

Third MODULE

NEW TO BONES

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Rationale :-

- This module designed in Bones to give the students a good knowledge about types of bones , functions of bones , parts of skeleton so all this information will made the student in the future when he become assistant have a good communication with the medical staff.

- **Central Idea :-**

- Central idea of this module include
- 1. types of bones.
- 2. functions of bones .
- 3. parts of skeleton.

- **Instructions:-**

- 1- Study the over view very well .
- 2- Identify the aims of modules .
- .

Functions of bones

- Support
- Protection
- Movement
- Blood cell formation
- Storage

Support

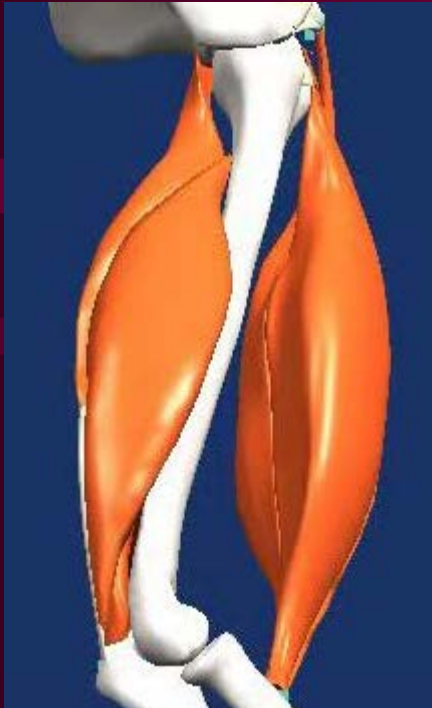
- Strong
- Rigid

Protection



- Surround organ
- Protect against damage

Movement



- Attach to bones
- Provide levers

Blood Cell Formation

COUNT DRACULA'S DATING PROBLEMS:



GROOMING

Can't use the mirror to check his hair.

PROTECTION

Druggists always swear they've never even heard of tooth condoms.

REJECTION

Really hates it when his date sighs and says, "Ya know, the great guys always turn out to be married, gay, or vampires."

- All blood cells formed in the bones
- Red marrow (hematopoiesis)

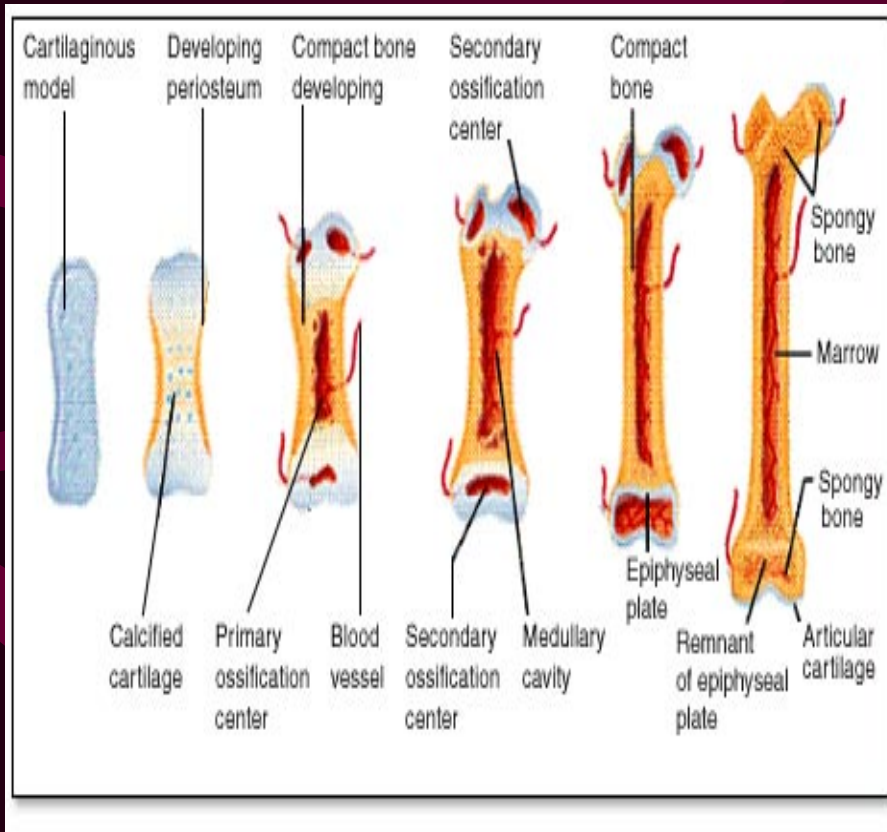
Storage

- Calcium
- Phosphate



磷酸钙(骨制) 2-4MM, P2O5>36%, Ca>20%, H2O<8%

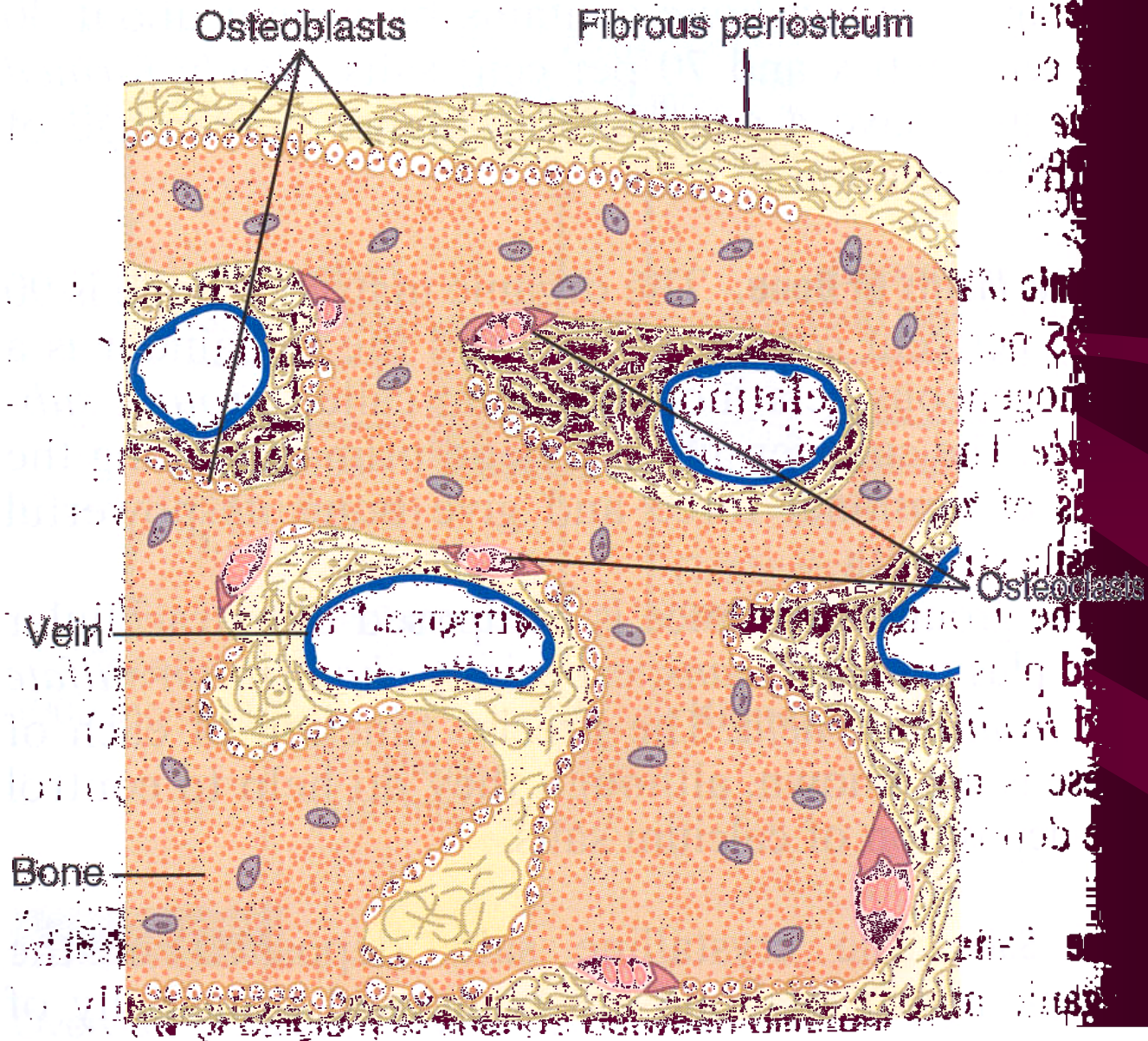
Bone Tissues



- Bone (osseous tissue)
- Dense connective tissue
- Cartilage
- Blood forming tissue
- Nervous tissue

Bone

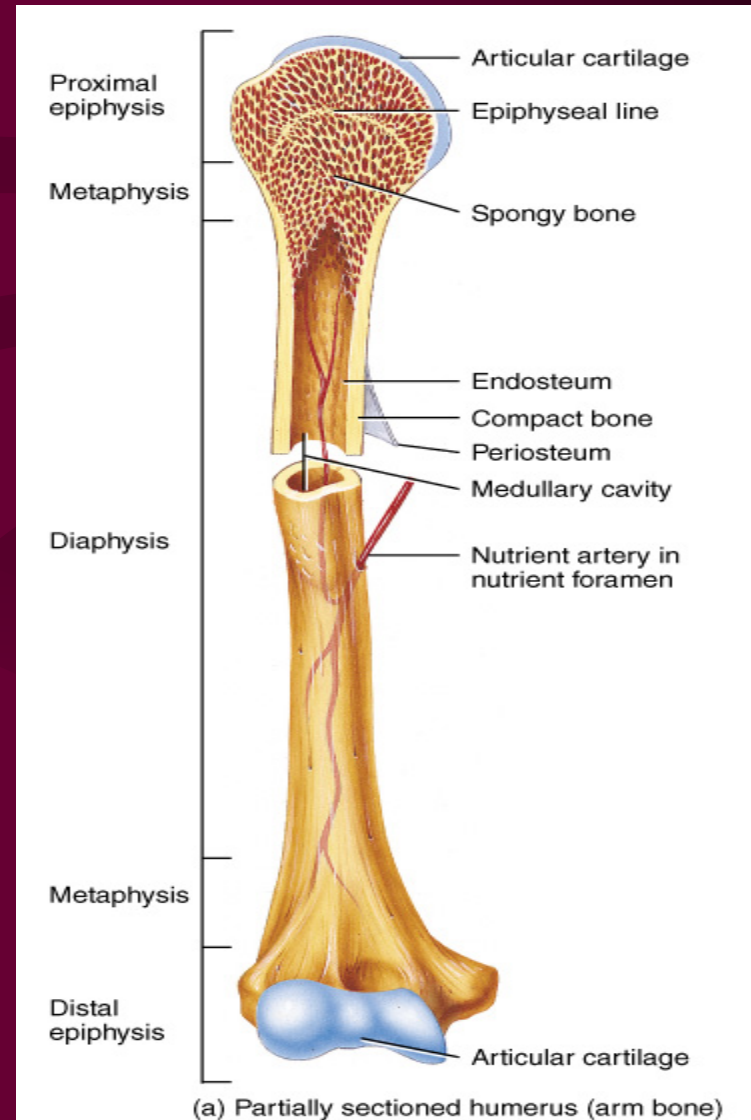
- Bone composition
 - 70% mineral (Ca^{2+} and PO_4^- as hydroxyapatite)
 - 22% protein (95% Type I collagen + 5% proteoglycans and other materials)
 - 8% water
- Two major types of bone
 - Compact (cortical, i.e., long bones)
 - Mechanical and protective functions
 - Cancellous (spongy, i.e., vertebrae)
 - Metabolic regulation of calcium
- Four types of cells
 - Osteoblasts
 - Osteoclasts
 - Osteocytes
 - Bone lining cells



Two Kinds of Bone

Compact Bone

Spongy Bone

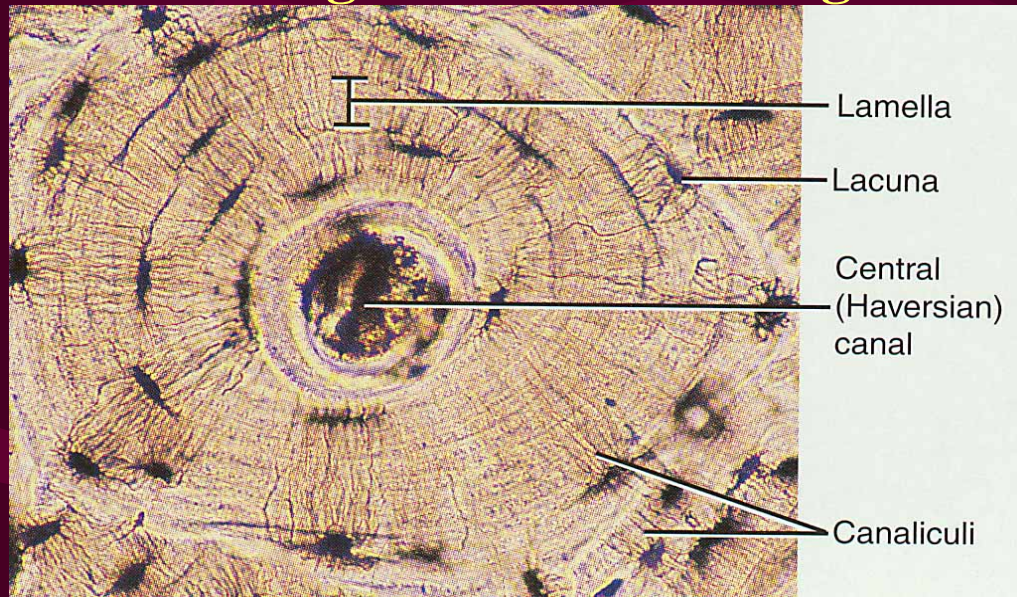


Compact Bone

- *Compact bone* is arranged in units called *osteons* or *Haversian systems*.
- Osteons (Haversian canal) contain blood vessels, lymphatic vessels, nerves
- Surrounding this canal are concentric rings of osteocytes along with the calcified matrix.
- Osteons are aligned in the same direction along lines of stress. These lines can slowly change as the stresses on the bone changes.

Histology of Compact Bone

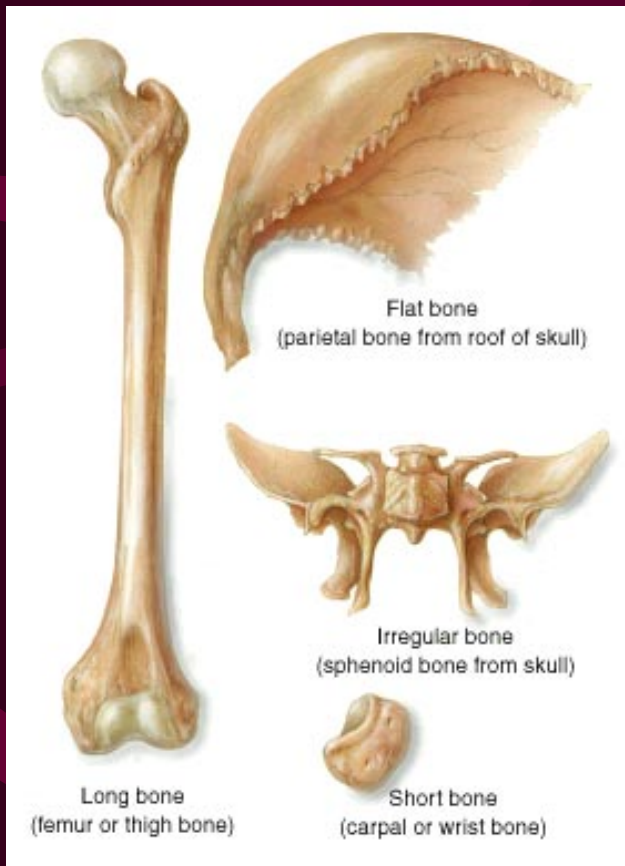
- **Osteon is concentric rings (lamellae) of calcified matrix surrounding a vertically oriented blood vessel**
- **Osteocytes are found in spaces called lacunae**
- **Osteocytes communicate through canaliculi filled with extracellular fluid that connect one cell to the next cell**
- **Interstitial lamellae represent older osteons that have been partially removed during tissue remodeling**



Spongy Bone

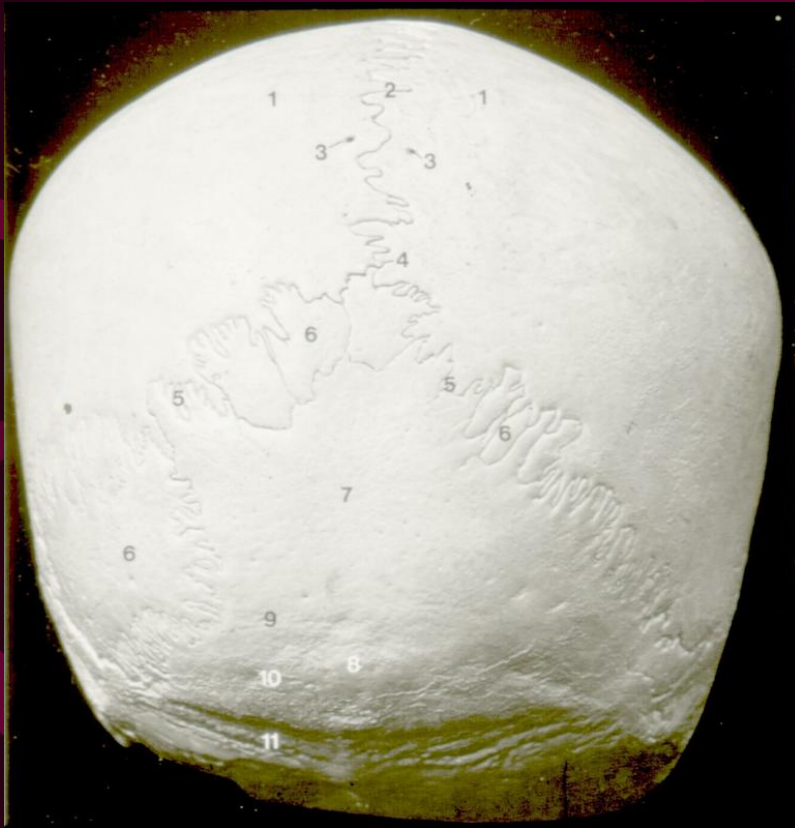
- **Spongy (cancellous) bone does not contain osteons. It consists of trabeculae surrounding many red marrow filled spaces (Figure 6.3b).**
- **It forms most of the structure of short, flat, and irregular bones, and the epiphyses of long bones.**
- **Spongy bone tissue is light and supports and protects the red bone marrow.**

Types of Bones



- Bones can be divided into four classes
 - Flat bones
 - Long bones
 - Short bones
 - Irregular bones
 - Sesamoid bone

Flat Bones



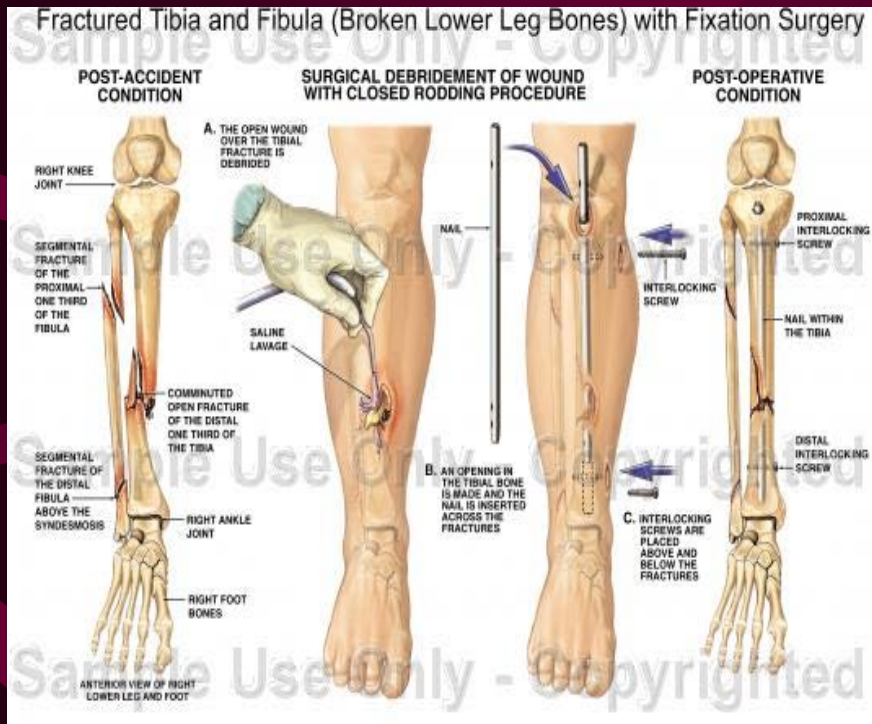
- Thin and flat
 - Cranium
 - Ribs
 - Sternum

Short Bones

- About equal in length and width
 - Wrist bones
 - Ankle bones



Long Bones



- Greater in length than width
- Absorb stress from body weight
 - Thighs
 - Legs
 - Arms
 - Forearms

Irregular bones



- Complex shapes
 - Vertebrae
 - Facial bones

Sesamoid bone

- short or irregular bones, imbedded in a tendon.
- Patella (knee cap)



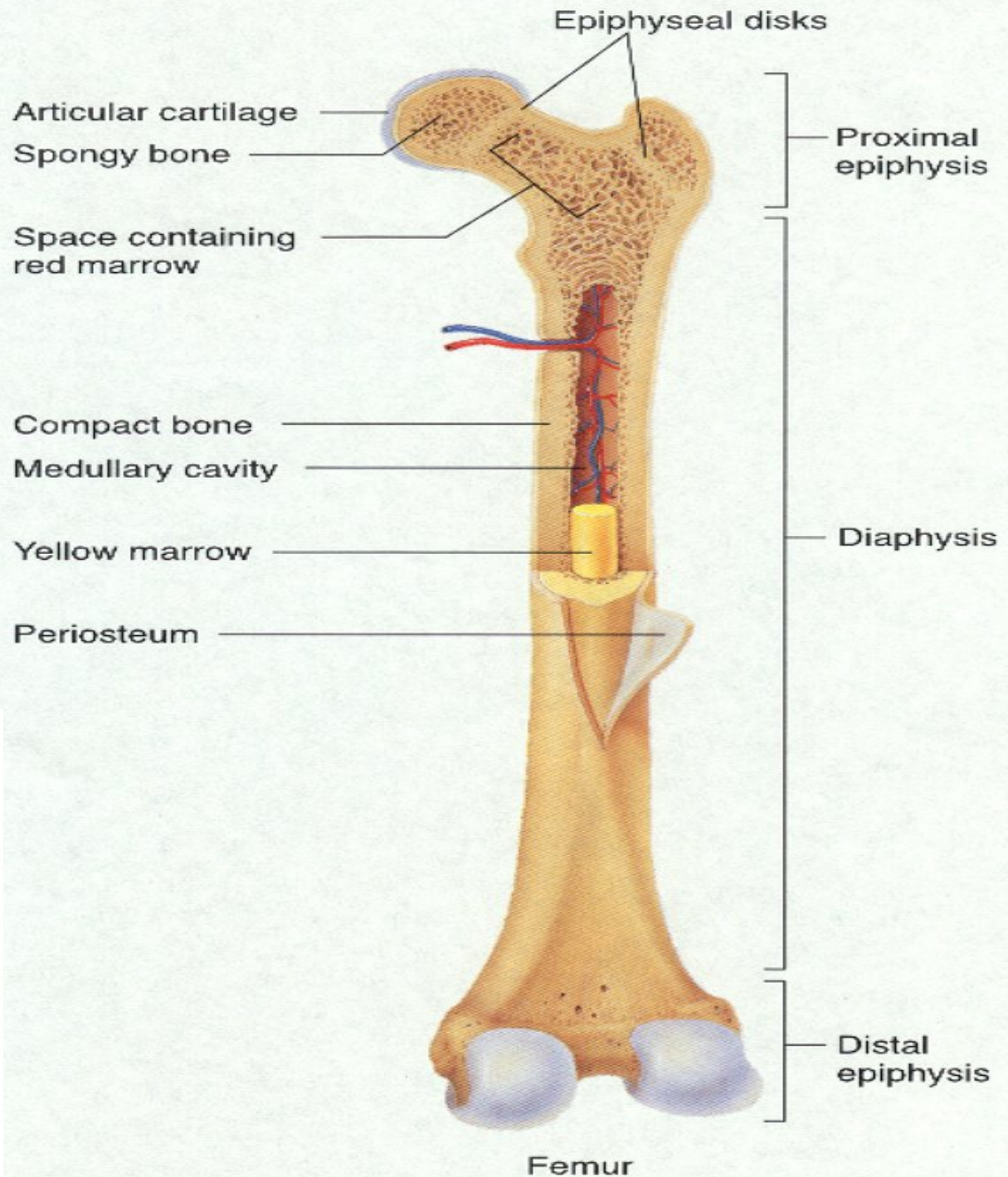
Parts of long bone

- 1) diaphysis: main shaft like structure, its hollow cylindrical shape, its functions of providing strong support bone.
- 2) epiphysis: both end of long bone, epiphysis have a bulbous shape that provide generous space near joint.
 - For muscle attachment and give stability of joint.

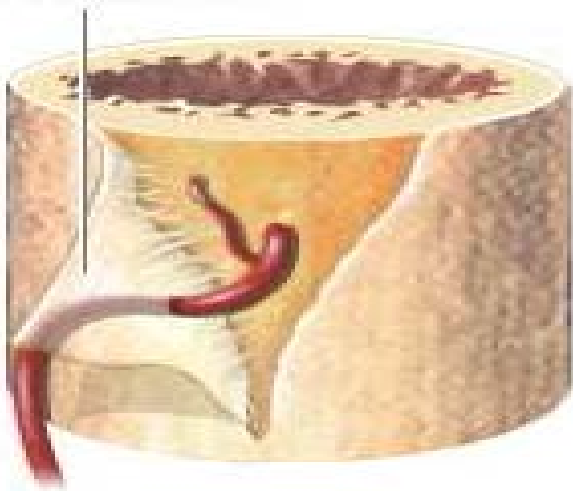
Parts of long bone

- 3) articular cartilage thin layer of hyaline cartilage that covers joint surface.
- 4) Periosteum: dense white fibrous membrane that cover bone except at joint surface and anchoring bone to muscles.
- 5) Marrow cavity: a tubelike hollow space in the diaphysis of long bone.
- 6) endosteum: a thin epithelial membrane that line the medullry cavity.

Long Bone Structure



Periosteum

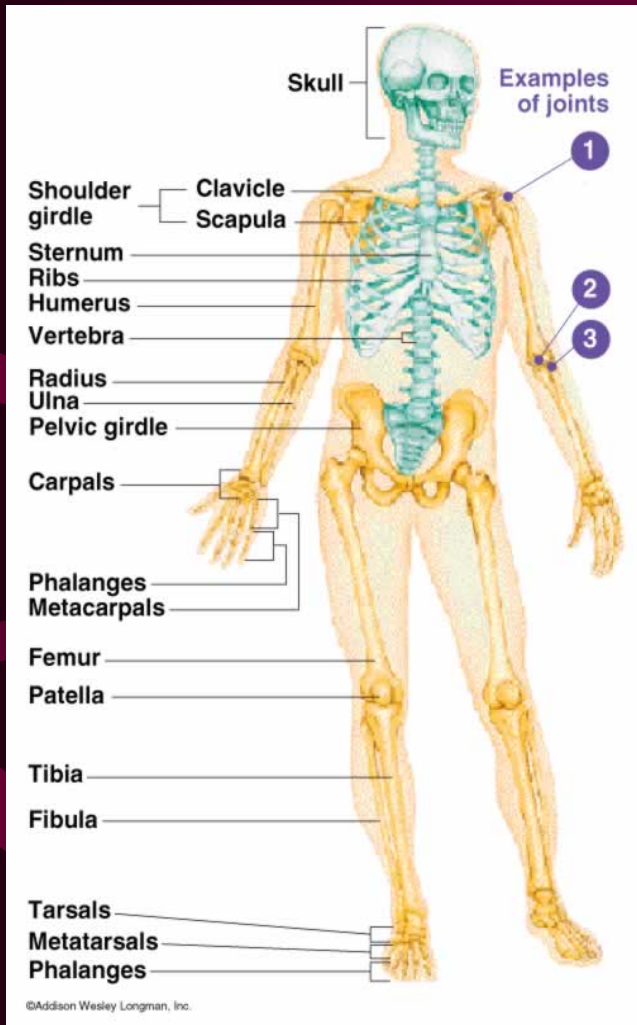


THE SKELETAL SYSTEM: *OVERVIEW*

I. INTRODUCTION

- The organs of the skeletal system include the bones and the structures that connect bones to other structures, including ligaments, tendons, and cartilages.
- The adult skeleton is composed of 206 separate bones.

Skeleton



- Divided into two parts
 - Axial
 - Appendicular

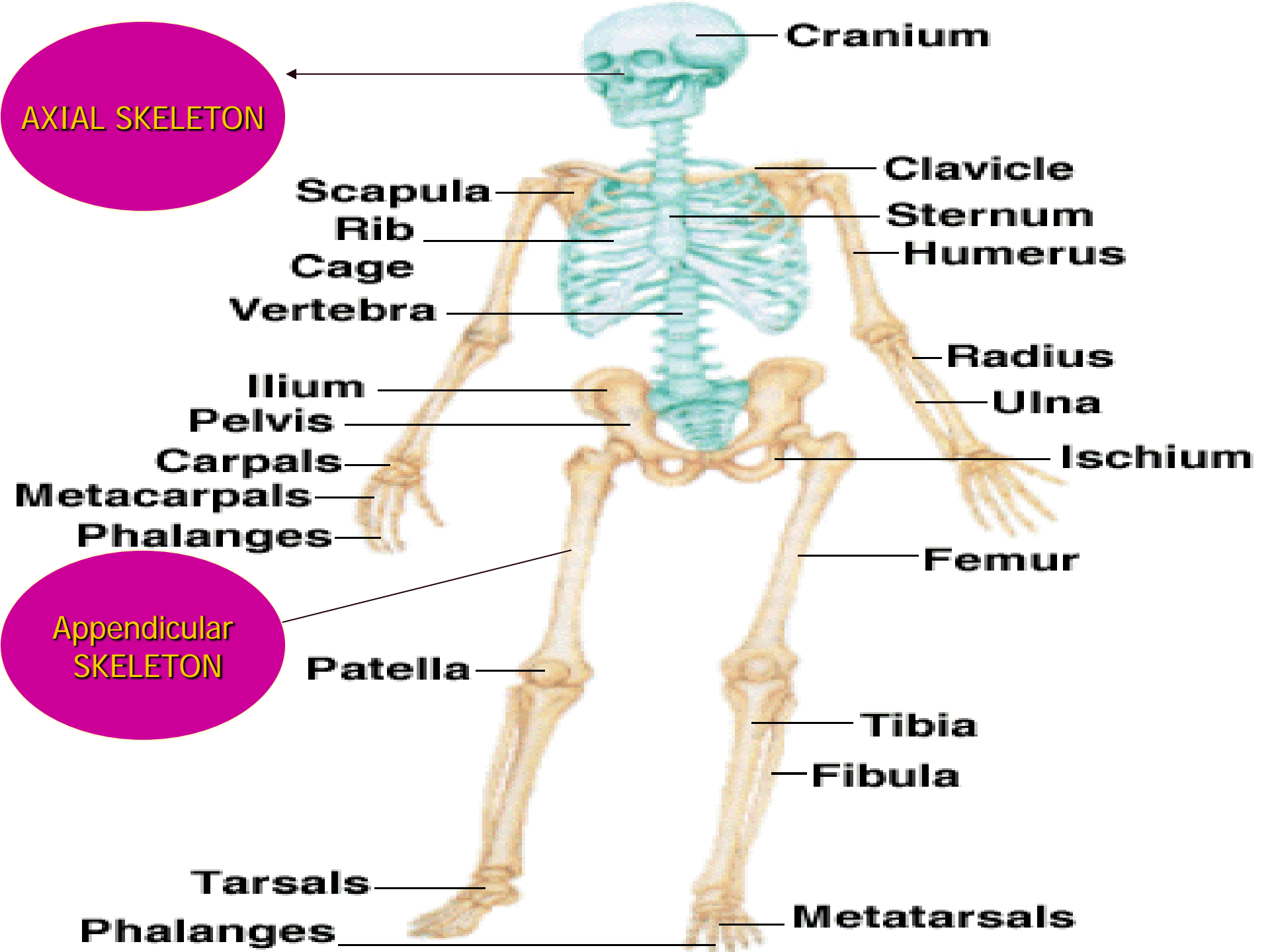
Division of skeleton

– Axial skeleton

- Includes the bones of:
- skull, vertebral column, and rib cage.
- These bones are involved in protection, support, and carrying other body parts.

– Appendicular skeleton

- Bones of upper & lower limbs and the girdles (shoulder bones and hip bones) that attach them to the axial skeleton.
- Involved in locomotion and manipulation of the environment.



AXIAL SKELETON

Cranium

Scapula

Clavicle

Rib

Sternum

Cage

Humerus

Vertebra

Radius

Ilium

Ulna

Pelvis

Ischium

Carpals

Femur

Metacarpals

Phalanges

**Appendicular
SKELETON**

Patella

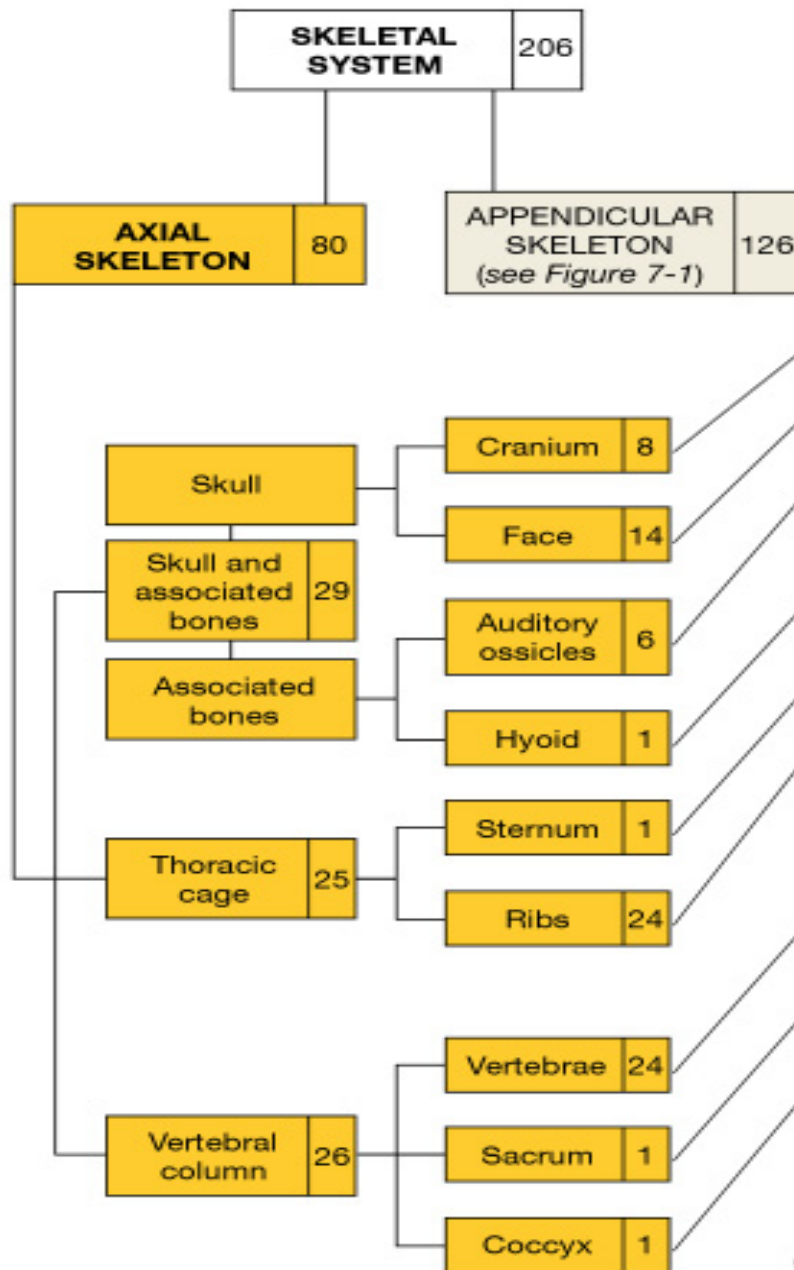
Tibia

Fibula

Tarsals

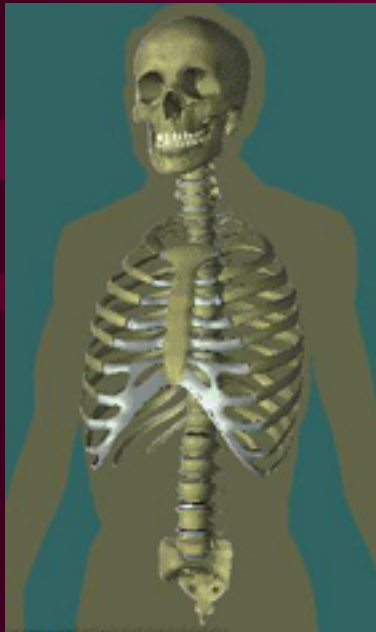
Phalanges

Metatarsals



(a) Skeletal system, axial components highlighted

Axial Skeleton



- Skull
- Vertebral column
- Bony thorax
(thoracic cage)

Skull



- Cranium
- Facial bones

AXIAL SKELETON

- 1) Skull: 28 irregular shaped bones from the skull.
- The skull consists of two major division:
 - a) Cranium is formed by eight bones.
 - b) Face is formed by fourteen bones.

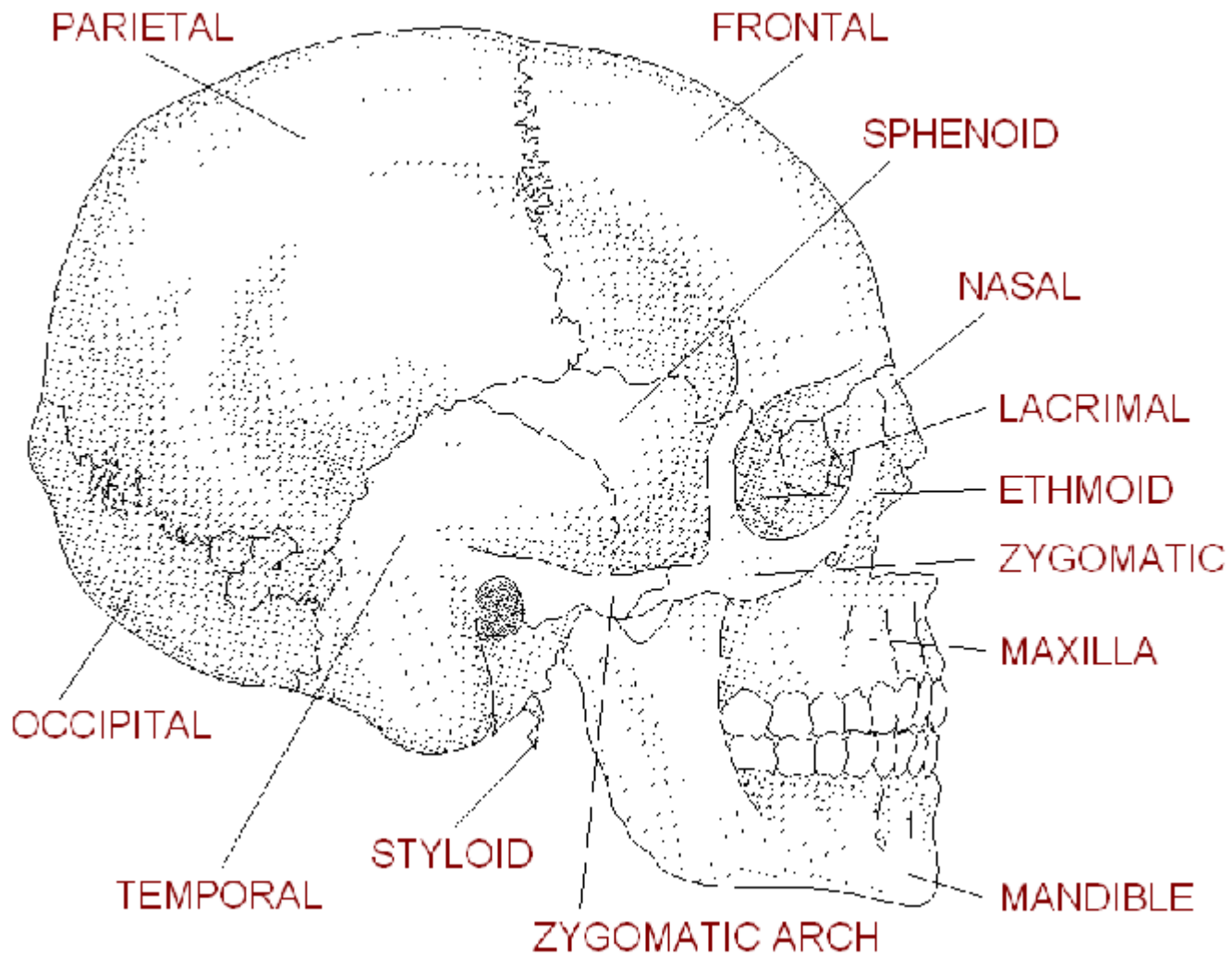
Cranial Bones		Facial Bones	
Occipital bone	Single	Vomer	Single
Frontal bone	Single	Lacrimal bones	Paired
Parietal bones	Paired	Nasal bones	Paired
Temporal bones	Paired	Inferior nasal conchae	Paired
Sphenoid bone	Single	Zygomatic bones	Paired
Ethmoid bone	Single	Maxillary bones	Paired
		Mandible	Single

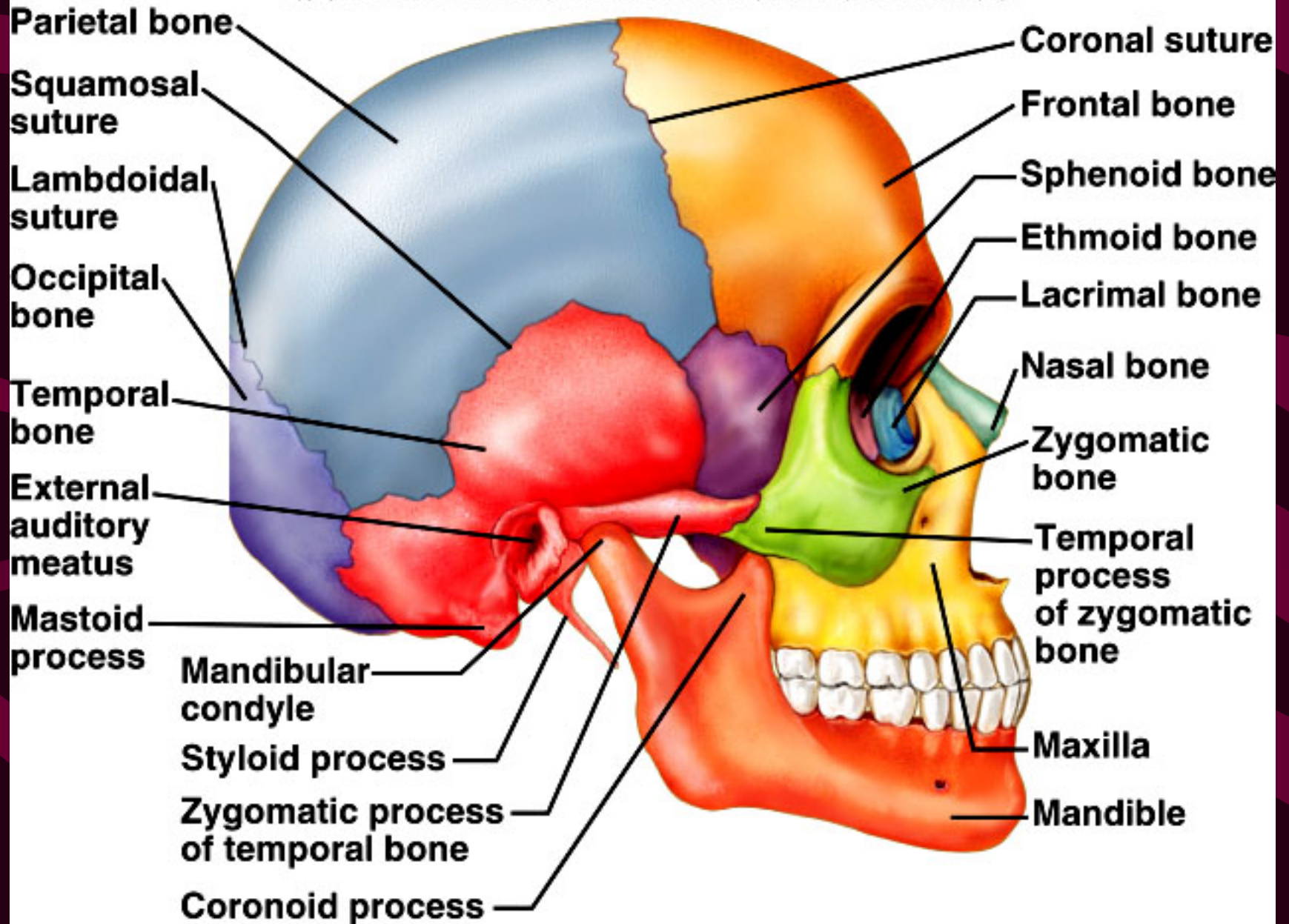
*Note that there are single and paired bones.

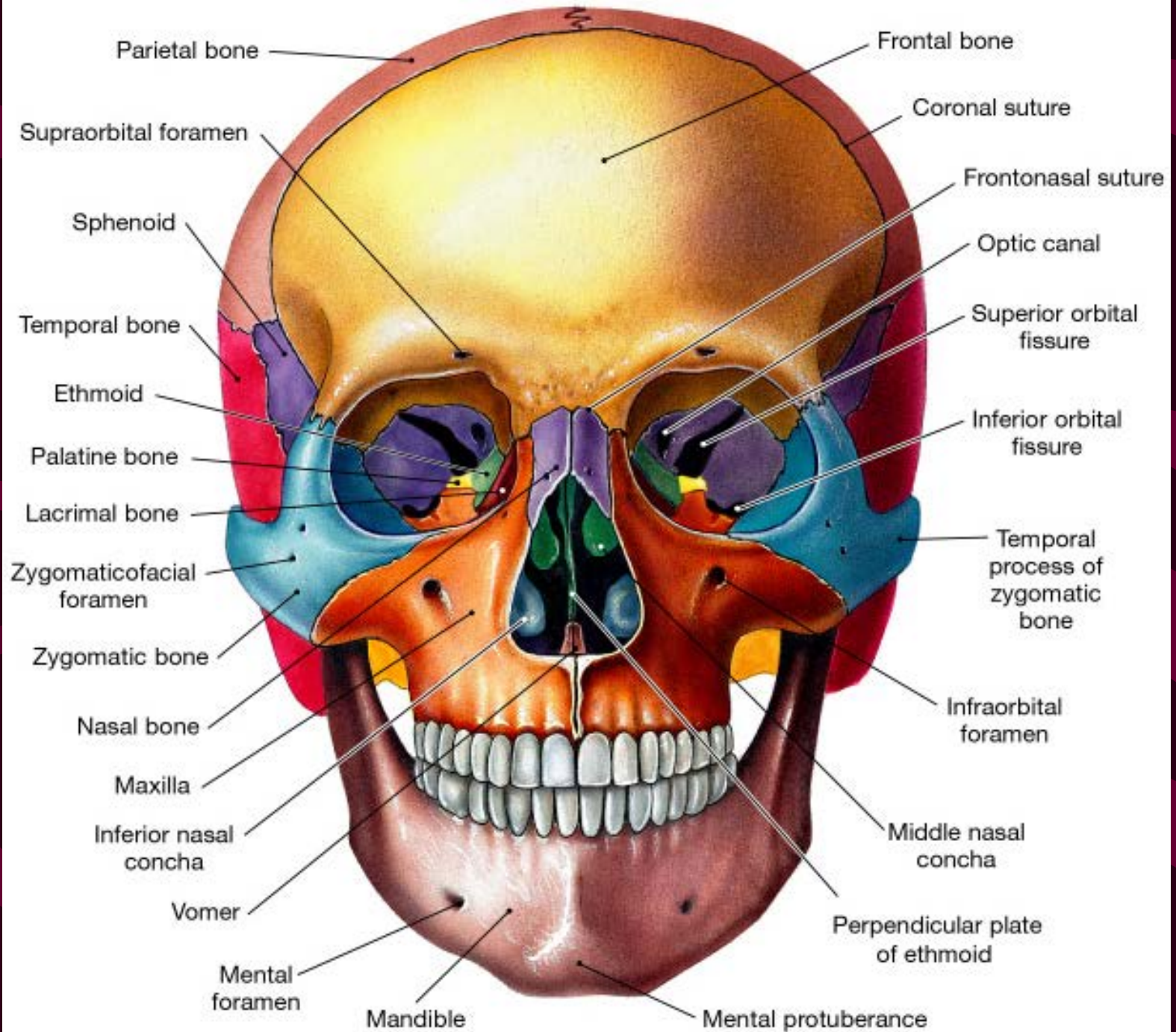
Sutures

- Immovable joints (synarthrotic, fibrous joints)
- Form boundaries between skull bones
- Four sutures
 - Coronal
 - Sagittal
 - Lambdoid
 - Squamous

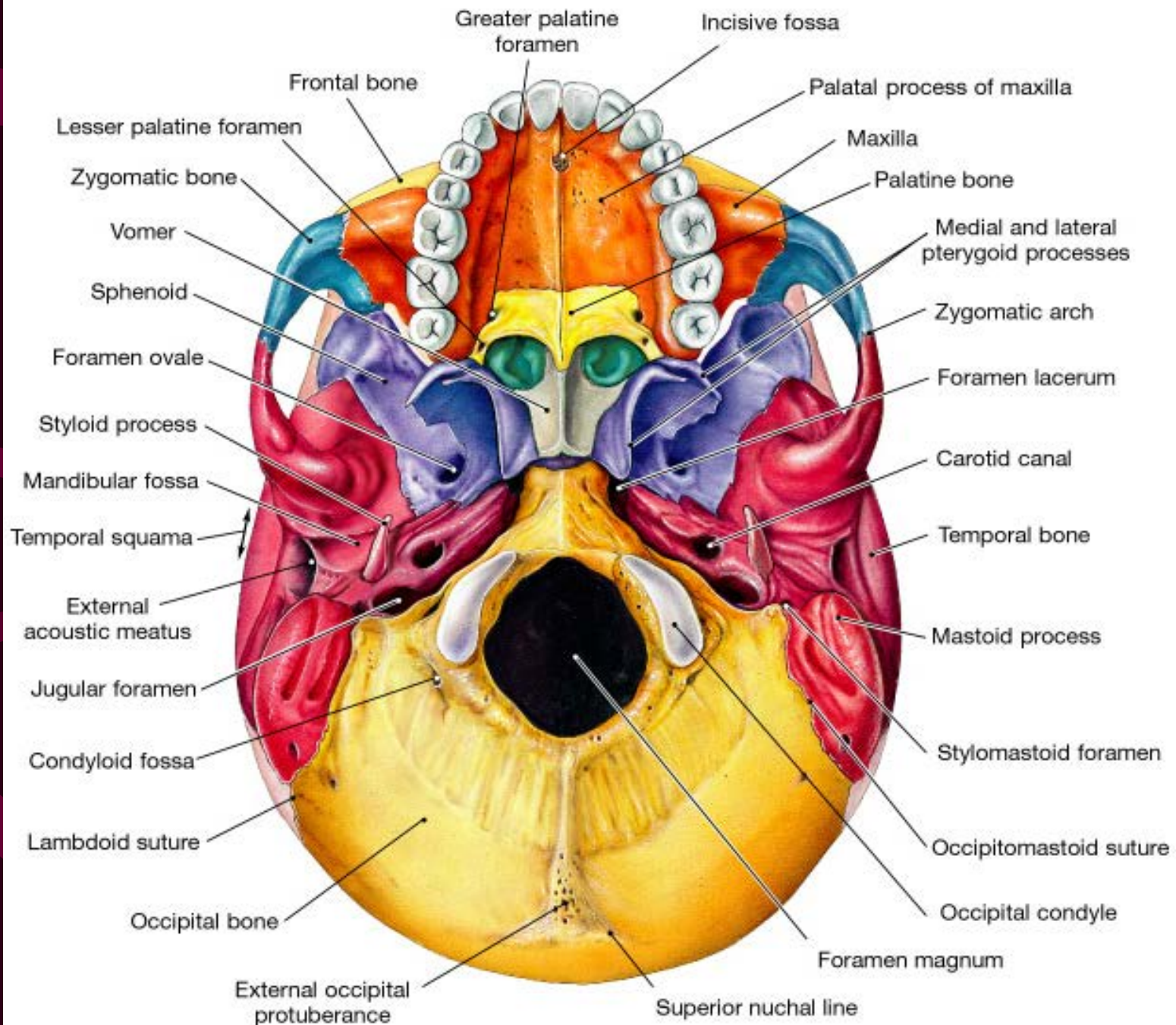
Suture	Bony Articulations
Coronal suture	Frontal and parietal bones
Sagittal suture	Parietal bones
Lambdoidal suture	Occipital and parietal bones
Squamosal suture	Temporal and parietal bones



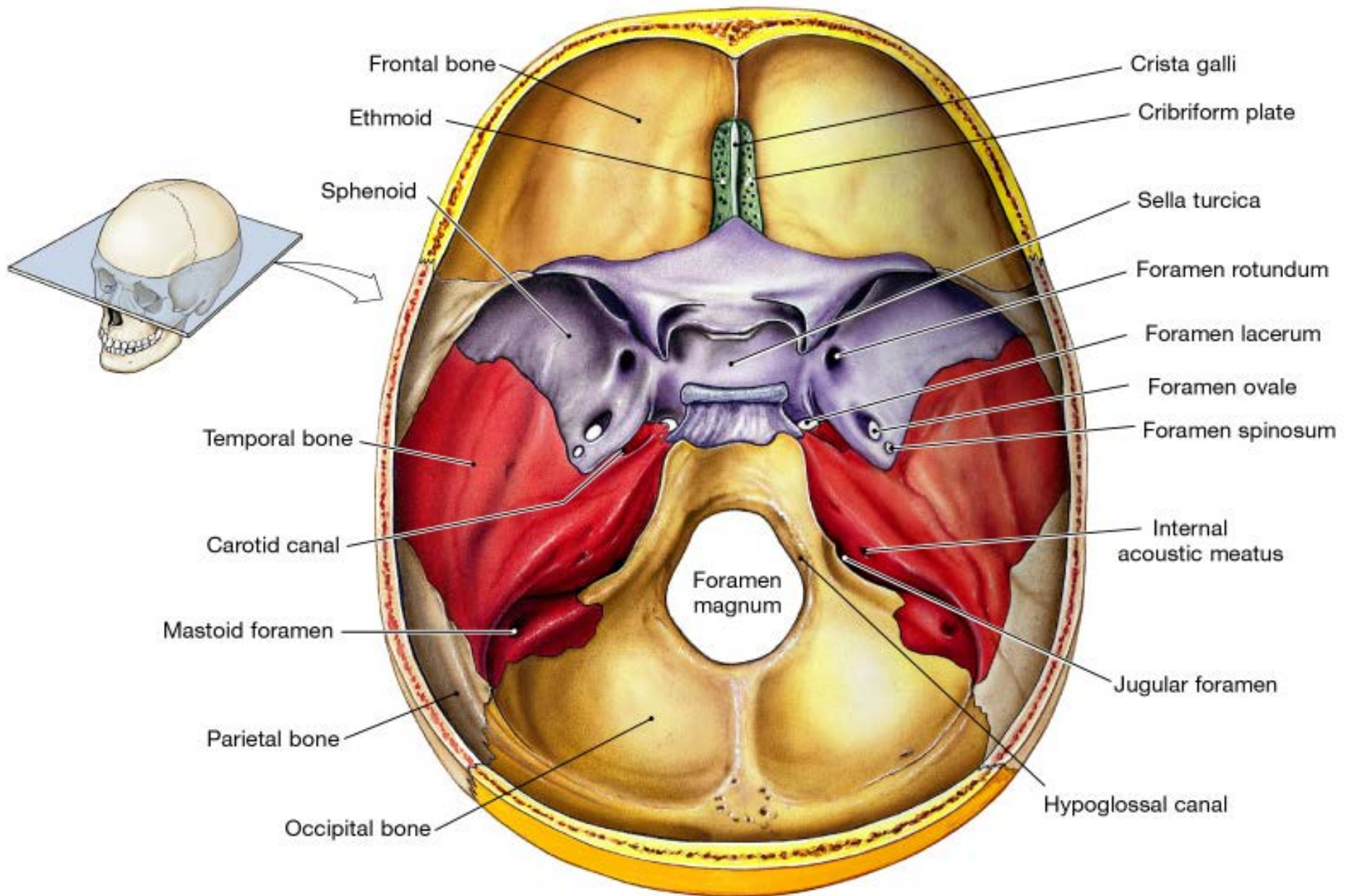


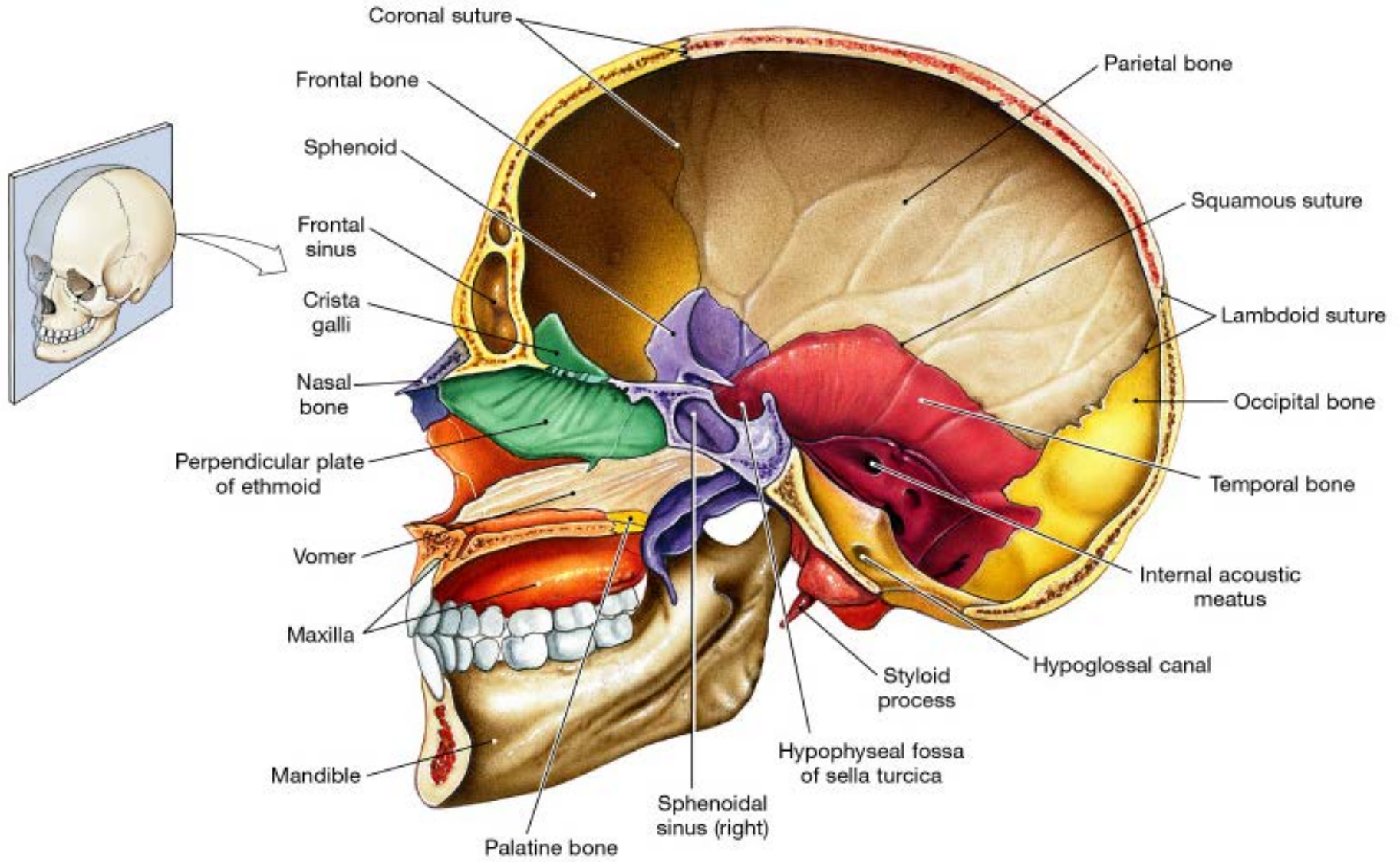


(d) Anterior view



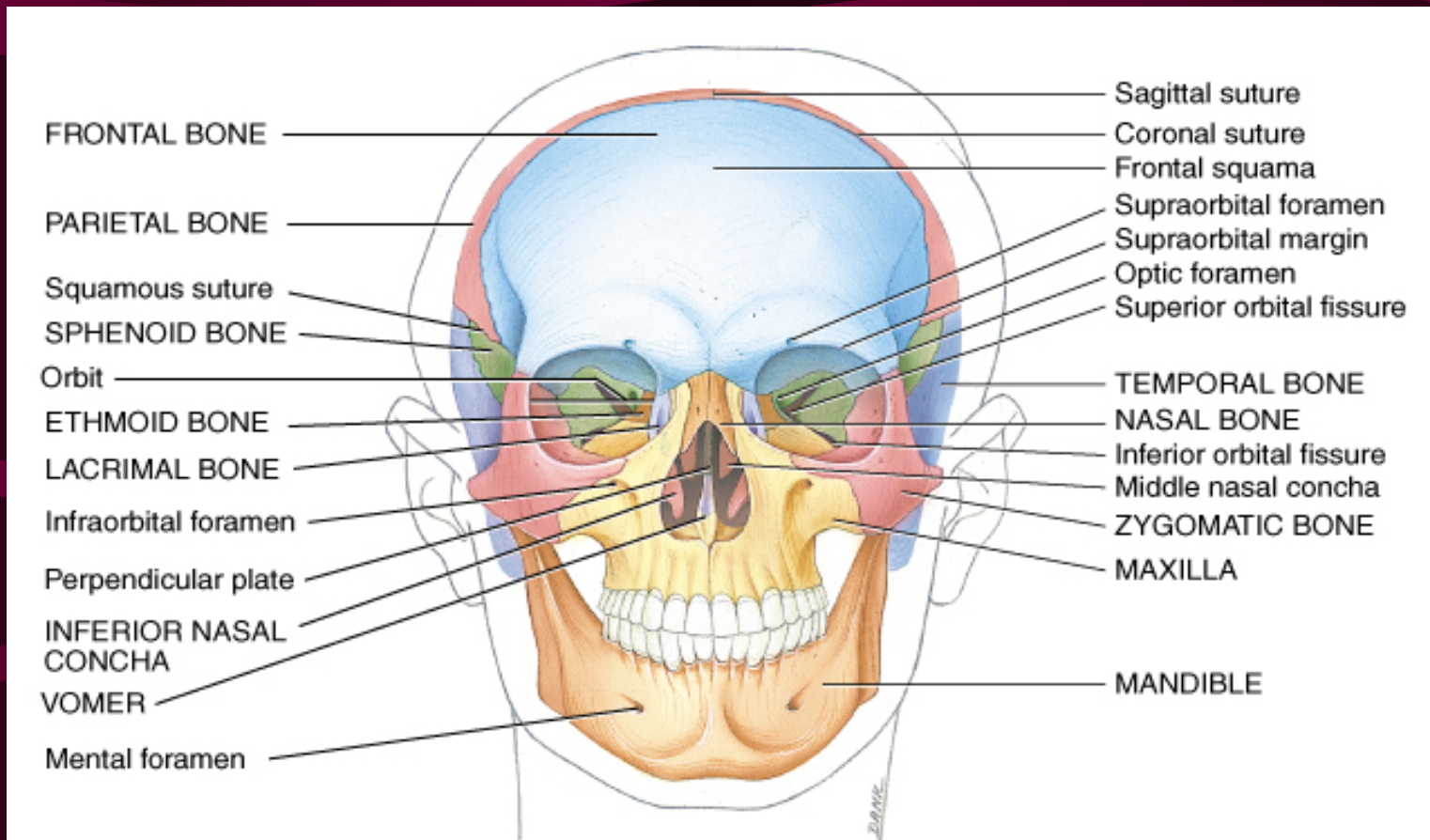
(e) Inferior view, mandible removed





Sagittal sections

14 Facial Bones



Nasal (2)

Mandible (1)

Inferior nasal conchae (2)

Maxillae (2)

Lacrima (2)

Zygomatic (2)

Palatine (2)

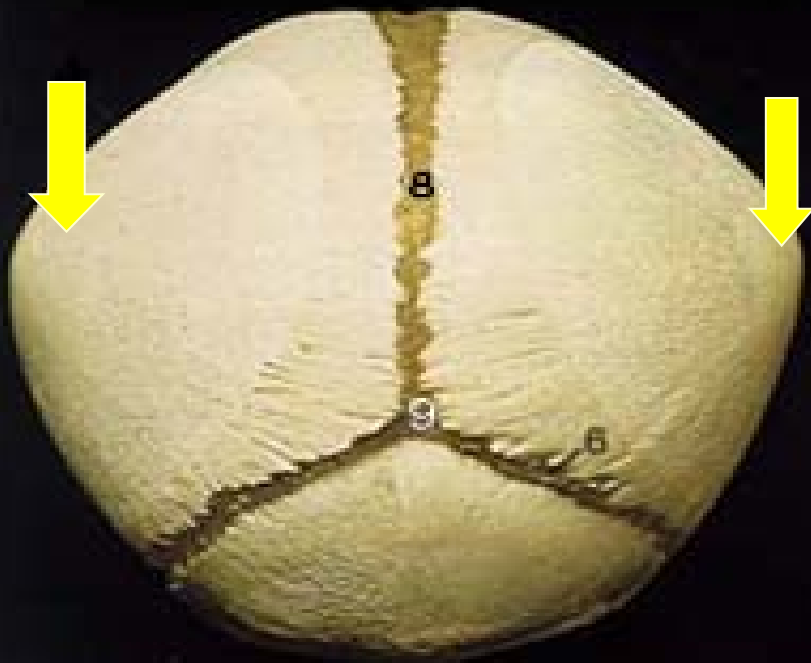
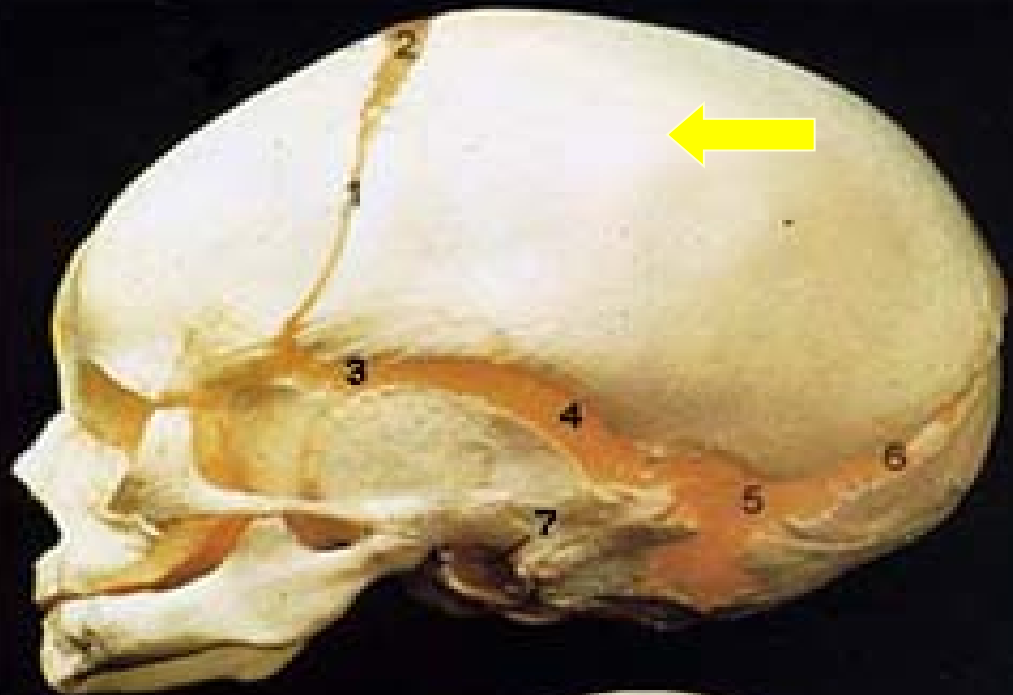
Vomer (1)

Fetal Skull

- Newborn infant skull isn't complete
- Not all the hyaline cartilage has yet ossified
- Cartilage meets at fontanel

Centers of Ossification

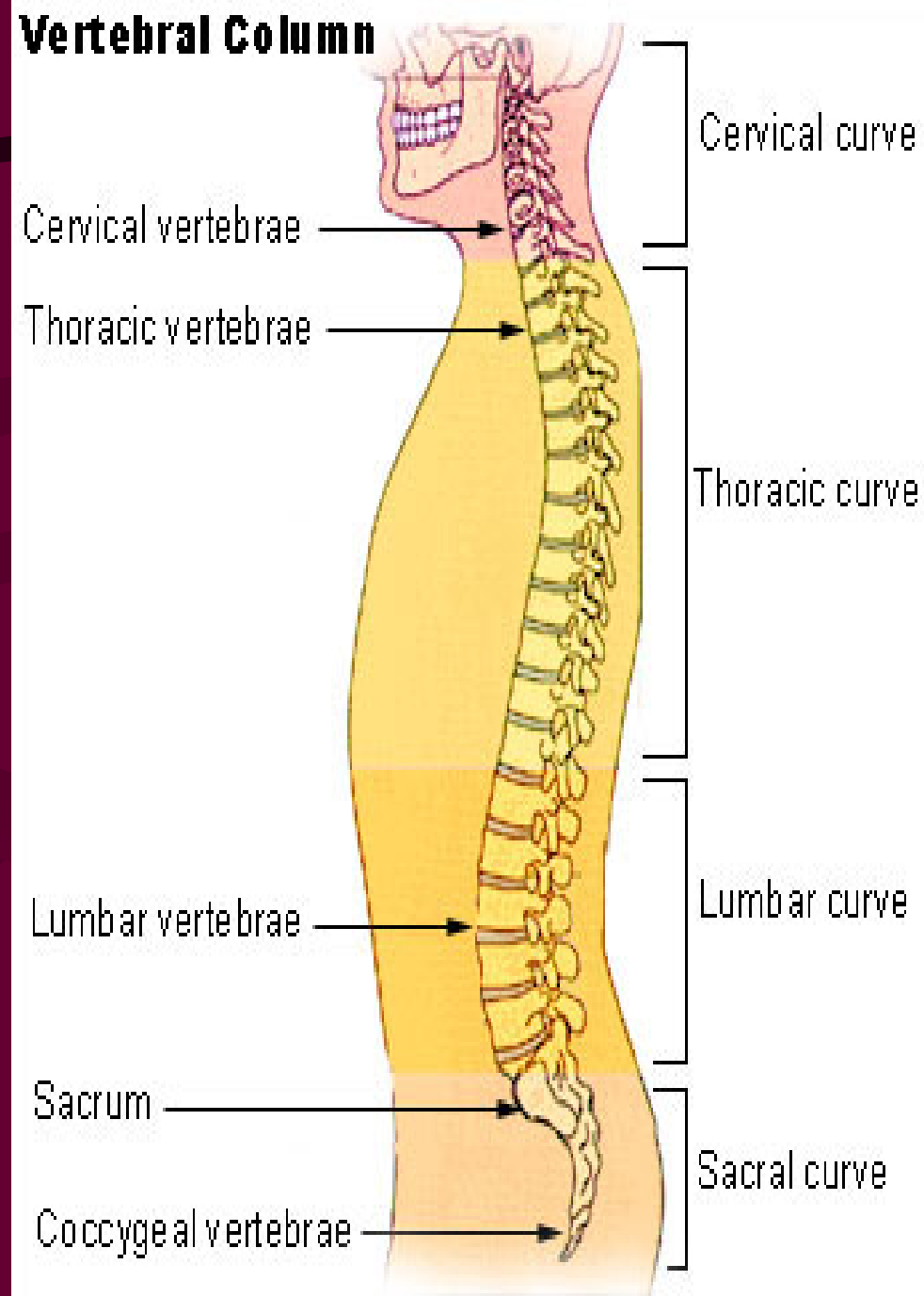
Centers of Ossification



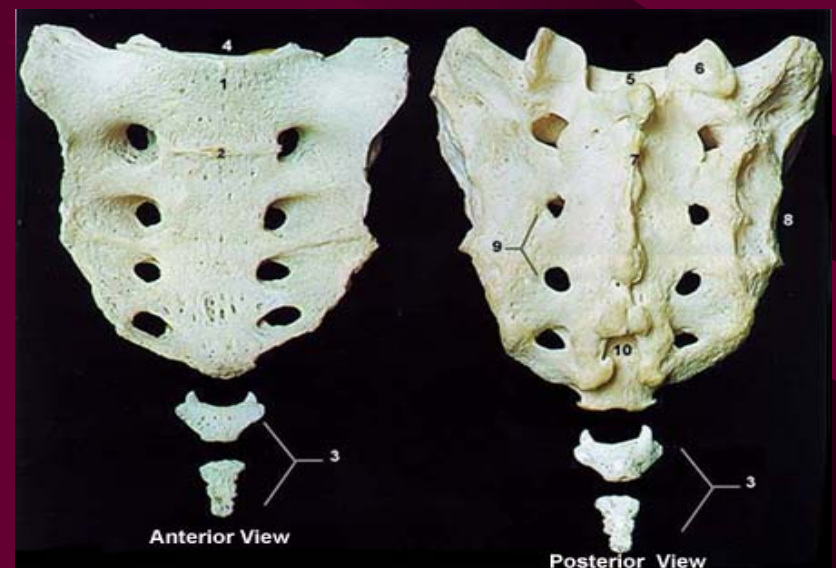
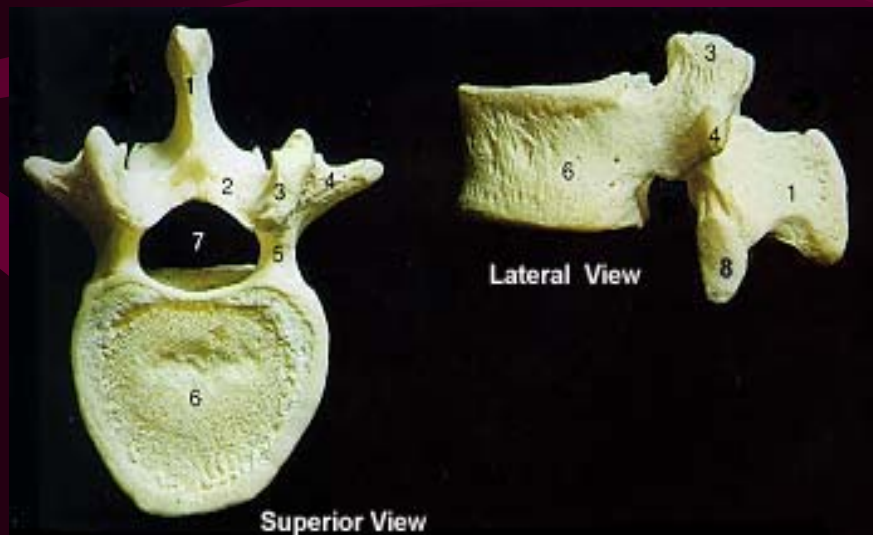
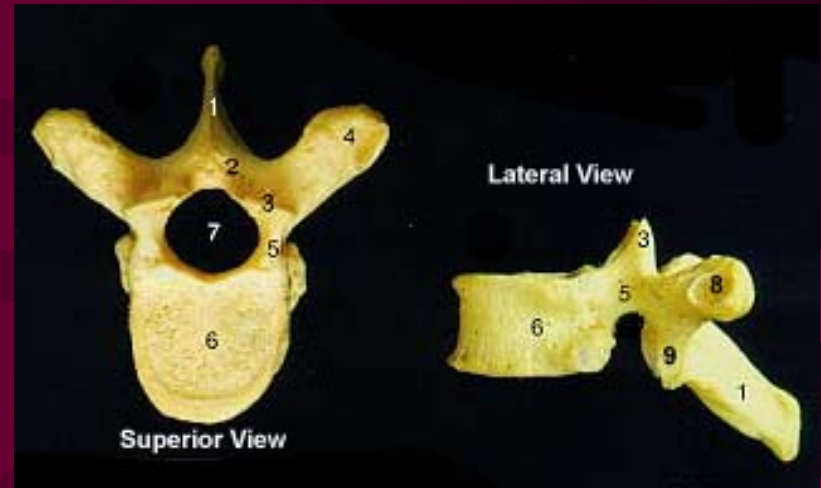
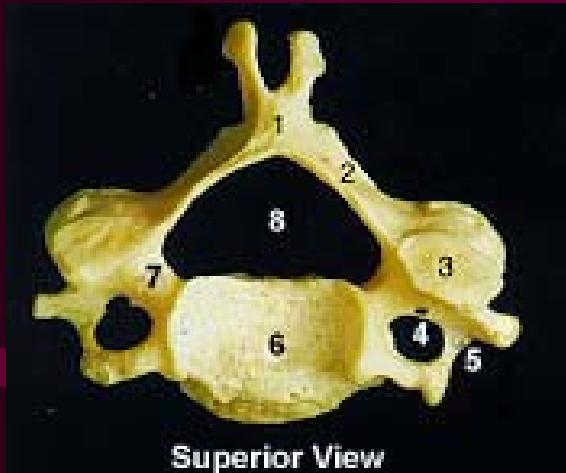
AXIAL SKELETON

2) VERTEBRAL COLUMN

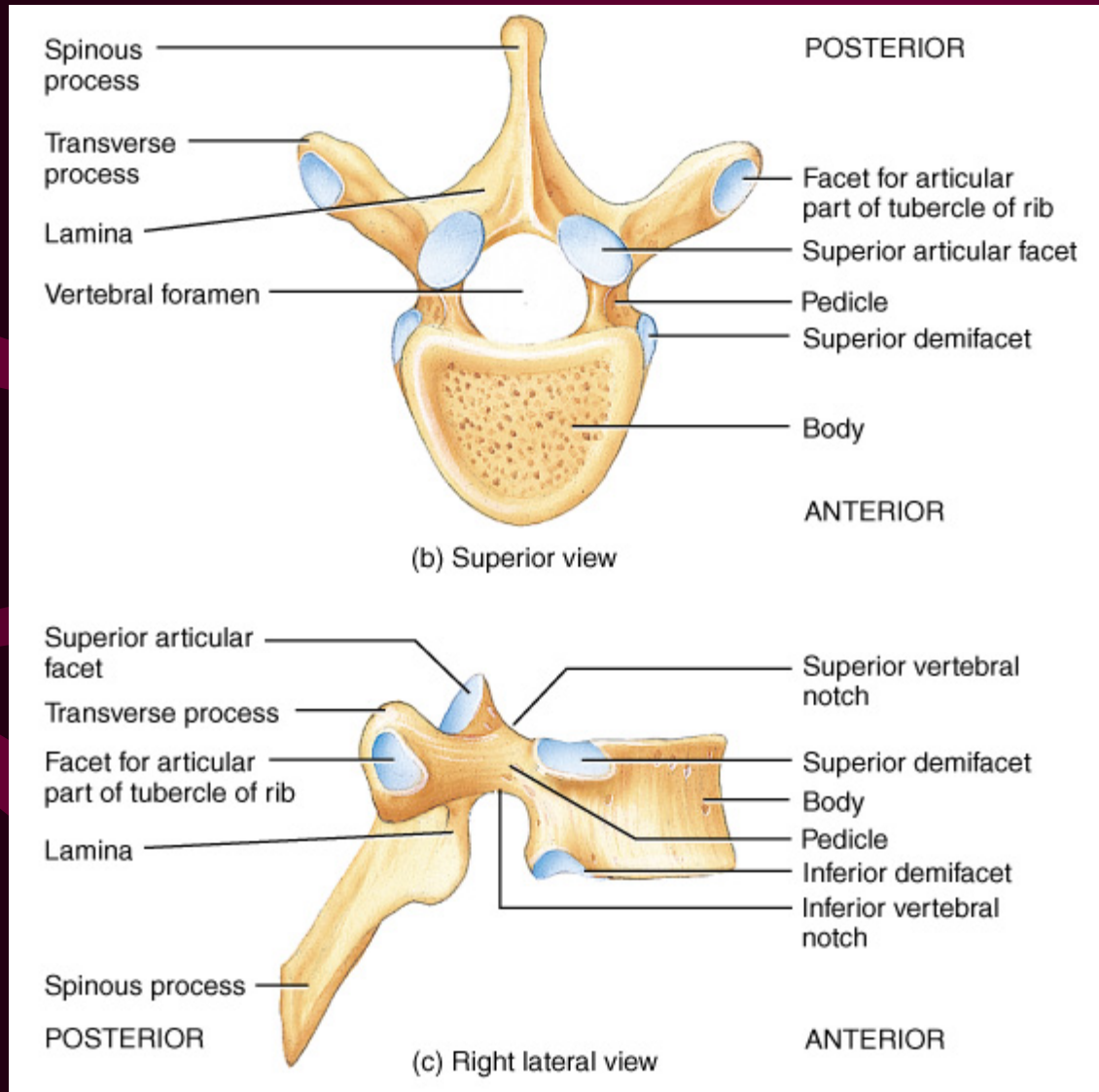
- Divided into 5 main regions
 1. Cervical spine (7)
 2. Thoracic spine (12)
 3. Lumbar spine (5)
 4. Sacrum (5)
 5. Coccyx (4)



Cervical, Thoracic, Lumbar, Sacrum and Coccyx

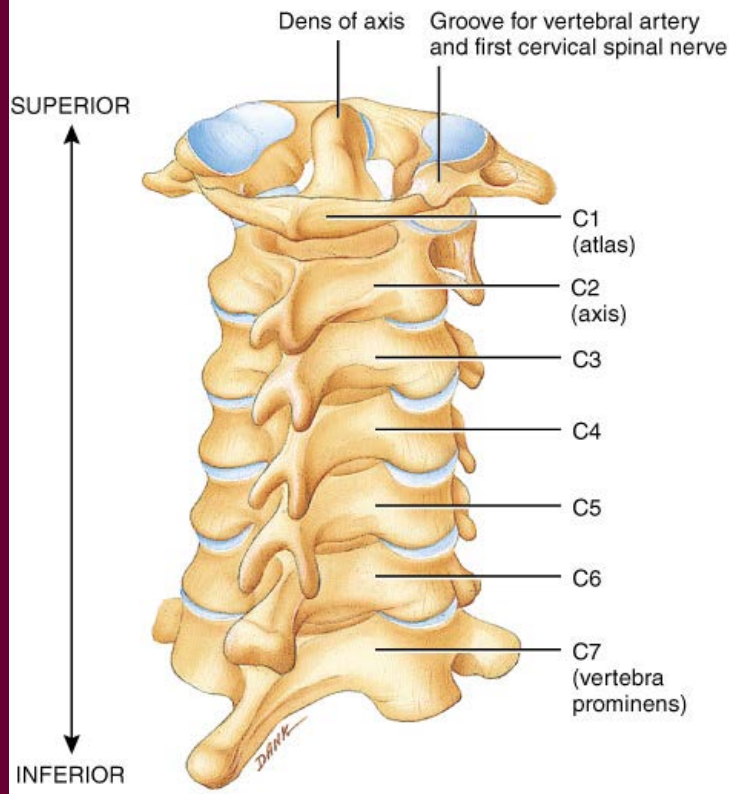
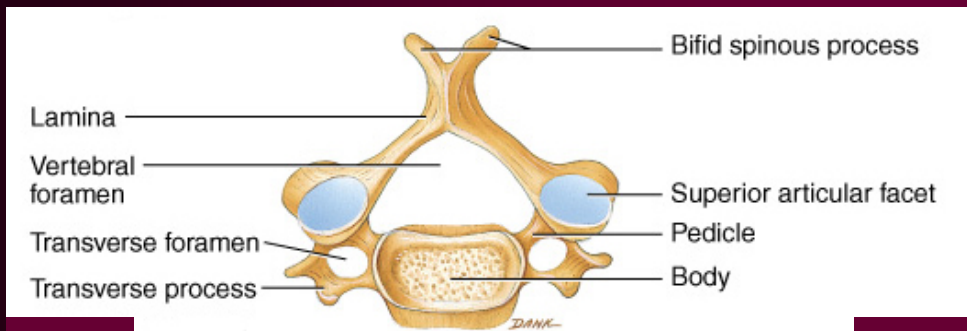


Typical Vertebrae



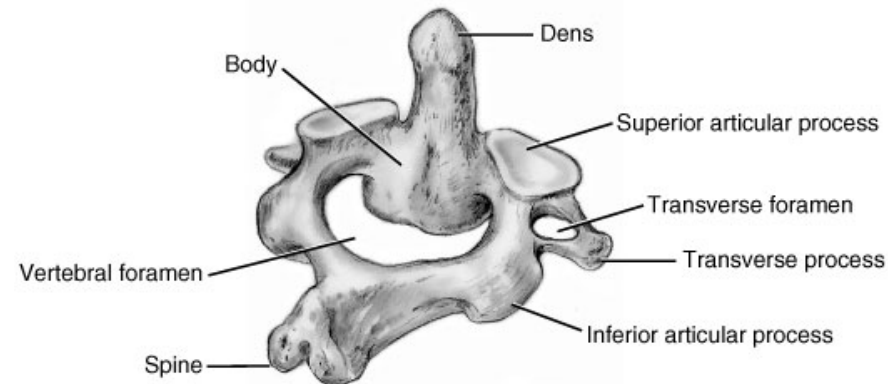
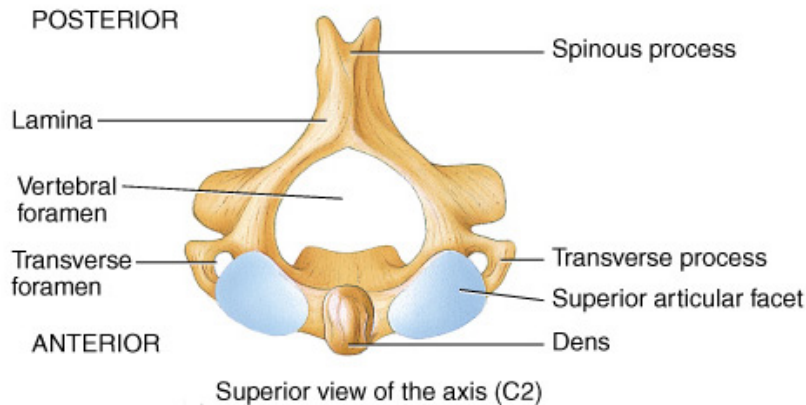
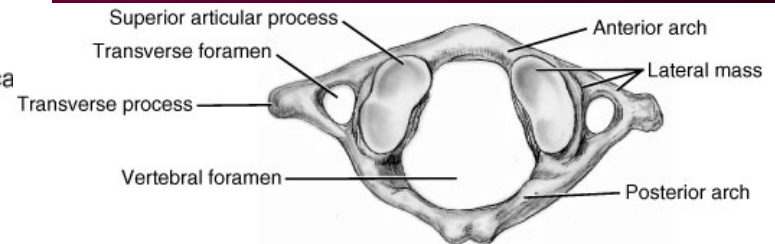
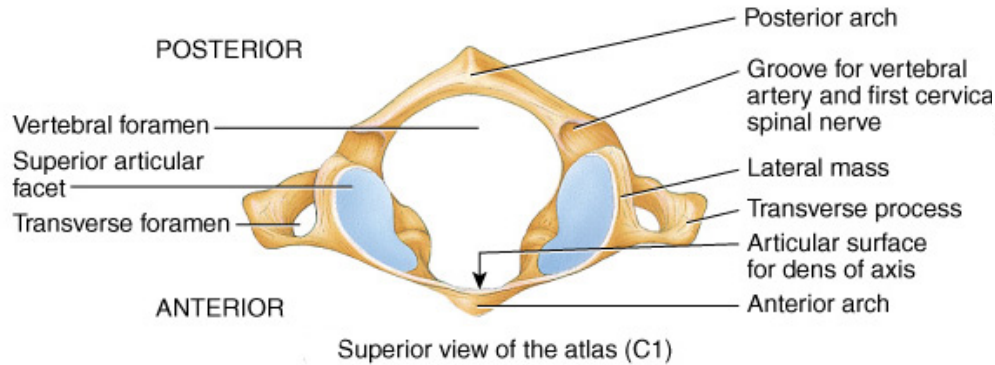
- Body
 - weight bearing
- Vertebral arch
 - pedicles
 - laminae
- Vertebral foramen
- Seven processes
 - 2 transverse
 - 1 spinous
 - 4 articular
- Vertebral notches

Typical Cervical Vertebrae (C3-C7)



- Smaller bodies
- Larger spinal canal
- Transverse processes
 - shorter
 - transverse foramen for vertebral artery
- Spinous processes of C2 to C6 often bifid
- 1st and 2nd cervical vertebrae are unique
 - atlas & axis

Atlas & Axis (C1-C2)



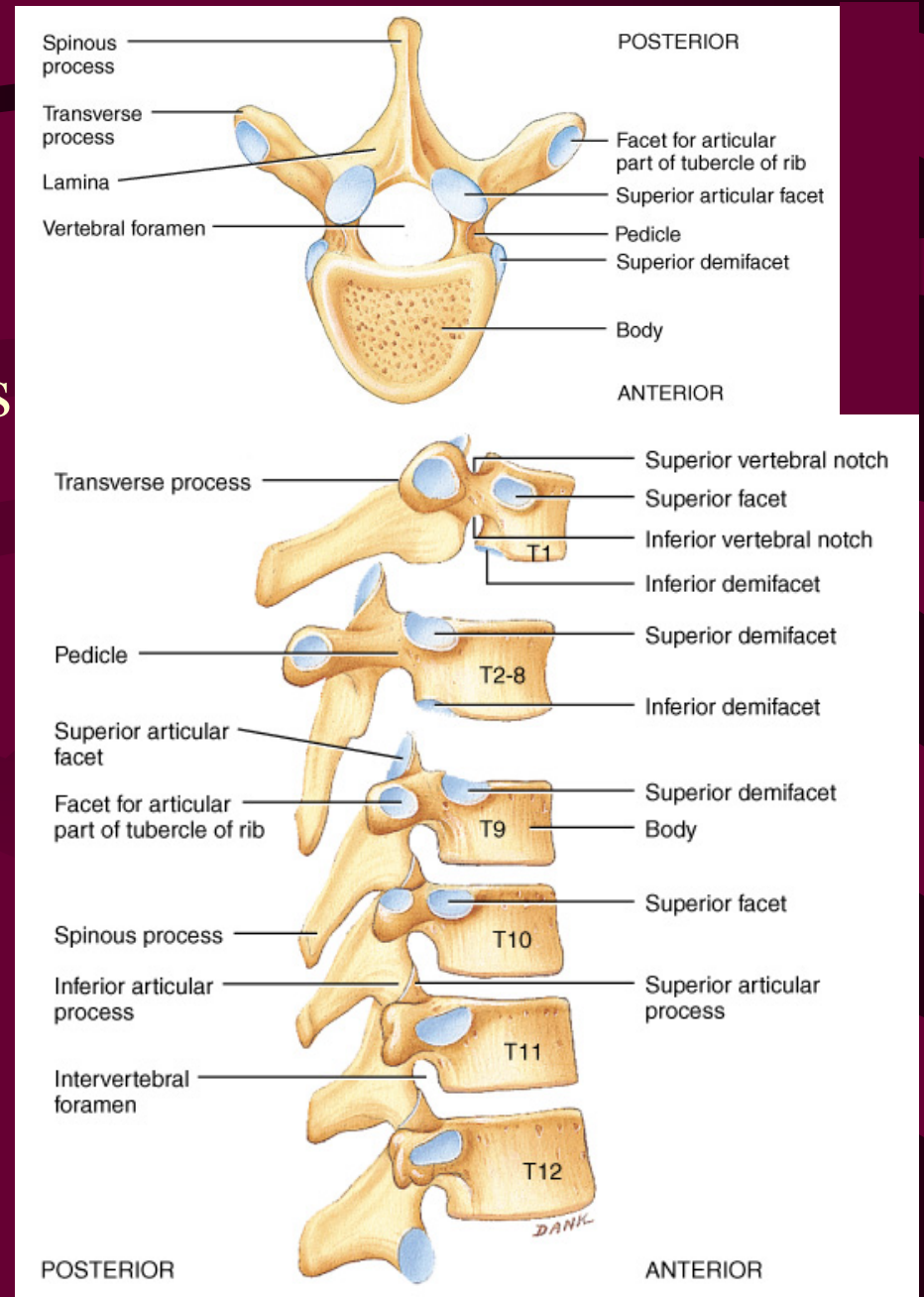
Second cervical vertebra, the axis. (Figure 3-64)

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- **Atlas** -- ring of bone, superior facets for occipital condyles
 - nodding movement at atlanto-occipital joint signifies “yes”
- **Axis** -- **dens or odontoid process** is body of atlas
 - pivotal movement at atlanto-axial joint signifies “no”

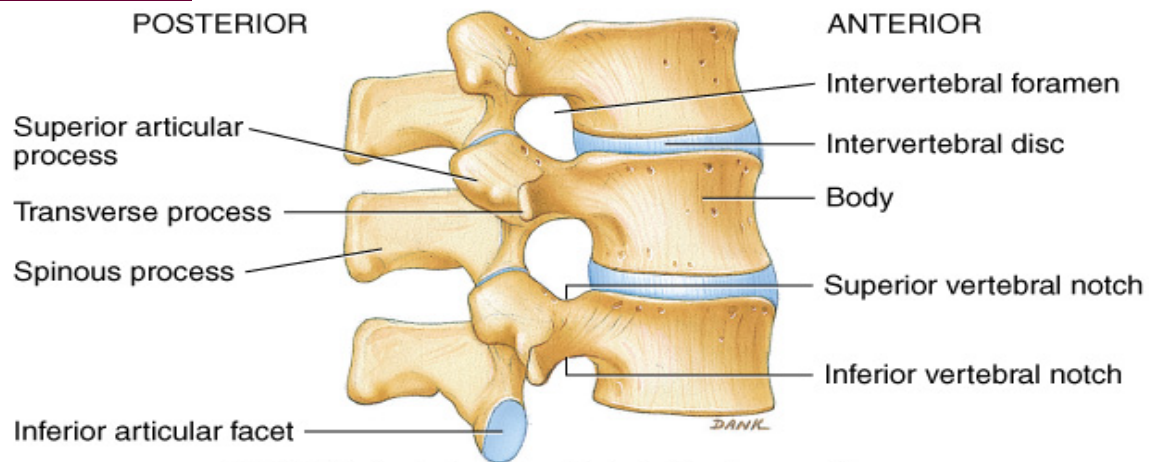
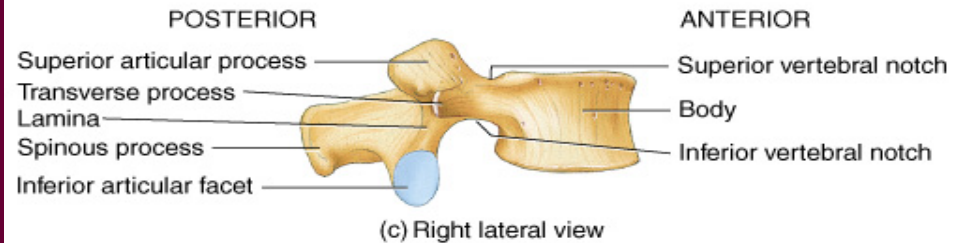
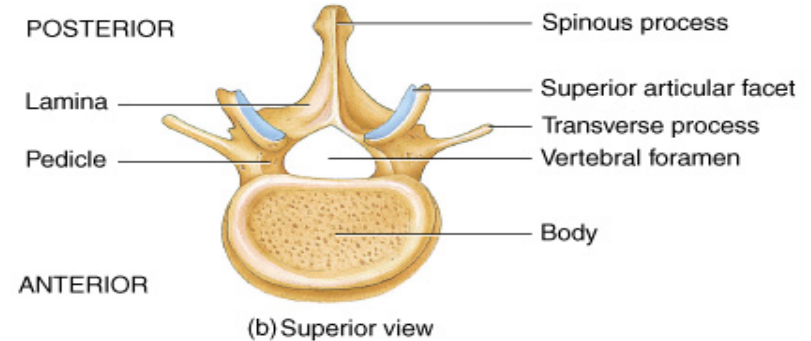
Thoracic Vertebrae (T1-T12)

- Larger and stronger bodies
- Longer transverse & spinous processes
- Facets or demifacets on body for head of rib
- Facets on transverse processes (T1-T10) for tubercle of rib

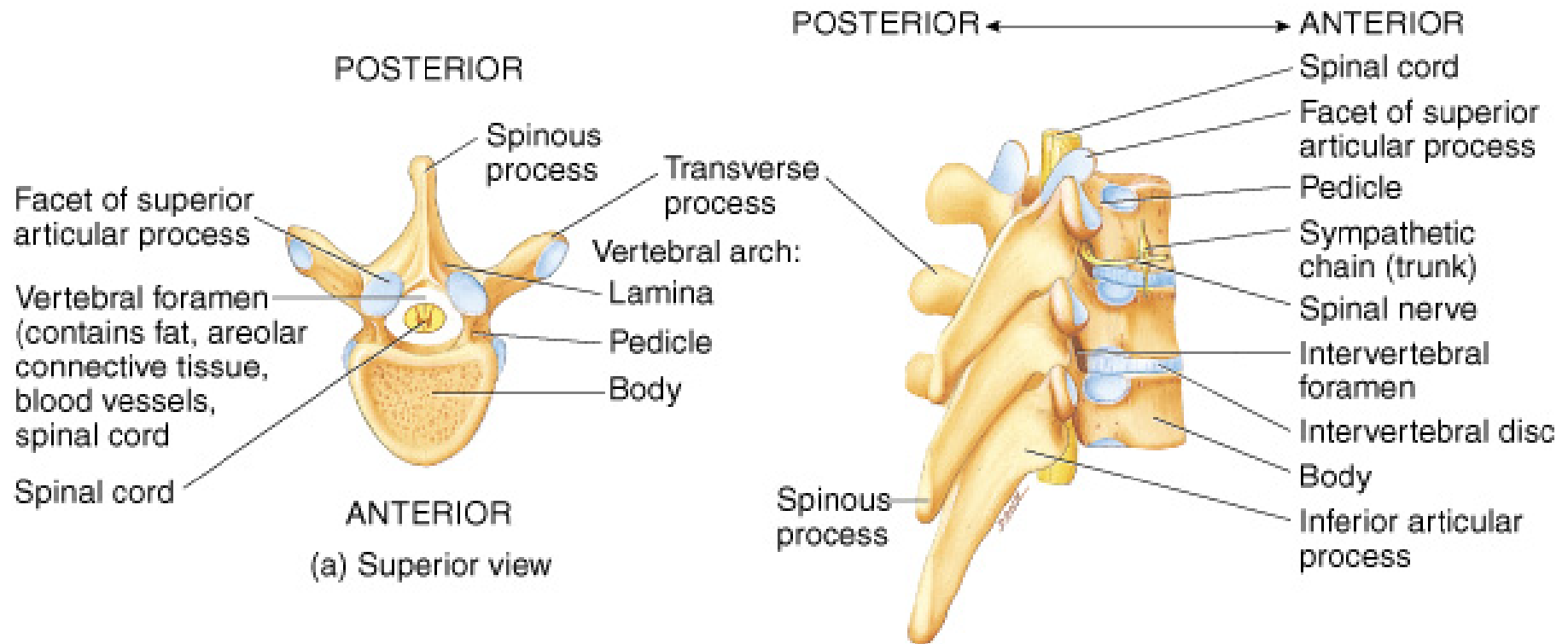


Lumbar Vertebrae

- Strongest & largest
- Short thick spinous & transverse processes
 - back musculature



Intervertebral Foramen & Spinal Canal

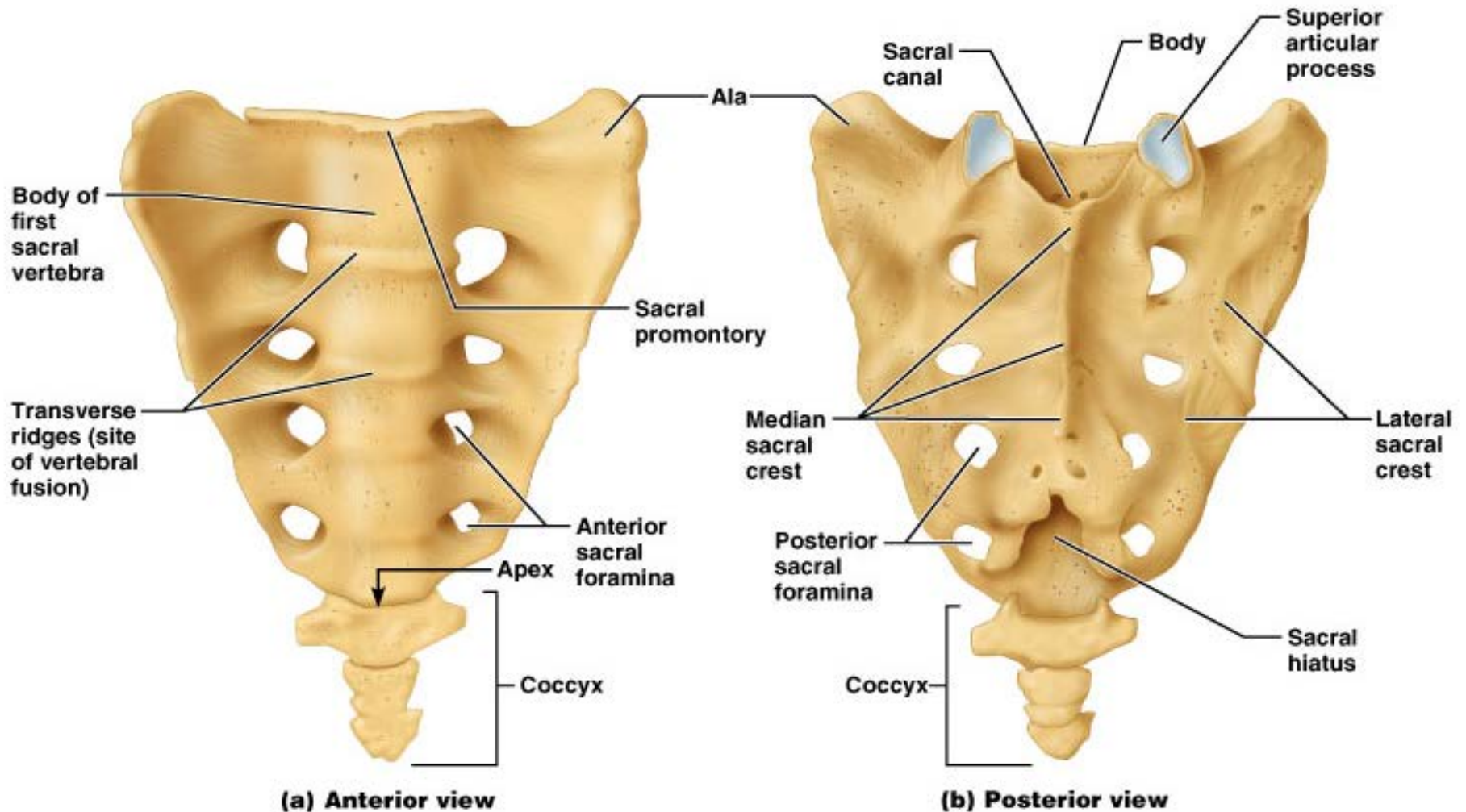


- Spinal canal is all vertebral foramen together
- Intervertebral foramen are 2 vertebral notches together

Sacrum ($S_1 - S_5$)

- Shapes the posterior wall of pelvis
- Formed from 5 fused vertebrae
- Superior surface articulates with L_5
- Inferiorly articulates with coccyx
- Sacral promontory – where the first sacral vertebrae bulges into pelvic cavity
- Center of gravity is 1 cm posterior to sacral promontory

Sacrum



Coccyx

- Is the "tailbone"
- Formed from 3-5 fused vertebrae
- Offers only slight support to pelvic organs

Fetal Vertebral Column

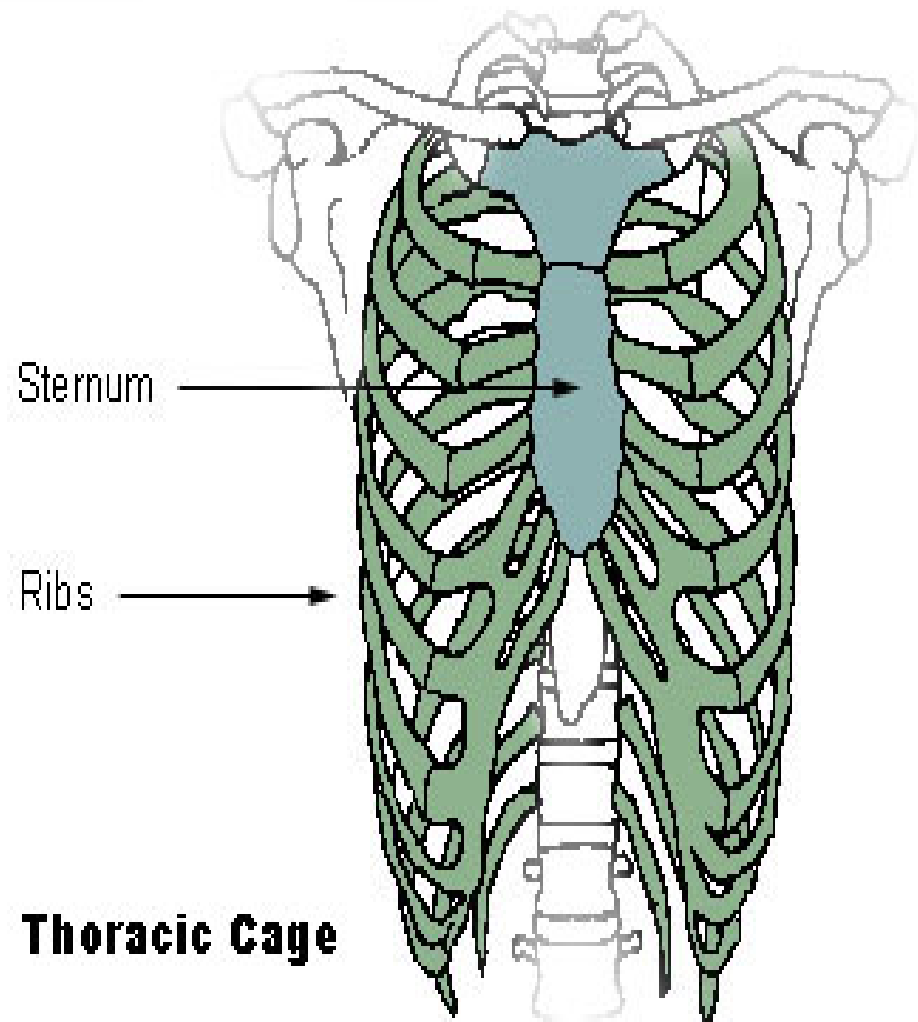
- Originally a convex curve
- As baby learns to lift it's head, the cervical curve develops
- As baby learns to walk, Lumbar curve develops

Bony Thorax

- Consists of the ribs, sternum and thoracic vertebrae
- Provides a bony, protective cage around the organs of the thoracic cavity
- Heart, Lungs and major blood vessels

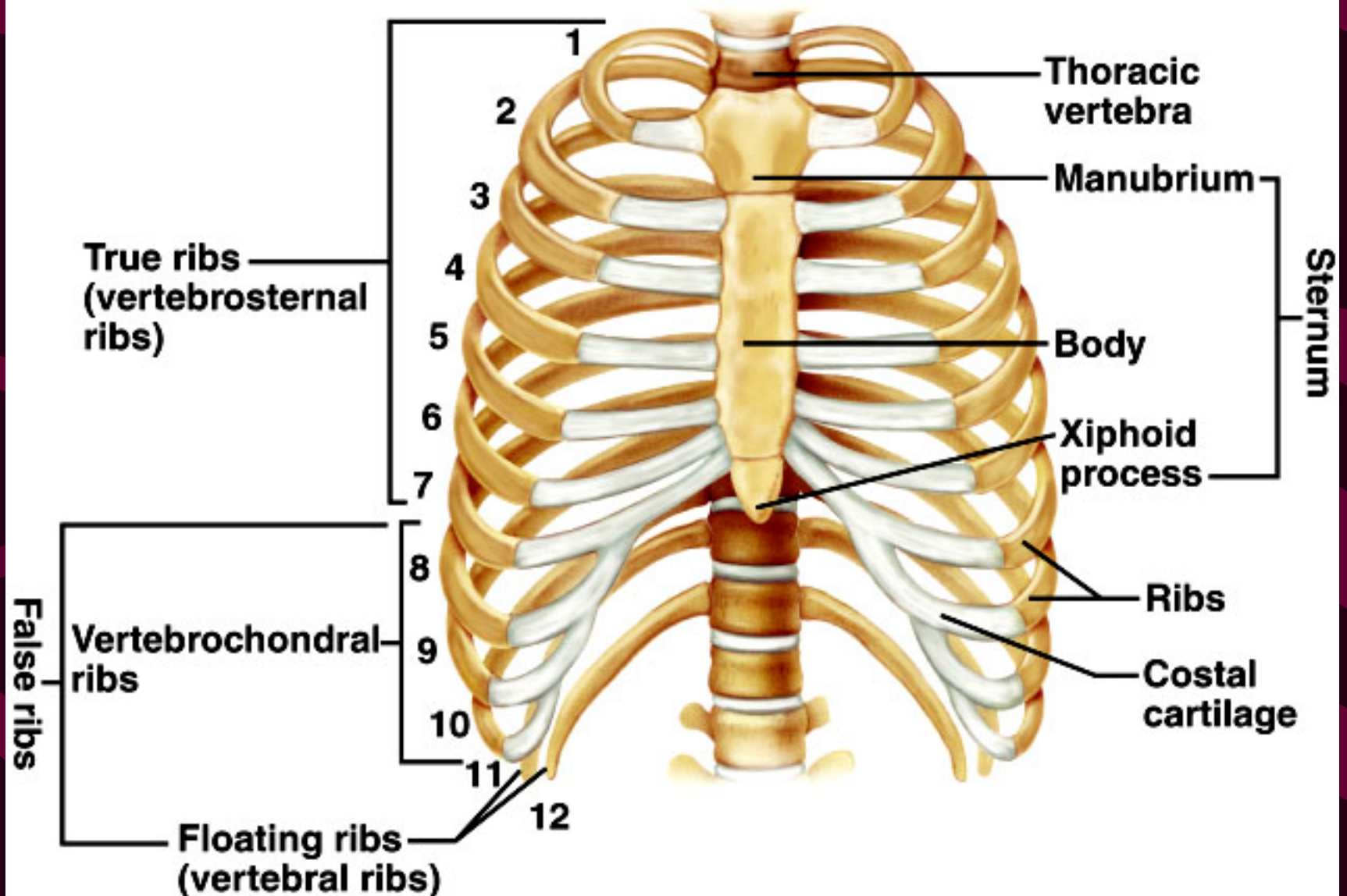
AXIAL SKELETON

- THORAX
- 12 pairs of ribs
- Joined to thoracic vertebrae
- Top 10 ribs joined to sternum
- Remaining two have “free” ends – ‘floating’



Types of ribs:-

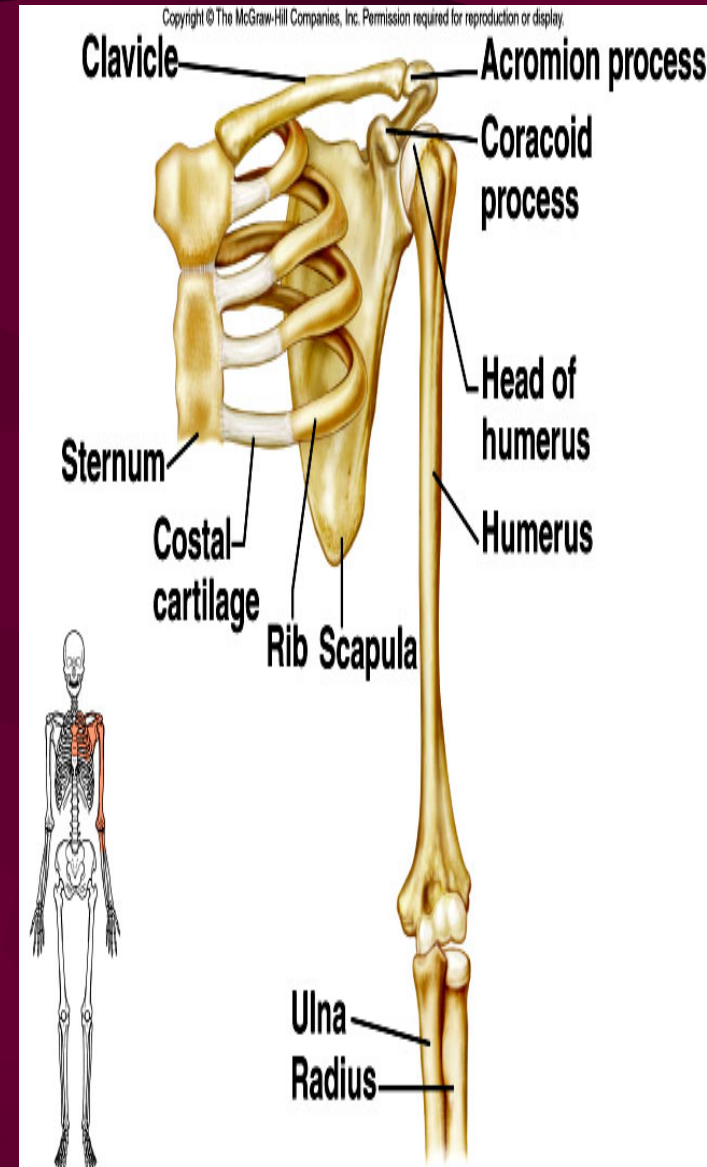
- True ribs are directly attached to the sternum (first seven pairs)
- Three false ribs are joined to the 7th rib
- Two pairs of floating ribs



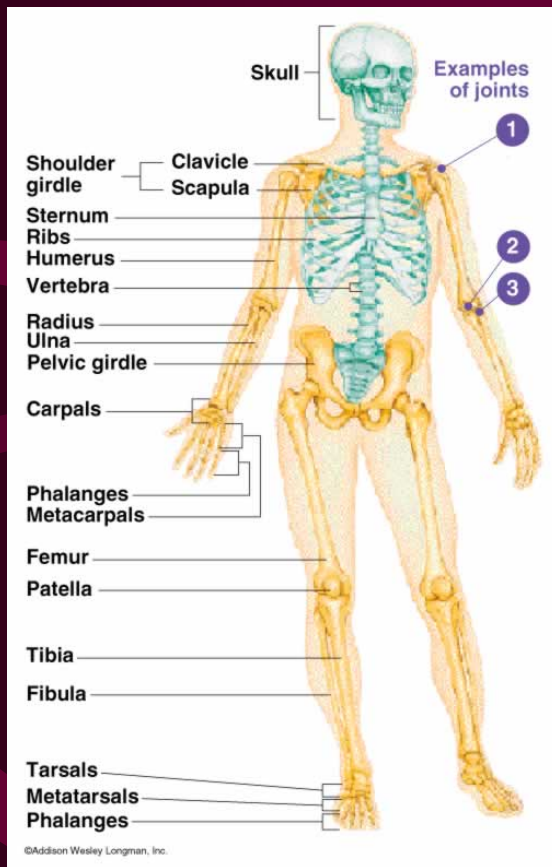
Clavicles and scapulae

Help brace shoulders

Attachment sites for muscles



Appendicular Skeleton



- Pelvic Girdle
- Lower Limbs
- Pectoral Girdles
- Clavicles
- Scapulae
- Upper limbs

Bones of upper limb

Humerus (upper arm)

Radius; ulna

Carpals, metacarpals, phalanges

Bones of lower limb

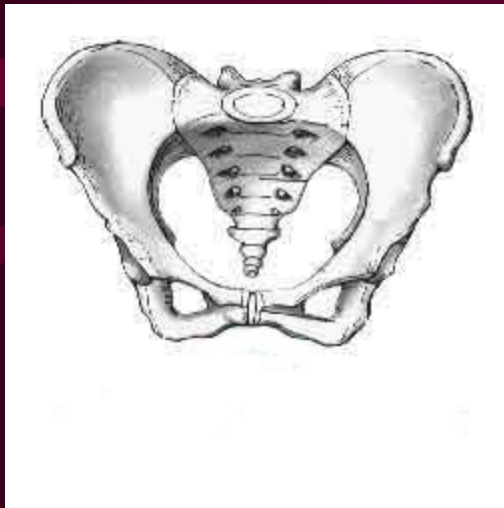
Femur

Patella

Tibia, fibula

Tarsals, metatarsals, phalanges

Pelvic Girdle



- Strong frame
- Supports lower limbs

Pelvis



- Two coxial bones
- Sacrum
 - Three separate bones in the fetus
 - The three join anteriorly

Female and Male Pelvis are Different

Male pelvis: anterior view

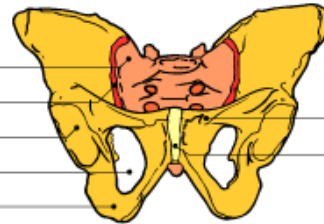
1 Sacrum

2 Sacroiliac joint

7 Acetabulum

8 Obturator foramen

5 Ischium



4 Pubis

4b Symphysis pubis

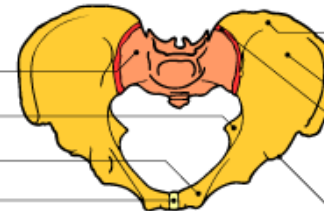
Male pelvis: superior view

1 Sacrum

5a Ischial spine

4d Pubic tubercle

4b Symphysis pubis



3 Ilium

3a Iliac crest

3b Iliac fossa

2 Sacroiliac joint

3c Anterior inferior iliac spine

Female pelvis: anterior view

7 Acetabulum

8 Obturator foramen

6 Coccyx

5 Ischium



4b Symphysis pubis

4 Pubis

Female pelvis: superior view

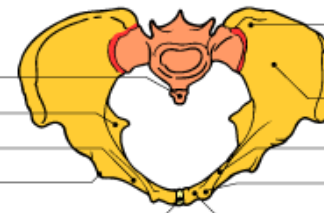
6 Coccyx

5a Ischial spine

4 Pubis

4a Iliopubic eminence

4b Symphysis pubis



3 Ilium

3a Iliac crest

3b Iliac fossa

4e Pubic pecten

4d Pubic tubercle

4c Pubic crest

Pelvic Girdle Differences

Feature	Male	Female
Orientation	Tilted backward	Tilted forward
Pelvic inlet	Narrow, heart - shaped	Wide, oval-shaped
Pubic arch	Less than 90°	Greater than 90°
Sacrum	Narrow and long	Wide and short, greater curvature
Bone thickness	Thick and heavy	Thin and light
Coccyx	Immovable	Movable

Bone Surface Markings

- Foramen = opening (arteries, nerves)
- Fossa = shallow depression
- Sulcus = shallow groove (artery or nerve)
- Canal = longer, tubelike opening
- Fissure = narrow, cleftlike opening
- Notch = indentation at the end of a bone
- Meatus = type of canal
- Condyle = large, round protuberance, attachment of muscles
- Epicondyle = above or upon a condyle
- Facet = smooth flat articular surface
- Trochanter = very large projection
- Tuberosity = large, rounded, roughened projection
- Tubercle = rounded eminence/elevation
- Crest = roughened border or ridge
- Spine = sharply pointed projection