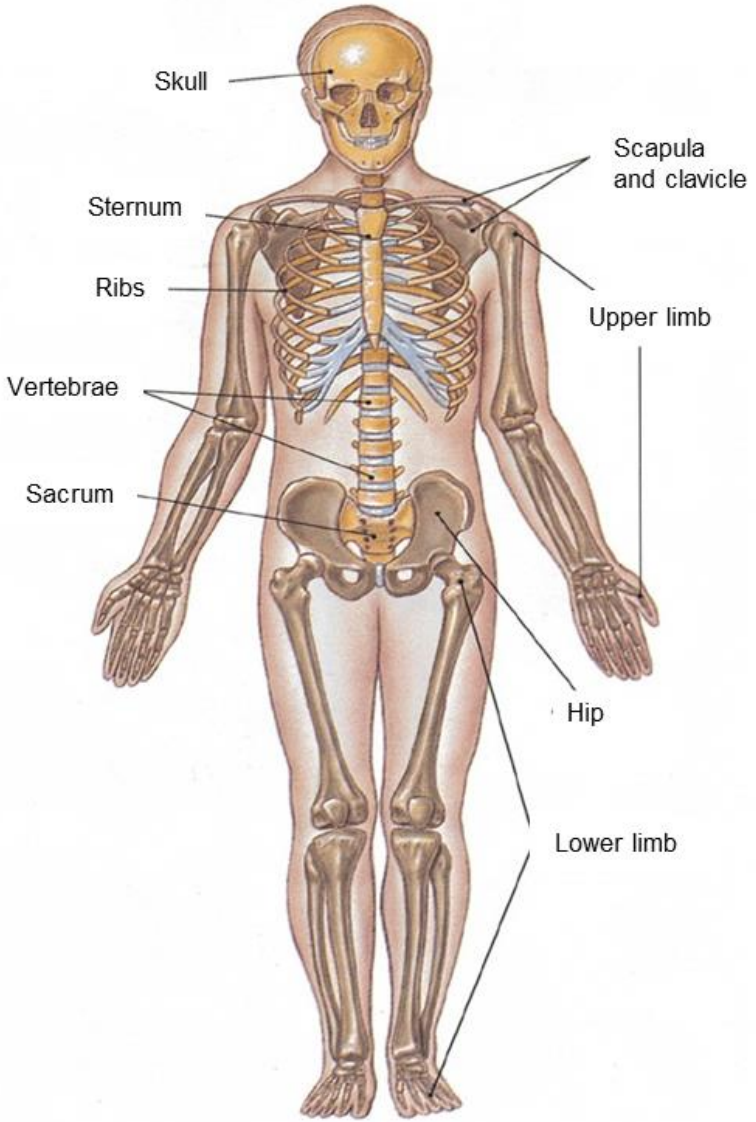
ANATOMY AND PHYSIOLOGY (C.I.)

HUMAN ANATOMY
(Mod. A)

THE SKELETON

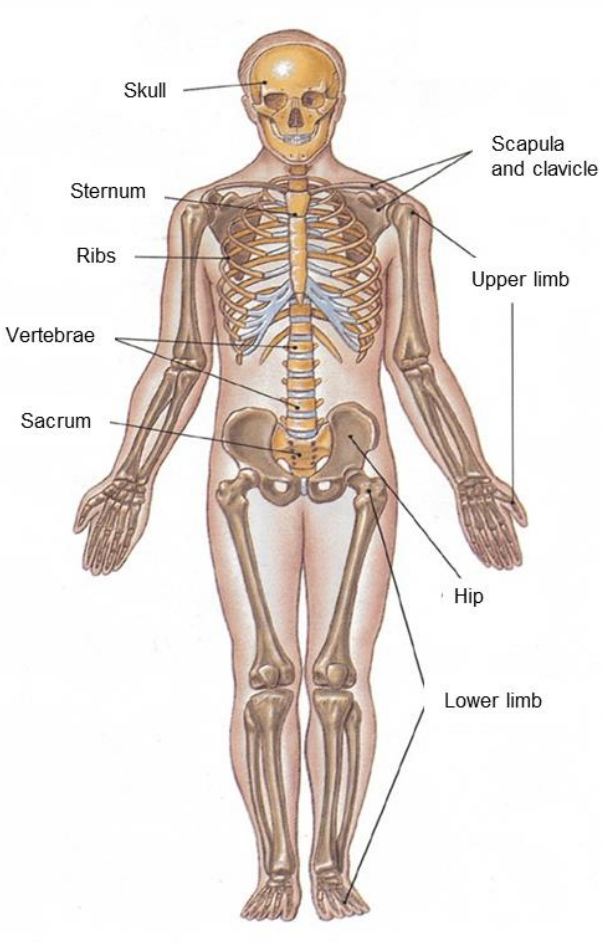
INTRODUCTION TO THE SKELETAL SYSTEM

FUNCTIONS



The **skeletal system** includes all the bones which form the human/animal body, and performs the following critical functions:

- **SUPPORT (mechanical function)**
- **PROTECTION**
- **MINERAL STORAGE**
- **PRODUCTION OF BLOOD CELLS**



- **SUPPORT/MECHANICAL FUNCTION/PROTECTION**

A) Support and protection of internal organs (e.g. rib cage; cranial bones; vertebral column)

B) Serving as point of insertion for muscles: the skeletal system is often considered together with the muscles and the connections between the bones (i.e., joints) (Locomotor system = MOTRICITY).

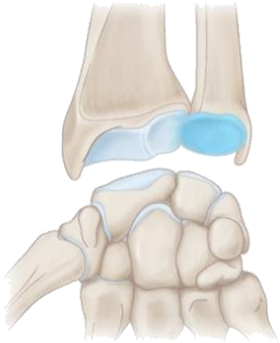
Skeletal muscles, inserting onto the bones via tendons, facilitate body movements:

- *BONES → passive component of the locomotor system*
- *MUSCLES → active component*

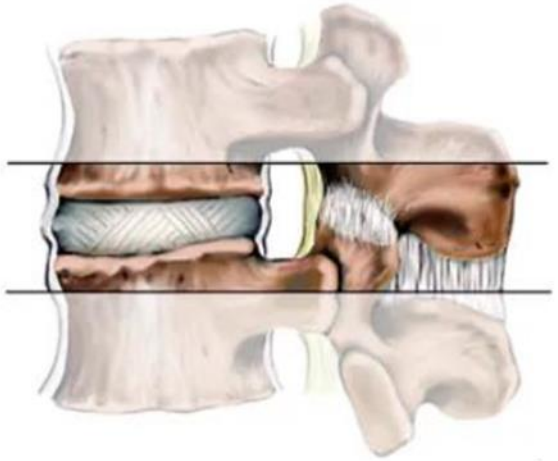
JOINTS

All forms of connections between the bones of the skeleton are called JOINTS. The connection is mediated by CONNECTIVE TISSUES. It is possible to distinguish:

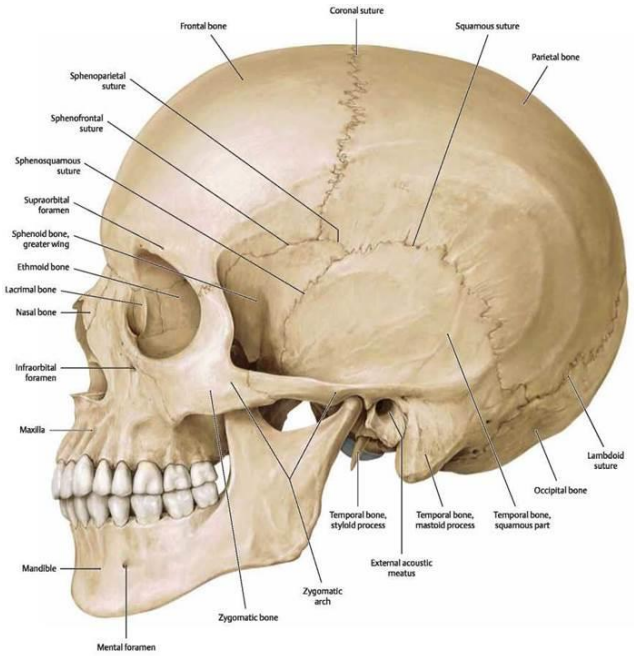
FREELY MOVEABLE J. (Diarthrosis)
→ FREE MOVEMENT
between the articulated bones
Sinovial joints
(e.g. shoulder, elbow, hip, knee)

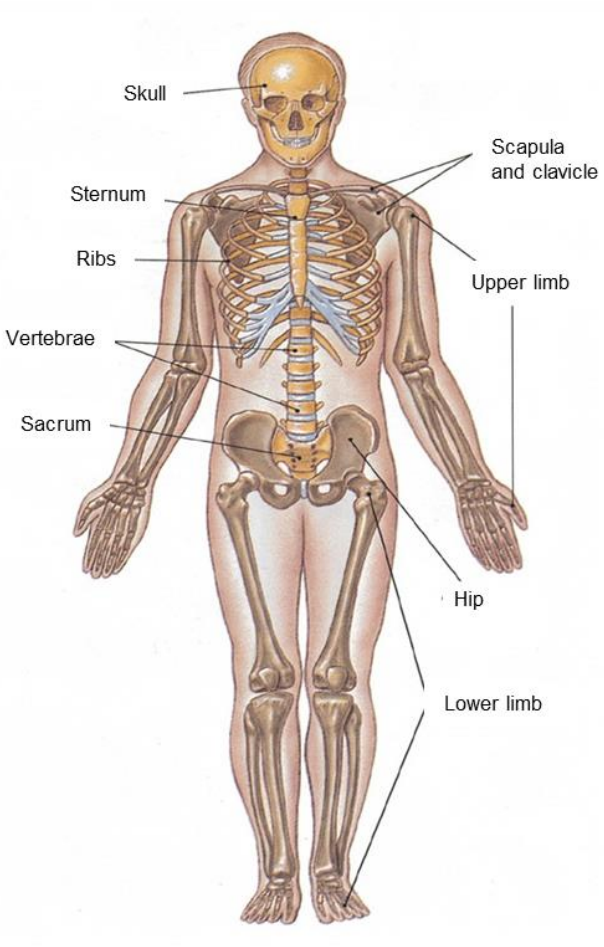


SLIGHTLY MOVEABLE J. (Amphiarthrosis)
→ LIMITED MOVEMENT
between the articulated bones
Cartilage joints
(e.g. vertebrae; ribs-vertebrae; ribs-sternum)



IMMOBILE J. (Synarthrosis)
→ NO MOVEMENT
between the articulated bones
Fibrous joints
(e.g. cranial sutures)





- **MINERAL STORAGE**

Bones = acts as a reservoir for a number of minerals important to the functioning of the body, especially calcium and phosphorus. These minerals are in homeostasis with biological fluids, primarily blood = they can be released back into the bloodstream to maintain levels needed to support physiological processes.

E.g., Calcium ions are essential for muscle contractions

→ Mineral exchanges are regulated by HORMONES (e.g. calcitonin, parathyroid hormone)

- **BLOOD CELLS PRODUCTION**

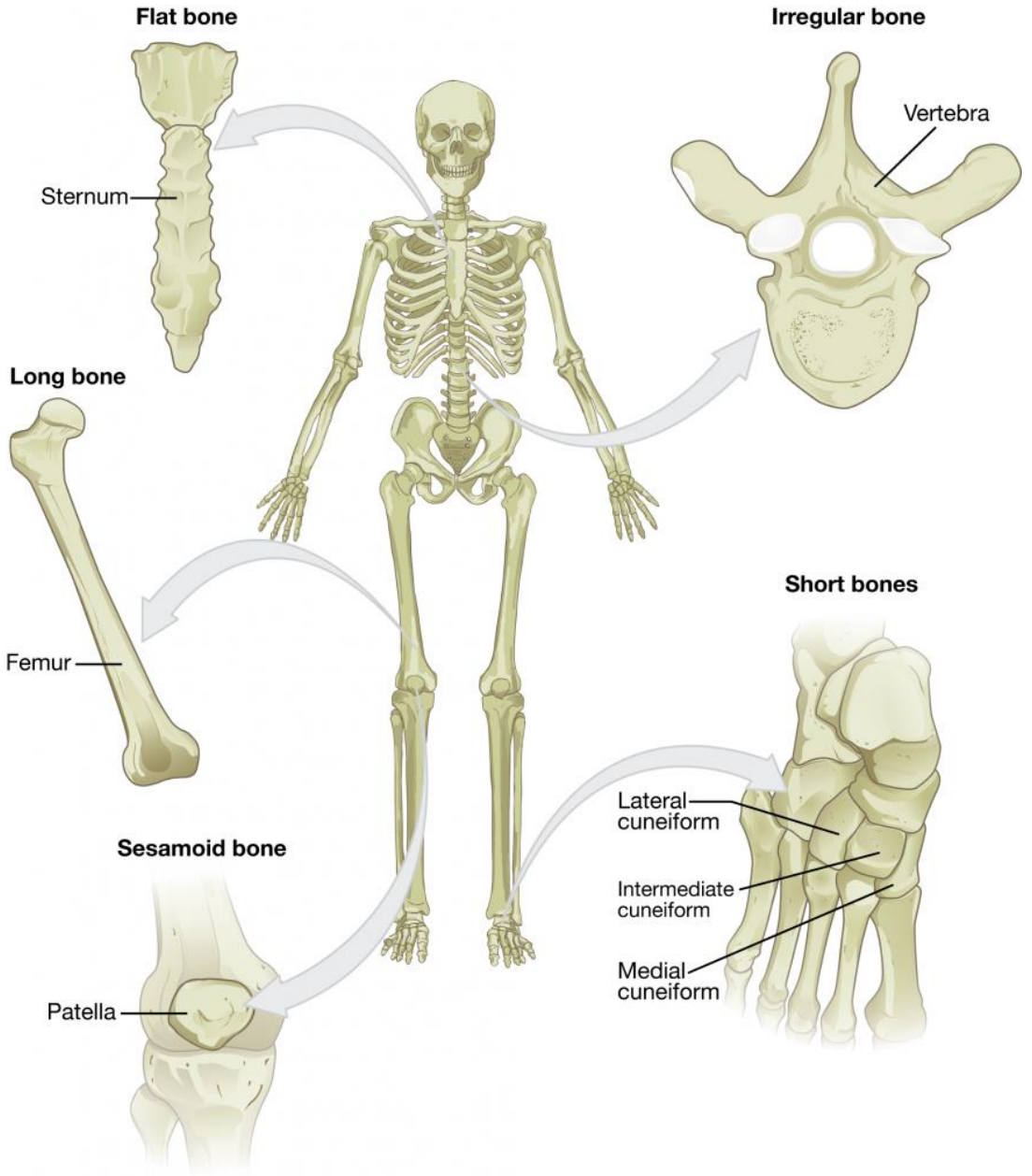
The softer connective tissue that fills the interior of most bone is referred to as bone marrow. There are two types of bone marrow:

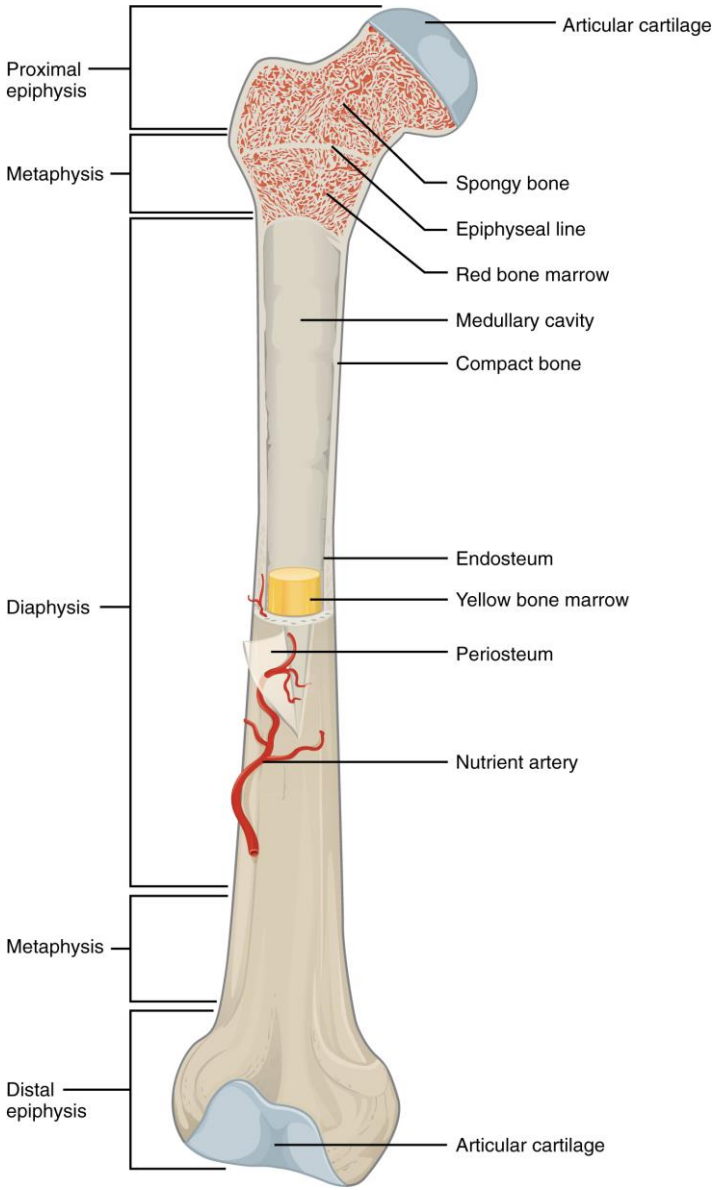
a) **Yellow marrow** contains adipose tissue (source of energy)
b) **Red marrow** is where hematopoiesis - the production of blood cells takes place. *Red blood cells, white blood cells, and platelets are all produced in the red marrow.*
FLAT BONES (e.g. sternum, hip bone)

BONES

Bone Classifications

Bone classification	Features	Function(s)	Examples
Long	Cylinder-like shape, longer than it is wide	Leverage	Femur, tibia, fibula, metatarsals, humerus, ulna, radius, metacarpals, phalanges
Short	Cube-like shape, approximately equal in length, width, and thickness	Provide stability, support, while allowing for some motion	Carpals, tarsals
Flat	Thin and curved	Points of attachment for muscles; protectors of internal organs	Sternum, ribs, scapulae, cranial bones
Irregular	Complex shape	Protect internal organs	Vertebrae, facial bones
Sesamoid	Small and round; embedded in tendons	Protect tendons from compressive forces	Patellae





STRUCTURE OF THE LONG BONES

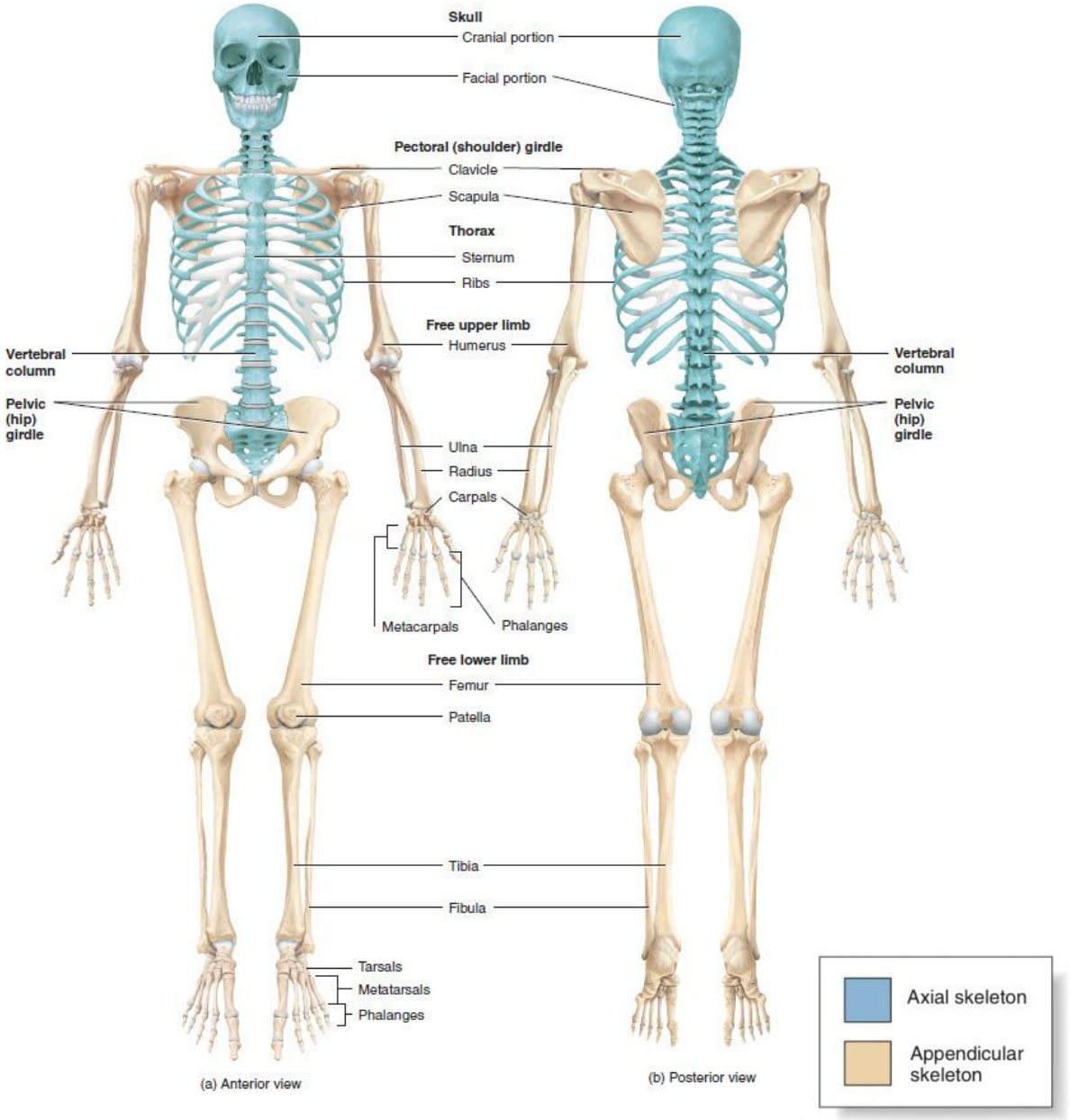
EPIPHYSIS: it is the wider section at each end of the bone (plural = epiphyses), which is filled with spongy bone. **Red marrow** fills the spaces in the spongy bone.

DIAPHYSIS: it is the tubular portion that runs between the proximal and distal ends of the bone. It is a hollow cylinder filled with red marrow in the child and yellow marrow in the adult. The hollow region in the diaphysis is called the medullary cavity. The walls of the diaphysis are composed of dense and hard compact bone.

METAPHYSIS: the portion of bone where each epiphysis meets the diaphysis; it contains the epiphyseal plate (growth plate), a layer of hyaline cartilage in a growing bone.

When the bone stops growing in early adulthood (approximately 18–21 years), the cartilage is replaced by osseous tissue and the epiphyseal plate becomes an epiphyseal line.

THE SKELETON



The human skeleton (**206 bones**) is divided into:

AXIAL SKELETON (80 bones)

↓

SKELETON of the body AXIS
Or skeleton of the TRUNK

- Bones of the skull and associated bones (6 little auditory bones and the hyoid bone);
- Bones of the vertebral column (cervical, thoracic and lumbar vertebrae, sacrum and coccyx bones);
- Bones which form the thoracic cage (ribs and sternum).

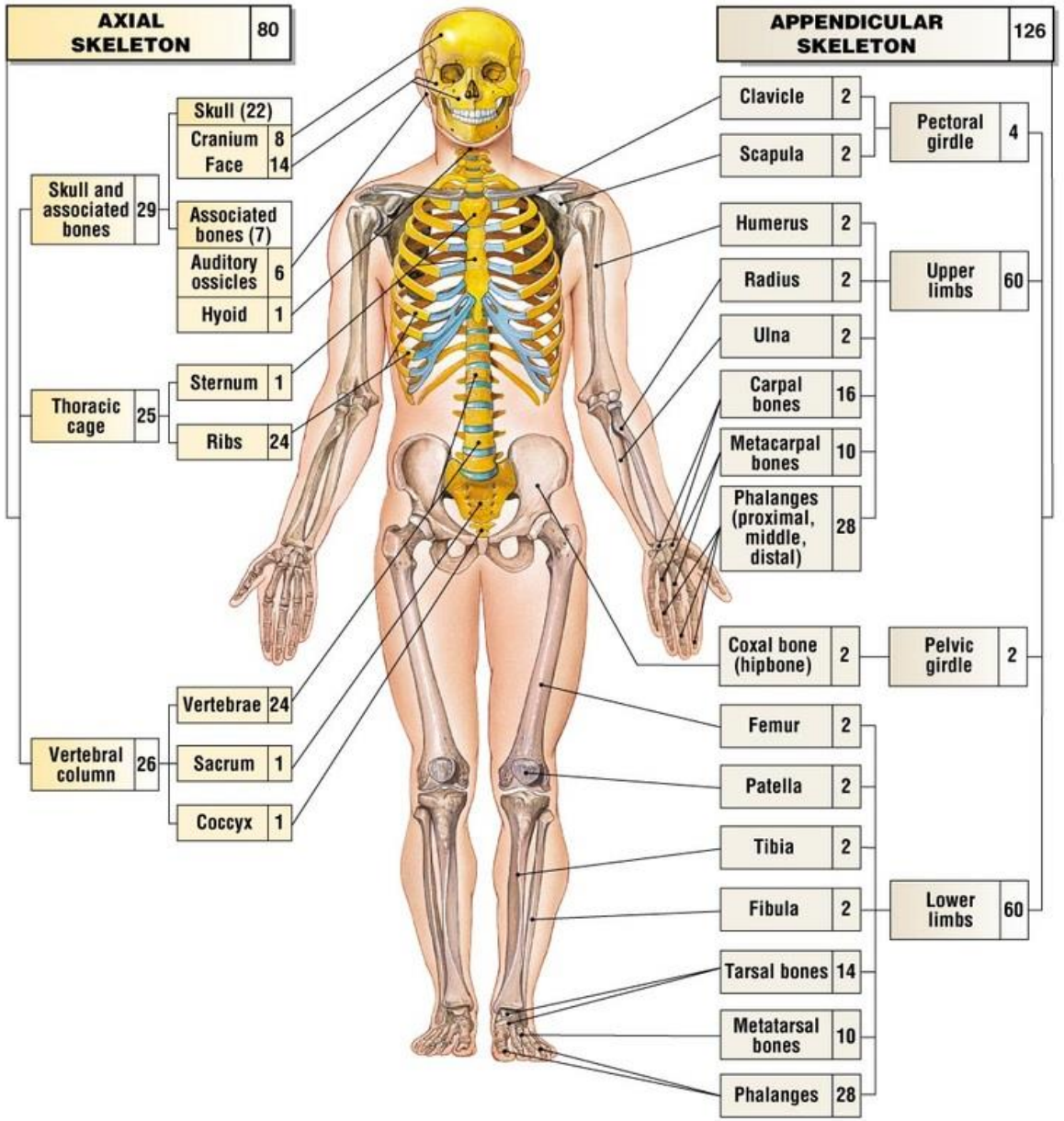
APPENDICULAR SKELETON (126 bones)

↓

SKELETON of the LIMBS

- Bones of the upper and lower limbs
- Pectoral or shoulder girdle
- Pelvic girdle

THE SKELETON



APPENDICULAR SKELETON

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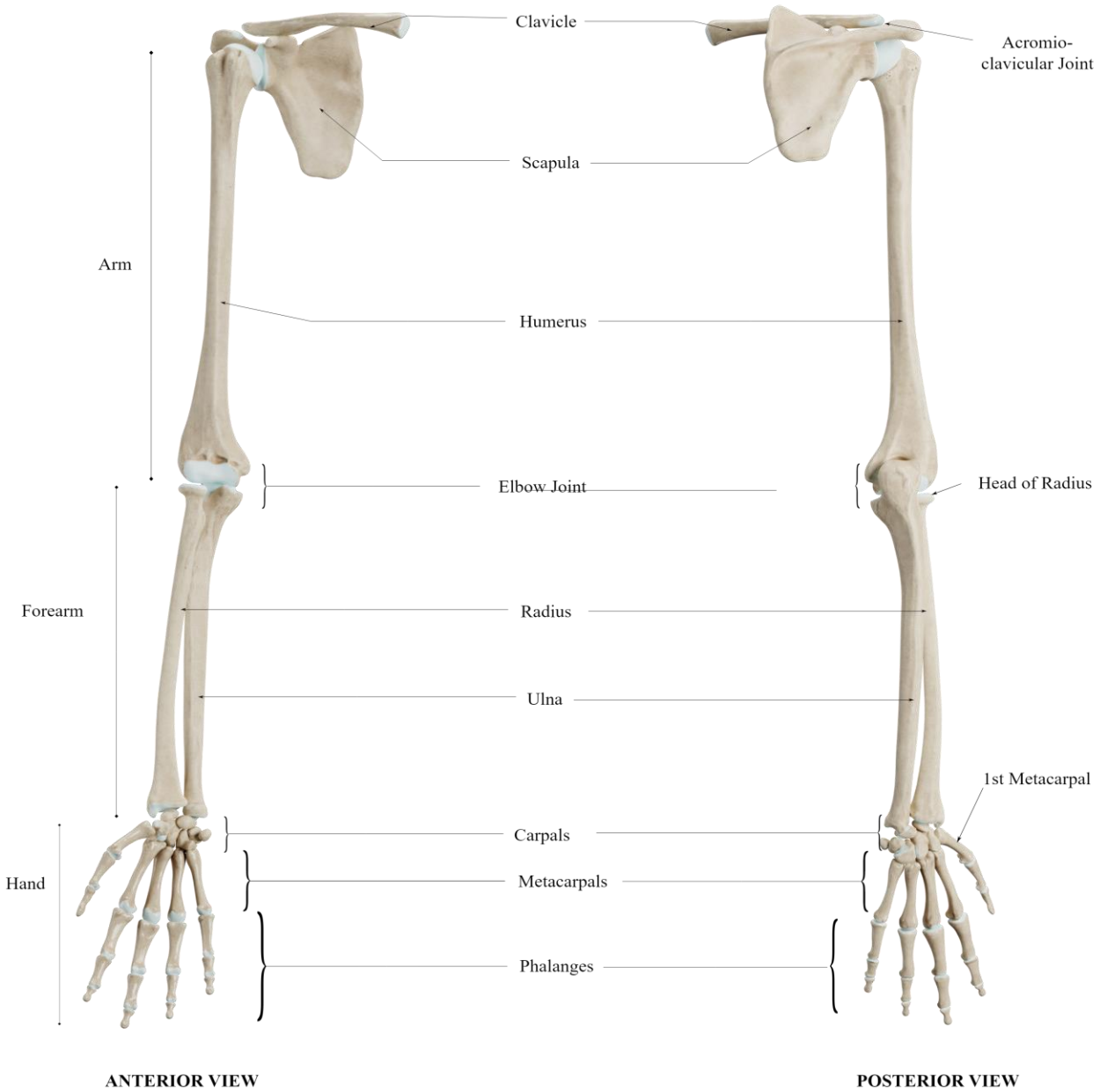


UPPER LIMB

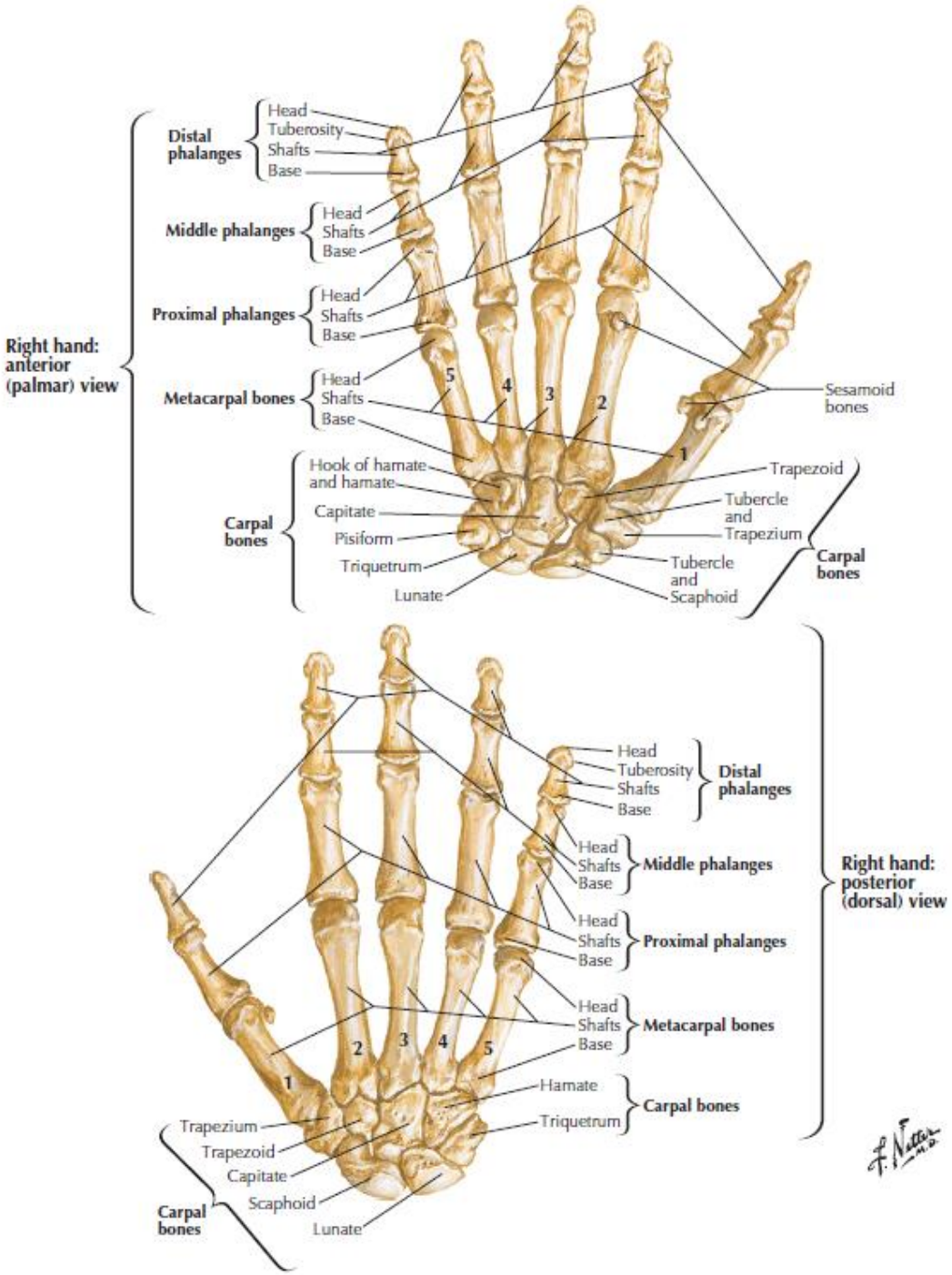
The bone of the ARM is the HUMERUS

The bones of the FOREARM are RADIUS and ULNA

The bones of the WRIST are the CARPAL BONES

The bones of the HAND are the METACARPALS and PHALANGES

APPENDICULAR SKELETON



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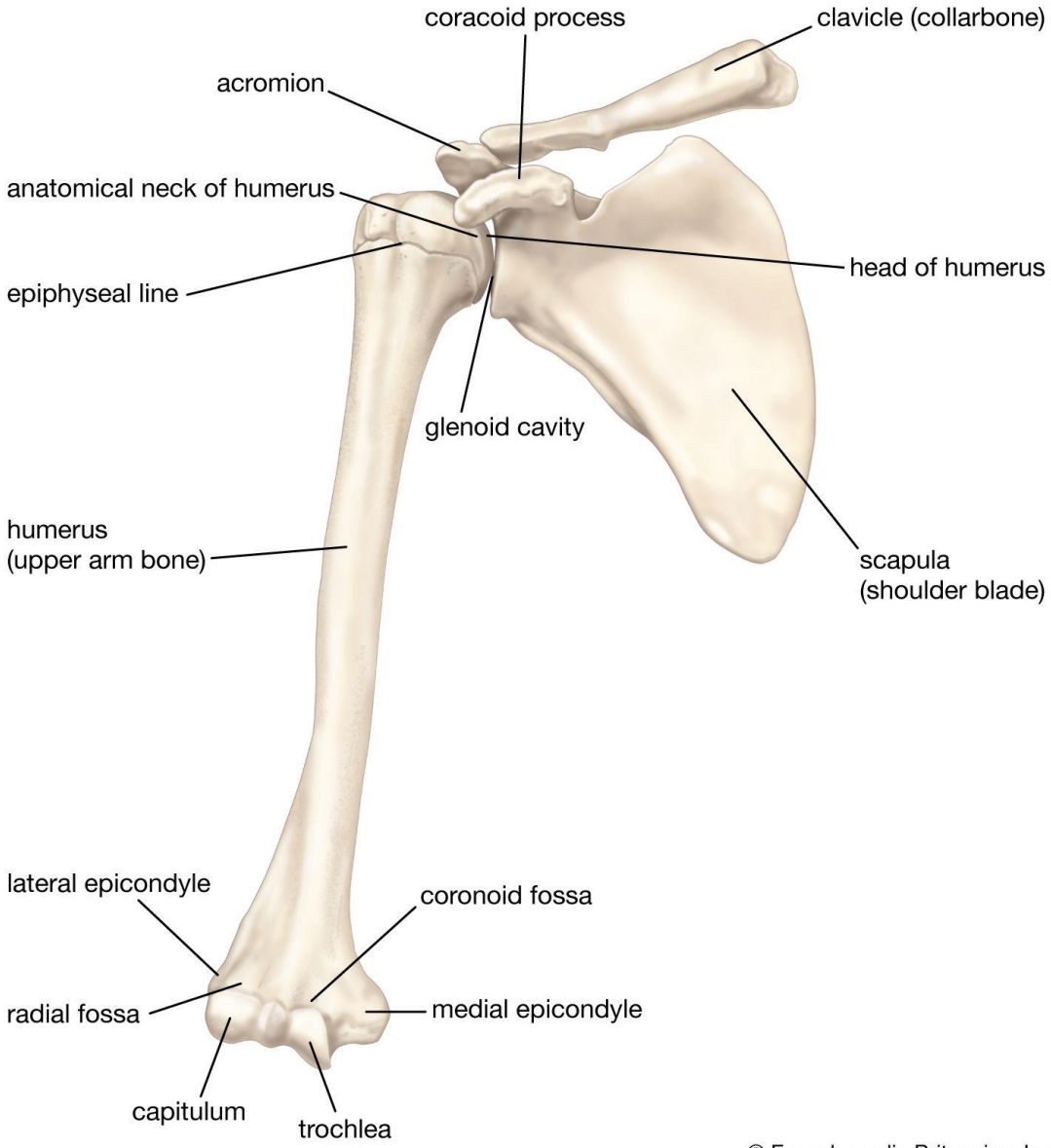


PECTORAL GIRDLE

It connects the upper limb with the axial skeleton

↓

The HUMERUS (arm bone) articulates with the SCAPULA to form the shoulder joint.

The SCAPULA articulates with the CLAVICLE through the *acromion* or *acromial process* forming the acromioclavicular joint.

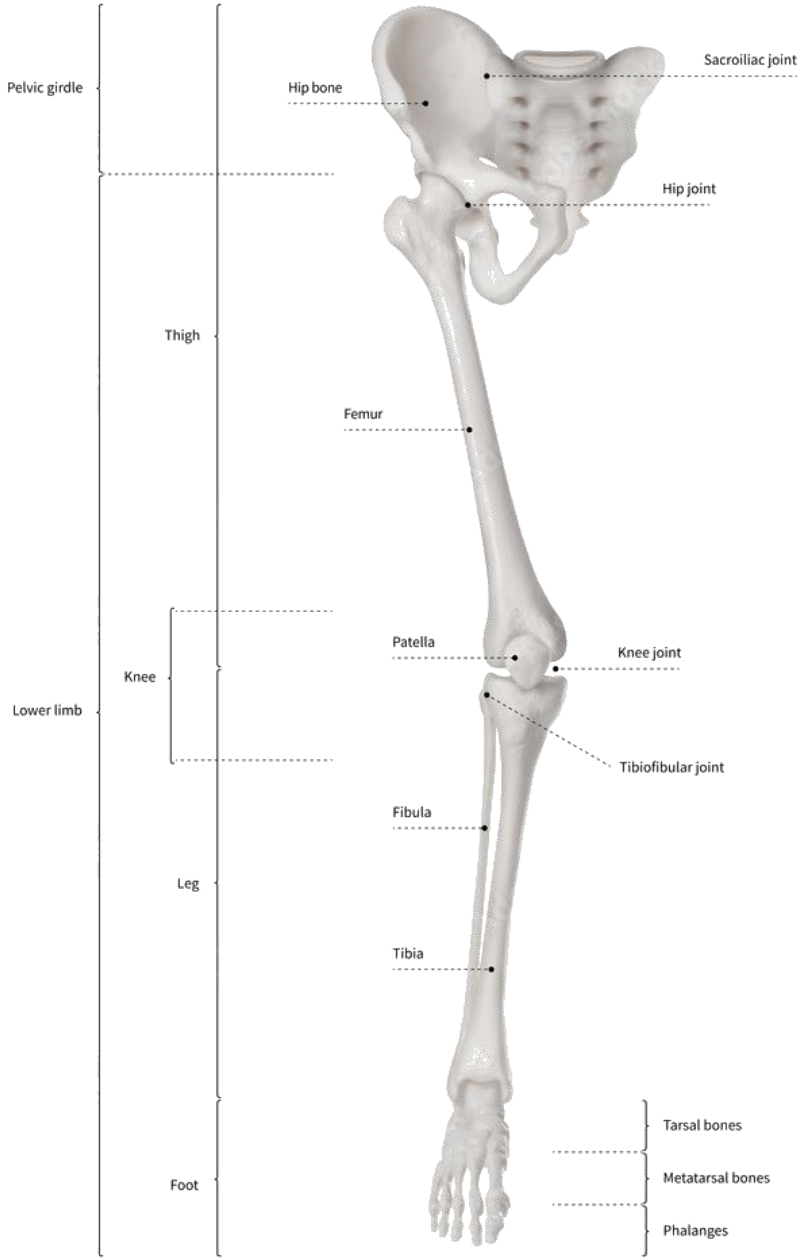
The CLAVICLE articulates with the STERNUM through the sternoclavicular joint which forms the only bony attachment between the upper limb and the axial skeleton

SCAPULA + CLAVICLE

↓

PECTORAL GIRDLE
or SHOULDER GIRDLE

APPENDICULAR SKELETON



LOWER LIMB

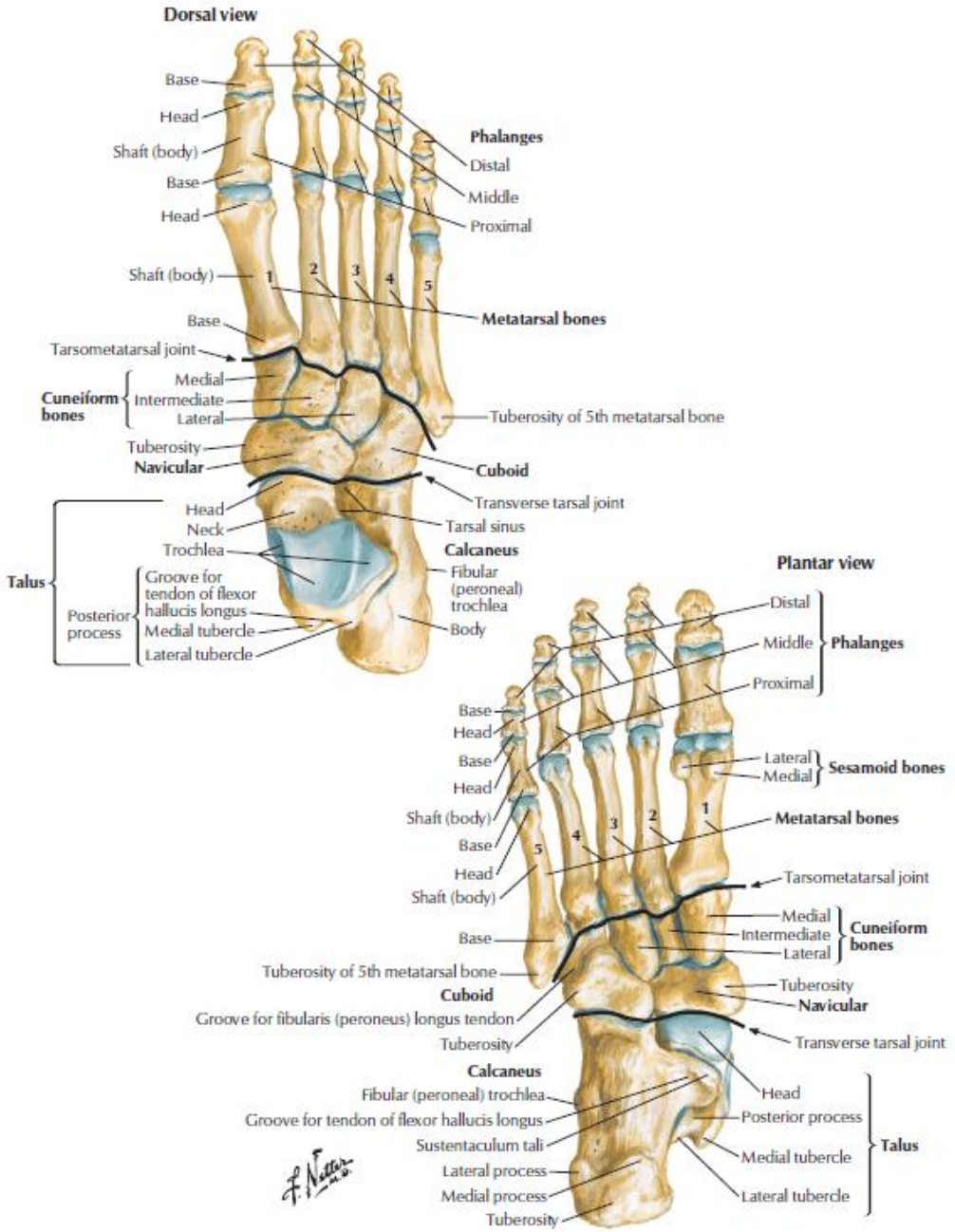
The bone of the THIGH is the FEMUR

The bone of the KNEE is the PATELLA

The bones of the LEG are TIBIA and FIBULA

The bones of the FOOT are the TARSAL BONES, the METATARSAL BONES and the PHALANGES

APPENDICULAR SKELETON



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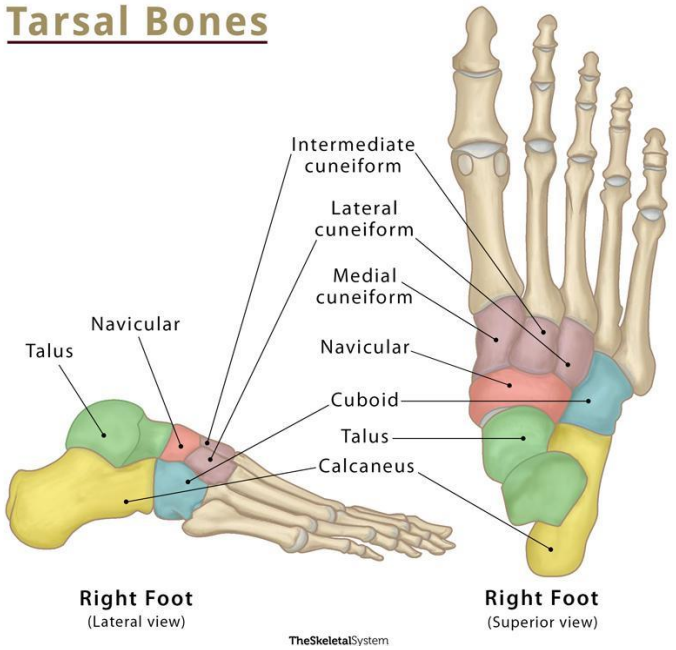
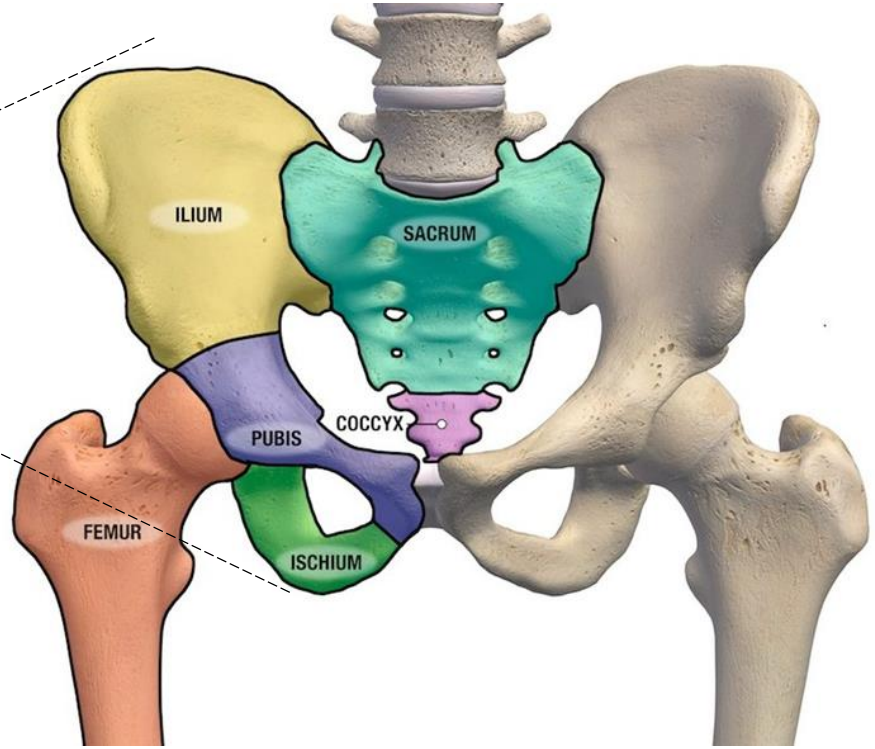


PELVIC GIRDLE

HIP BONE
3 bones
fused together:
ILIUM
ISCHIUM
PUBIS



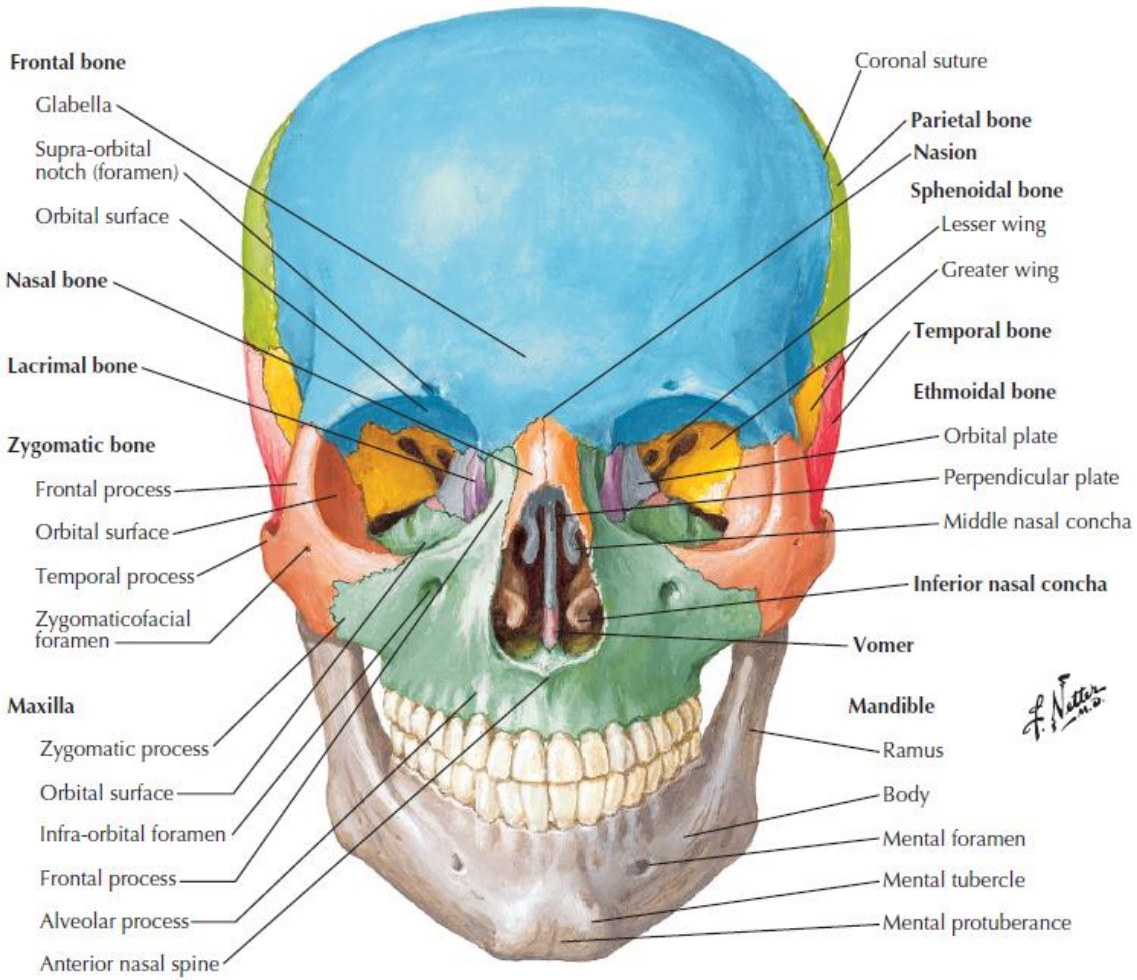
The FEMUR articulates at the proximal side with the HIP BONE (or COXAL bone), which forms the **pelvic girdle** (hip girdle) = connects the skeleton of the lower limb to the axial skeleton.

The two HIP BONES articulate:

- anteriorly with each other to form a specialized joint called **pubic symphysis**
- posteriorly with the SACRUM to form the **sacroiliac joint**

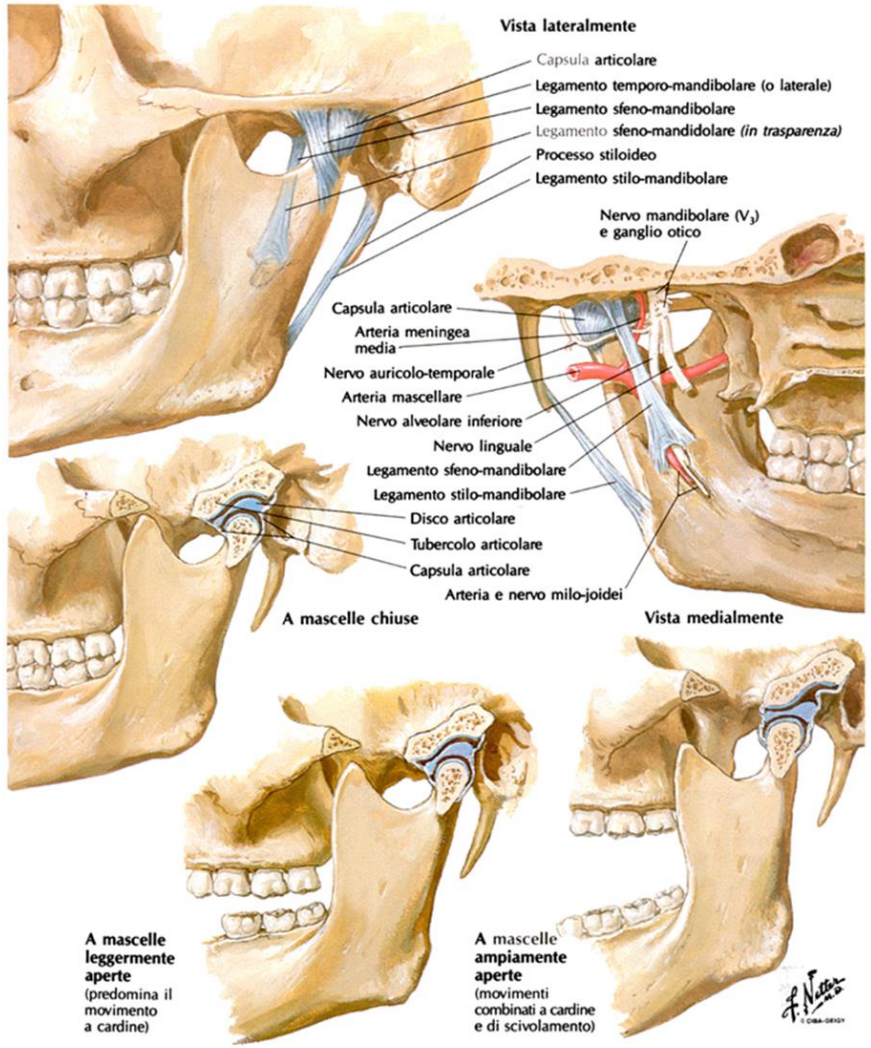
HIP BONES + SACRUM + COCCYX
↓
PELVIS

AXIAL SKELETON

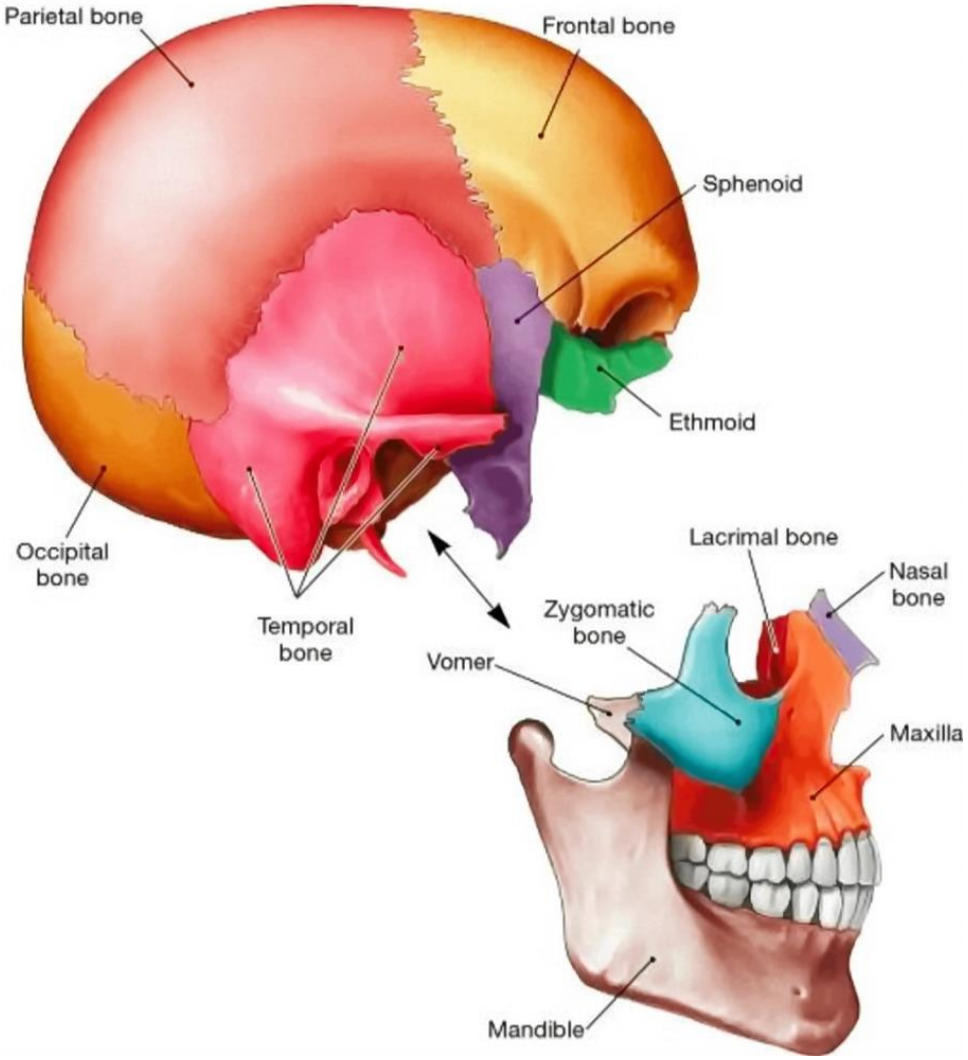


Several bones articulated together mainly through CRANIAL SUTURES

TEMPOROMANDIBULAR JOINT
Single mobile joint
Temporal bone - mandibular condyle



SKULL

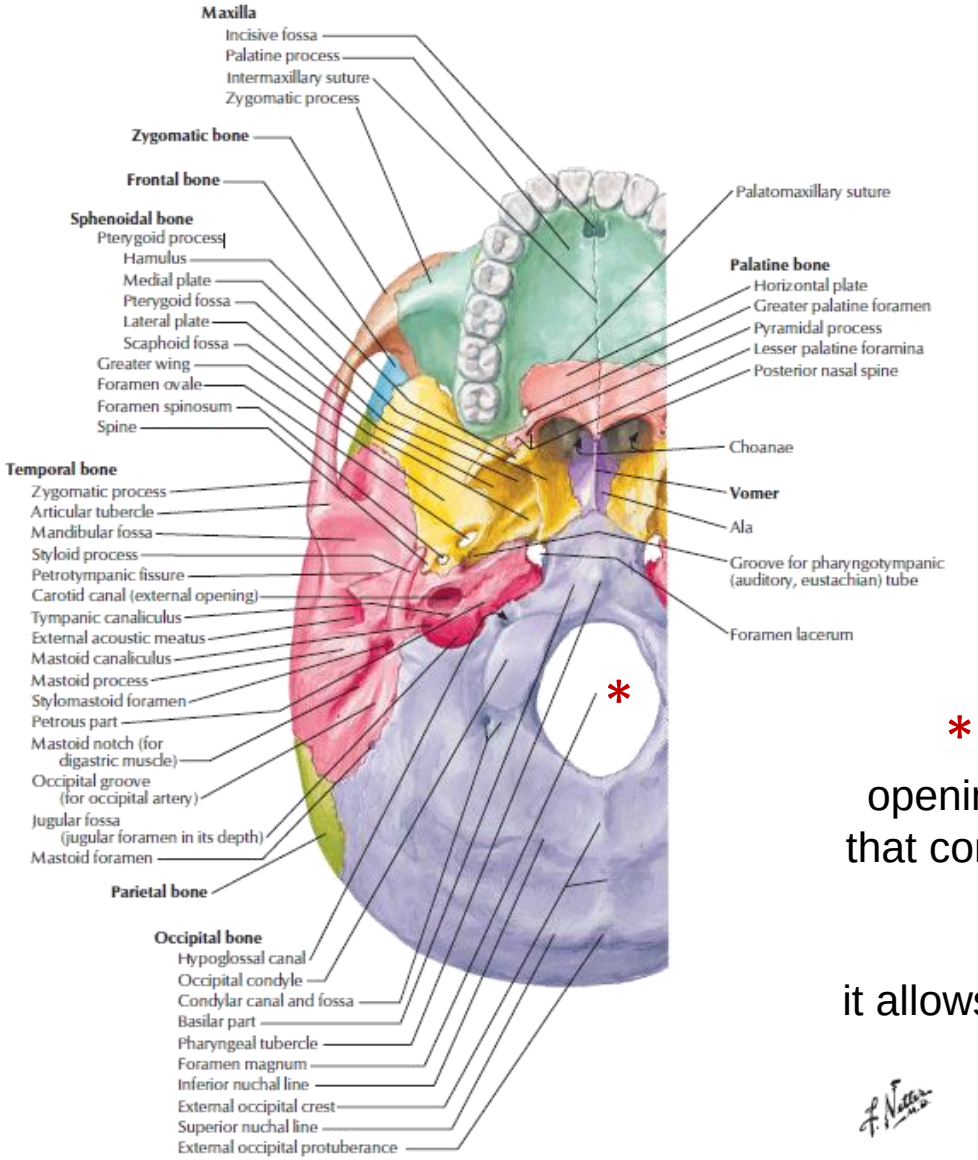


The skull is divided into 2 regions:

A) NEUROCRANIUM =
it forms the upper and back part of the skull; it delimits the cranial cavity where the brain is contained; it forms a protective case around the brain

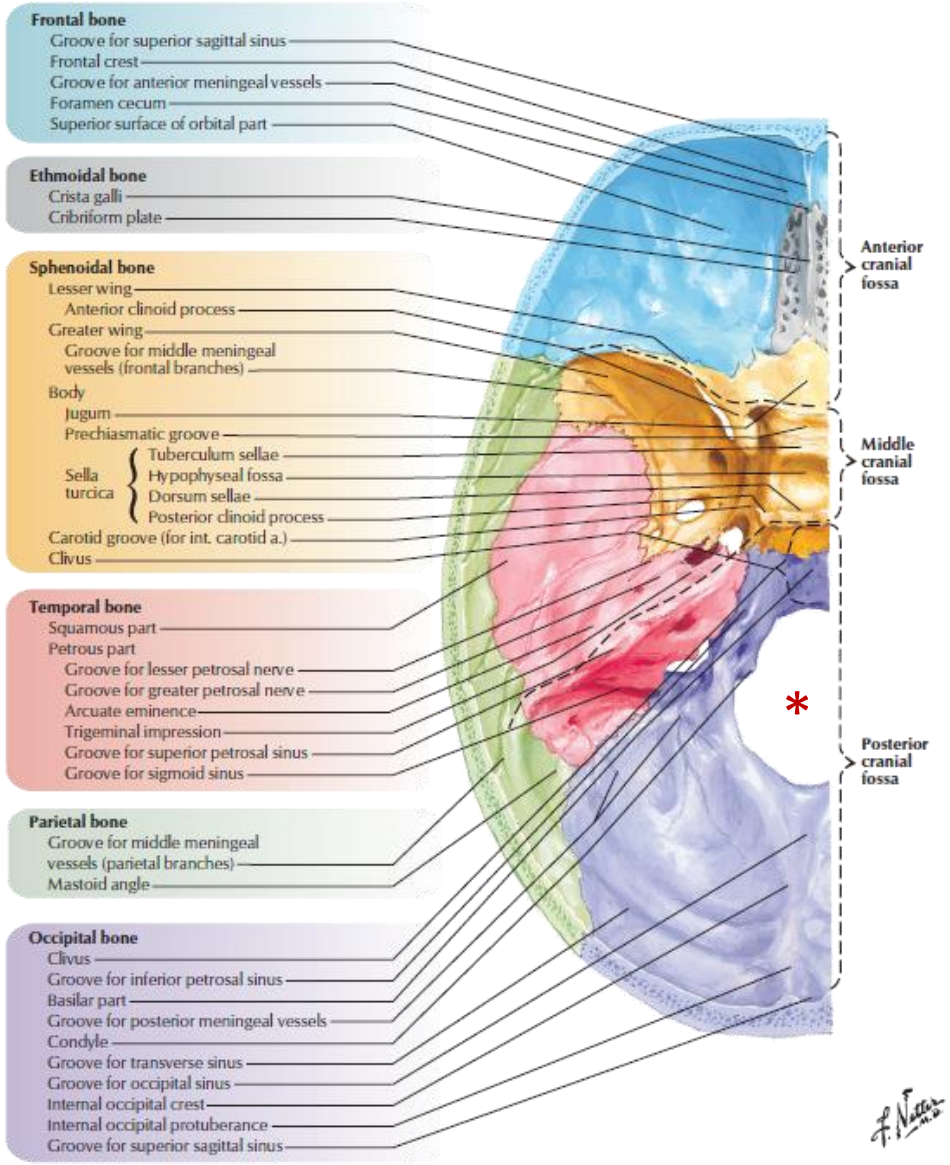
B) FACIAL SKELETON =
It delimits the initial part of the respiratory and digestive systems, so it delimits the nasal and oral cavities.

CRANIAL BASE, inferior view

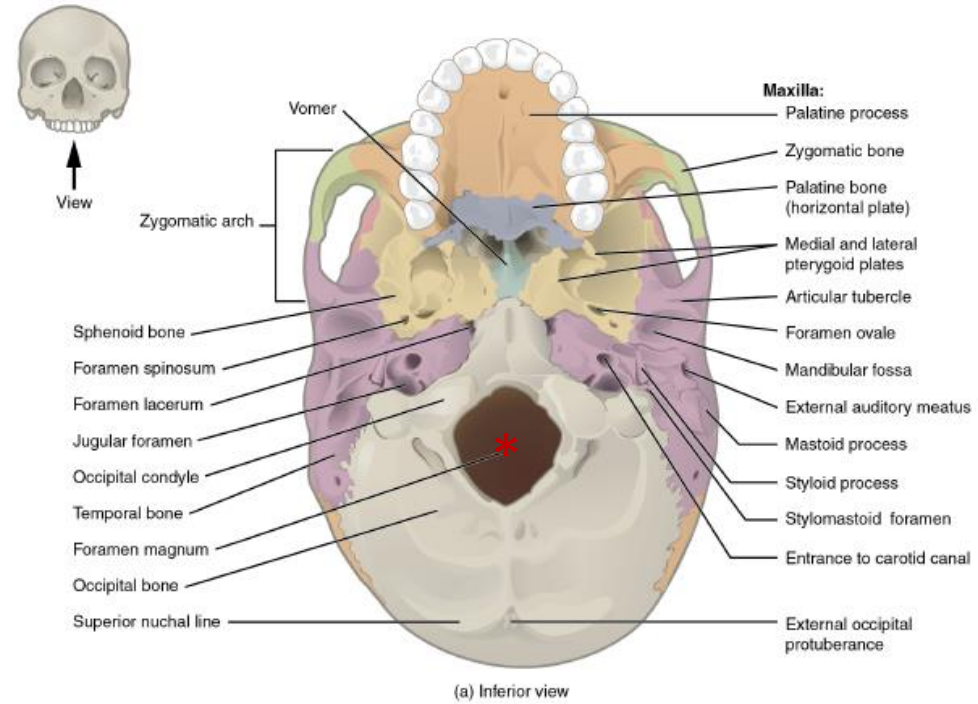


***Foramen Magnum**
opening in the base of the skull
that connects the cranial cavity to
the vertebral canal
↓
it allows to connect the spinal cord
to the brain

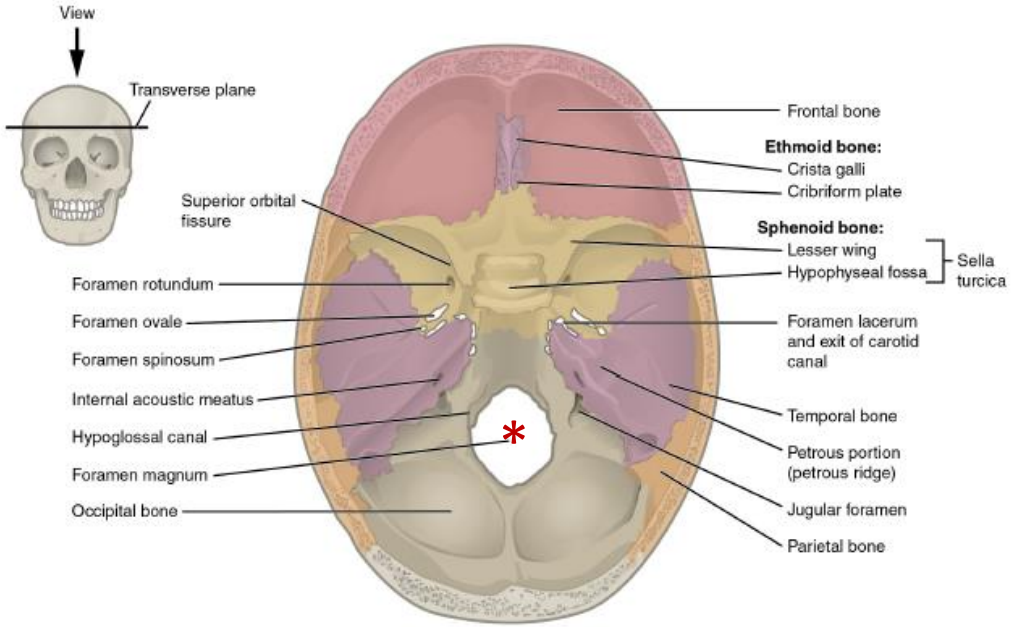
CRANIAL BASE, superior view



SKULL



(a) Inferior view



(b) Superior view

* **Foramen Magnum**

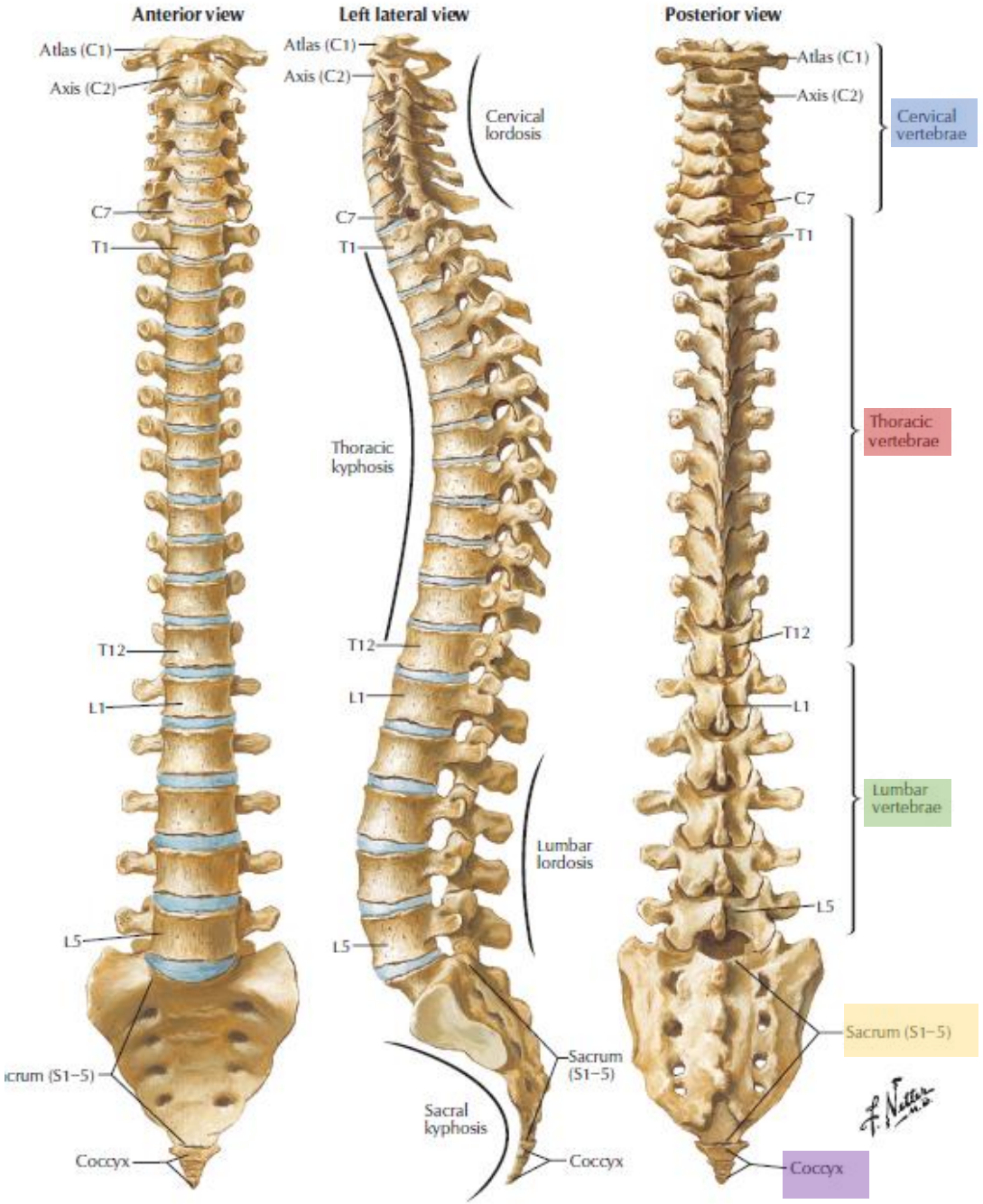
opening in the base of the skull that connects the cranial cavity to the vertebral canal

↓

it allows to connect the spinal cord to the brain

AXIAL SKELETON – The vertebral column

VERTEBRAL COLUMN



The VERTEBRAL COLUMN (or spinal column or SPINE) consists of multiple bones articulated together, placed one above the other and which are called VERTEBRAE.

Depending on the body region, the vertebrae have different names.
From top to bottom we distinguish:

CERVICAL VERTEBRAE = 7 vertebrae of the neck (C1-C7)

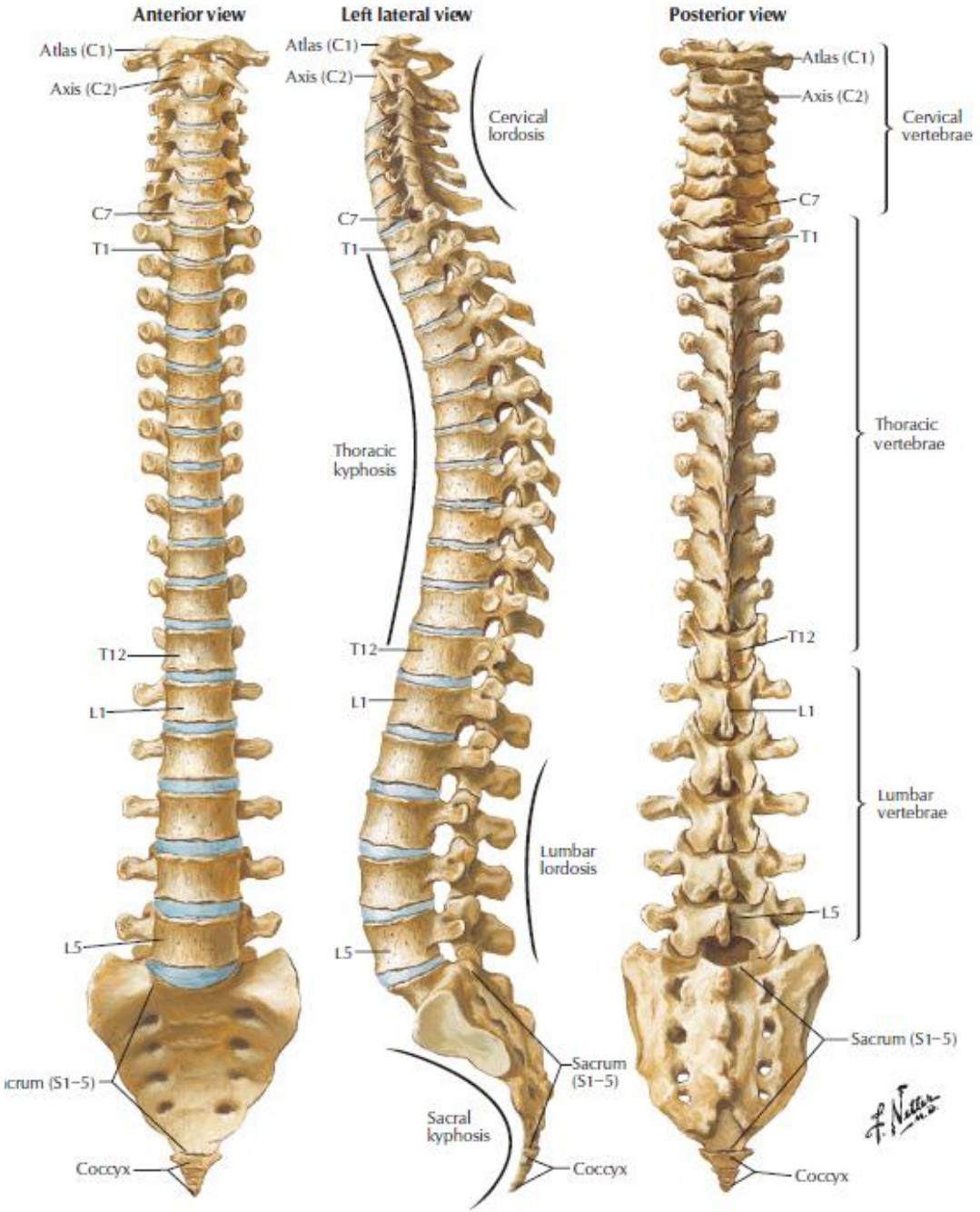
THORACIC VERTEBRAE = 12 vertebrae of the thorax (T1-T12)

LUMBAR VERTEBRAE = 5 vertebre of the lower back (L1-L5)

SACRUM = in the adult it is a single bone that derives from the fusion of 5 segments → S1-S5

COCCYX (Co) = single bone that derives from the fusion of 3 - 4 smaller segments

VERTEBRAL COLUMN

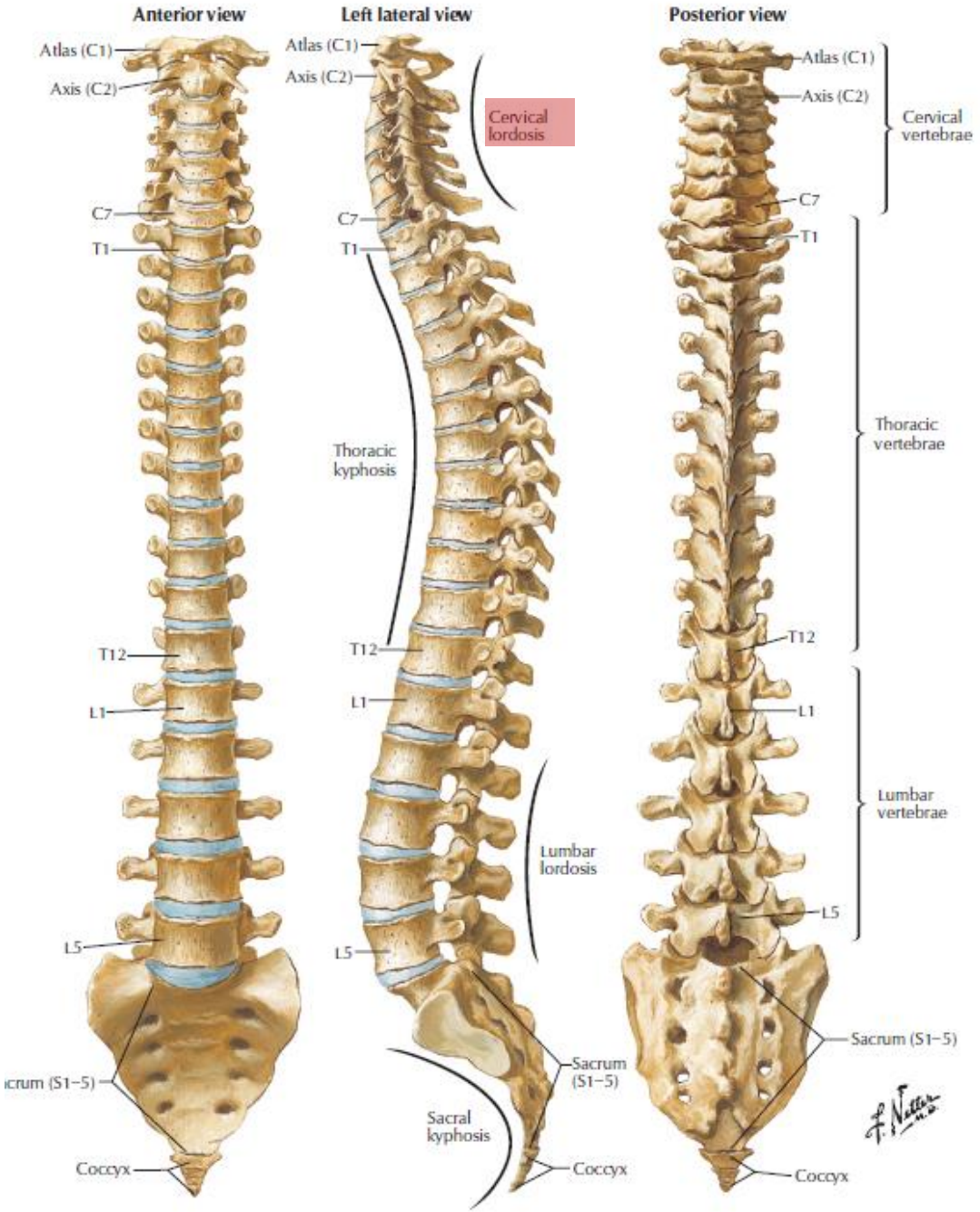


The vertebral column presents

PHYSIOLOGICAL CURVATURES

that can be observed from the LATERAL VIEW

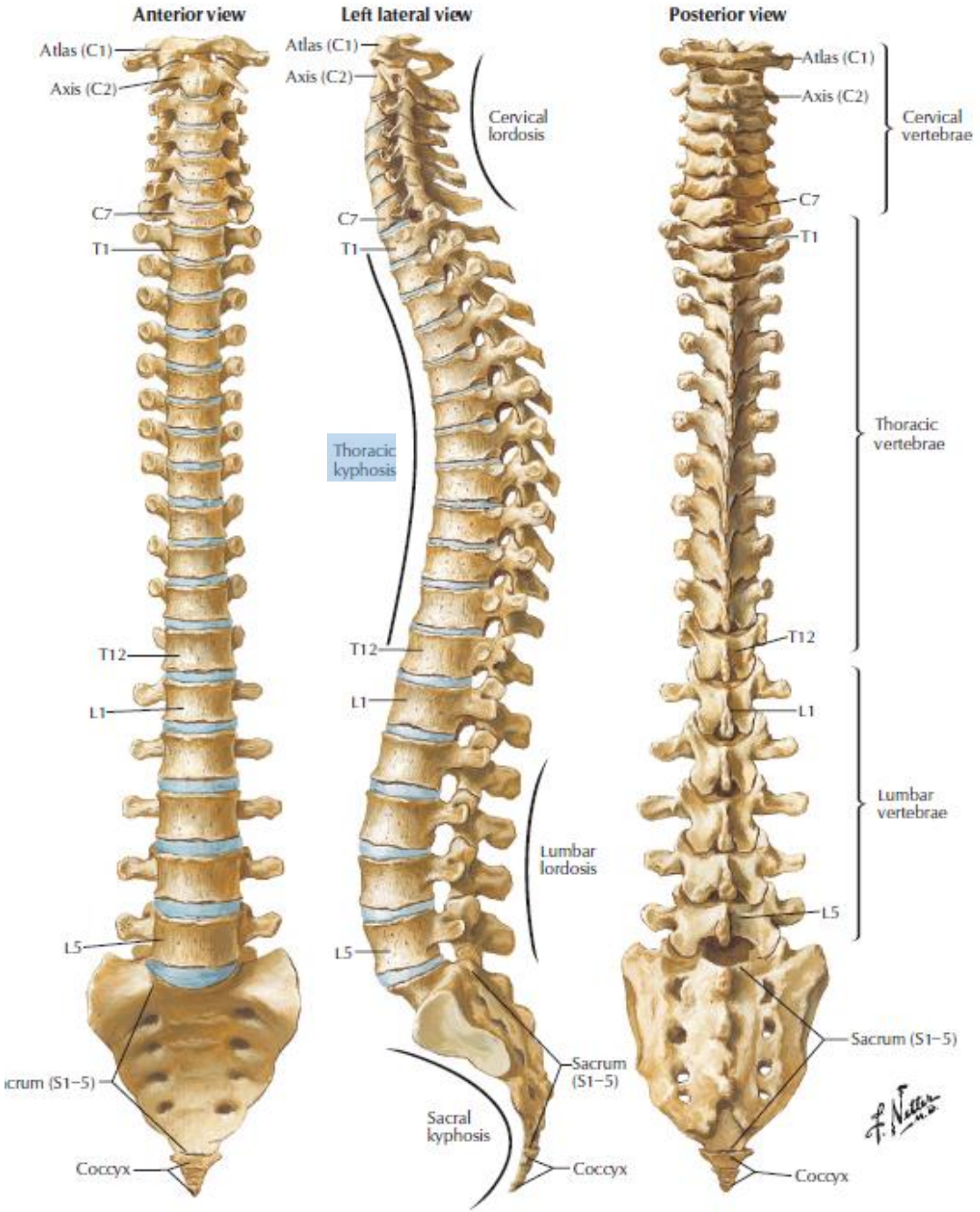
VERTEBRAL COLUMN



The vertebral column presents
PHYSIOLOGICAL CURVATURES
that can be observed from the LATERAL VIEW

FIRST CURVATURE, cervical region =
ANTERIOR CONVEXITY and POSTERIOR CONCAVITY
(CERVICAL LORDOSIS)

VERTEBRAL COLUMN

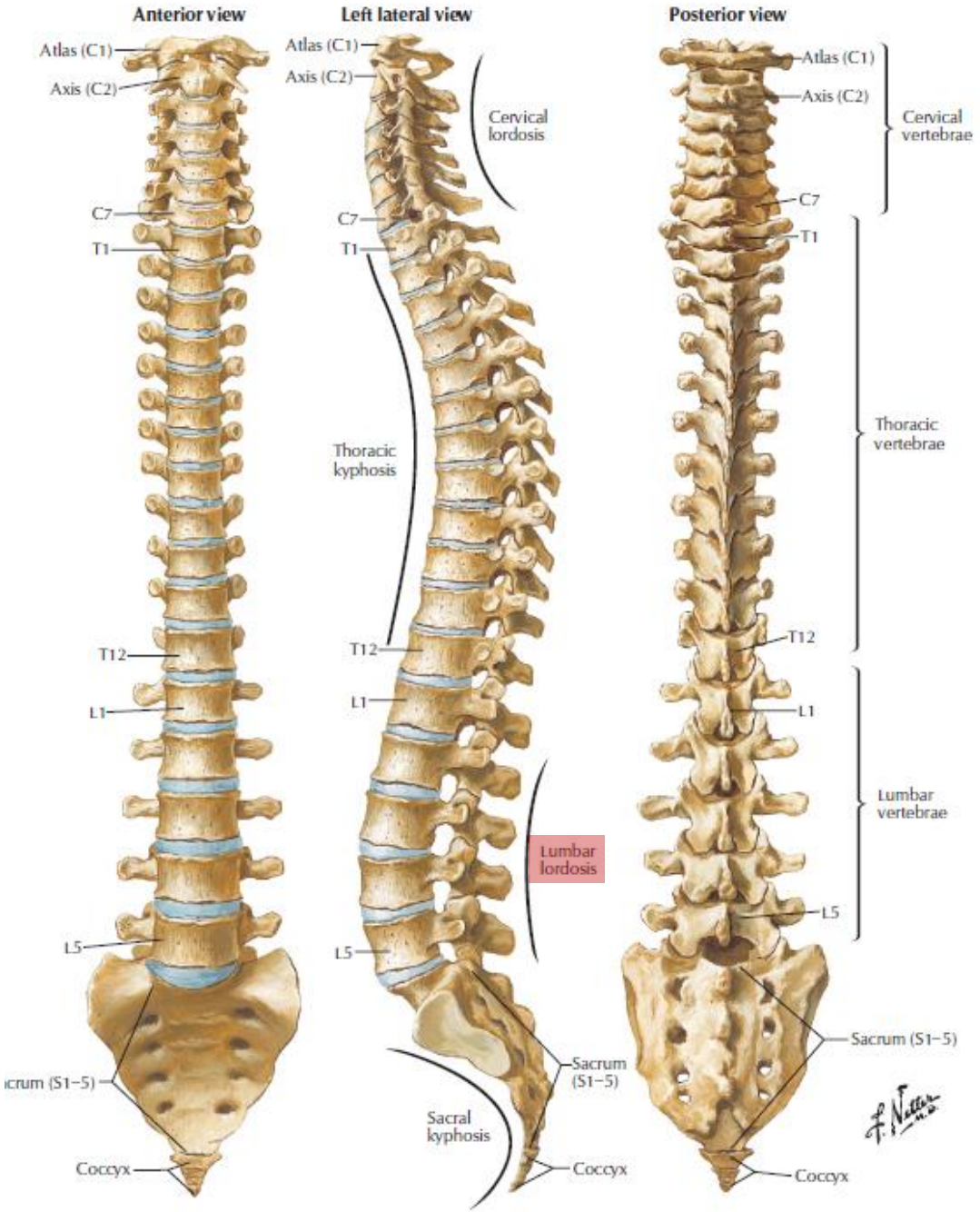


The vertebral column presents
PHYSIOLOGICAL CURVATURES
that can be observed from the LATERAL VIEW

FIRST CURVATURE, cervical region =
ANTERIOR CONVEXITY and POSTERIOR CONCAVITY
(*CERVICAL LORDOSIS*)

SECOND CURVATURE, thoracic region =
POSTERIOR CONVEXITY and ANTERIOR CONCAVITY
(*THORACIC KYPHOSIS*)

VERTEBRAL COLUMN



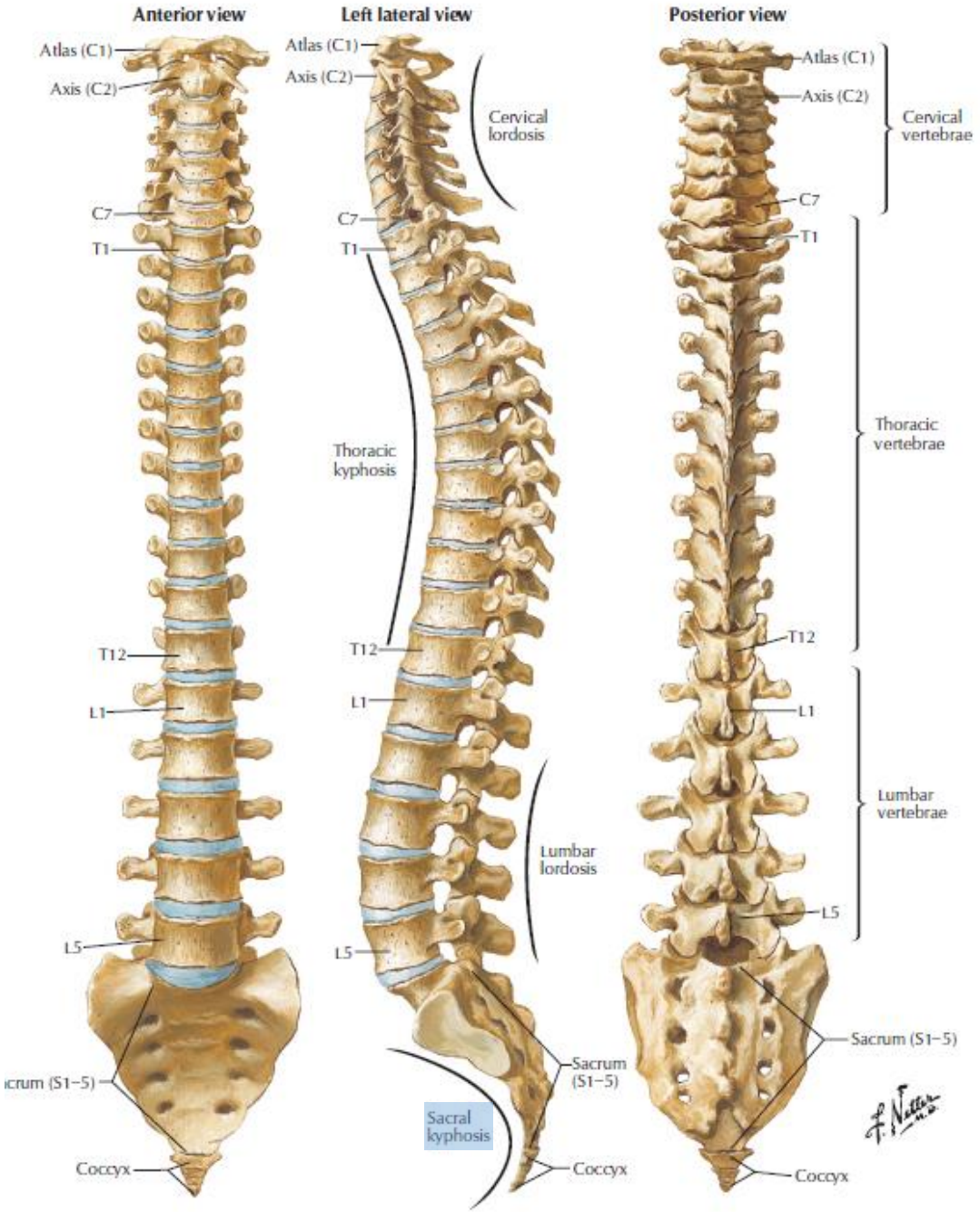
The vertebral column presents
PHYSIOLOGICAL CURVATURES
that can be observed from the LATERAL VIEW

FIRST CURVATURE, cervical region =
ANTERIOR CONVEXITY and POSTERIOR CONCAVITY
(CERVICAL LORDOSIS)

SECOND CURVATURE, thoracic region =
POSTERIOR CONVEXITY and ANTERIOR CONCAVITY
(THORACIC KYPHOSIS)

THIRD CURVATURE, lumbar region =
ANTERIOR CONVEXITY and POSTERIOR CONCAVITY
(LUMBAR LORDOSIS)

VERTEBRAL COLUMN



The vertebral column presents
PHYSIOLOGICAL CURVATURES
that can be observed from the LATERAL VIEW

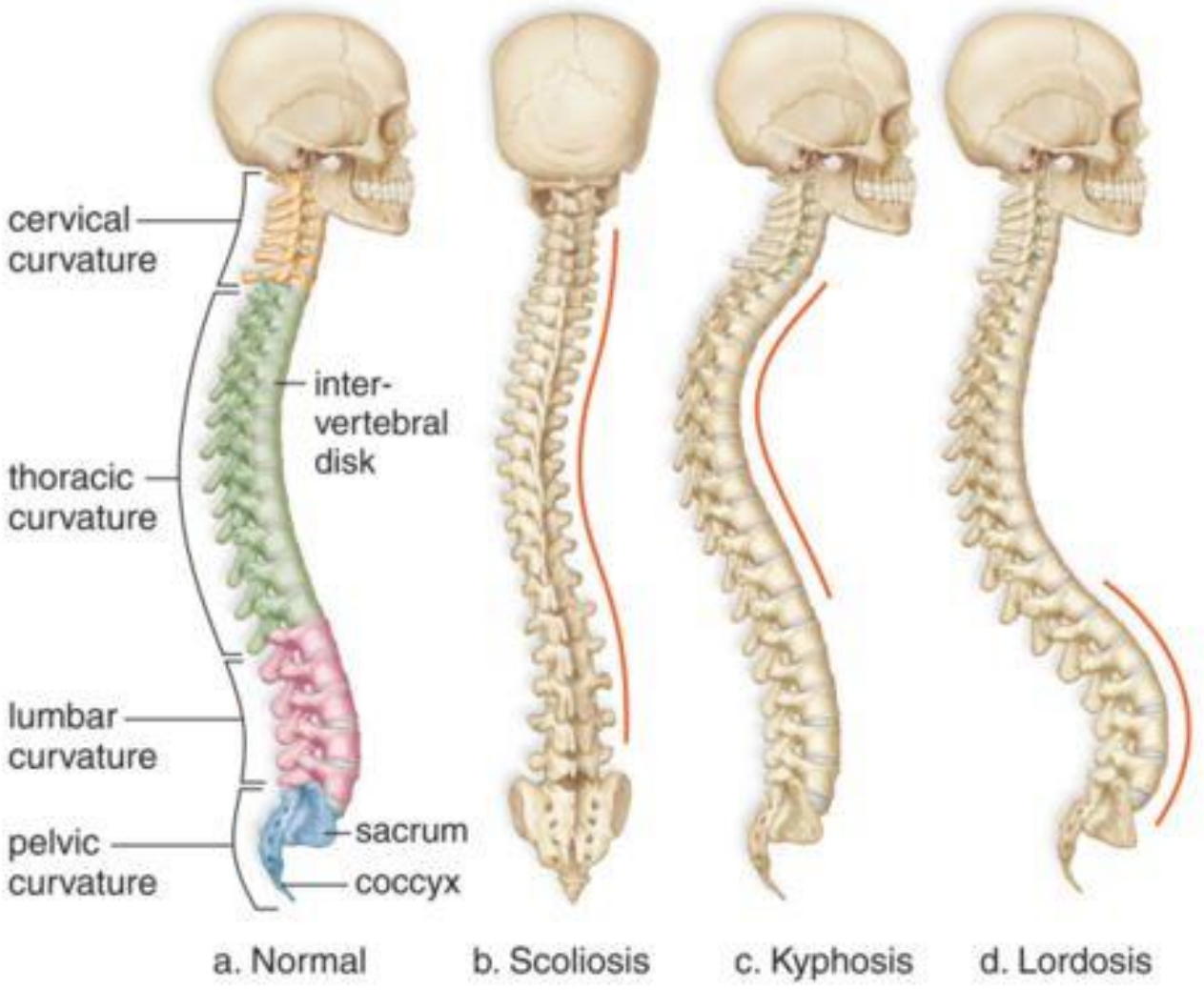
FIRST CURVATURE, cervical region =
ANTERIOR CONVEXITY and POSTERIOR CONCAVITY
(CERVICAL LORDOSIS)

SECOND CURVATURE, thoracic region =
POSTERIOR CONVEXITY and ANTERIOR CONCAVITY
(THORACIC KYPHOSIS)

THIRD CURVATURE, lumbar region =
ANTERIOR CONVEXITY and POSTERIOR CONCAVITY
(LUMBAR LORDOSIS)

FOURTH CURVATURE, sacrococcygeal region =
POSTERIOR CONVEXITY and ANTERIOR CONCAVITY
(SACRAL KYPHOSIS)

VERTEBRAL COLUMN



The normal vertebral column presents
PHYSIOLOGICAL CURVATURES
↓
As long as they remain within certain limits, otherwise they become
PATHOLOGICAL CURVATURES

SCOLIOSIS = an abnormal lateral curvature. The cause is usually unknown, but it may result from weakness of the back muscles, defects such as differential growth rates in the right and left sides of the vertebral column, or differences in the length of the lower limbs.

KYPHOSIS = an excessive posterior curvature of the thoracic region, common in old aged people

LORDOSIS = an excessive anterior curvature of the lumbar region, most commonly associated with obesity or late pregnancy.

ANATOMY AND PHYSIOLOGY (C.I.)

HUMAN ANATOMY
(Mod. A)

THE SKELETON