HUMAN ANATOMY

THE SKELETAL SYSTEM

Collage of Pharmacy

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LEARNING OBJECTIVES

- Upon completing this lecture, students will be able to:
  - Describe the axial bones and appendicular bones.
  - Classify bones according to their shape.
  - To observe and identify features of a skull bone.
  - To observe and identify features of vertebral column.
  - To observe and identify the other bones of the body.

INTRODUCTION

- Theoretical lecture and practical session
- Materials
  - Human skeleton model.
  - Disarticulated human skeleton.
- Practical activities
  - Bone identification.
  - Bone articulation.

SKELETON ANATOMY

- WHAT:
  - The **skeletal system** is made up of multiple groups of **skeletal parts (bones)** that are connected by **cartilage** and other tissues, forming the structural framework of the body.

SKELETON ANATOMY

- HOW:
  - The skeletal system is the internal frame of the body and includes bones, cartilages, joints, and ligaments.
  - In addition to providing structure, bones articulate, or come together, at joints to allow body movement.
- WHY:
  - The skeleton is essential for protecting organs, producing blood cells, storing essential minerals, and anchoring skeletal muscles so that their contractions cause body movements.

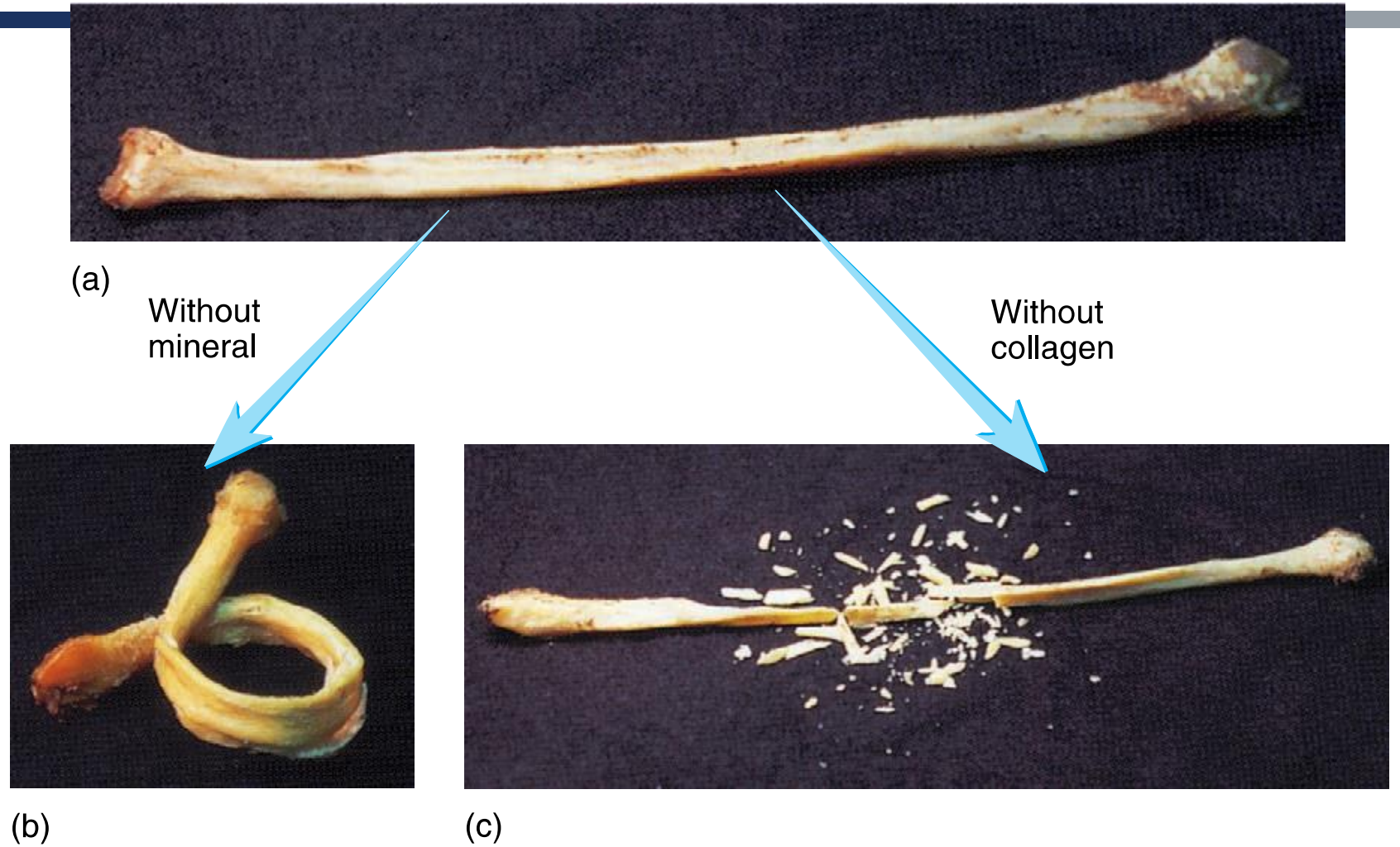


FIGURE 6.2 Effects of Changing the Bone Matrix

(*a*) Normal bone. (*b*) Demineralized bone, in which collagen is the primary remaining component, can be bent without breaking. (*c*) When collagen is removed, mineral is the primary remaining component, making the bone so brittle that it is easily shattered.

KEY FEATURES OF THE SKELETAL SYSTEM

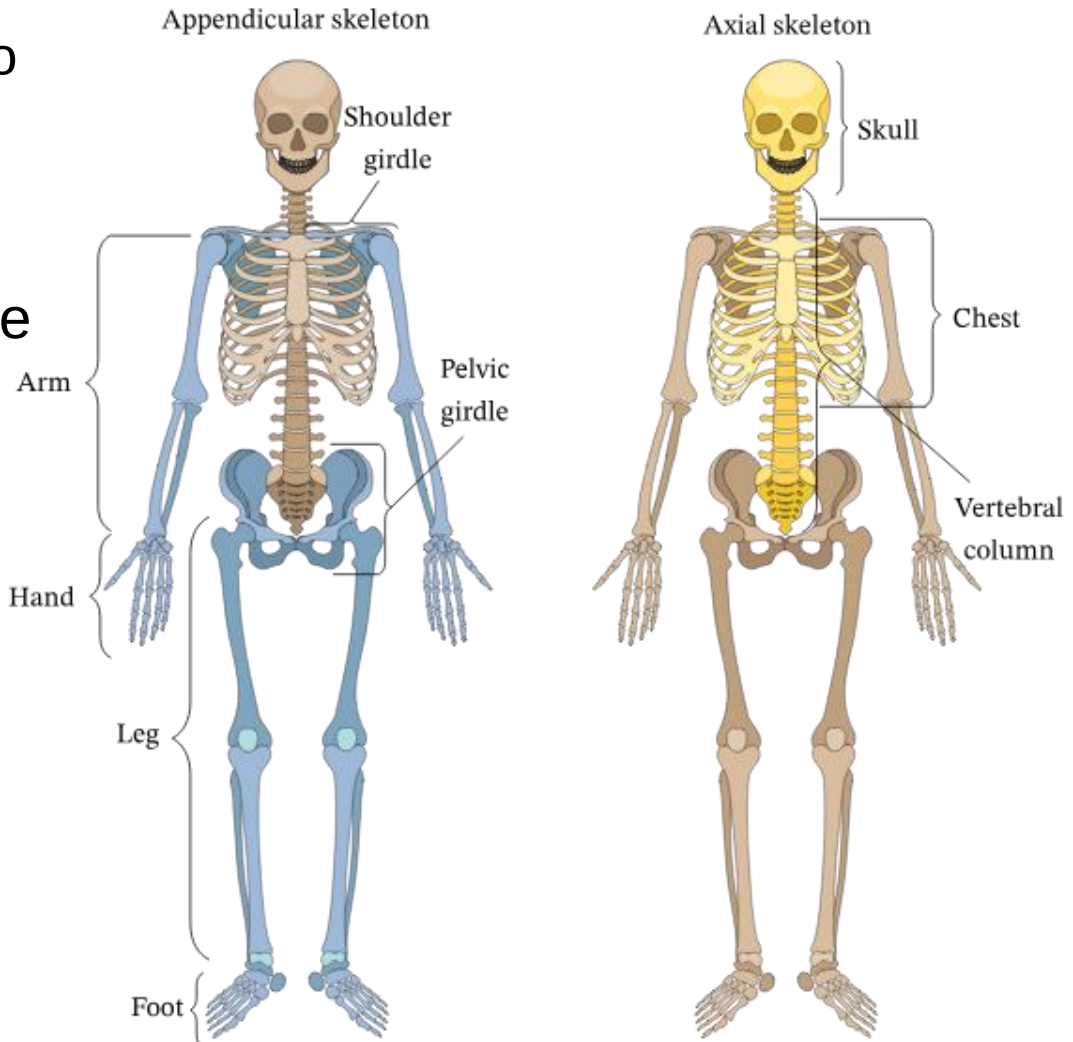
- Bones – Provide structure, support, and protection fo organs.
- Cartilage – A flexible connective tissue that cushions joints and allows smooth movement.
- Joints – Points where bones meet, enabling moveme (e.g., hinge joints in knees, ball-and-socket joints in hips).
- Ligaments & Tendons – Ligaments connect bone to bone, while tendons connect muscle to bone.

THE SKELETAL SYSTEM: BONES

CLASSIFICATION OF SKELETON

The human skeleton has 206 bones (in adults) divided into two main groups:

- **Axial skeleton (central bones):**
  - The skull, rib cage, vertebral column, hyoid bone
  - Provides central support and protection
  - 80 bones
- **Appendicular skeleton (peripheral bones):**
  - The upper and lower limbs, shoulder and hip girdles
  - Facilitates movement
  - 126 bones



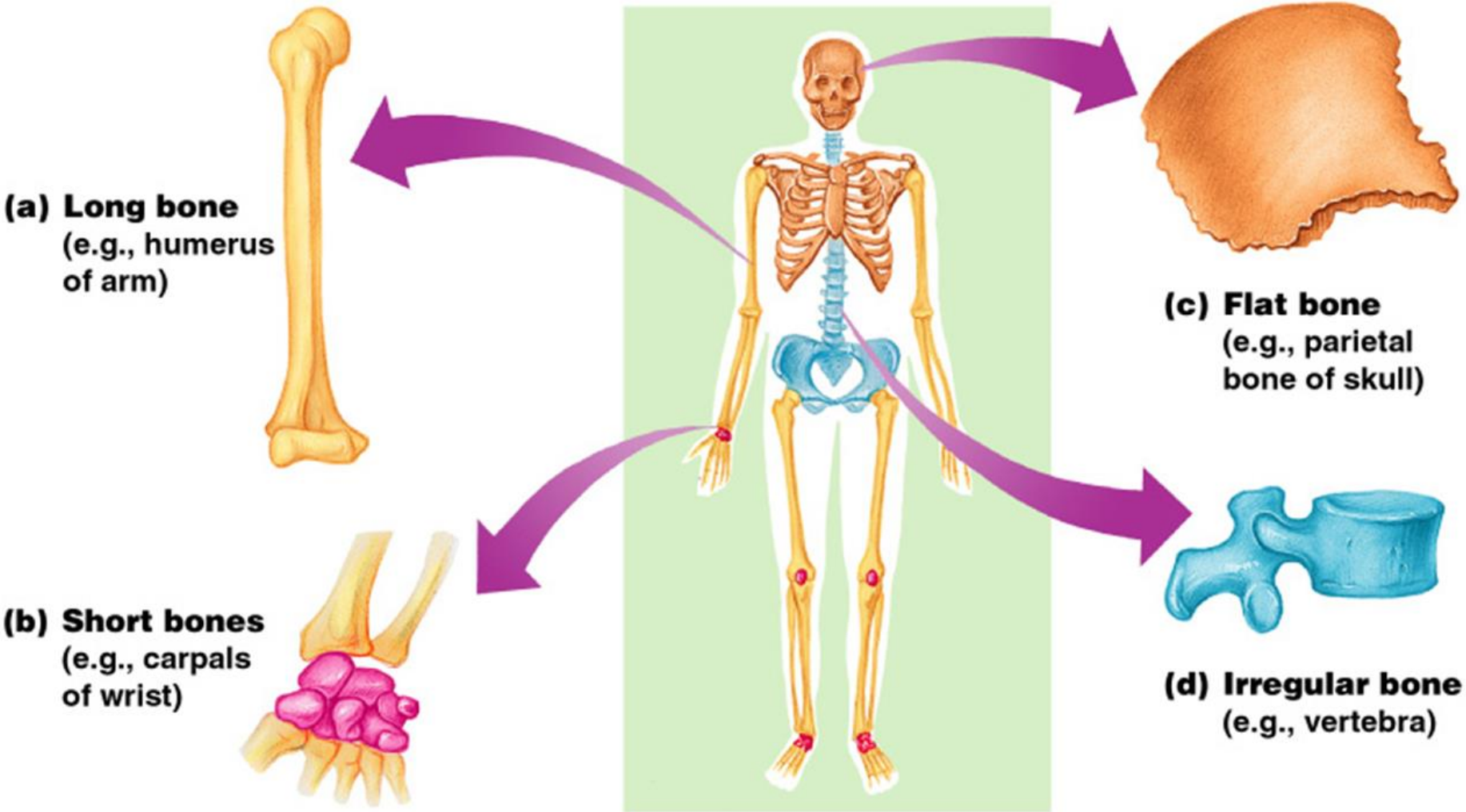
FYI

TABLE 7.1 **Number of Named Bones Listed by Category**

Bones		Number
Axial Skeleton		
Skull (Cranium)		
Braincase (neurocranium)		
Paired (left and right)	Parietal	2
	Temporal	2
Unpaired (single)	Frontal	1
	Sphenoid	1
	Occipital	1
	Ethmoid	1
Face (viscerocranium)		
Paired	Maxilla	2
	Zygomatic	2
	Palatine	2
	Lacrimal	2
	Nasal	2
	Inferior nasal concha	2
Unpaired	Mandible	1
	Vomer	1
	Total skull bones	22
Bones Associated with the Skull		
Auditory ossicles		
Malleus		2
Incus		2
Stapes		2
Hyoid		1
	Total associated bones	7
Vertebral Column		
Cervical vertebrae		7
Thoracic vertebrae		12
Lumbar vertebrae		5
Sacrum		1
Coccyx		1
	Total vertebral column bones	26
Rib Cage (Thoracic Cage)		
Ribs		24
Sternum		1
	Total rib cage bones	25
	Total axial skeleton bones	80

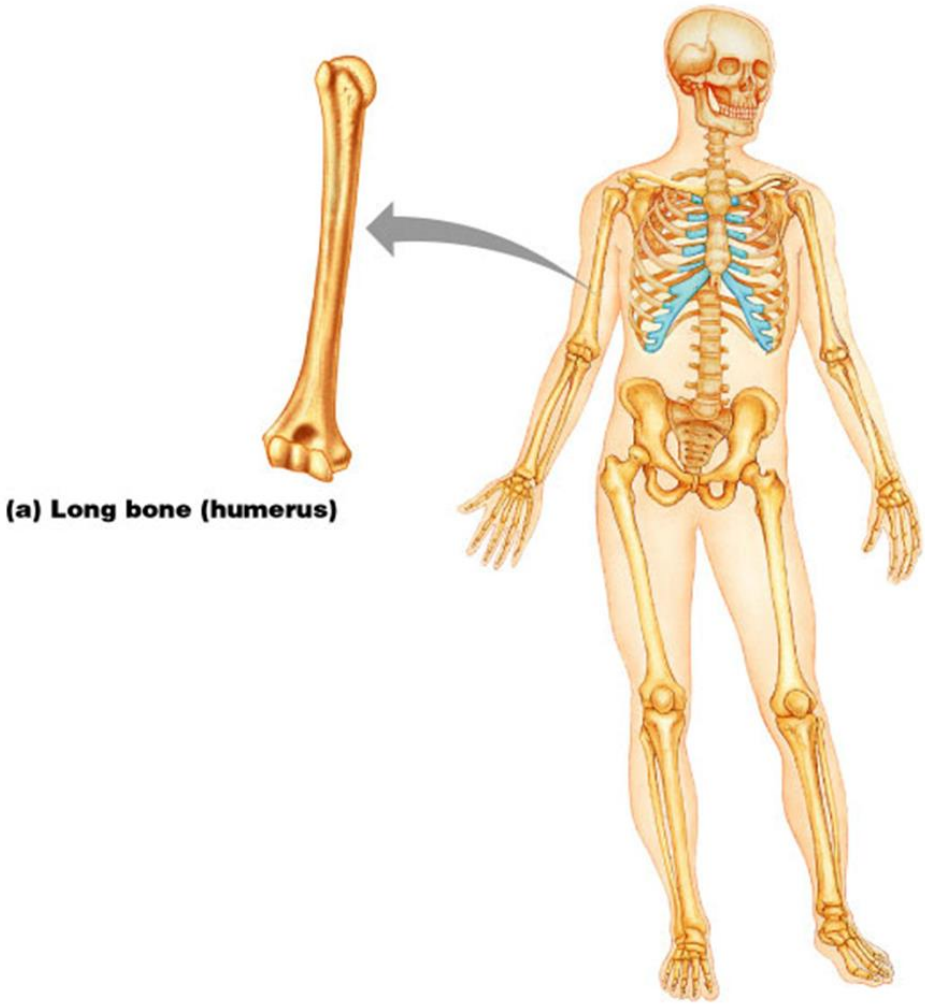
Bones		Number
Appendicular Skeleton		
Pectoral Girdle		
Scapula		2
Clavicle		2
Upper Limb		
Humerus		2
Ulna		2
Radius		2
Carpal bones		16
Metacarpal bones		10
Phalanges		28
	Total girdle and upper limb bones	64
Pelvic Girdle		
Coxal bone		2
Lower Limb		
Femur		2
Tibia		2
Fibula		2
Patella		2
Tarsal bones		14
Metatarsal bones		10
Phalanges		28
	Total girdle and lower limb bones	62
	Total appendicular skeleton bones	126
	Total axial skeleton bones	80
	Total appendicular skeleton bones	126
	Total bones	206

CLASSIFICATION OF BONES ON THE BASIS OF SHAPE



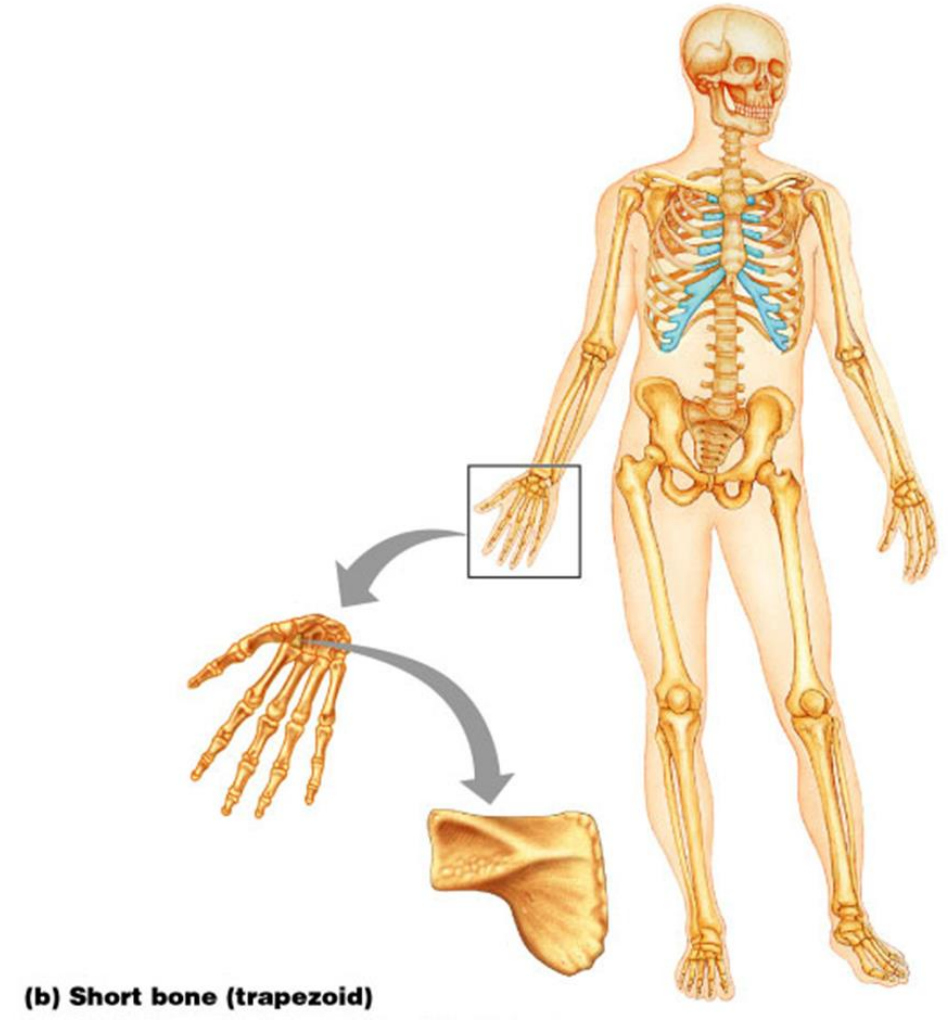
CLASSIFICATION OF BONES ON THE BASIS OF SHAPE

- **Long bones:**
  - The length is greater than the width.
  - e.g., humerus.



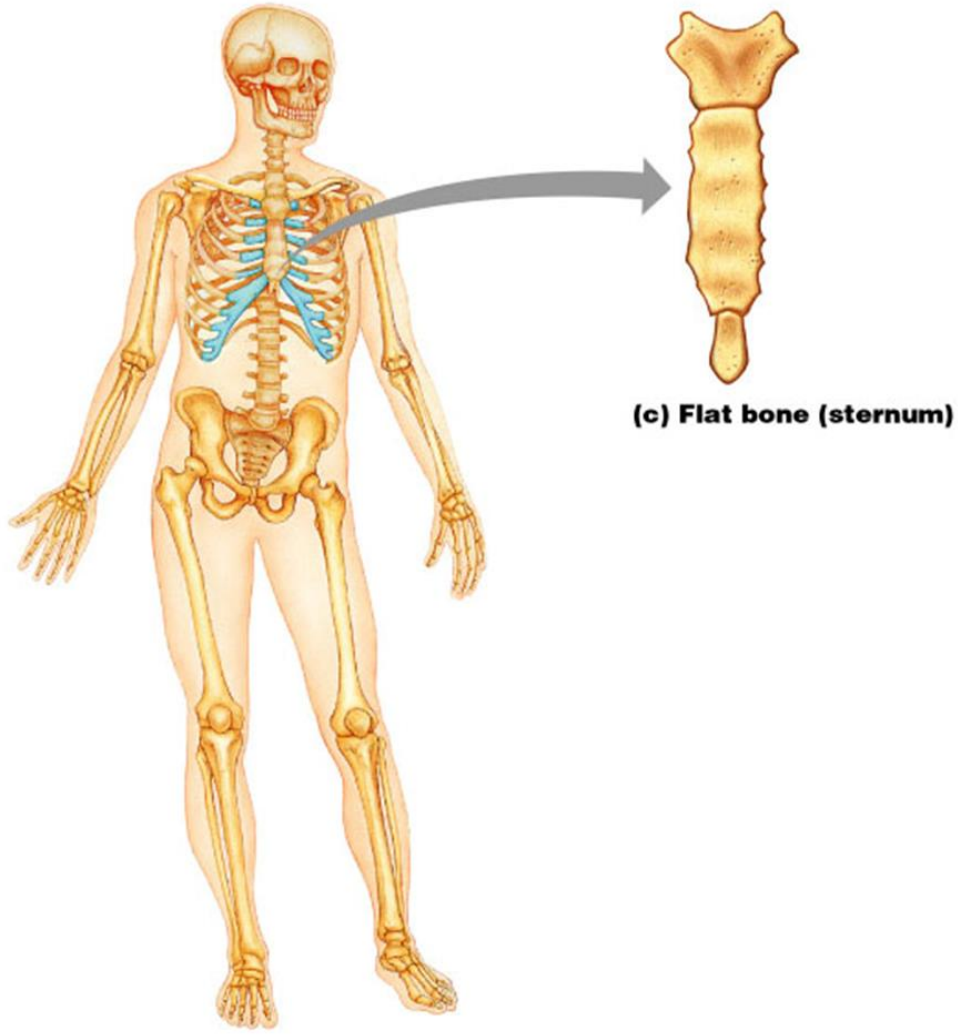
CLASSIFICATION OF BONES ON THE BASIS OF SHAPE

- **Short bones:**
  - Cube-shaped bones of the wrist and ankle.
  - e.g., Tarsals found in the foot.
  - e.g., Carpals found in the hand.



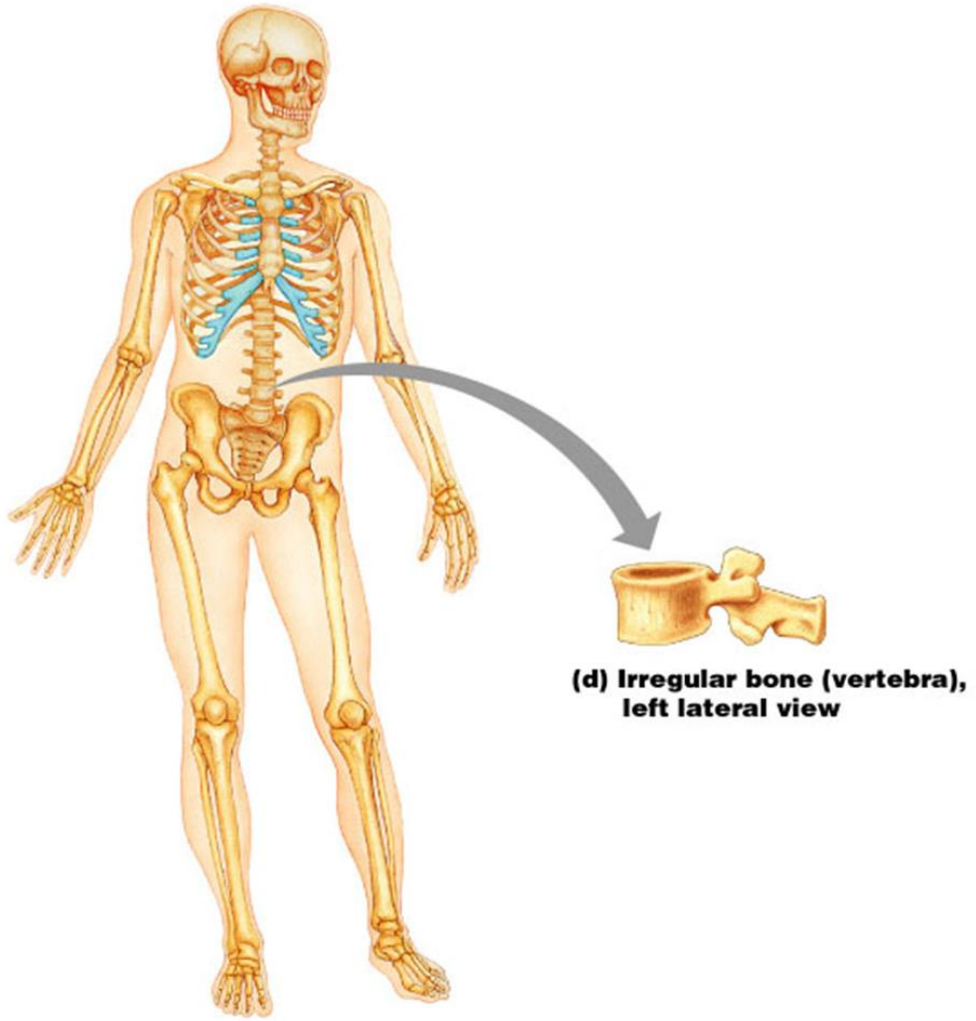
CLASSIFICATION OF BONES ON THE BASIS OF SHAPE

- **Flat bones:**
  - Thin, flattened, and a bit curved.
  - e.g., sternum, and most skull bones.



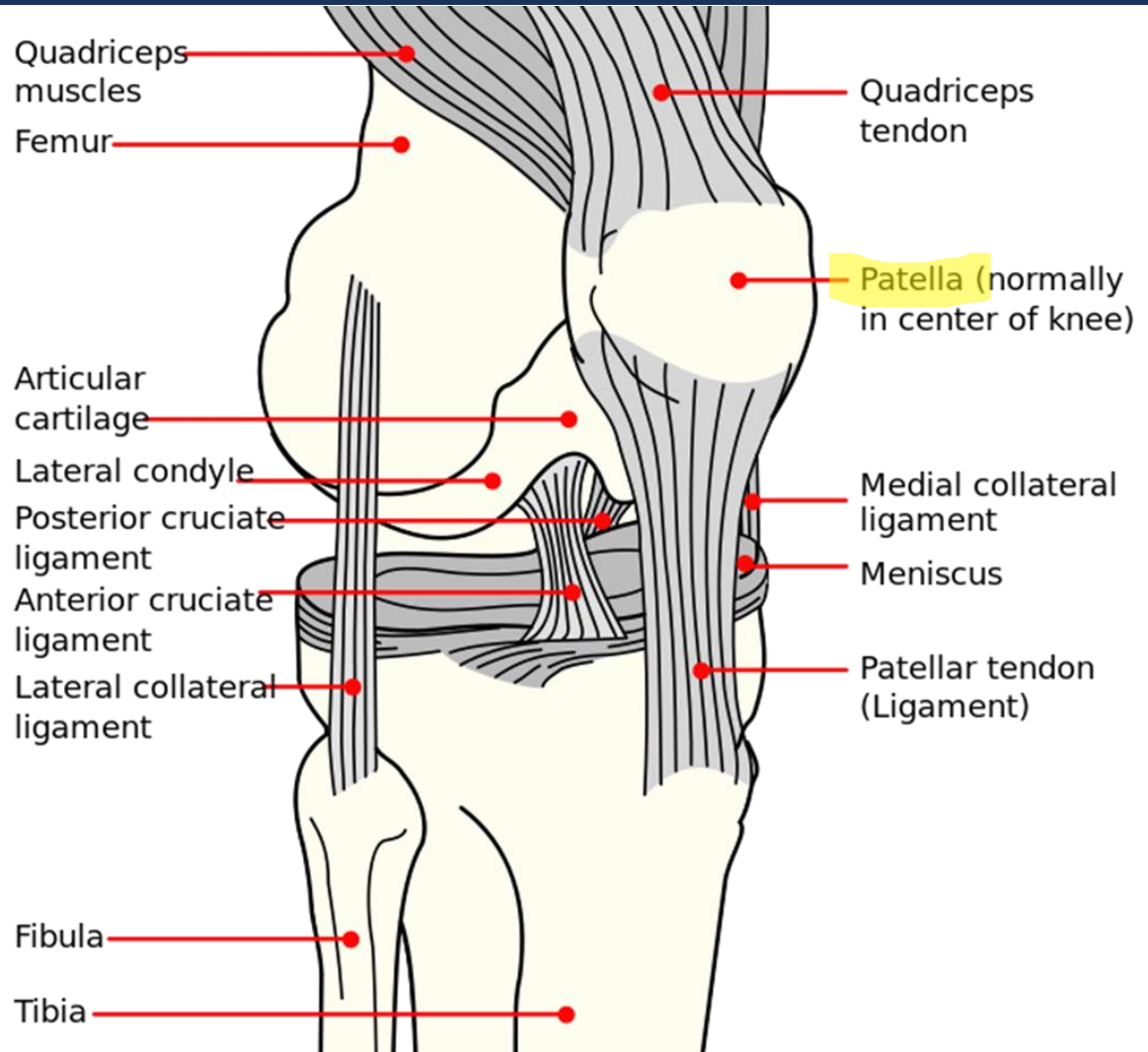
CLASSIFICATION OF BONES ON THE BASIS OF SHAPE

- **Irregular bones:**
  - Bones with complicated shapes.
  - e.g., vertebrae and hip bones.

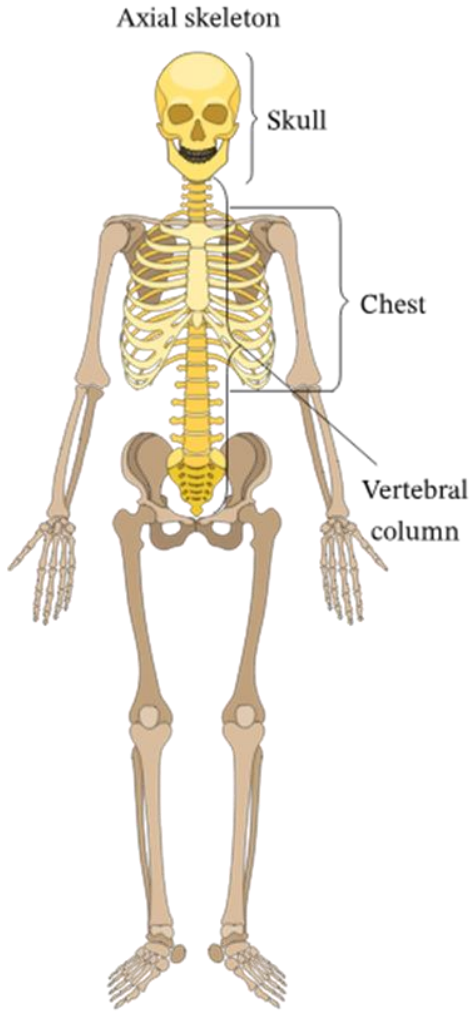


CLASSIFICATION OF BONES ON THE BASIS OF SHAPE

- **Sesamoid bones:**
  - Bones that form within tendons.
  - e.g., patella.

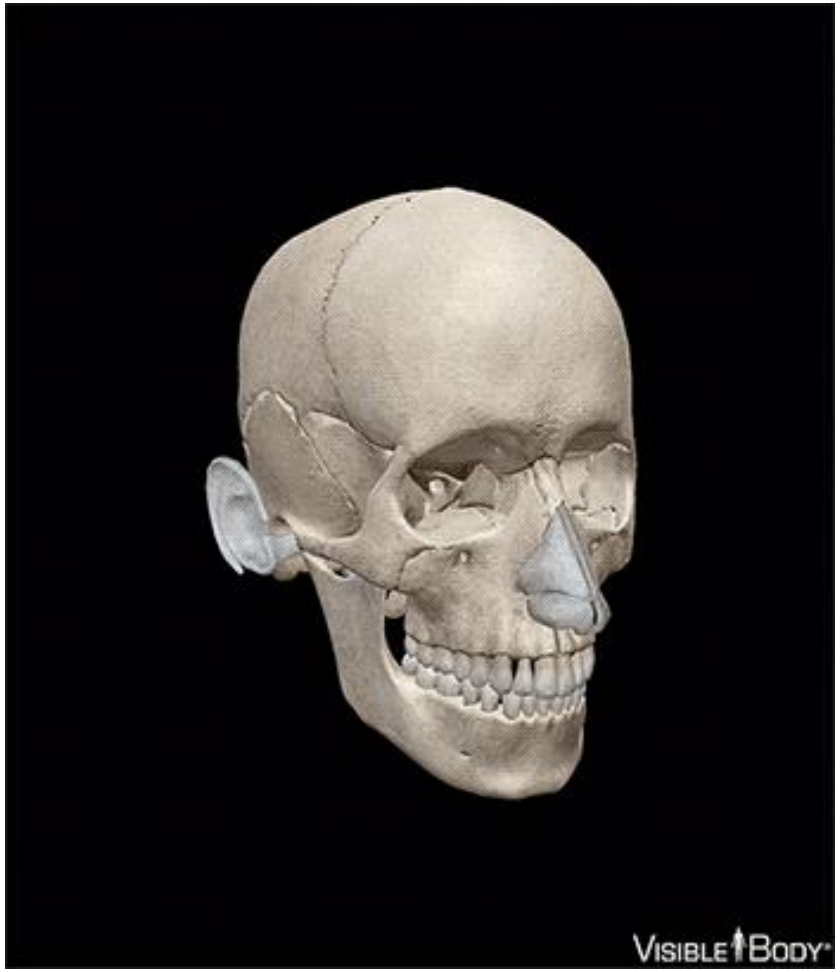


THE AXIAL SKELETON



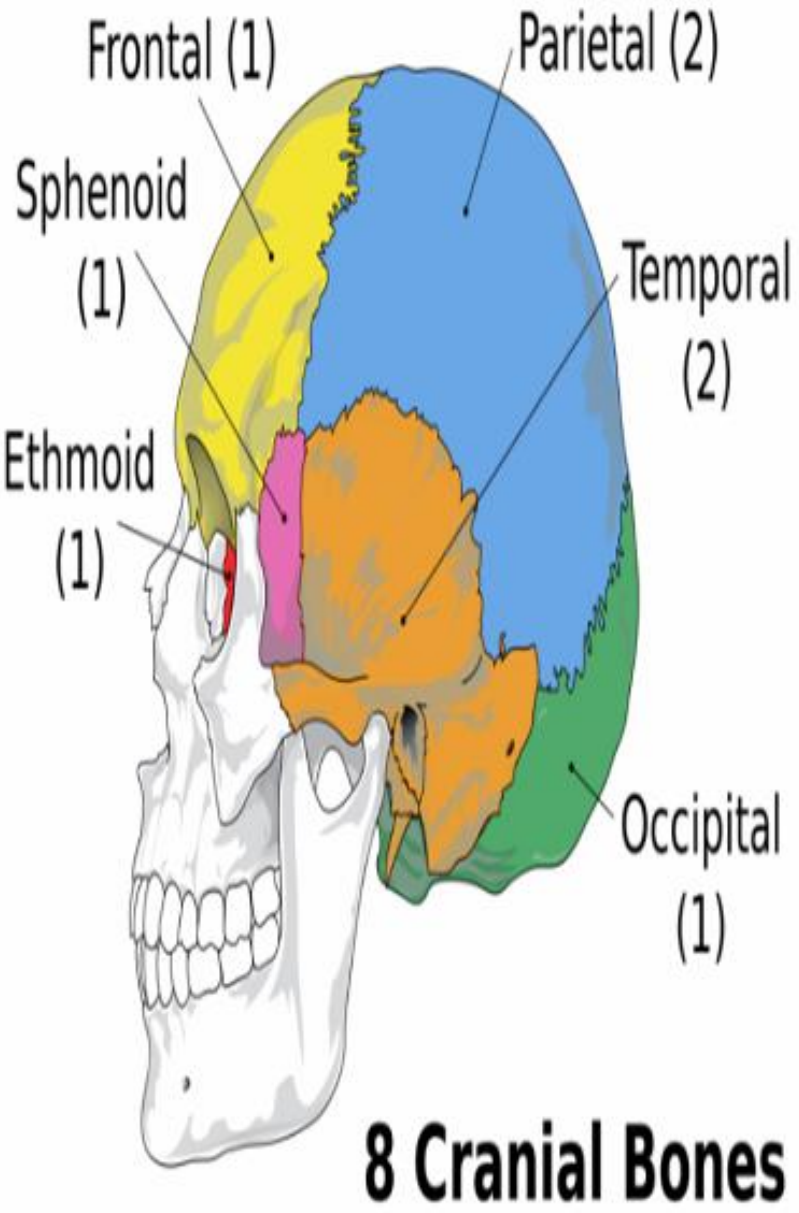
THE SKULL

- The **skull (cranium):**
  - The body's most complex bony structure.
  - The skull is composed of several separated bones united at immovable joint called suture (protection of brain).
  - Is formed by 22 bones:
    - **Cranial bones (8).**
    - **Facial bones (14).**



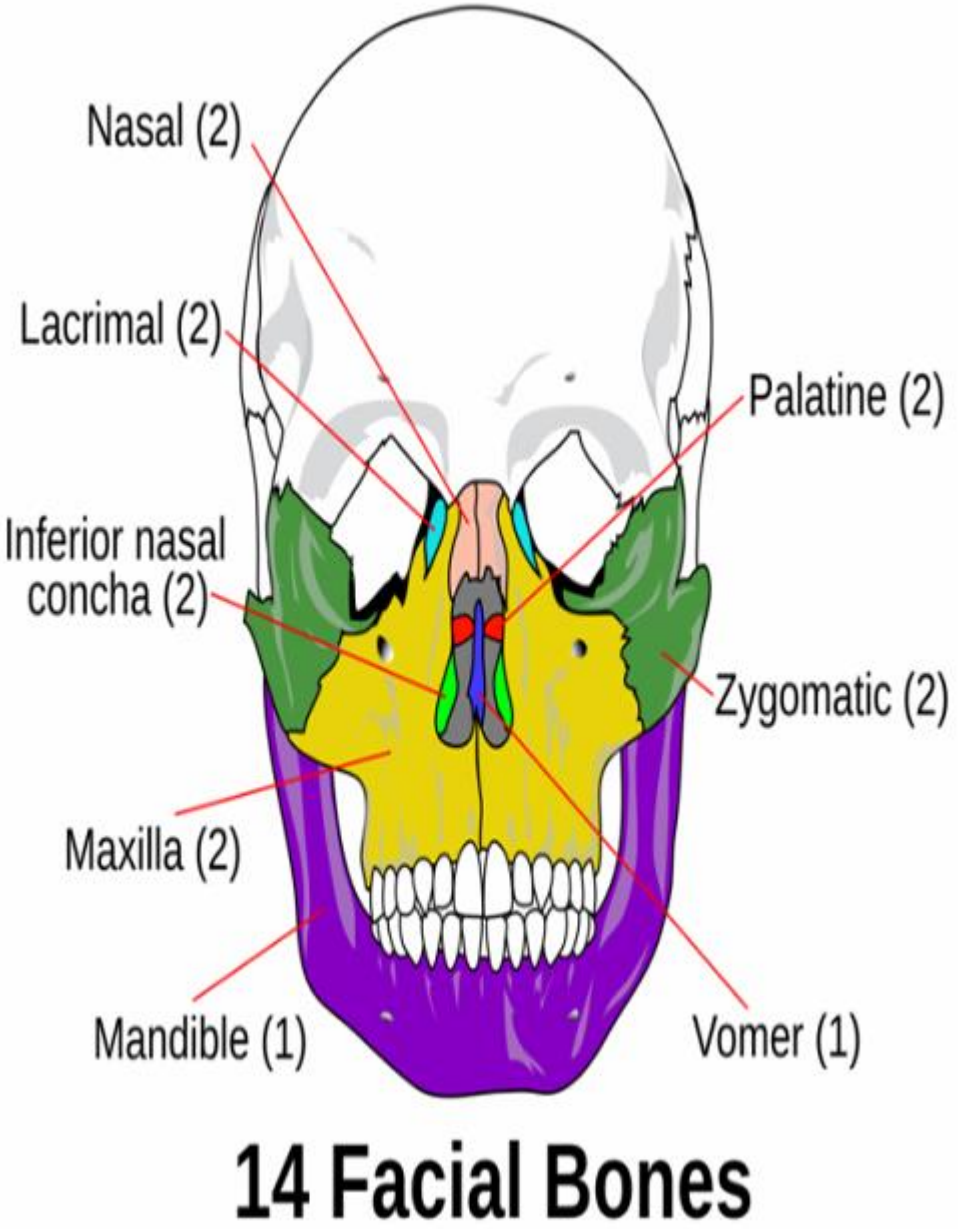
THE SKULL: ANATOMY OF THE CRANIAL BONES

- Eight cranial bones – two **parietal,** two **temporal**, **frontal**, **occipital**, **sphenoid,** and **ethmoid.**

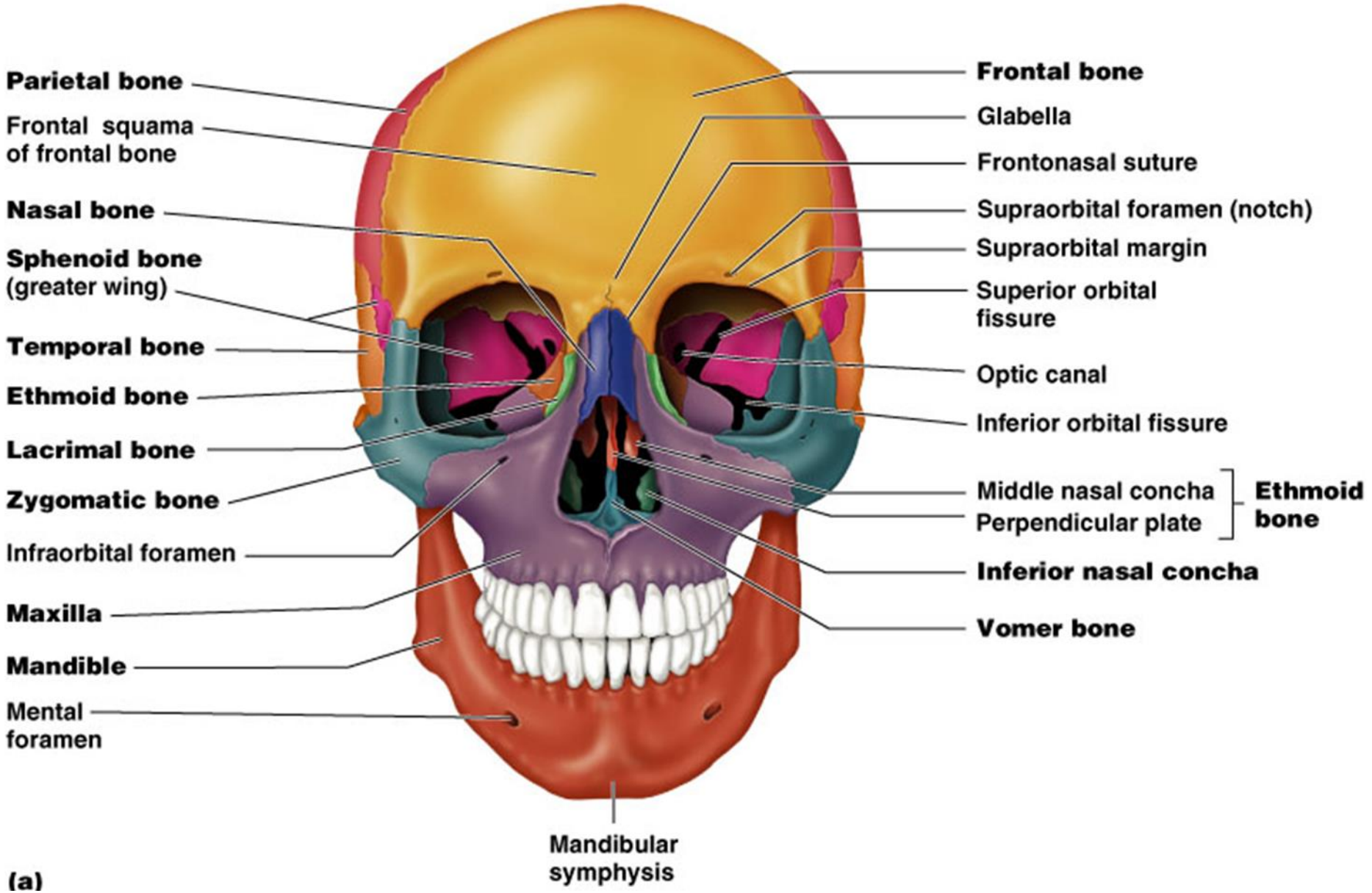


THE SKULL: ANATOMY OF THE FACIAL BONES

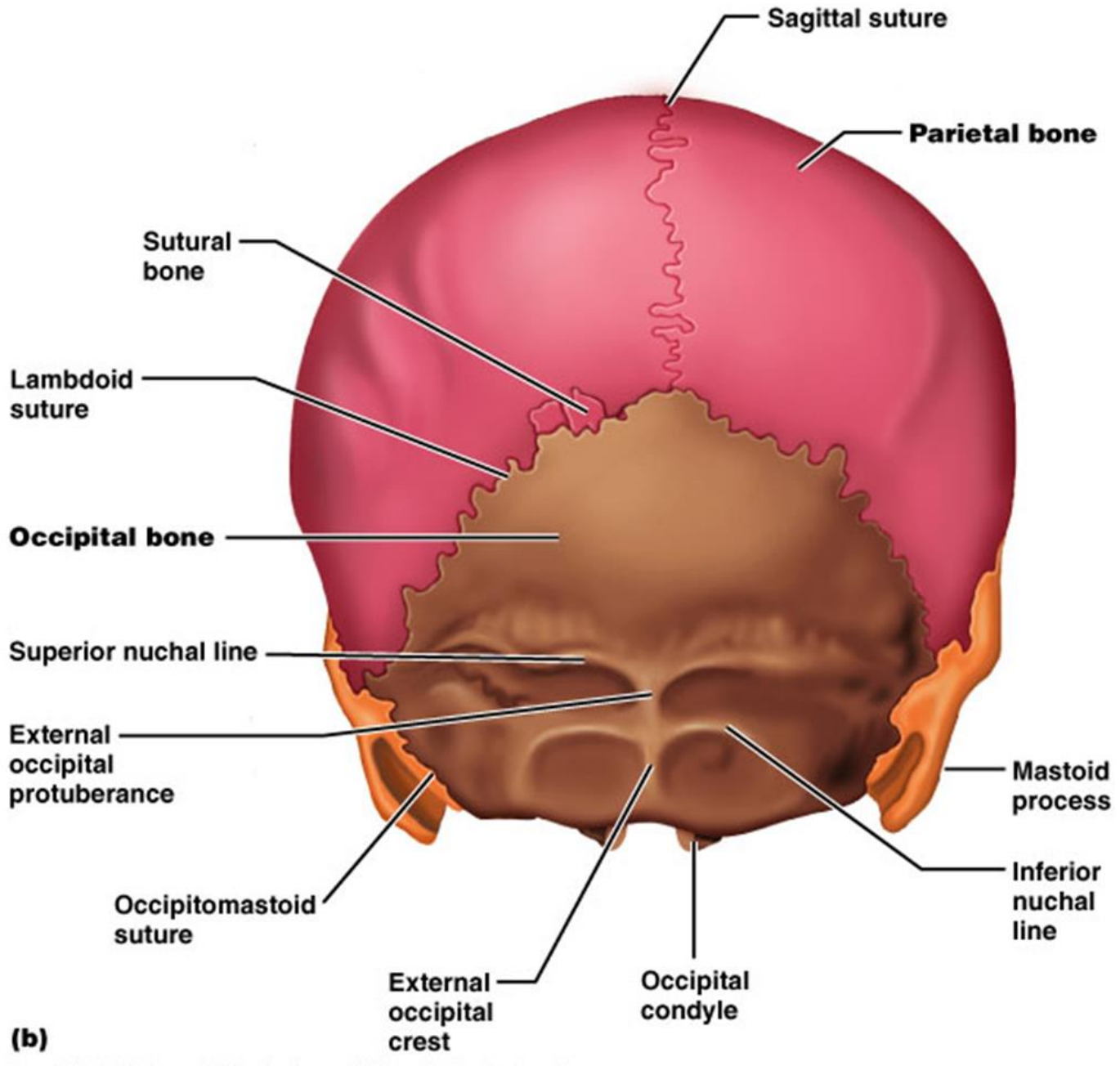
- Fourteen bones of which only the **mandible** and **vomer** are unpaired.
- The paired bones are the **maxillae**, **zygomatics**, **nasals**, **lacrimals**, **palatines,** and **inferior conchae.**



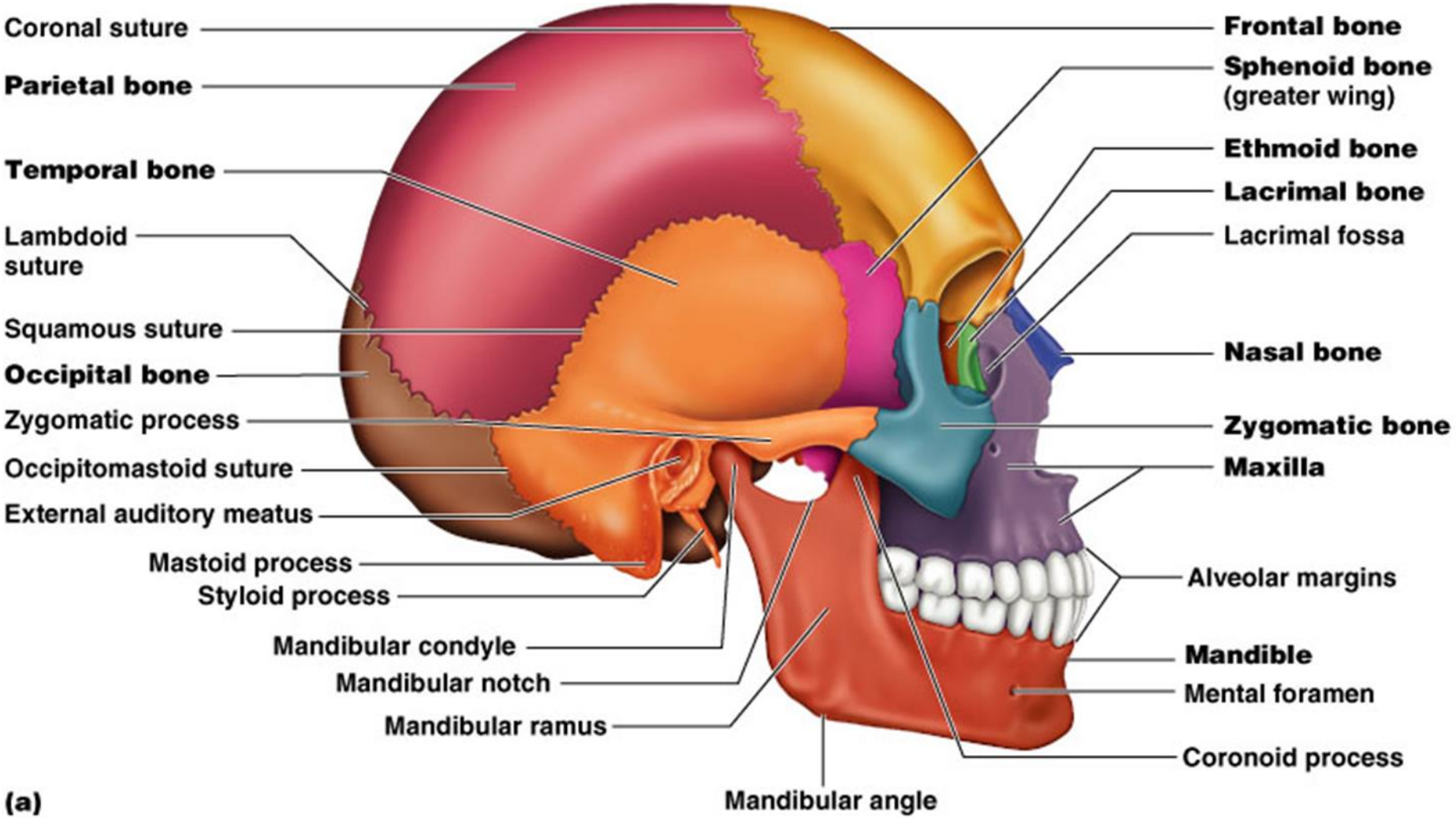
Anterior Aspects of the Skull



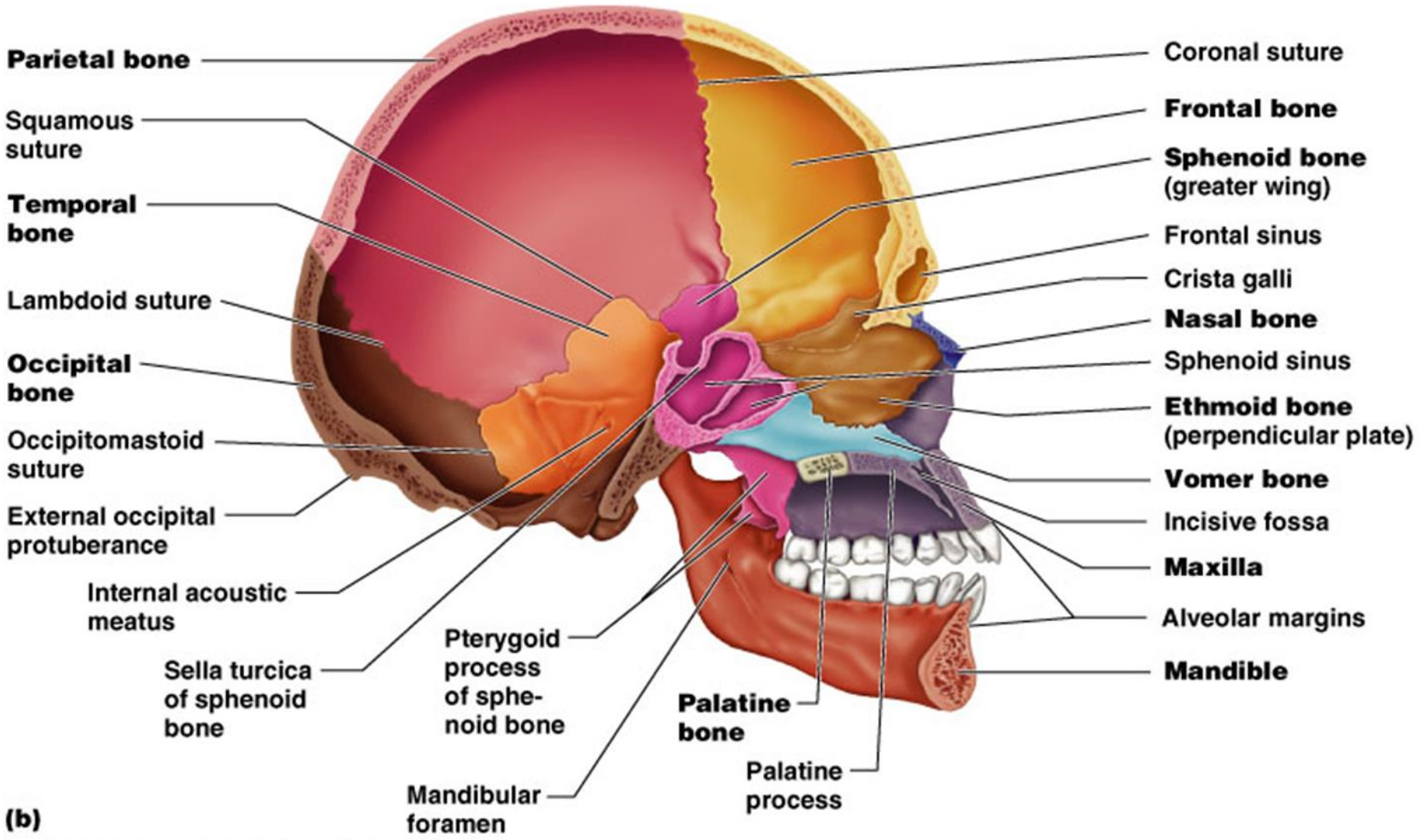
Posterior Aspects of the Skull



External Lateral Aspects of the Skull



Midsagittal Lateral Aspects of the Skull



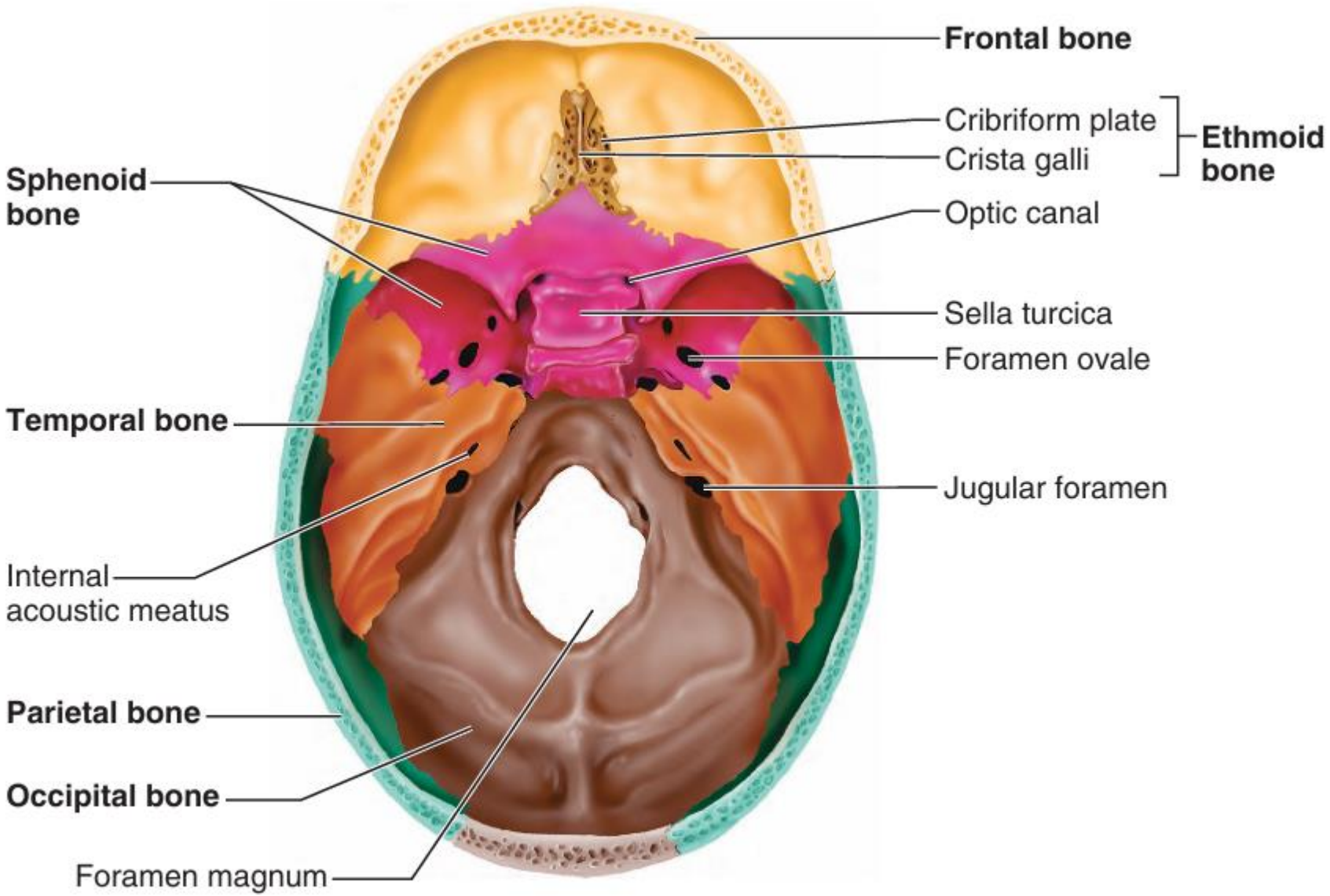


Figure 5.10 Human skull, superior view (top of cranium removed).

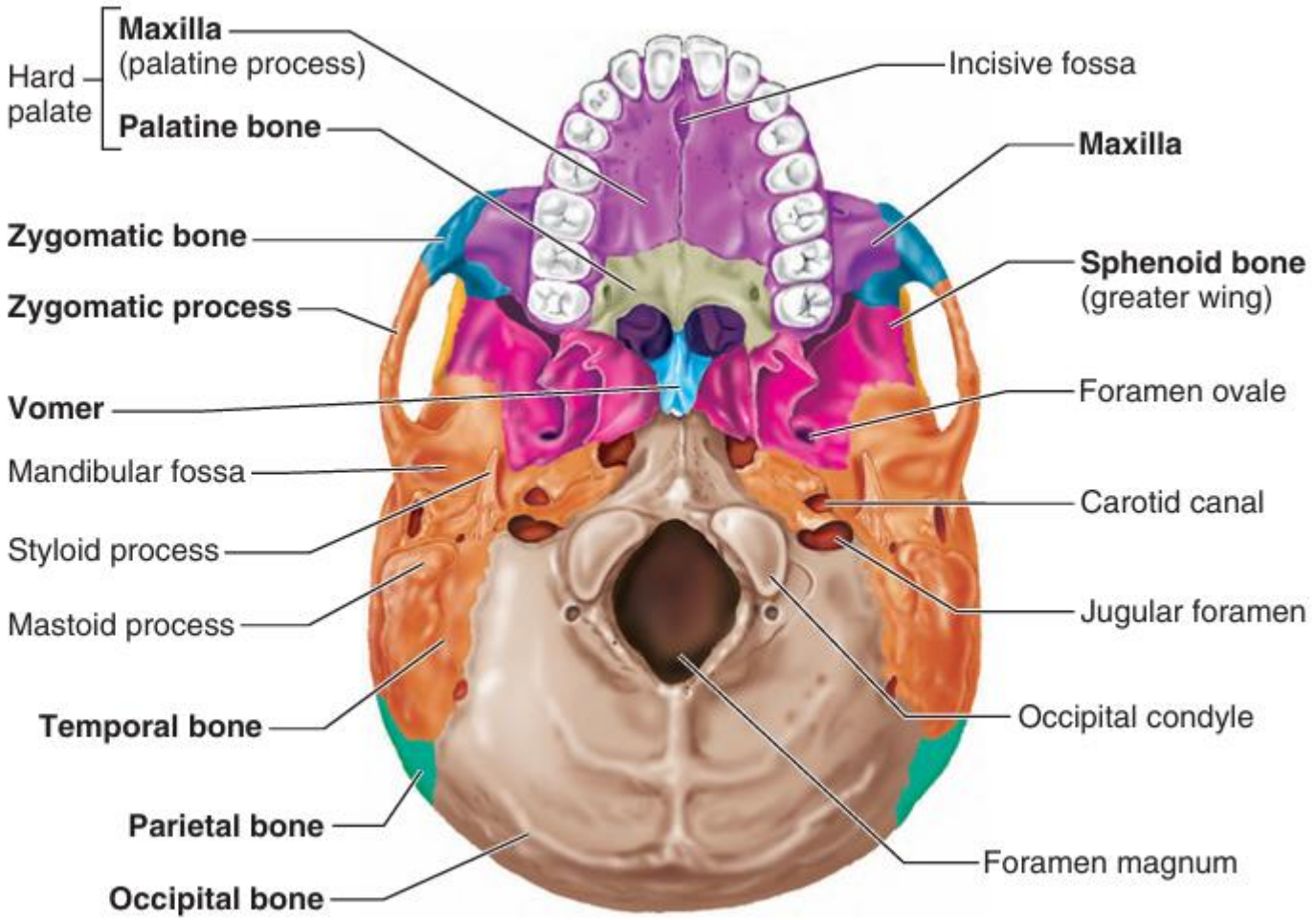
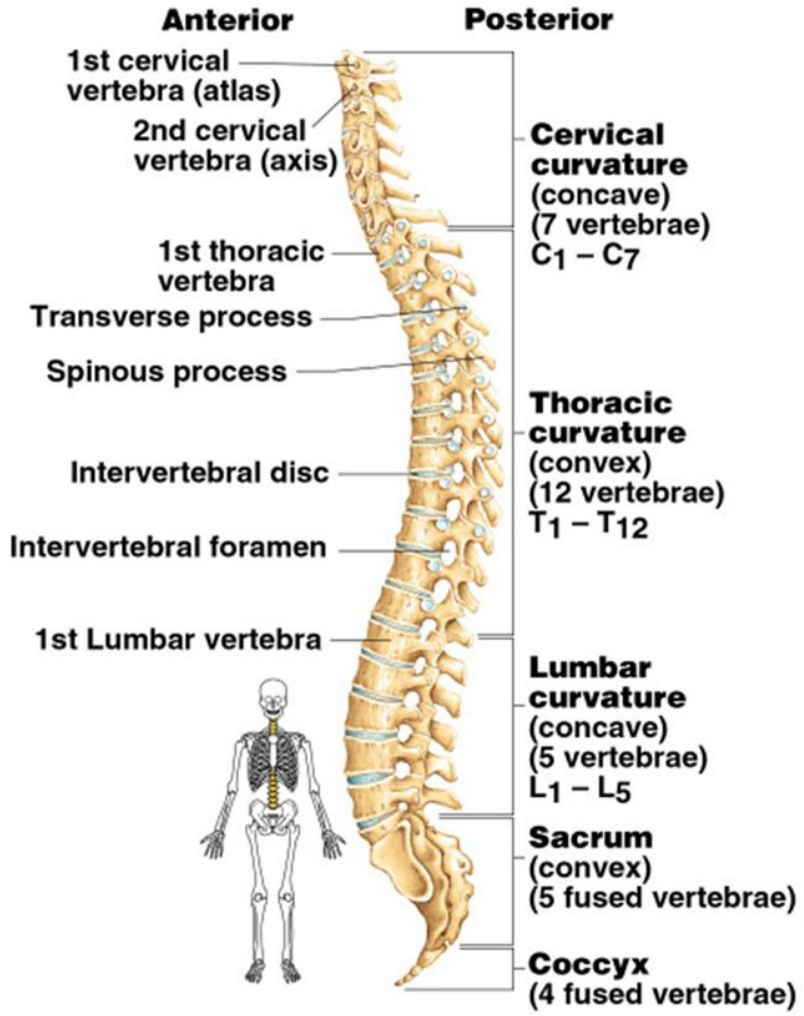


Figure 5.11 Human skull, inferior view (mandible removed).

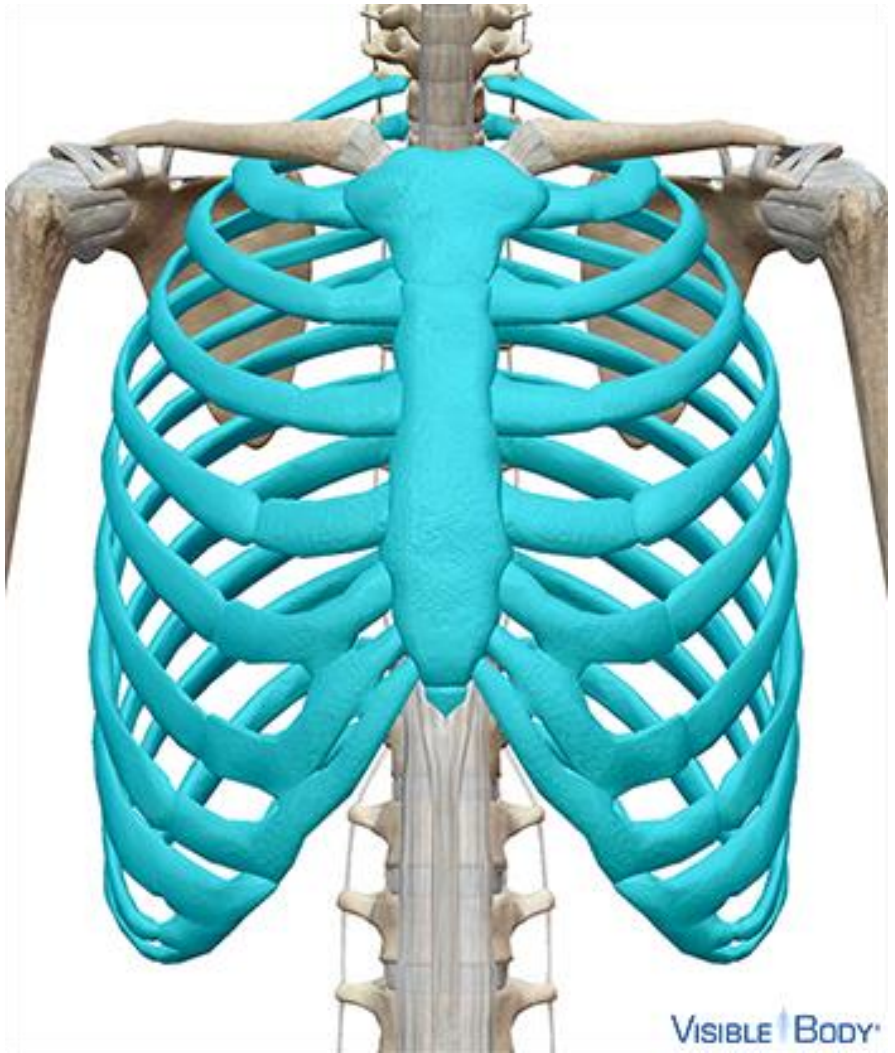
VETEBRAL BONES: VERTEBRAL COLUMN

- Formed from 33 irregular bones (**vertebrae**).
- Vertebrae separated by intervertebral discs made of cartilage.
- Each vertebrae group is given a name according to its location:
  - **Cervical vertebrae** – 7 bones of the neck.
  - **Thoracic vertebrae** – 12 bones of the torso.
  - **Lumbar vertebrae** – 5 bones of the lower back.
  - **Sacral** – 5 fused vertebrae; fused to form the sacrum, bone inferior to the lumbar vertebrae that articulates with the hip bones.
  - **Coccygeal/Coccyx**– 4 fused vertebrae; the lower 3 are fused.

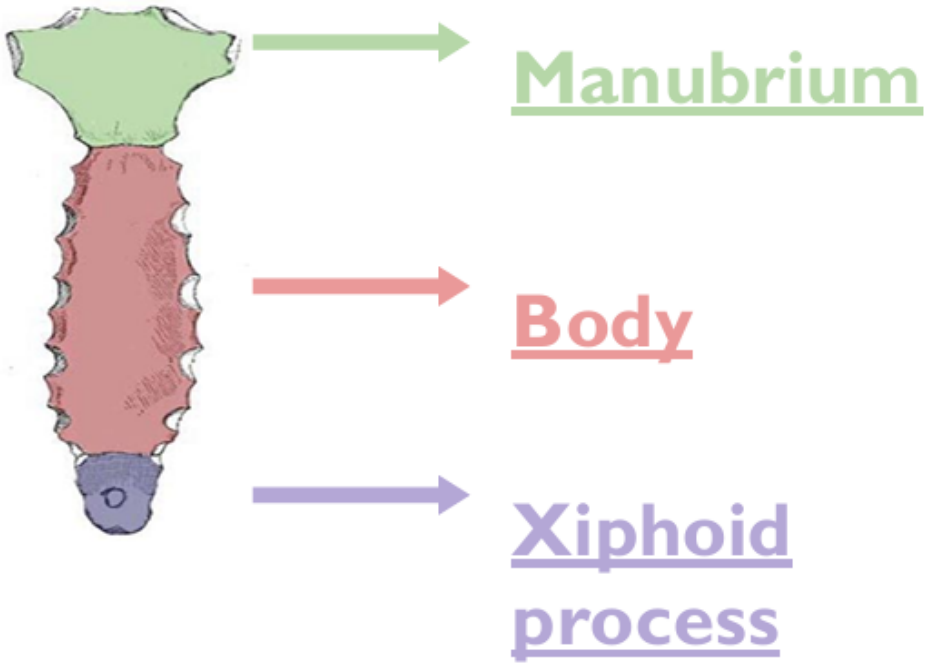


THORACIC CAGE

- Thoracic cage it is the bony – cartilaginous skeleton of the thorax protect the heart, lung, and great vessels.
- Thoracic cage is formed by:
  1. Sternum.
  2. 12 pairs of ribs with their costal cartilage.

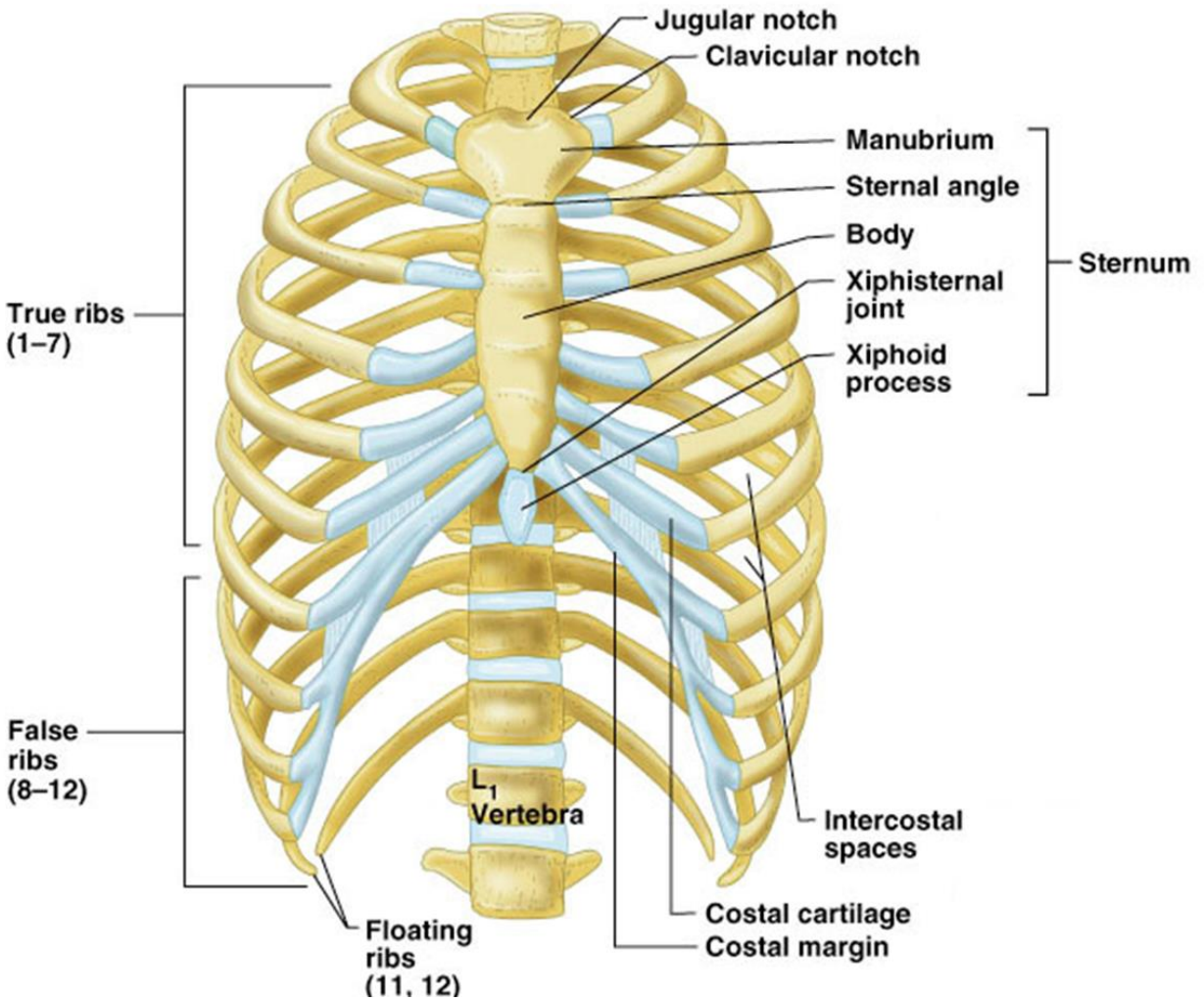


STERNUM



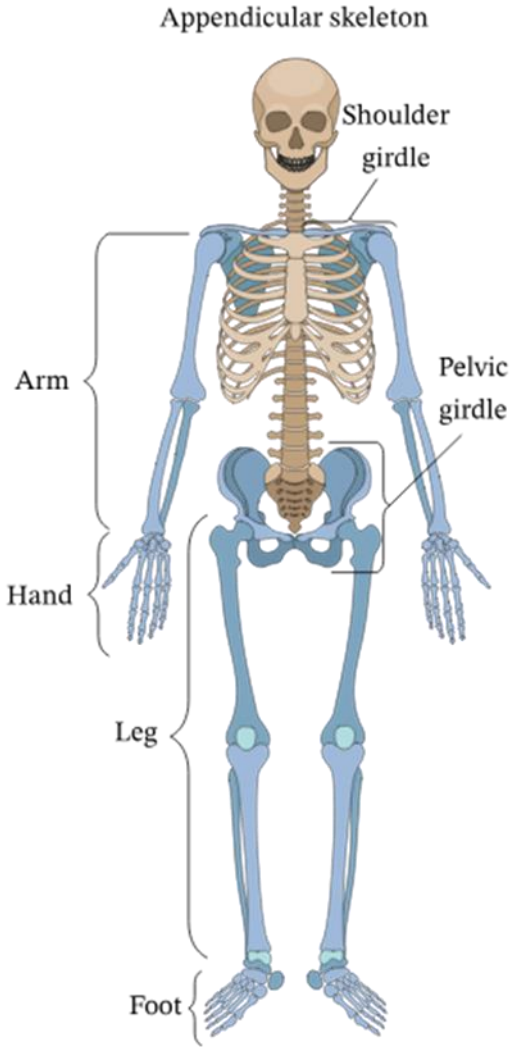
RIBS

- There are **twelve pair of ribs** forming the flaring sides of the thoracic cage.
- All ribs attach posteriorly to the thoracic vertebrae.
- The ribs are classified as true ribs (1-7) and false ribs (8-12):
  - **Ribs 1-7** (**true**) attach directly to the sternum via costal cartilages.
  - **Ribs 8-10** (**false**) attach indirectly to the sternum via costal cartilage.
  - **Ribs 11-12** (**floating/false** ribs) have no anterior attachment.



APPENDICULAR SKELETON

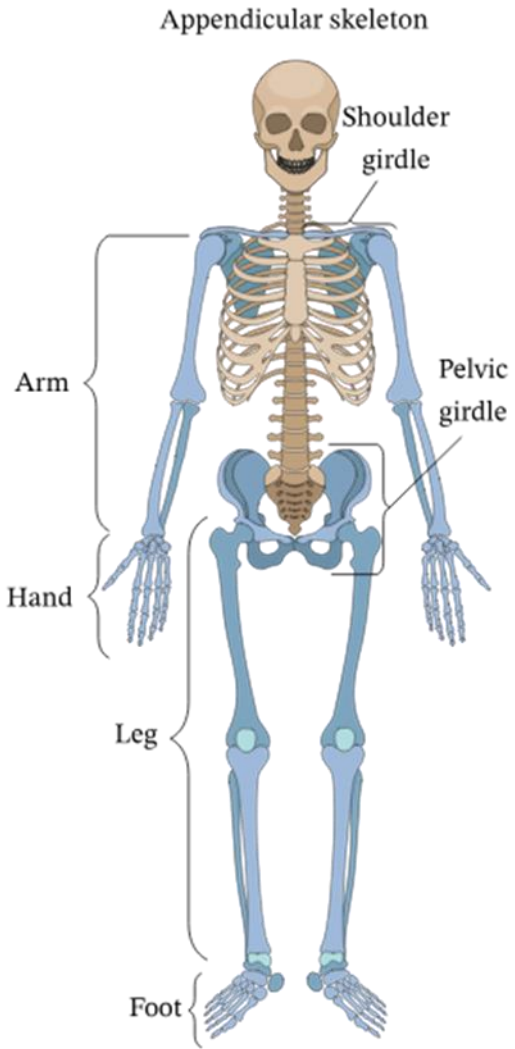
- The appendicular skeleton is made up of the **bones of the limbs** and their **girdles:**
  - **Pectoral girdles.**
  - **Pelvic girdle.**



APPENDICULAR SKELETON

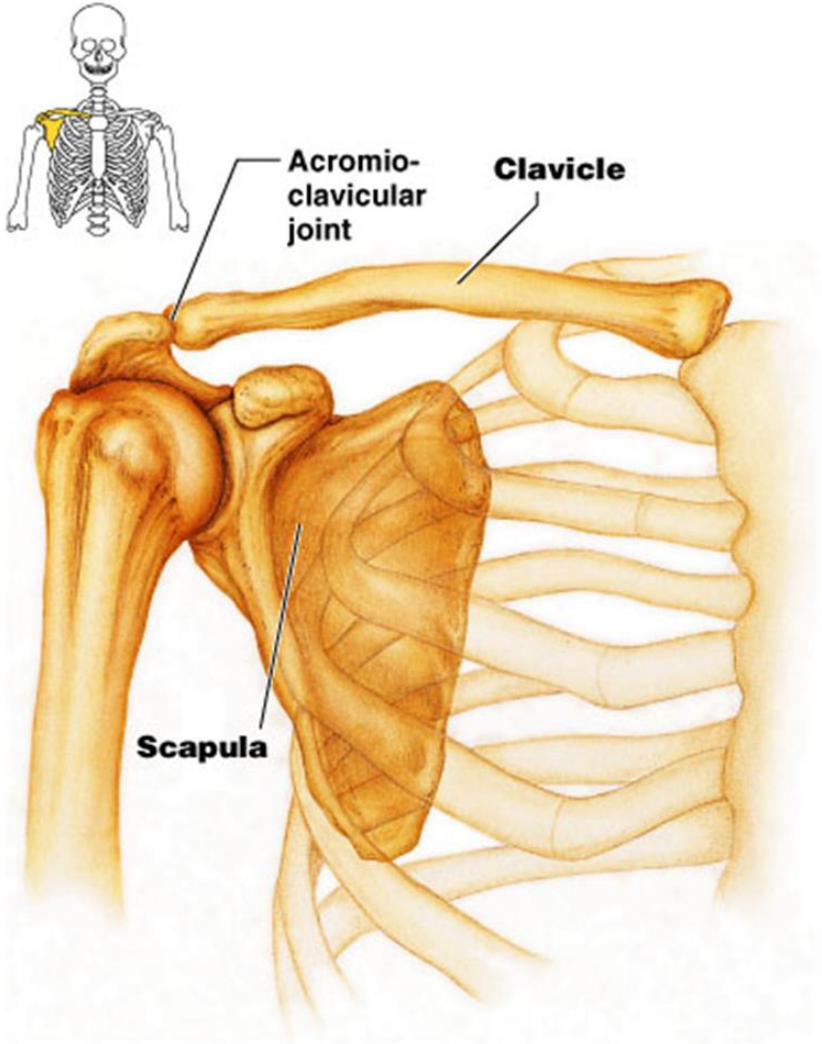
A-Upper limb:

- Consist from:
  - 1-Skeleton of the shoulder (Clavicle and scapula bone).
  - 2-Skeleton of the upper arm (Humerus bone).
  - 3-Skeleton bone of the forearm (Radius and ulna bones).
  - 4-Skeleton bone of the wrist (carpus).
  - 5-Skeleton bone of the palm.
  - 6-Skeleton bone of the fingers.

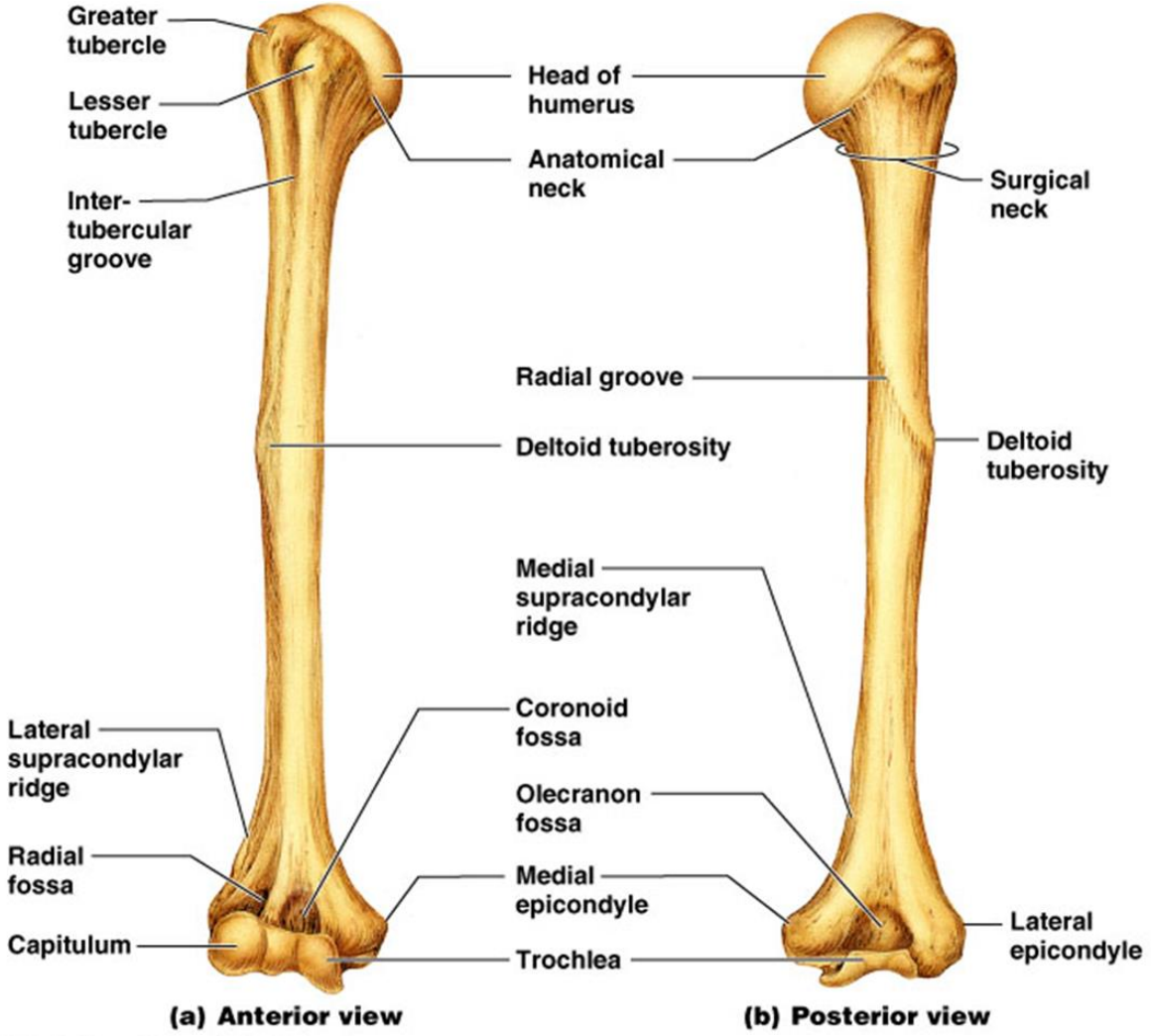


PECTORAL GIRDLES (SHOULDER GIRDLES)

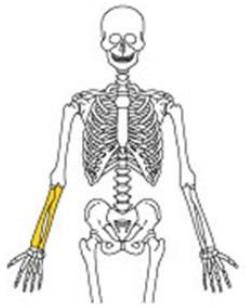
- The **pectoral girdles** consist of:
  - The anterior **clavicles** (Collarbones).
  - The posterior **scapulae** (Shoulder blades).

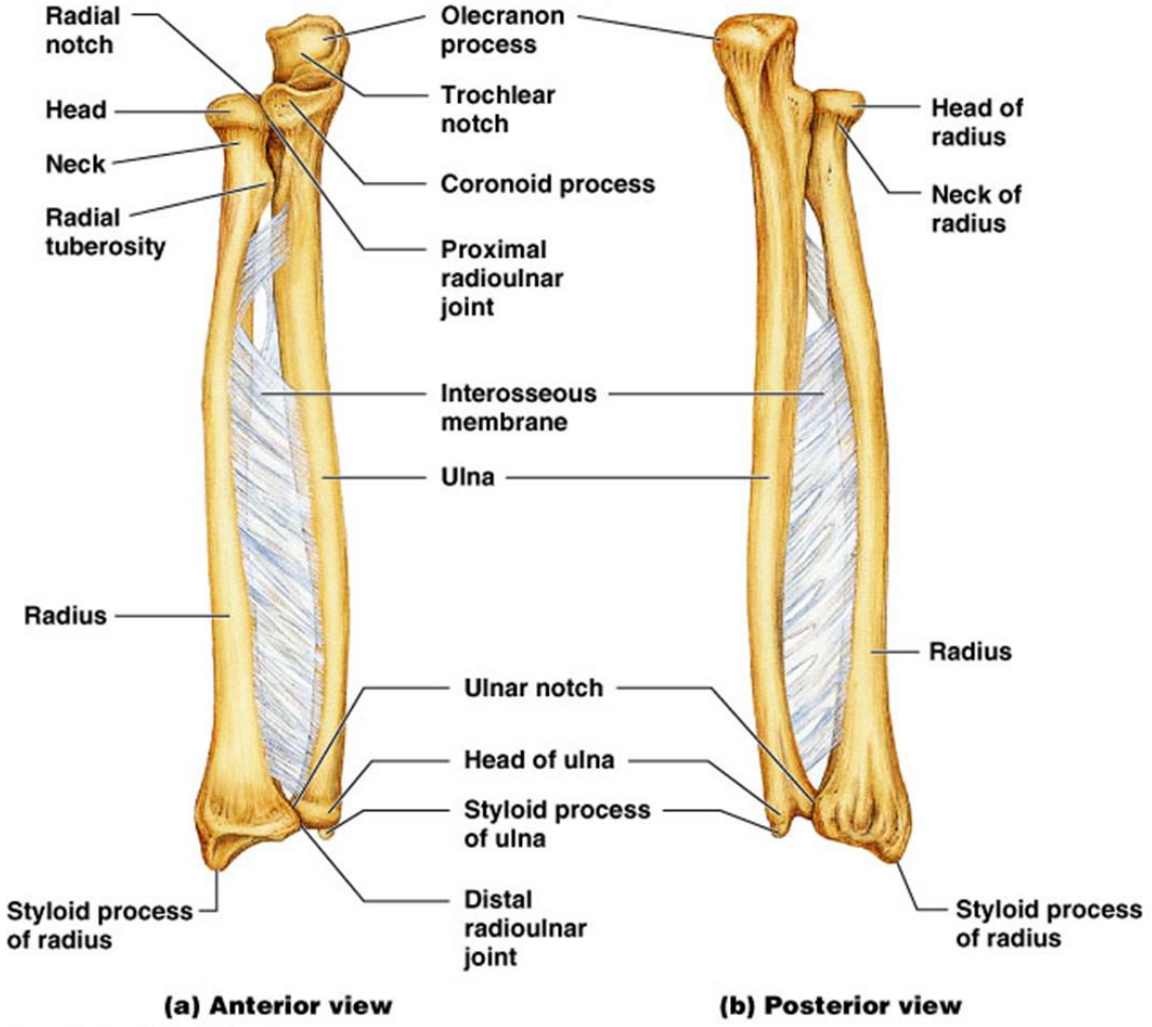


HUMERUS OF THE ARM



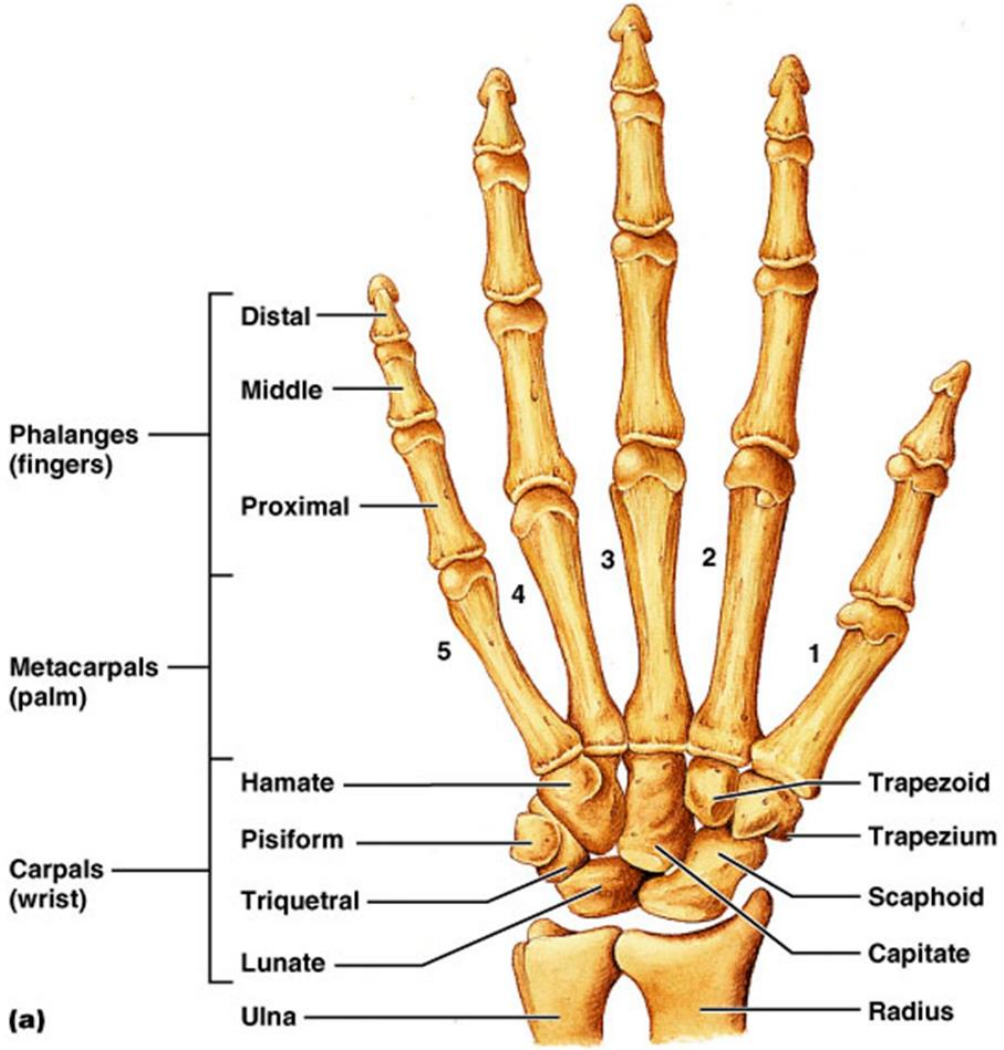
RADIUS AND ULNA: BONES OF THE FOREARM





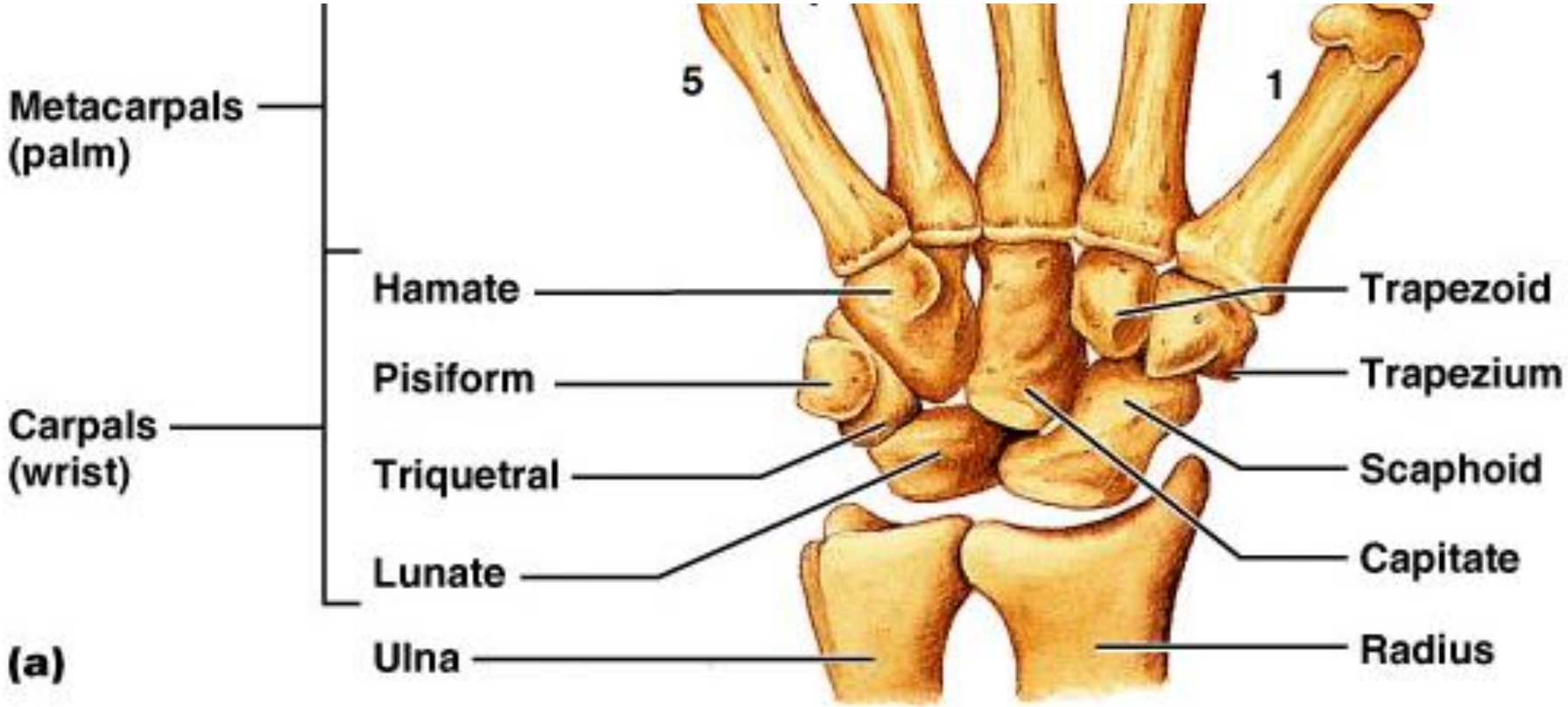
HAND

- Skeleton of the hand contains:
  - Wrist bones (**carpals**).
  - Bones of the palm (**metacarpals**).
  - Bones of the fingers (**phalanges**).



SKELETON BONE OF THE WRIST (CARPUS)

- The carpus (wrist) consists of 8 small carpal bones arranged in two rows (proximal & distal).



SKELETON BONE OF THE WRIST (CARPUS)

1. Proximal Row (Closer to Forearm – Lateral to Medial)

1. **Scaphoid** ("boat-shaped")
   - Articulates with radius.
2. **Lunate** ("moon-shaped")
3. **Triquetral** ("three-cornered")

2. Distal Row (Closer to Hand – Lateral to Medial)

1. **Trapezium** ("table-shaped")
   - Articulates with the thumb.
2. **Trapezoid** ("small table")
   - The smallest carpal bone in the distal row.
3. **Capitate** ("head-shaped")
   - Largest carpal bone.
4. **Hamate** ("hook-shaped")

SKELETON OF THE HAND

Skeleton Bone: The Palm

- There are five metacarpal bones each has base, shaft, and head.
- 1st metacarpal bone of the thumb is the shorter and mobile.

Skeleton Bone: The Fingers

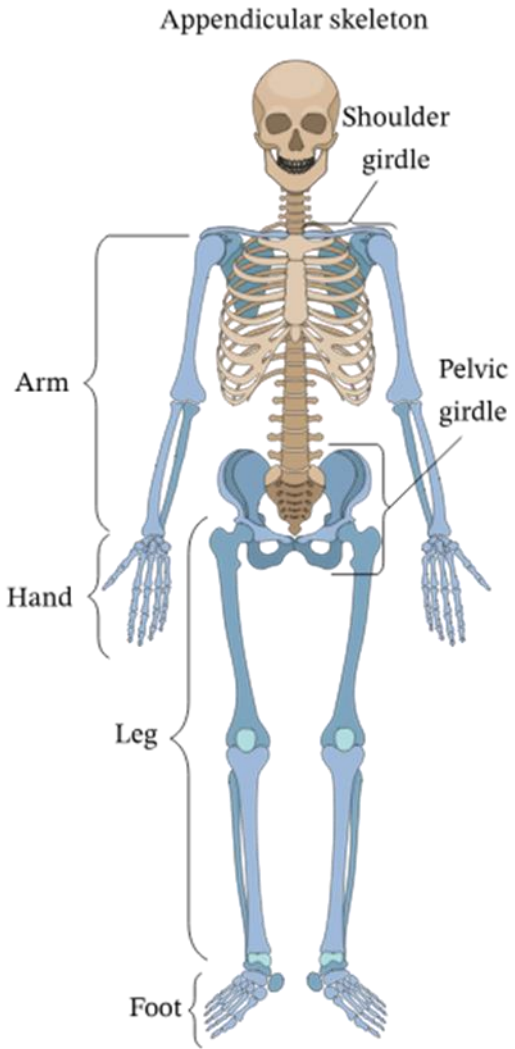
- There are three phalanges in each fingers but only two for the thumb (proximal and distal).
- 1st phalange-proximal.
- 2nd phalange-medial.
- 3rd phalange-distal.

BONES OF THE LOWER LIMBS

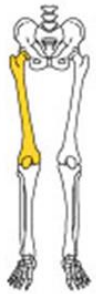
B-Lower limbs:

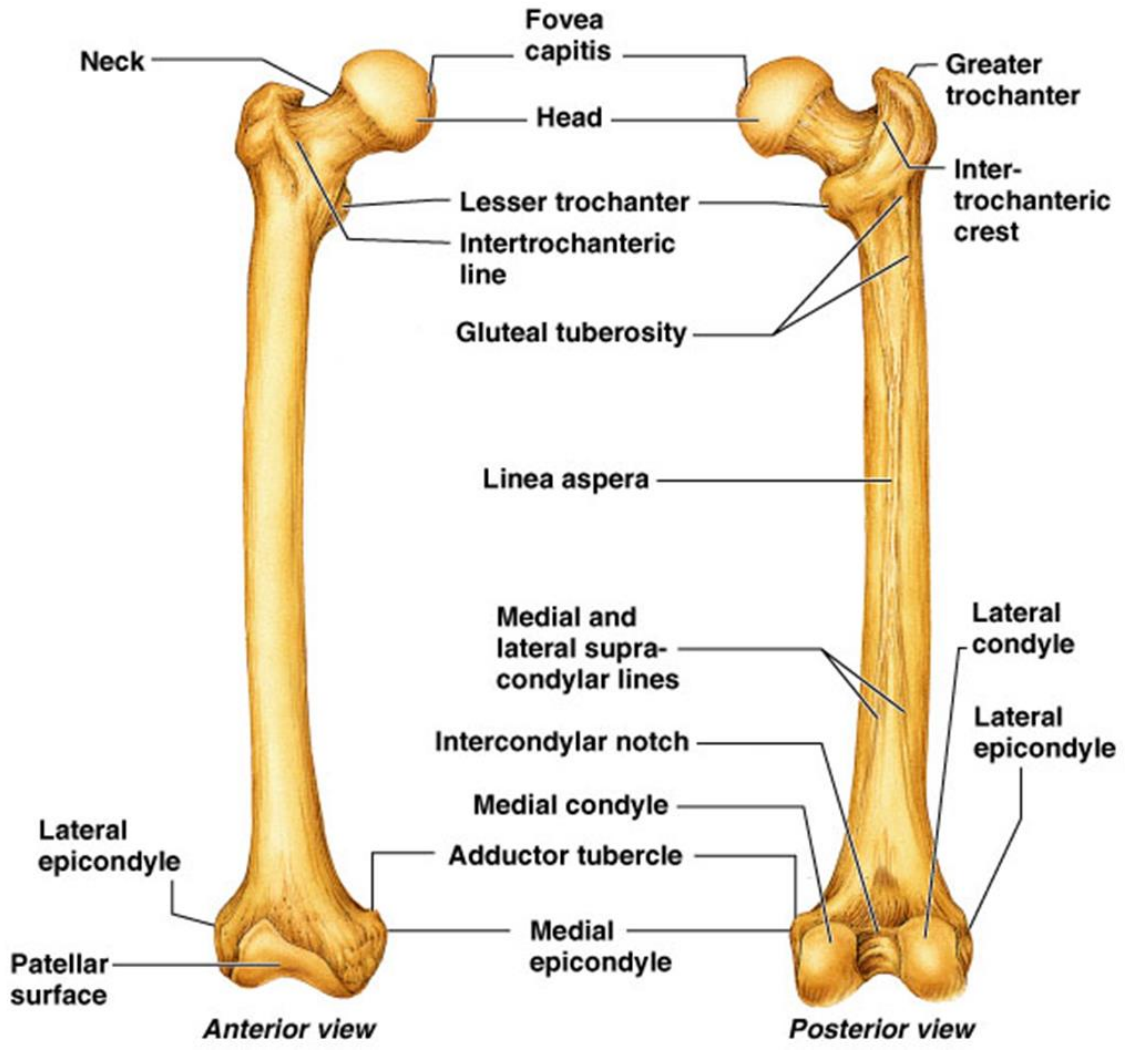
- The primary function of the lower limbs is to support the weight of the body and to provide stability in standing, walking, and running, etc.
- The lower limbs are divided into many regions:

1. Thigh (Femur bone).
2. Knee (Patella).
3. Leg (Tibia and fibula bones).
4. Ankle joint.
5. Foot.

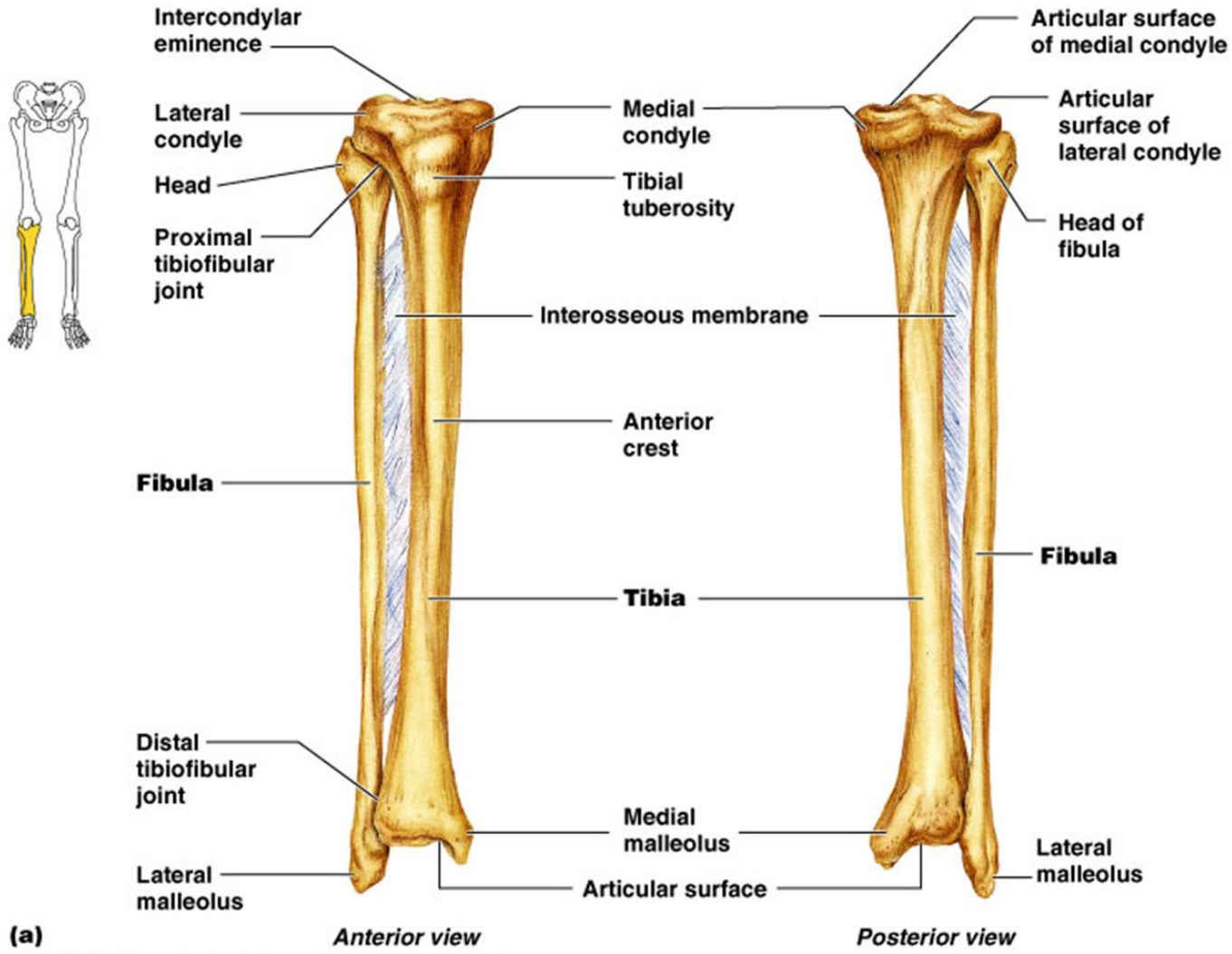


FEMUR

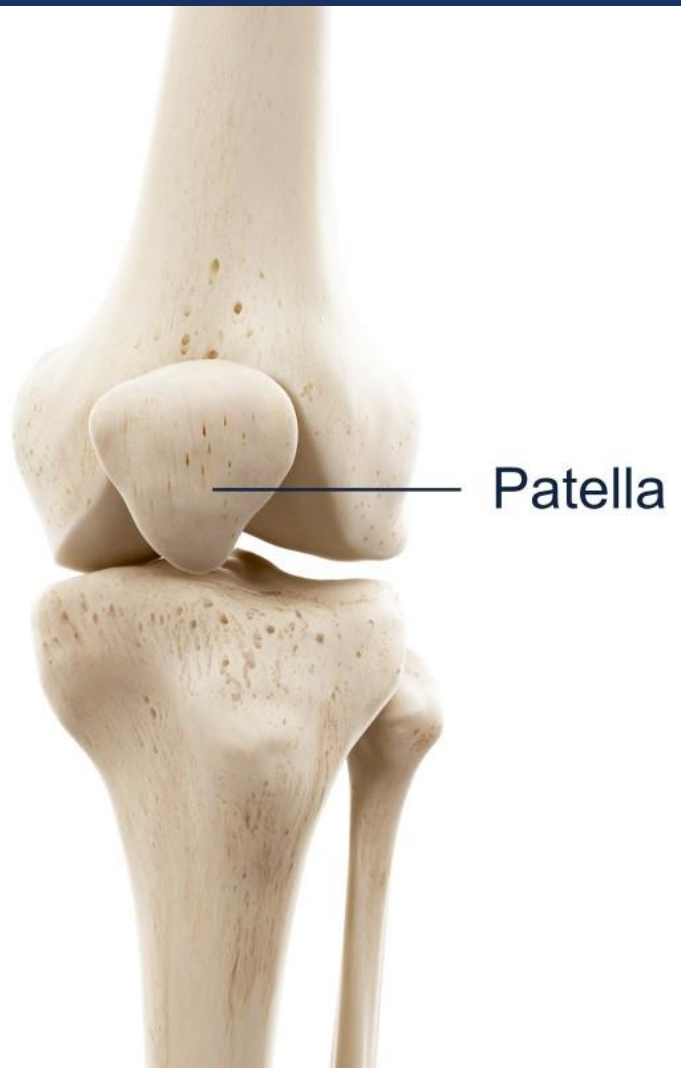



Fovea capitis
Neck
Head
Greater trochanter
Inter-trochanteric crest
Lesser trochanter
Intertrochanteric line
Gluteal tuberosity
Linea aspera
Medial and lateral supra-condylar lines
Lateral condyle
Lateral epicondyle
Intercondylar notch
Medial condyle
Lateral epicondyle
Adductor tubercle
Medial epicondyle
Patellar surface
Anterior view
Posterior view

TIBIA AND FIBULA

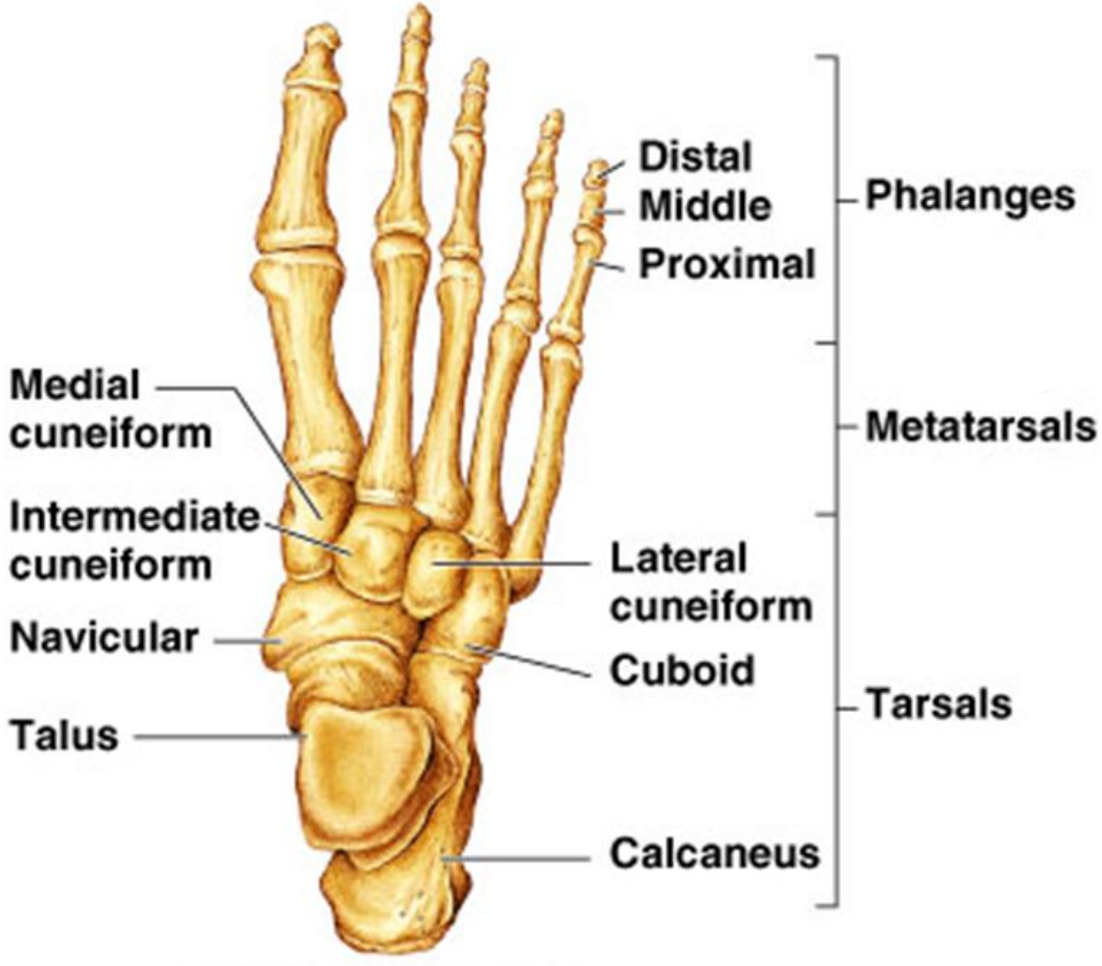


PATELLA



FOOT

- The skeleton of the foot includes:
  - **Tarsus.**
  - **Metatarsus.**
  - **Phalanges (toes).**



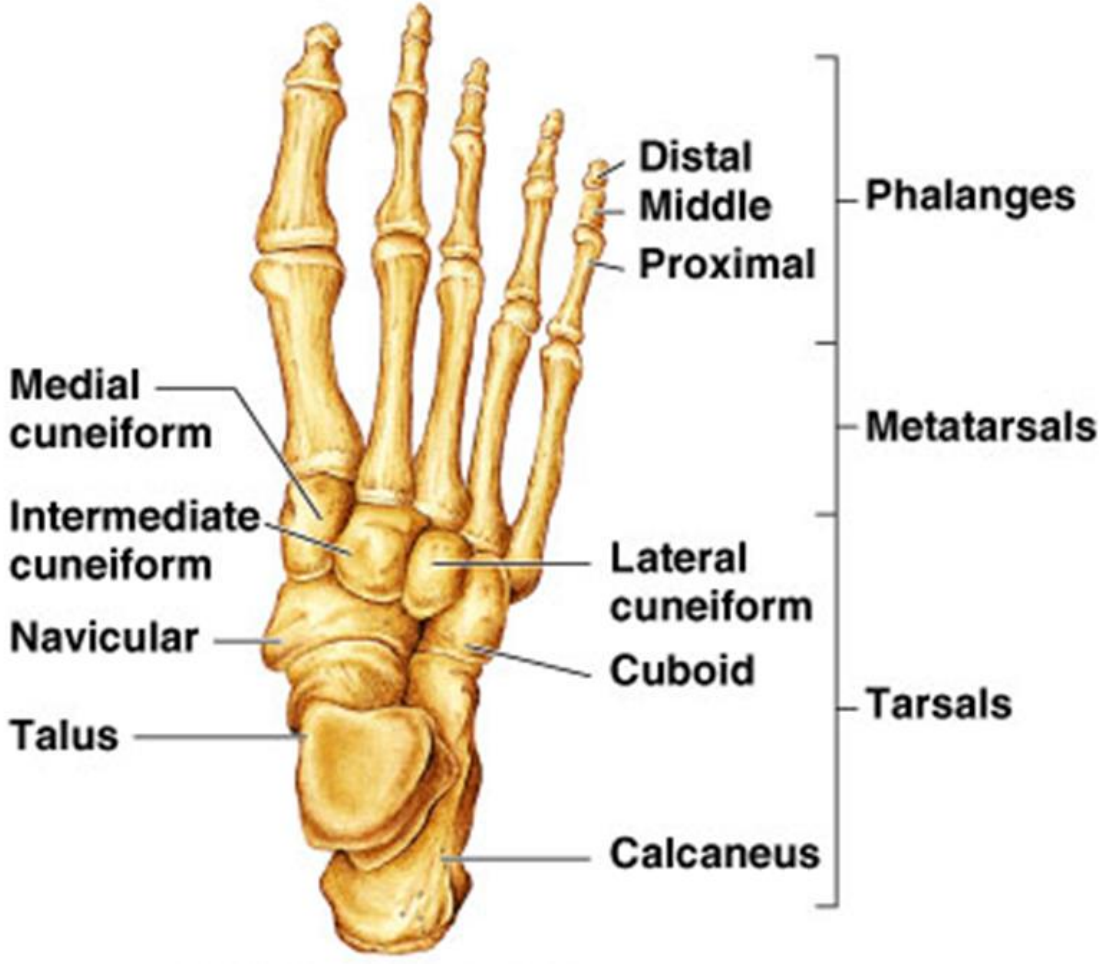
(a) Superior view

SKELETON OF THE ANKLE

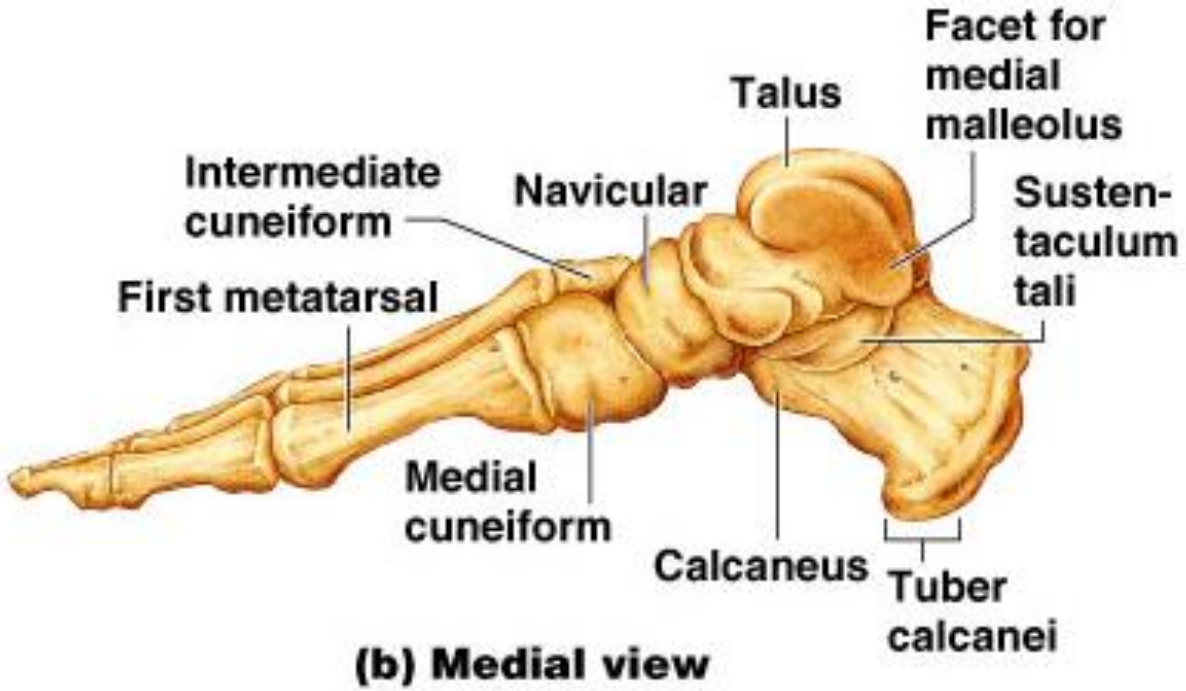
Skeleton of the Ankle:

The ankle consists of tarsal bones, which include 7 bones arranged in two rows:

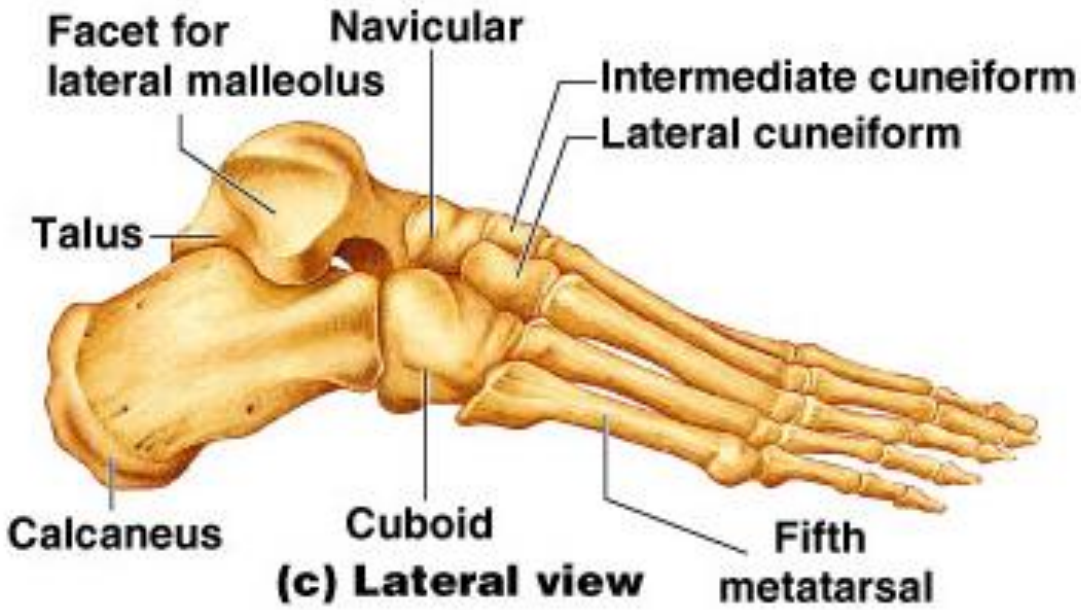
- The **posterior row** contains 2 bones:
  - **Talus.**
  - **Calcaneus.**
- The **anterior row** contains 5 bones:
  - 3 **Cuneiform** bones (medial, intermediate, lateral).
  - **Cuboid** bone.
  - **Navicular** bone (the seventh bone).



(a) Superior view



(b) Medial view

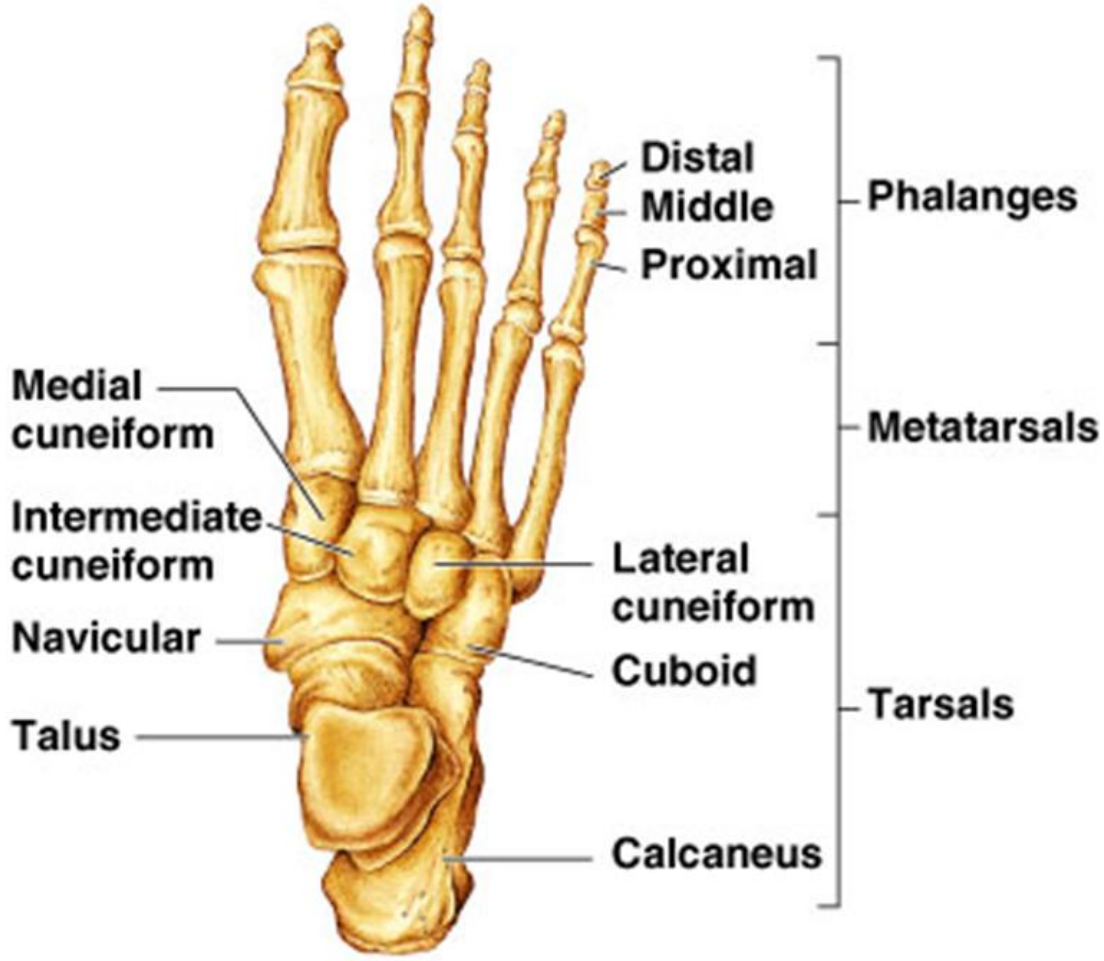


(c) Lateral view

SKELETON OF THE SOLE (FOOT)

Skeleton of the Sole (Foot):

- The foot consists of 5 metatarsal bones.
- The 1st metatarsal corresponds to the big toe.
- Each metatarsal has:
  - A **base** that articulates with the tarsal bones.
  - A **shaft** (body).
  - A **head** that articulates with the phalanges.

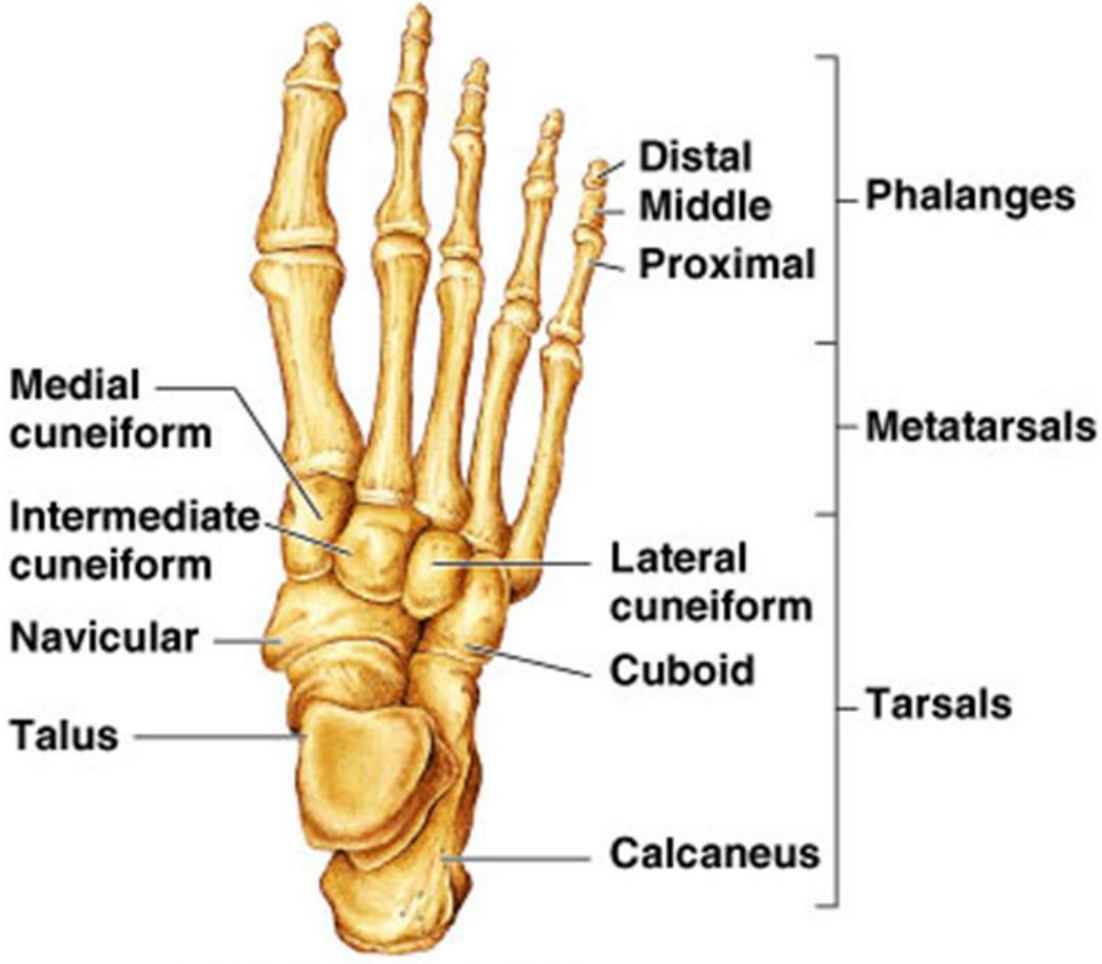


(a) Superior view

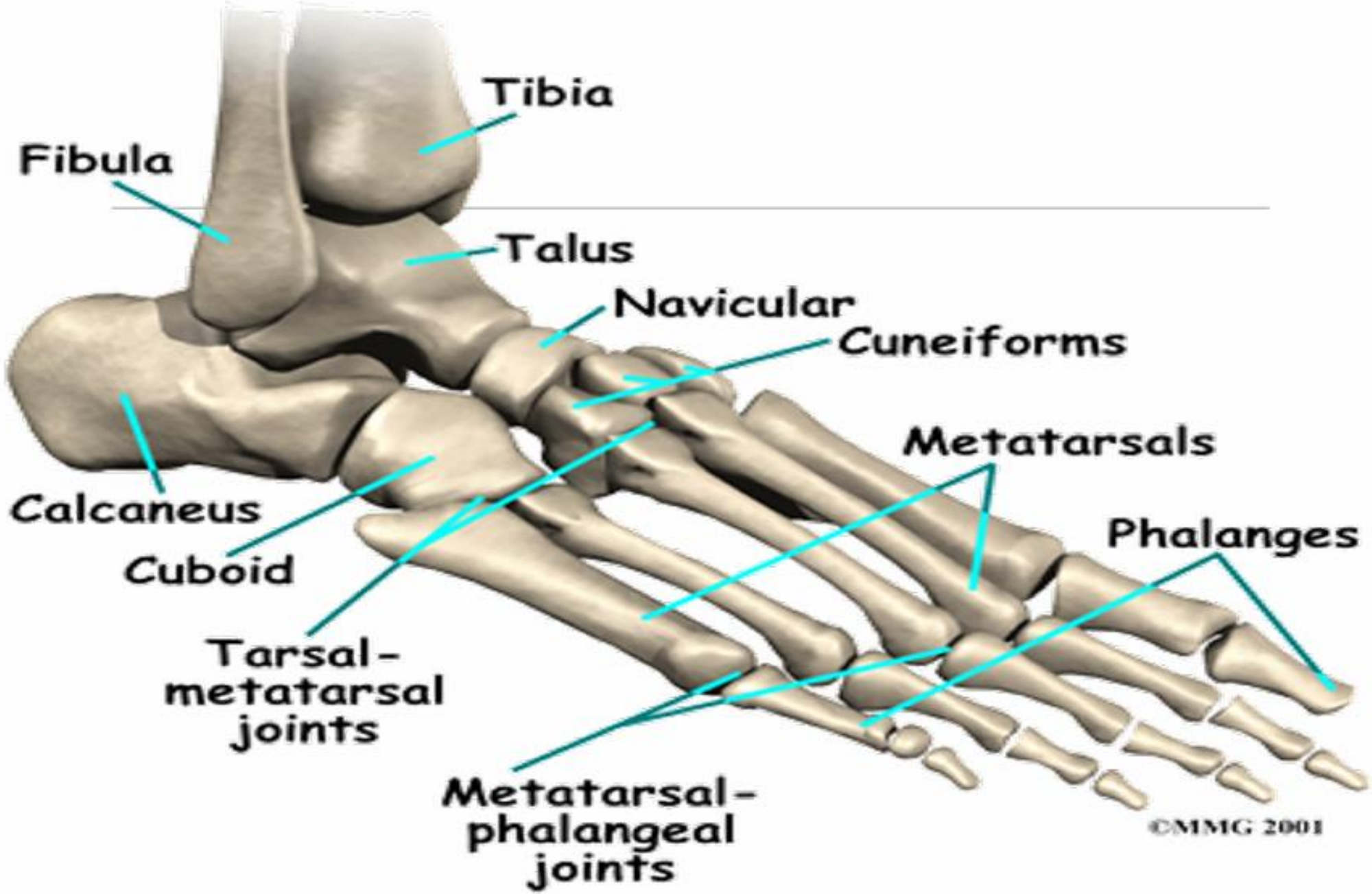
SKELETON OF THE TOES

Skeleton of the Toes:

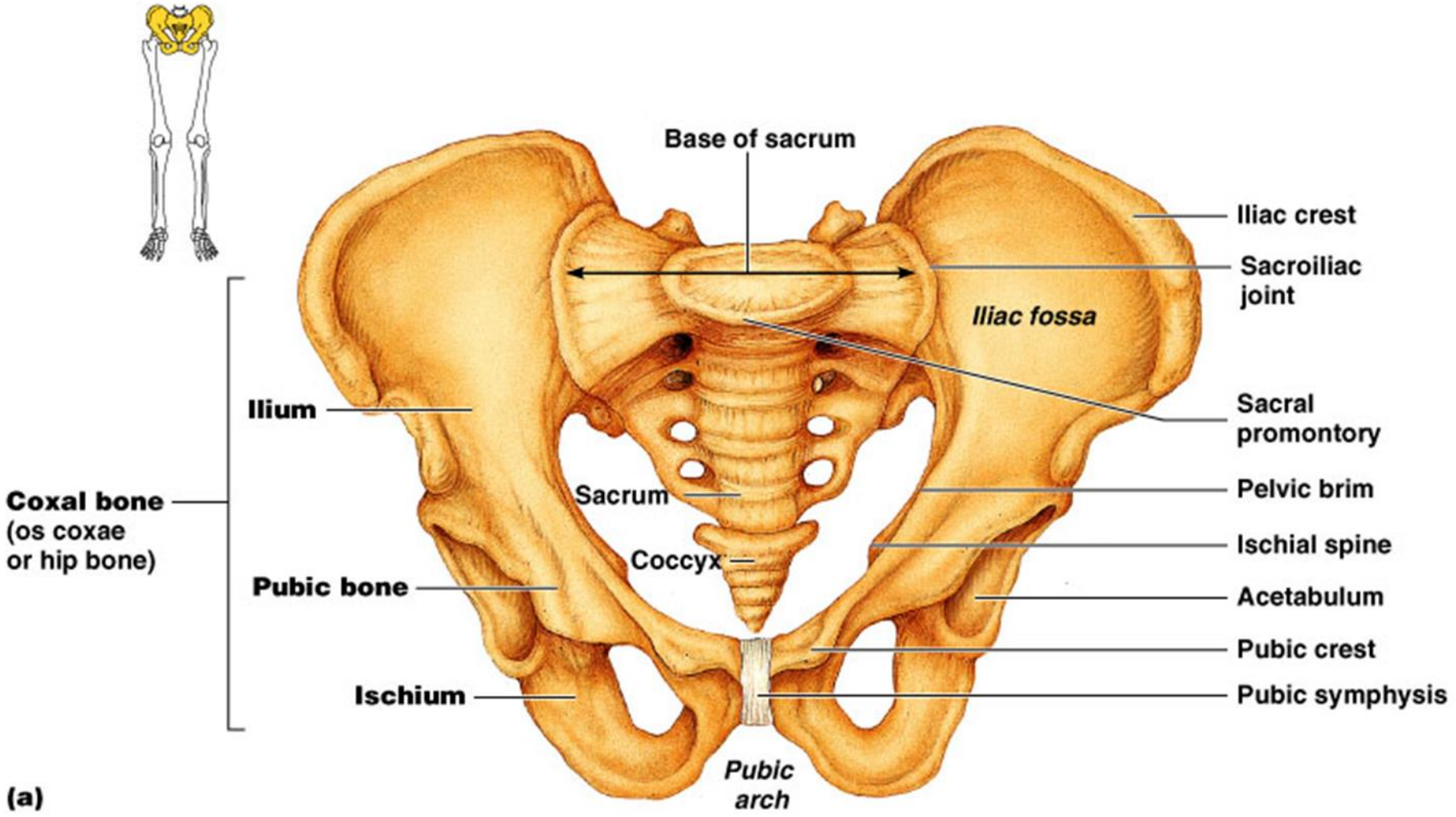
- The toes consist of phalanges (small bones):
- Each toe has 3 phalanges.
- The big toe has only 2 phalanges (proximal and distal).



(a) Superior view


Tibia
Fibula
Talus
Navicular
Cuneiforms
Metatarsals
Phalanges
Calcaneus
Cuboid
Tarsal-metatarsal joints
Metatarsal-phalangeal joints
©MMG 2001

PELVIC BONES: PELVIC GIRDLE (HIP)



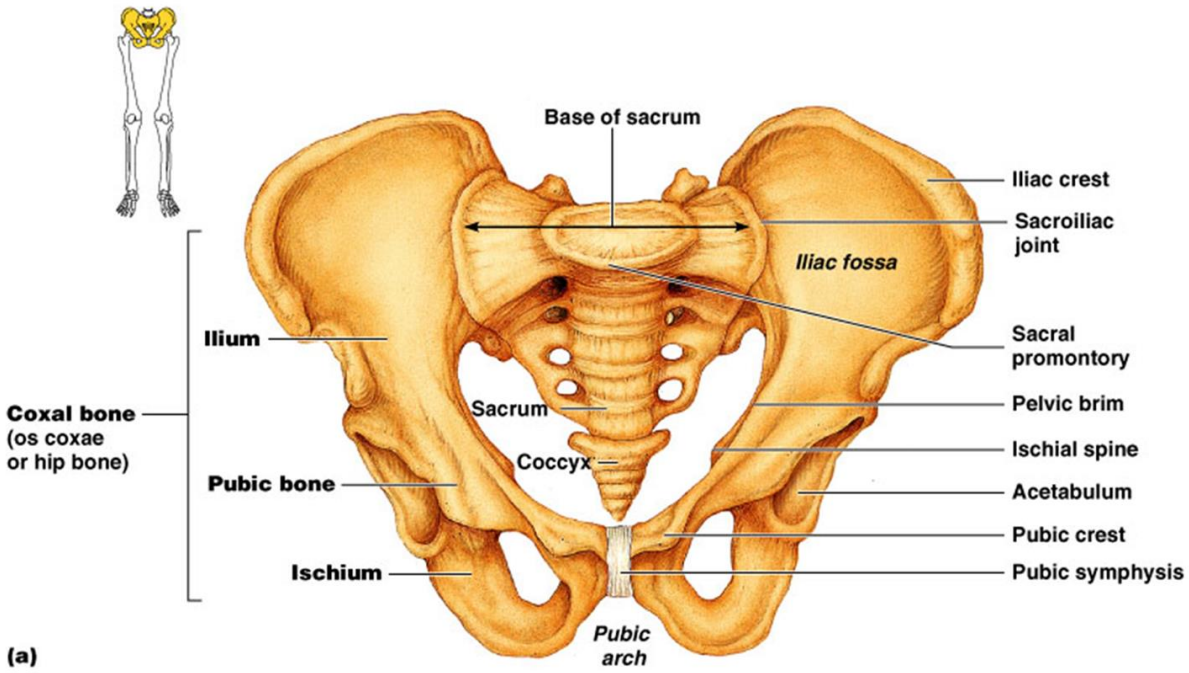
PELVIS

- The bony pelvis consists of **two hip bones**, the **sacrum**, and the **coccyx.**
- Each hip bone is a large, **irregularly shaped** bone that serves as the attachment point for the lower limbs.
- The hip bones articulate:
  - **Anteriorly** with each other at the pubic symphysis.
  - **Posteriorly** with the sacrum at the strong sacroiliac joint.
- Functions:
  - Protects abdominal organs.
  - Connects the trunk to the lower limbs.
  - Transmits body weight to the lower limbs.

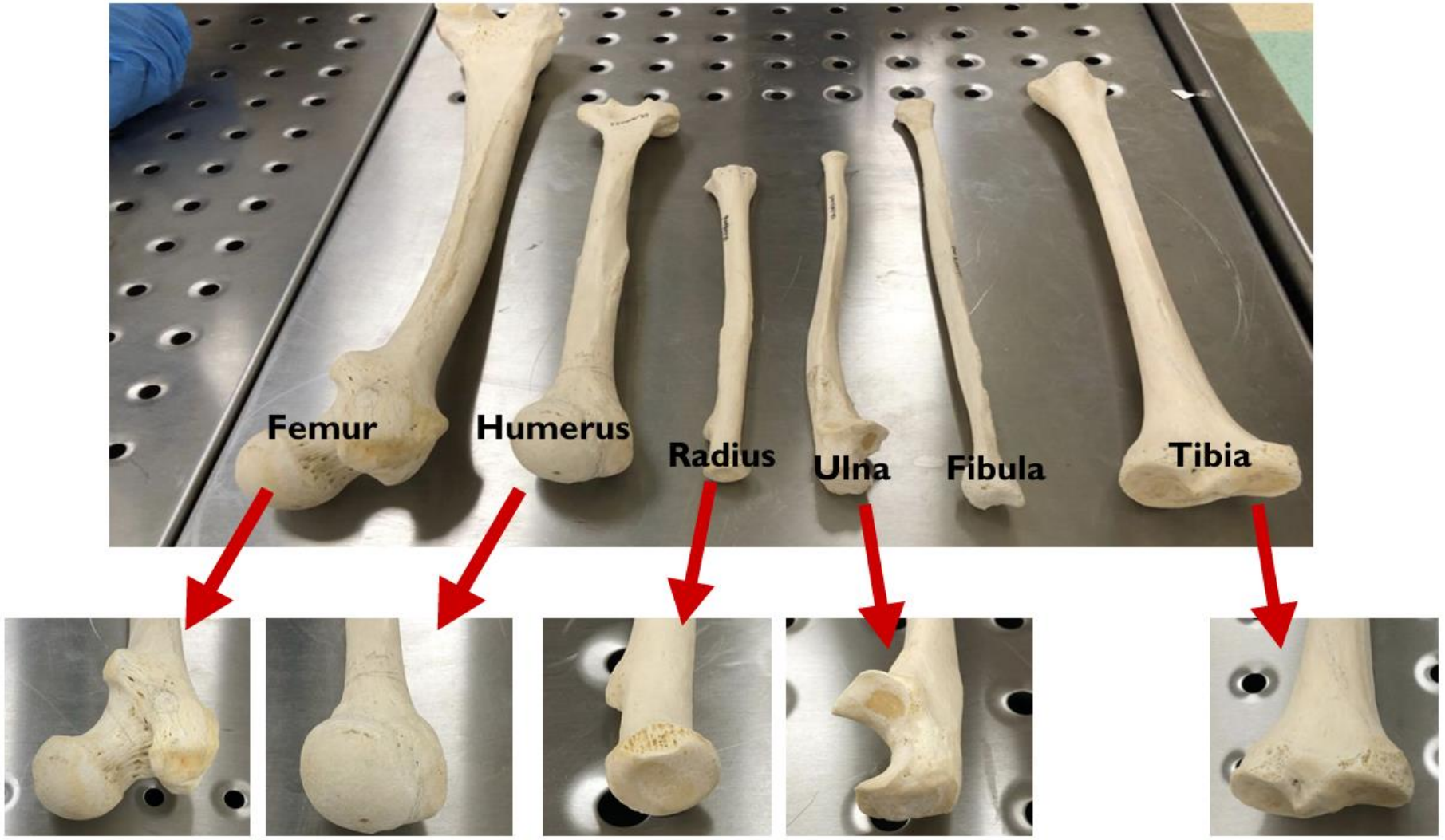
PELVIS

Each hip bone is formed by the fusion of three bones:

1. **Ilium** (superior portion):
   - Fan-shaped bone that expands upward.
2. **Pubis/pubic** (anterior portion):
   - Medial part of the hip bone.
3. **Ischium** (posteroinferior portion):
   - L-shaped bone forming the lower part.
   - "sitting bone“.



HOW TO DIFFERENTIATE BETWEEN BONES



HOW TO DIFFERENTIATE BETWEEN BONES

Name	Type of each bone	Skeleton division	Position
Ulna	Long bone	Appendicular skeleton	Bone of the forearm

THANK YOU