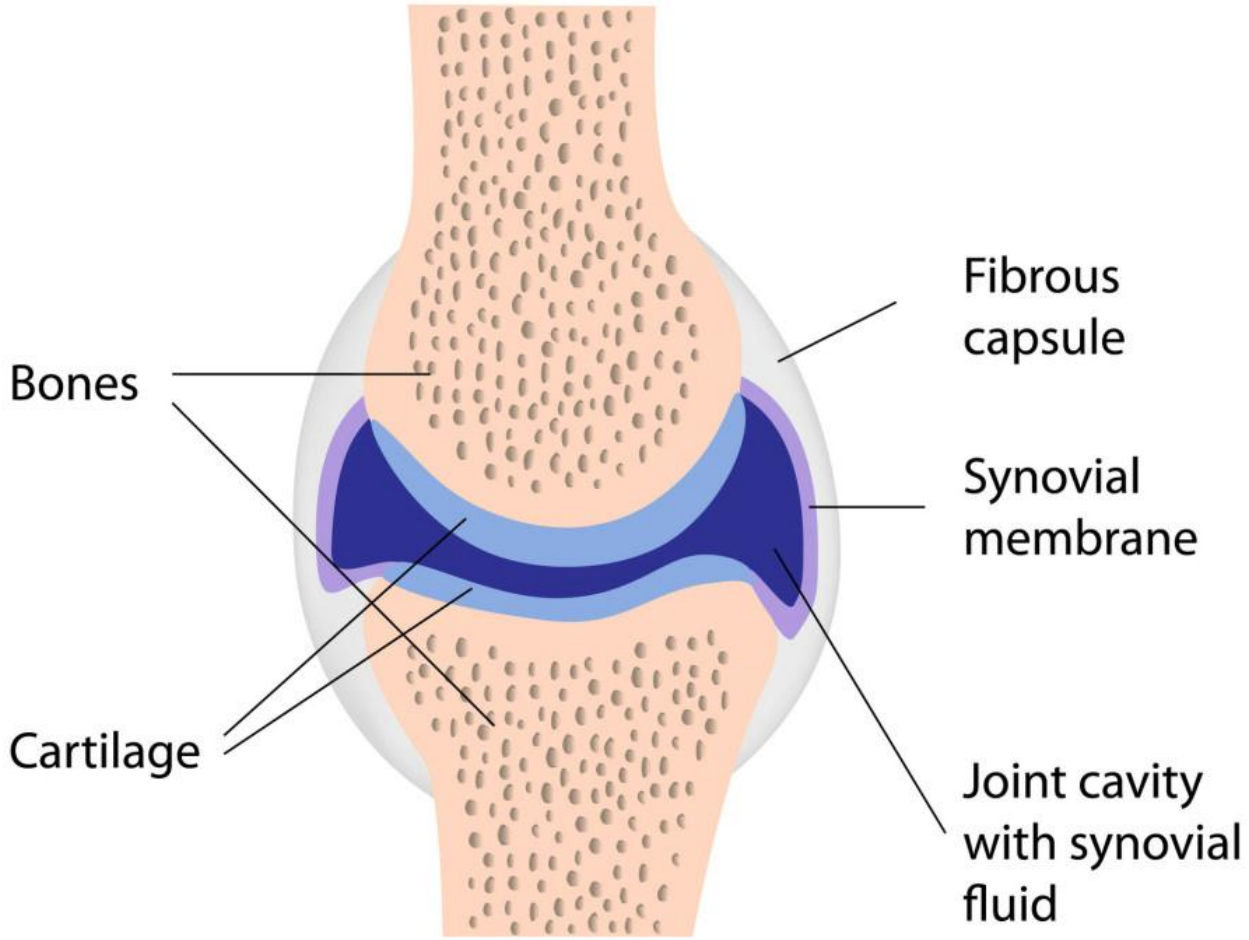


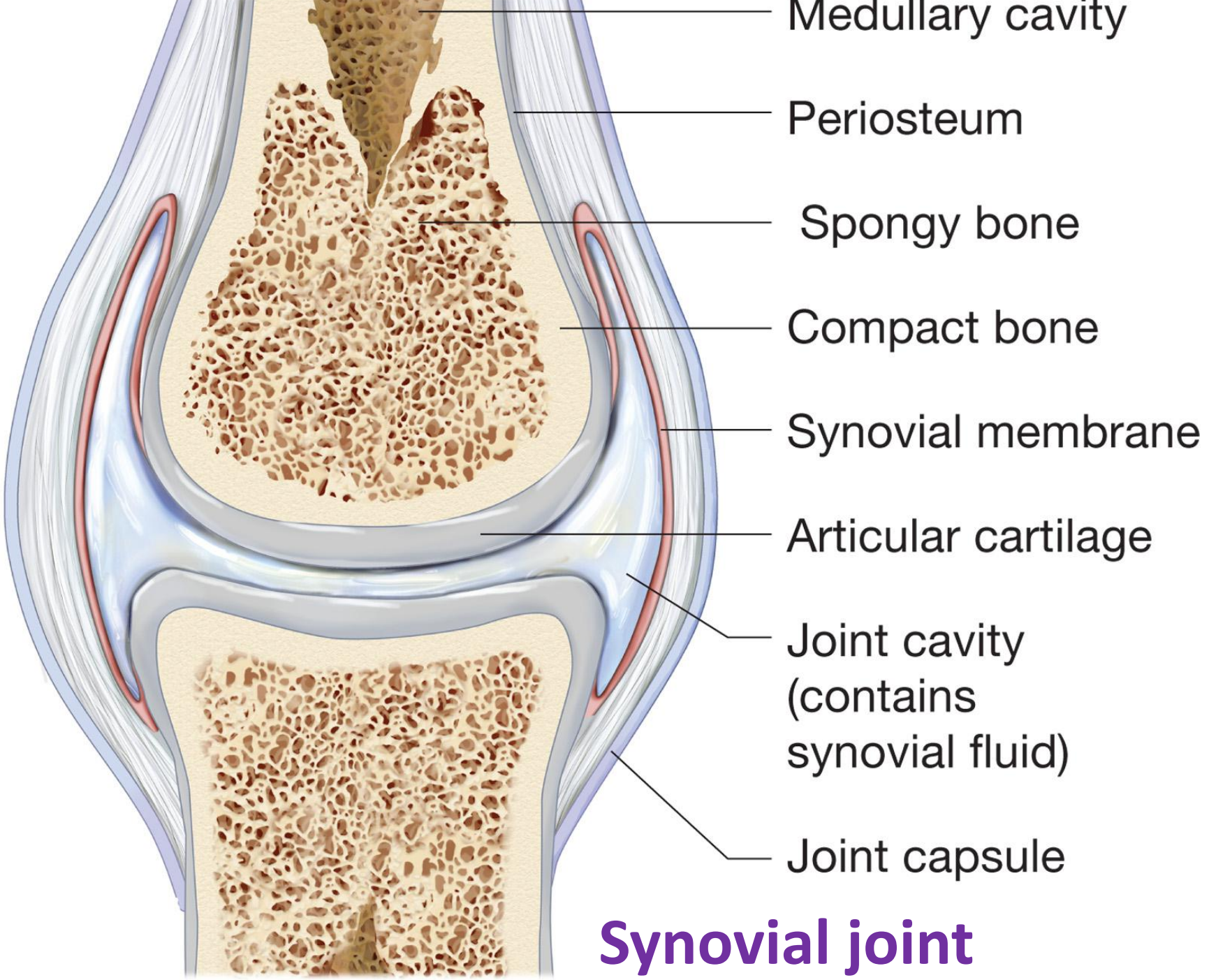
Structure of a joint


Muscle
Synovial cavity
Bursa
Joint capsule and synovial lining
Tendon
Enthesis
Enthesis
Epiphyseal bone
Articular cartilage
Ligament
Enthesis


Synovial capsule
or
Joint cavity
Capsular ligament
(Synovial Membrane)
Synovium
Articular cartilage
© teachmeanatomy

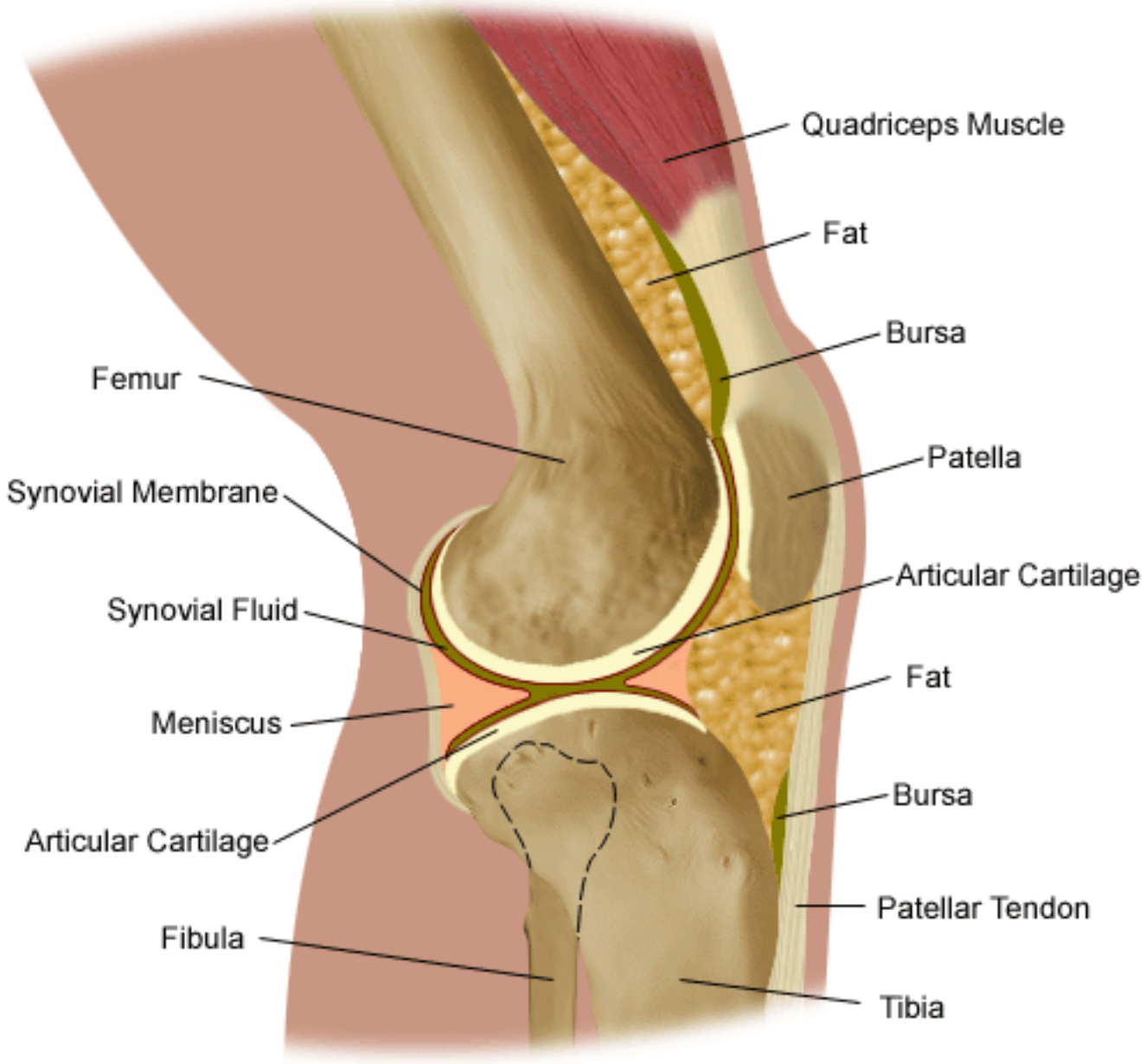
Synovial Joint





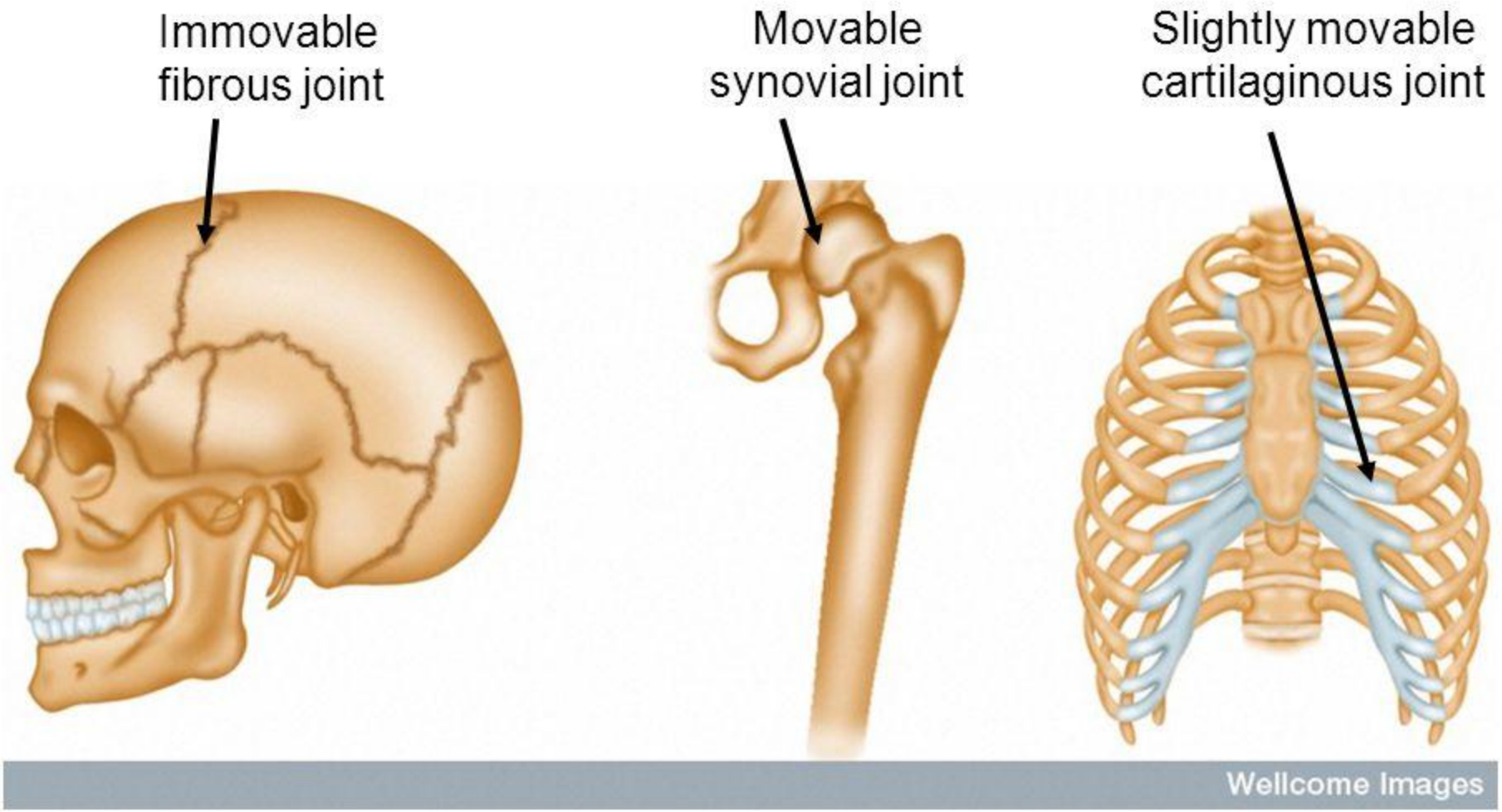
Synovial joint

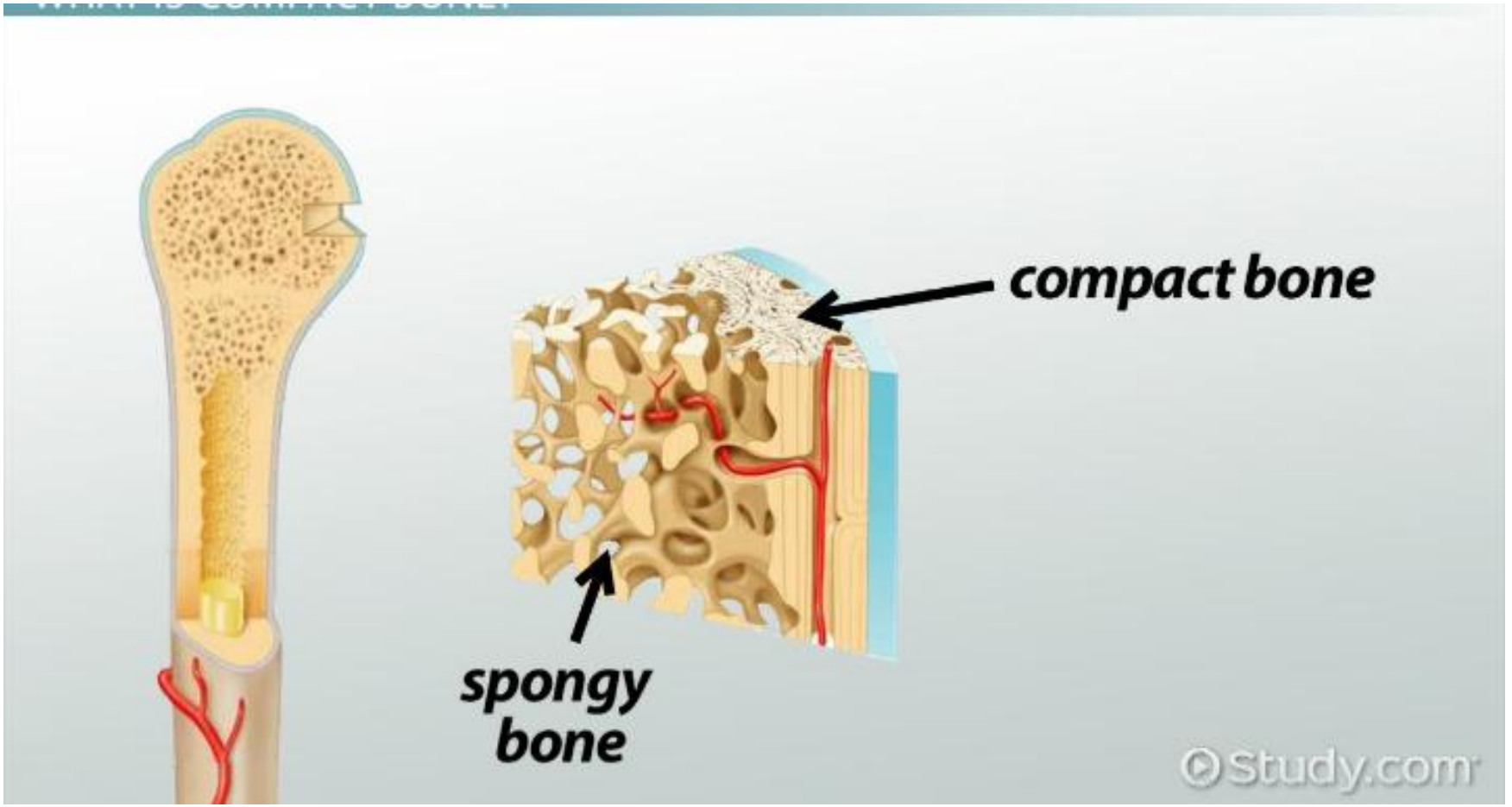
Anatomy of the Knee

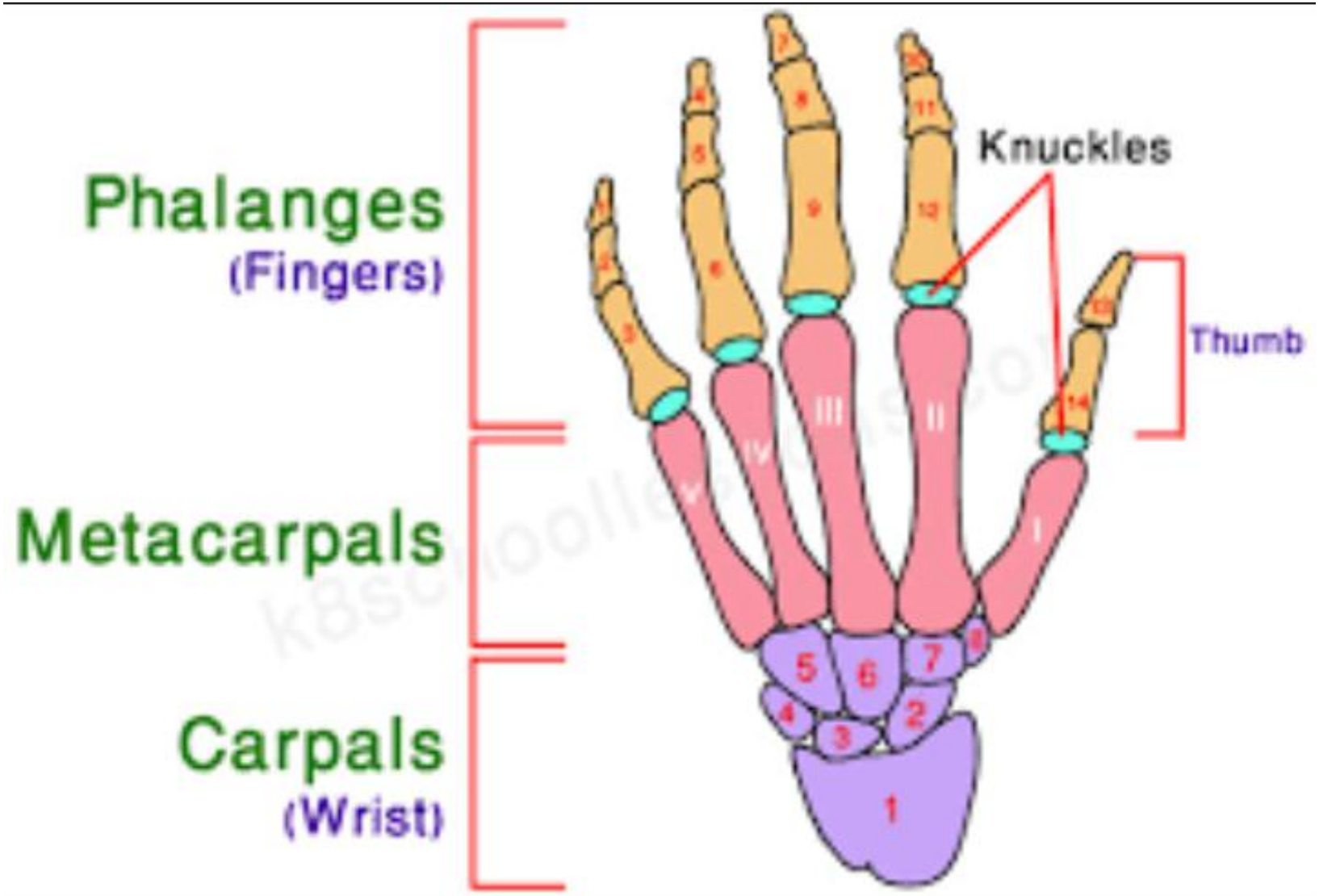


THANK YOU

Types of joints




compact bone
spongy bone
Study.com


Phalanges
(Fingers)
Metacarpals
Carpals
(Wrist)
Knuckles
Thumb
I
II
III
IV
V
1
2
3
4
5
6
7
8
9
10
11
12
13
14

There are four main kinds of moveable joints

(1) Ball and socket joints

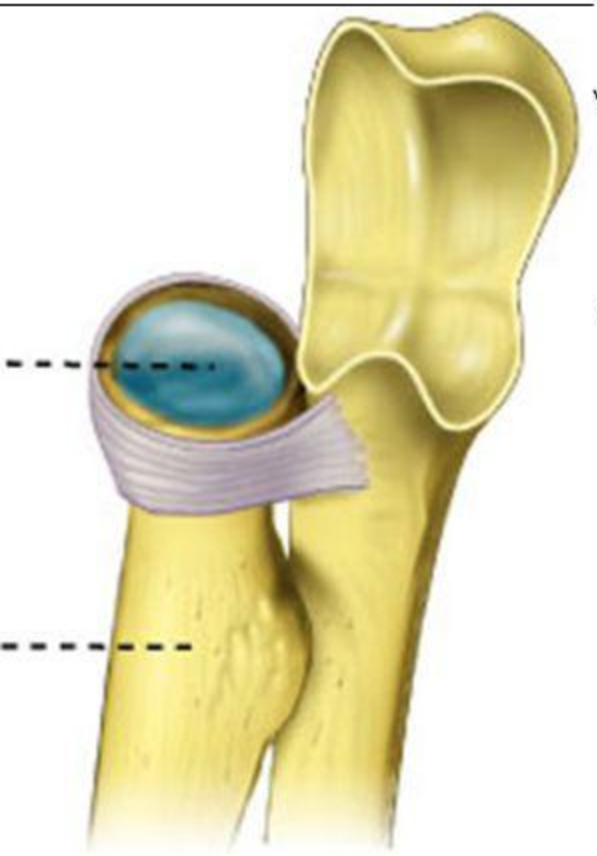
(2) Hinge joints

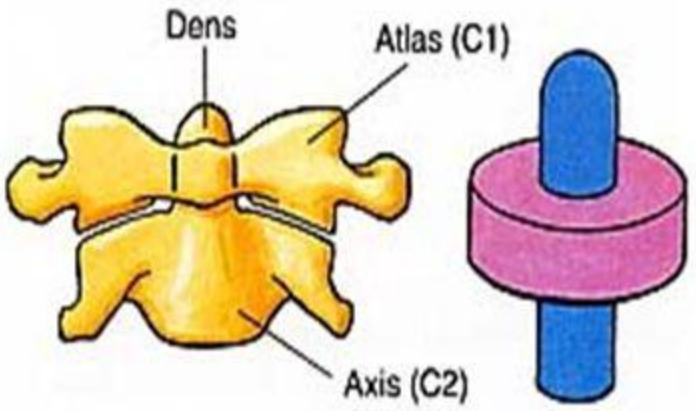
(3) Gliding or sliding joints

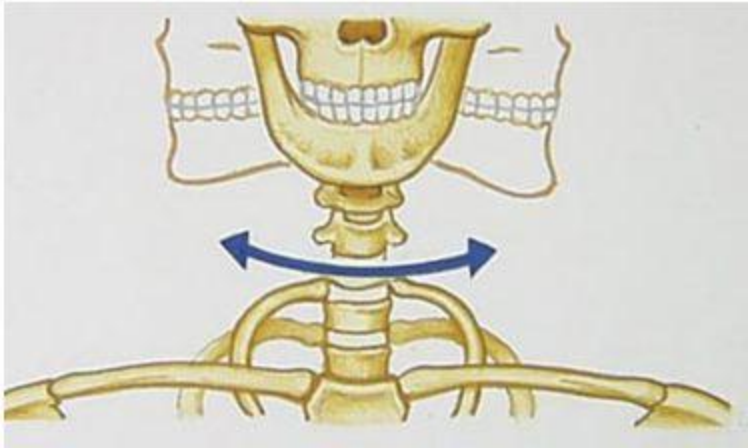
(4) pivot joints

Pivot Joint

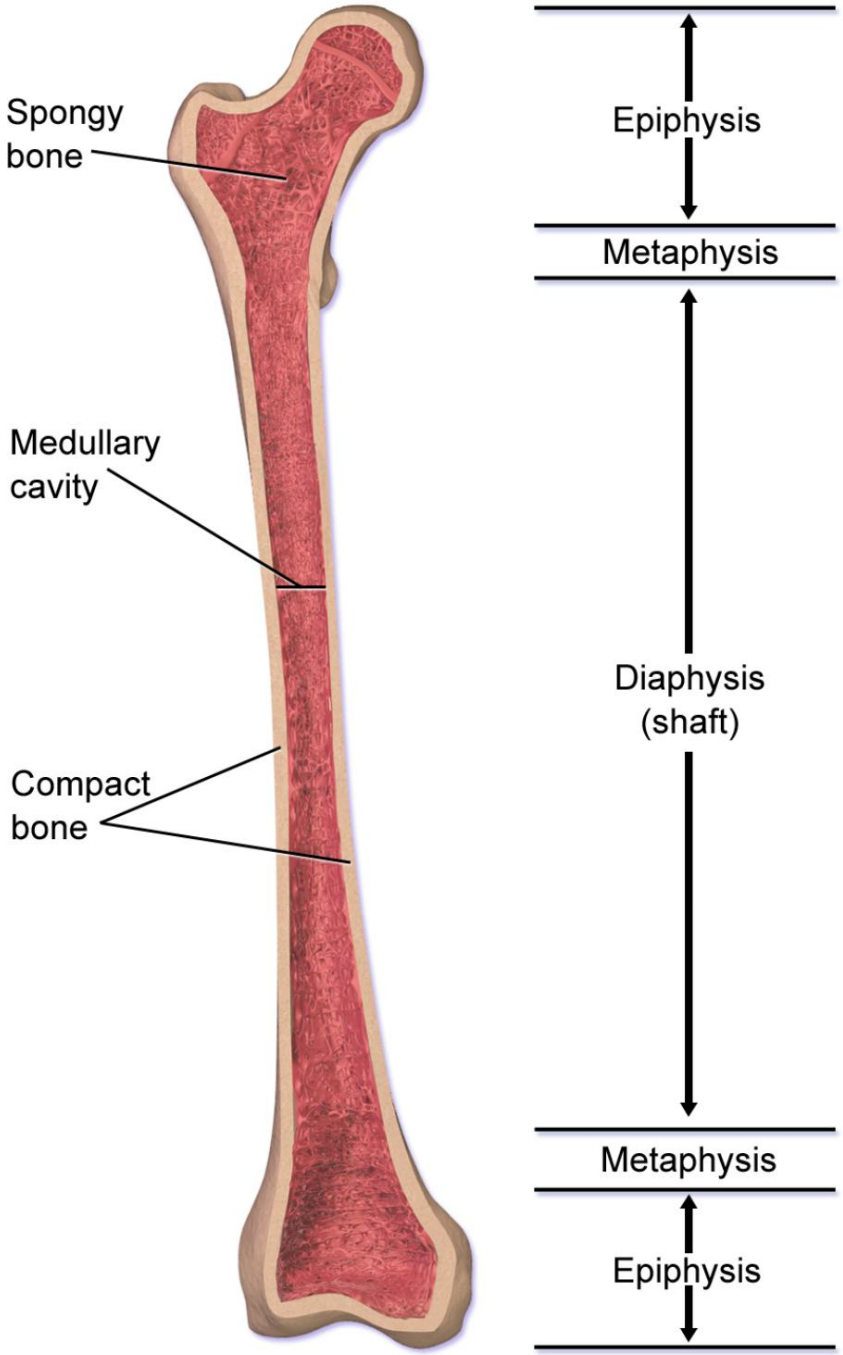
- Rounded end of one bone protrudes into “sleeve,” or ring, composed of bone or ligaments of another bone
- Examples: **Atlas and Axis and Radius and Ulna**







Structure of a Long Bone



Structure of the periosteum

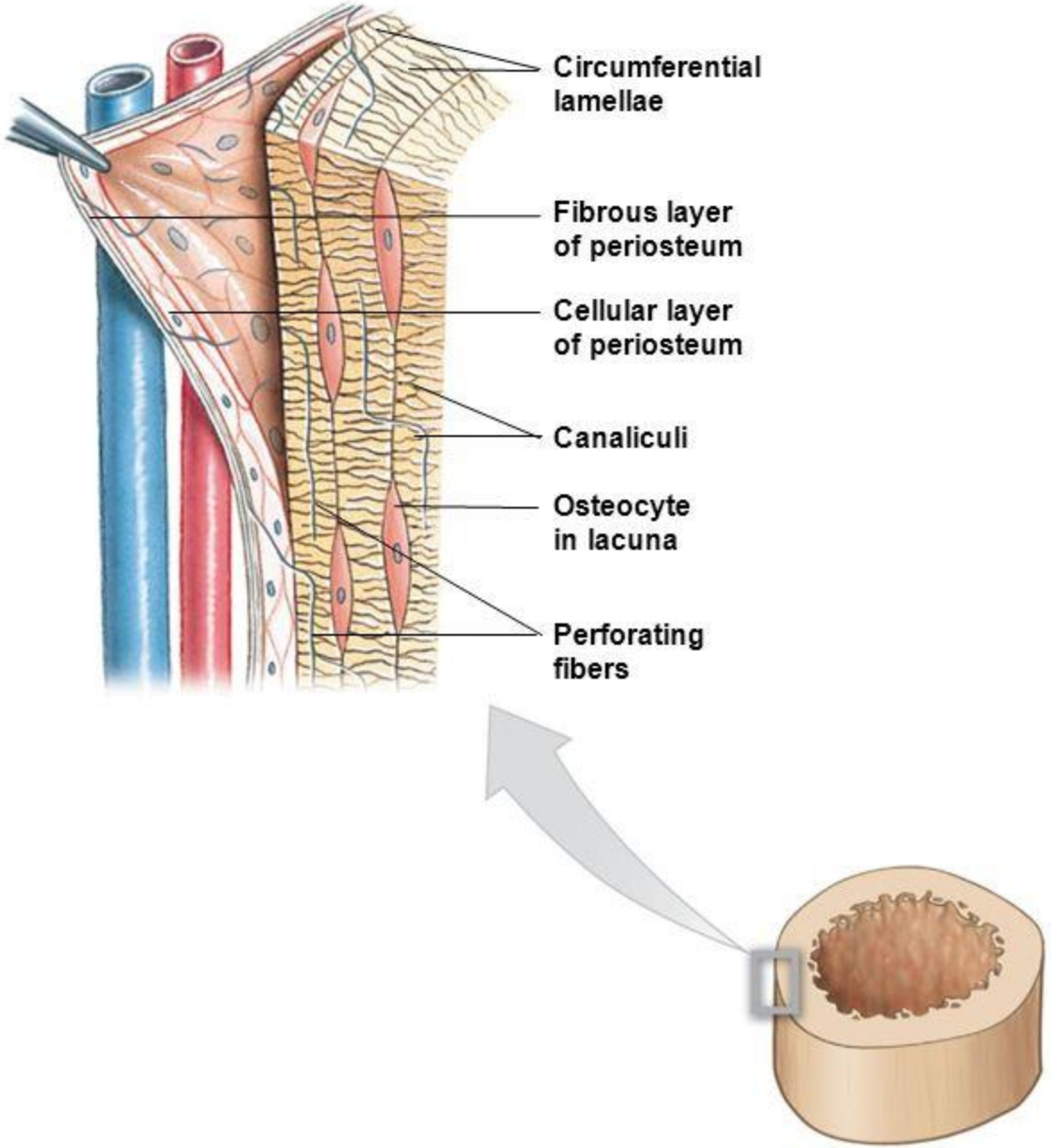
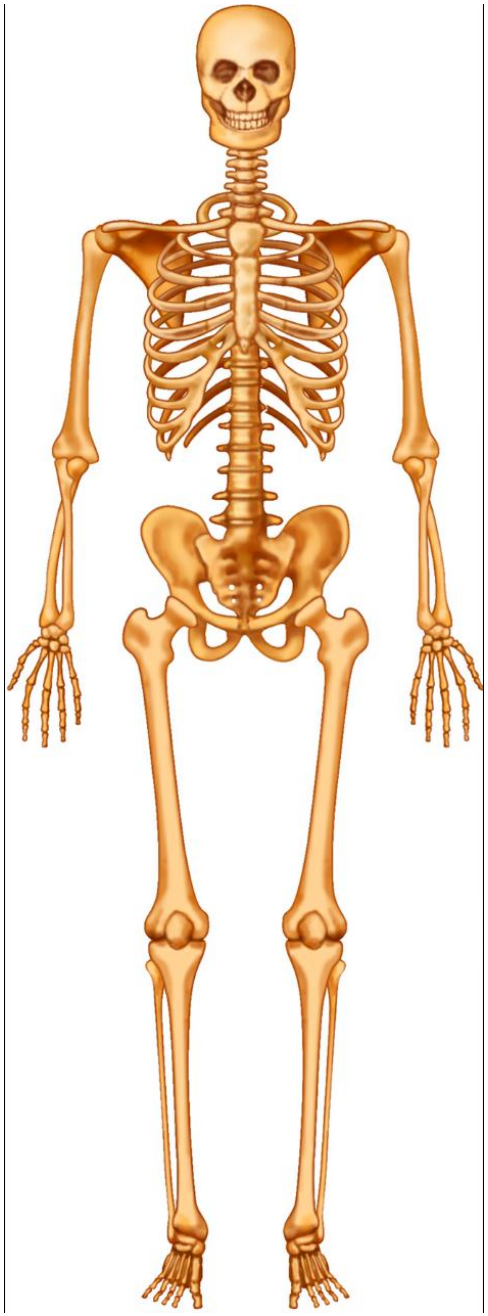
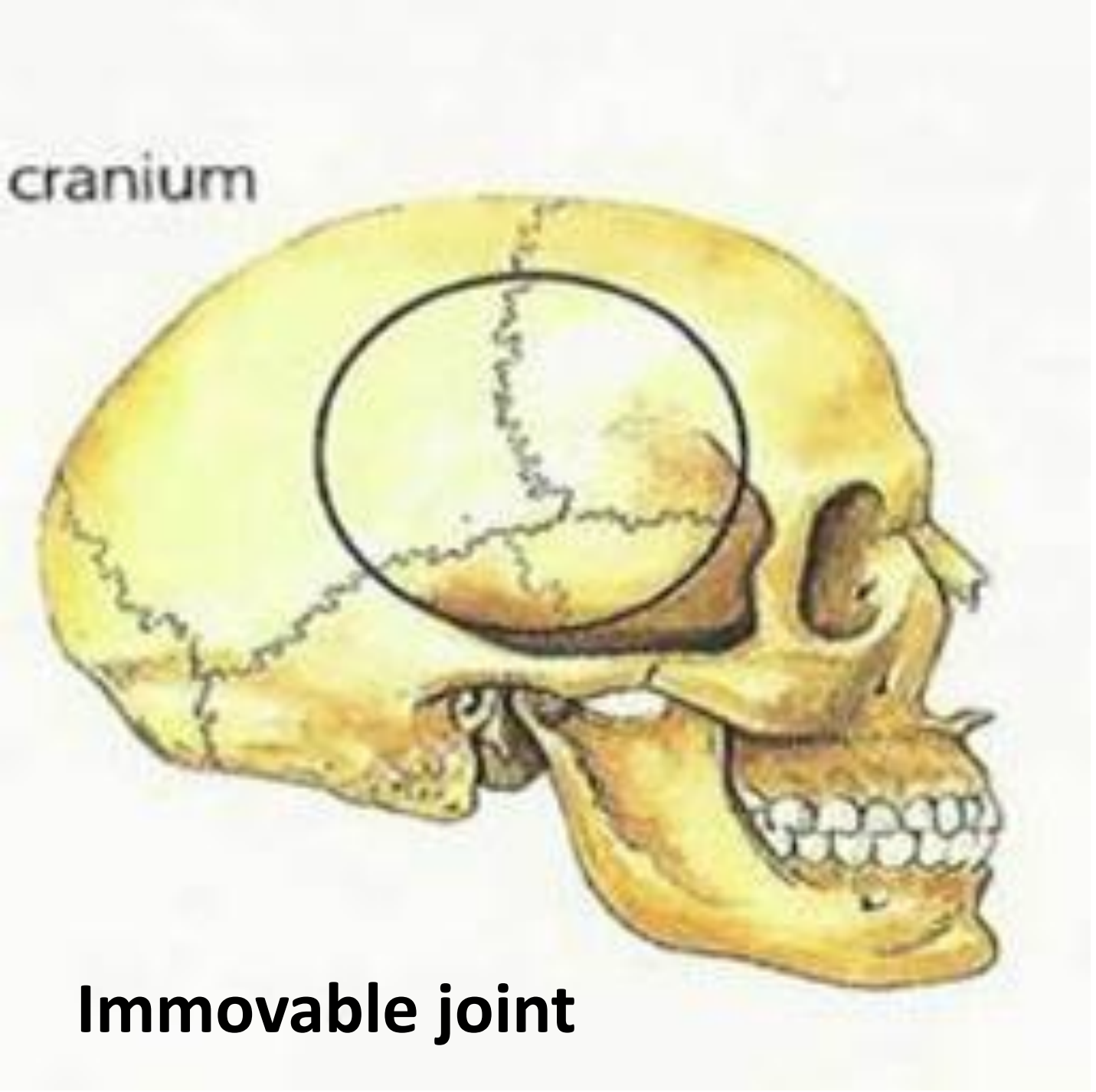


Figure 6.5 3





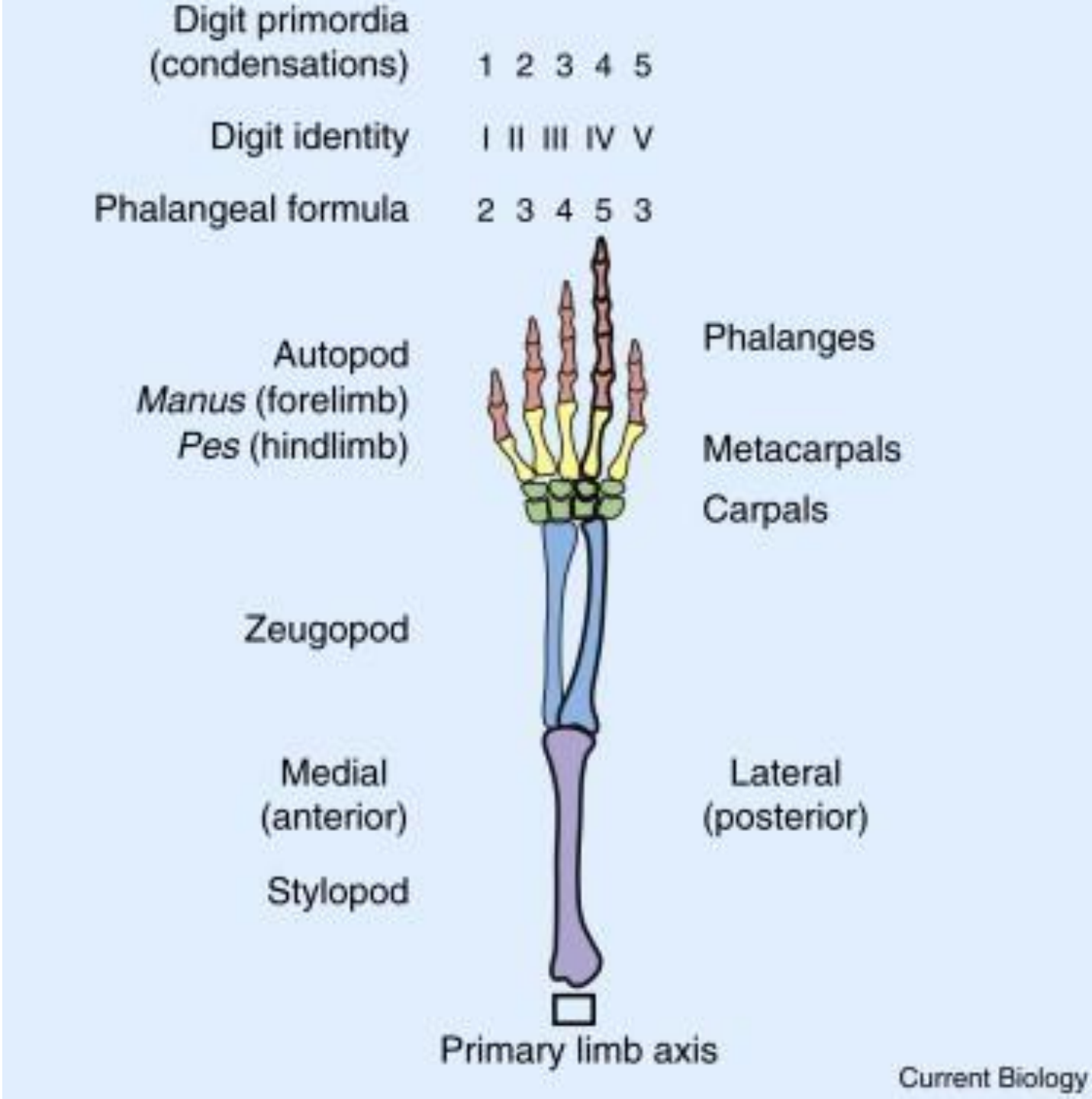
Immovable joint

Skeletal System

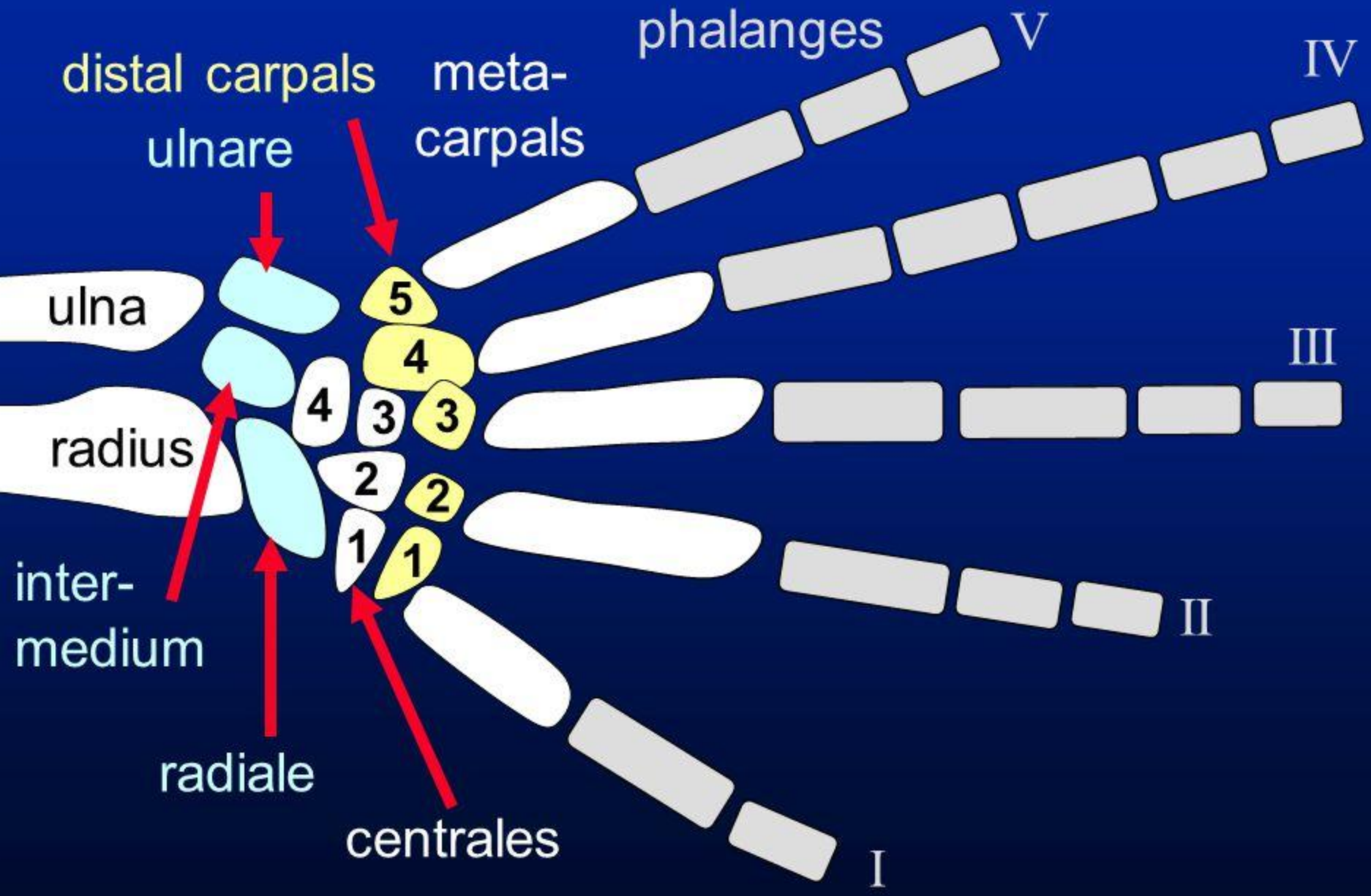
Three main components

- With respect to the pectoral and pelvic girdles:
  - Serially homologous –

3. Propodium (= stylopodium) – upper arm, upper leg
4. Epipodium (= zeugopodium) – forearm, shin
5. Autopodium – manus or pes (digits, and wrist and palm, or ankle and sole

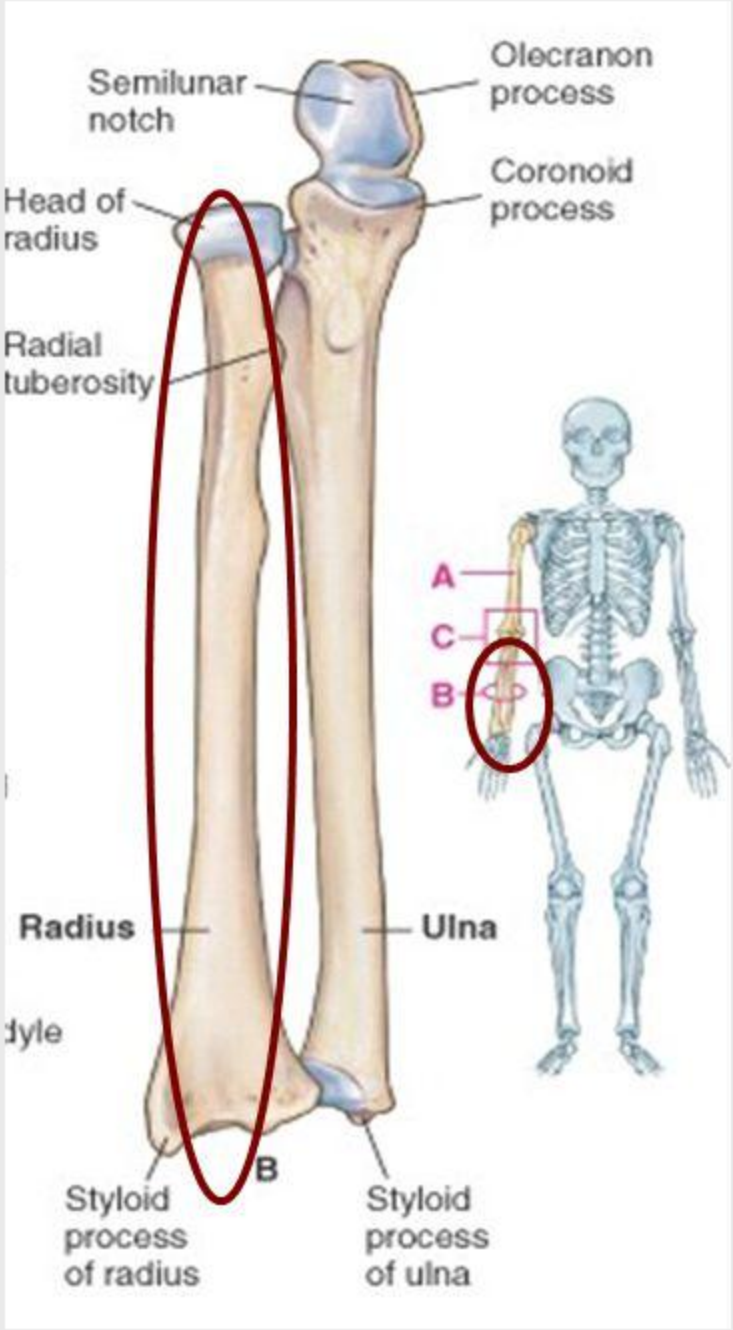

Digit primordia (condensations)
1 2 3 4 5
Digit identity
I II III IV V
Phalangeal formula
2 3 4 5 3
Autopod
Manus (forelimb)
Pes (hindlimb)
Phalanges
Metacarpals
Carpals
Zeugopod
Medial (anterior)
Lateral (posterior)
Stylopod
Primary limb axis
Current Biology

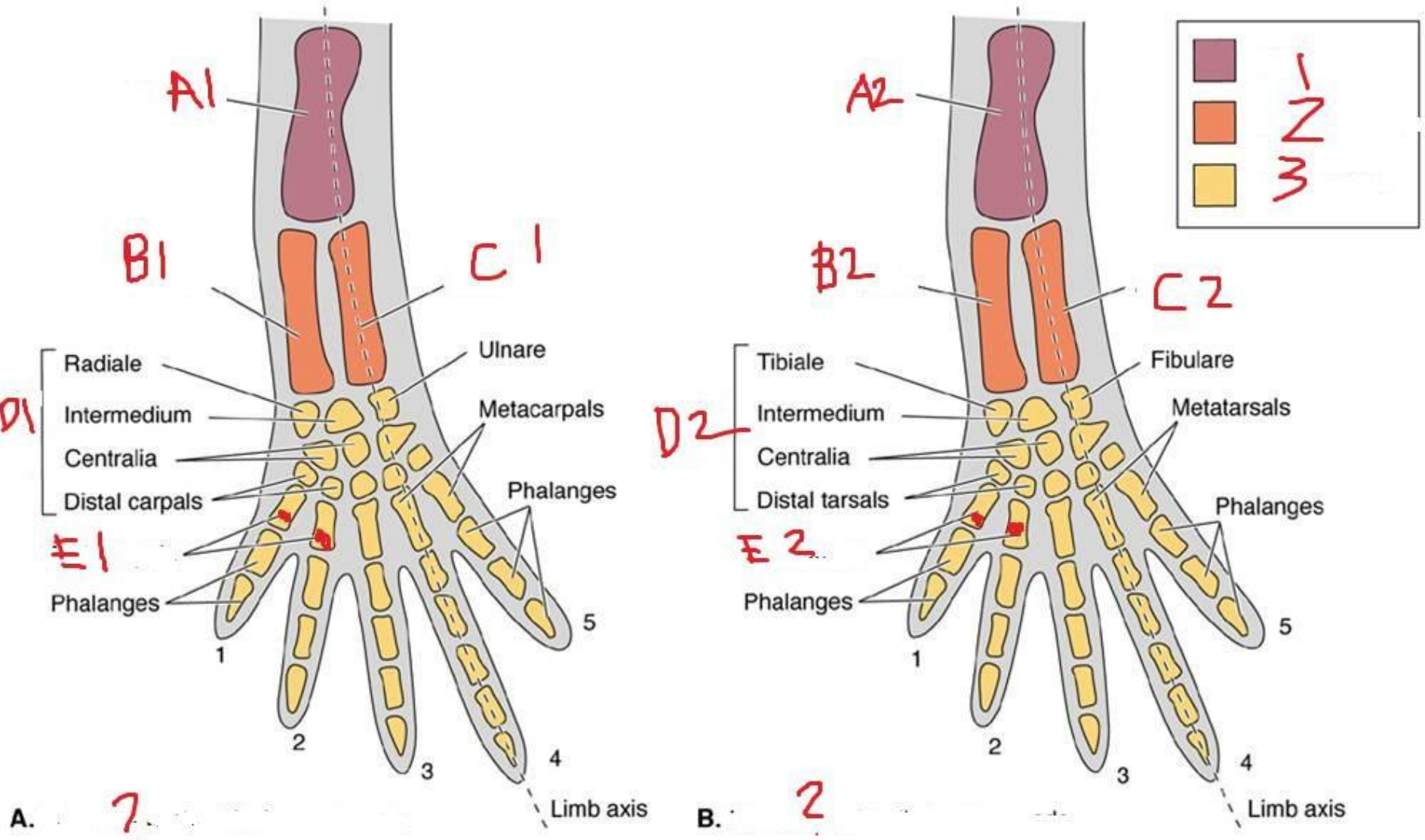
Ancestral Tetrapod Manus



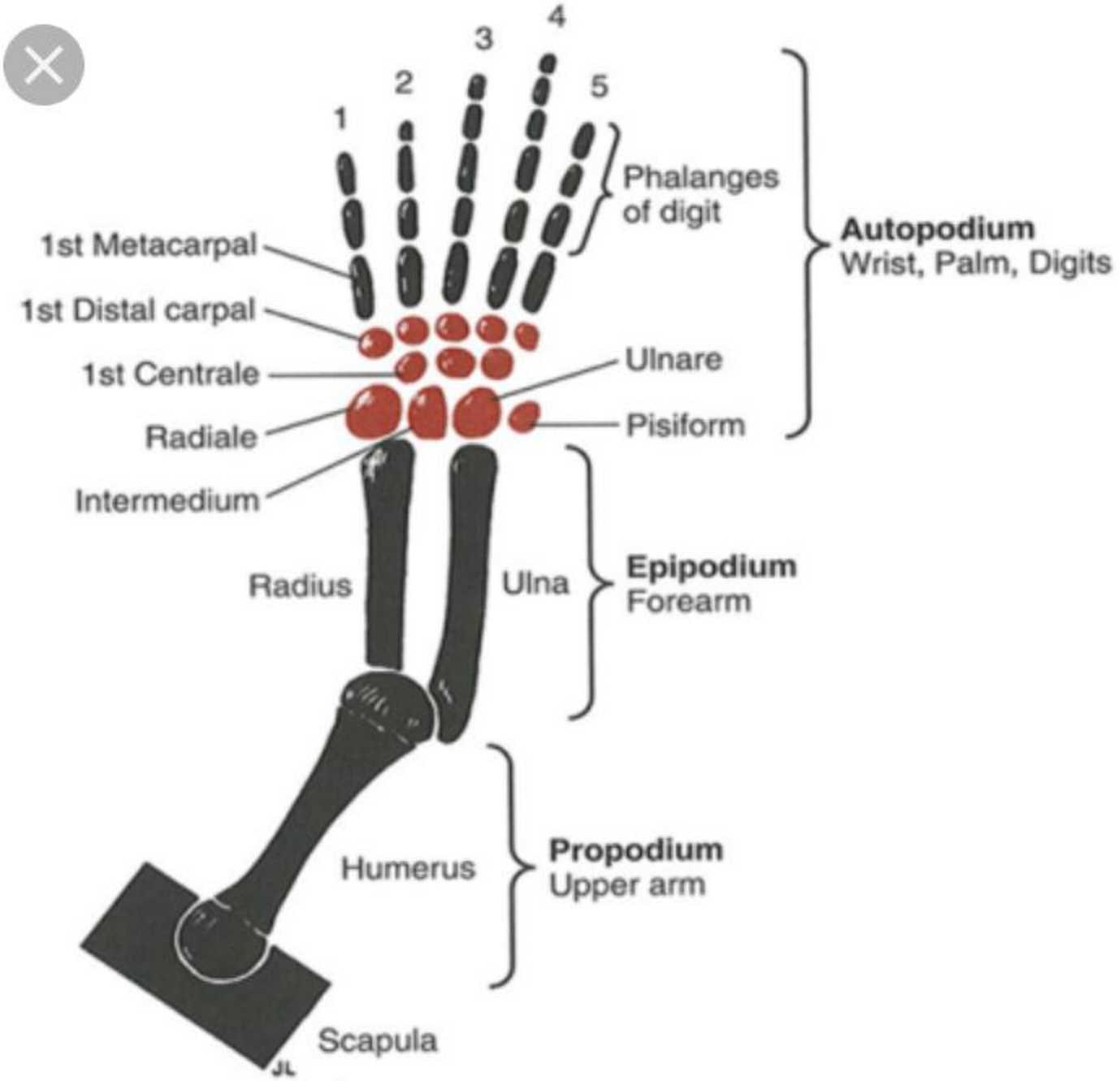
RADIUS – 2

- Radius and Ulna Are Bones of the Forearm
- Radius: Thumb Side, Ulna: Little Finger Side



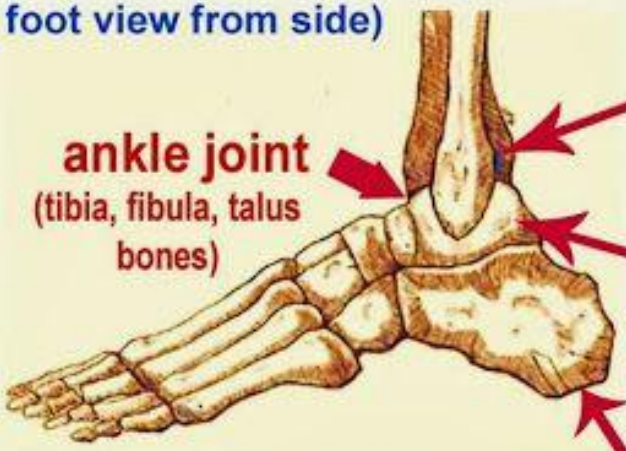


Cheiropterygium


1
2
3
4
5
Phalanges of digit
1st Metacarpal
1st Distal carpal
1st Centrale
Radiale
Intermedium
Ulnare
Pisiform
Autopodium
Wrist, Palm, Digits
Radius
Ulna
Epipodium
Forearm
Humerus
Propodium
Upper arm
Scapula
JL

ANKLE and FOOT BONES

(left foot view from side)



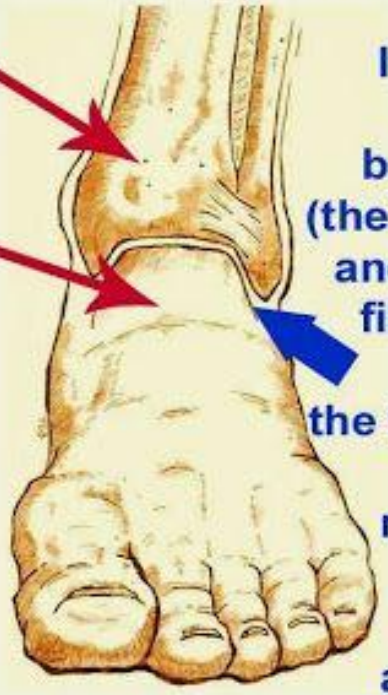
ankle joint
(tibia, fibula, talus bones)

tibia bone

talus bone

heel bone (calcaneus)

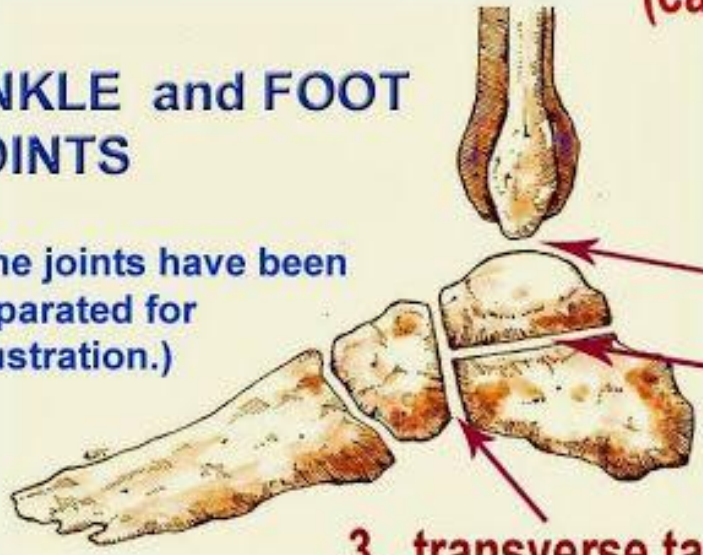
ANKLE JOINT



The lower leg bones (the tibia and the fibula) grip the talus to make up the ankle joint.

ANKLE and FOOT JOINTS

(The joints have been separated for illustration.)

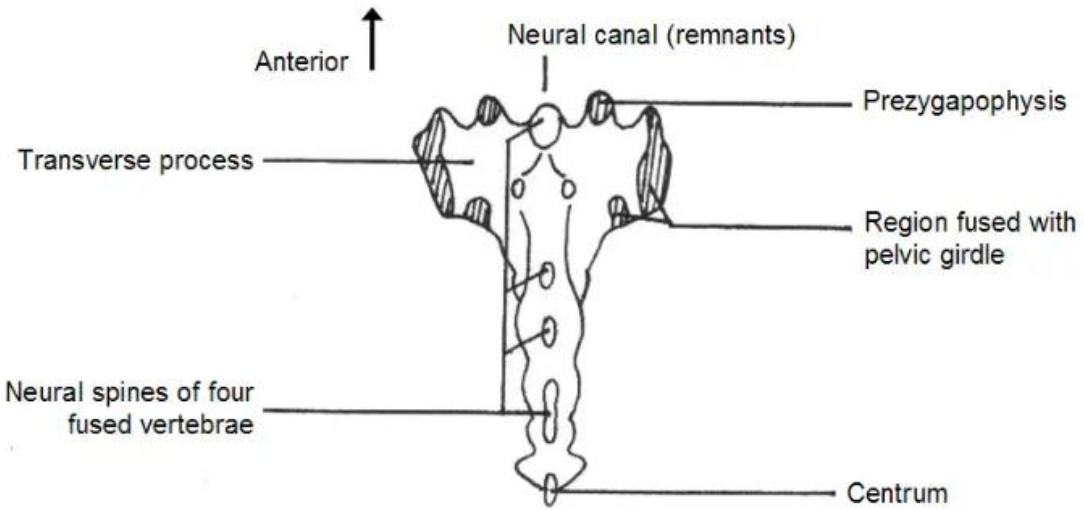


1. ankle joint
2. subtalar joint
3. transverse tarsal joint

Modified from DeLong, G, Ferran, H. Understanding Sports Injury: What Coaches and Athletes Need to Know. 2Snails, 2011. With permission.

Vertebrae of Rabbit

Sacrum: Dorsal view



Sacrum of rabbit