

Biology 323

Human Anatomy for Biology Majors

Lecture 3

Dr. Stuart S. Sumida

Integument

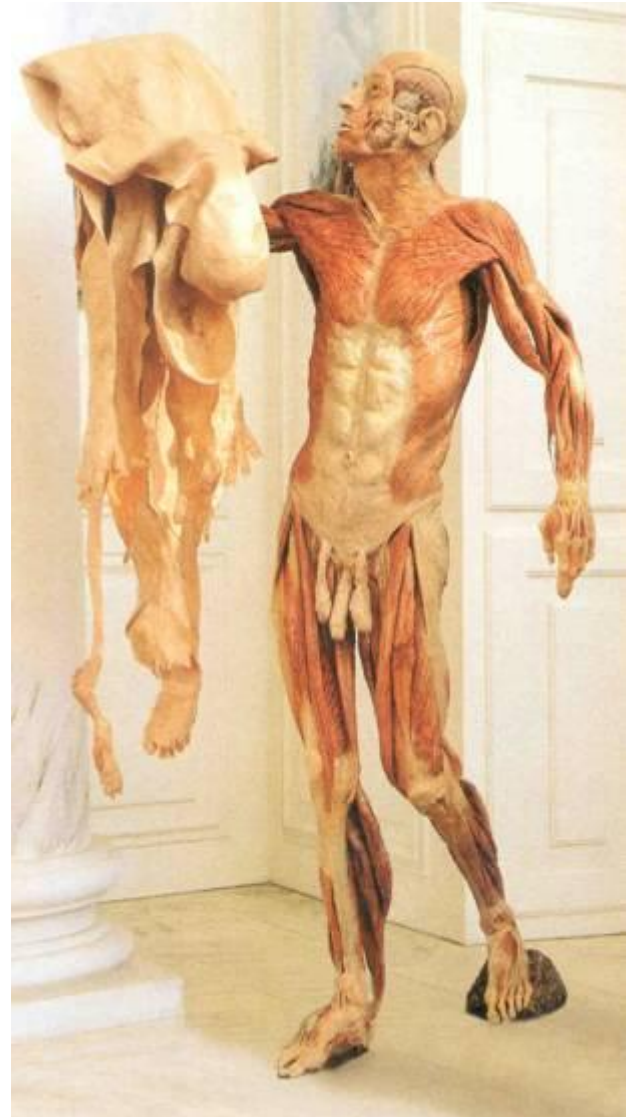
Support Structures; Axial Skeleton



Integumentary System

Functions

- Protection
- Sensory
- Synthesis

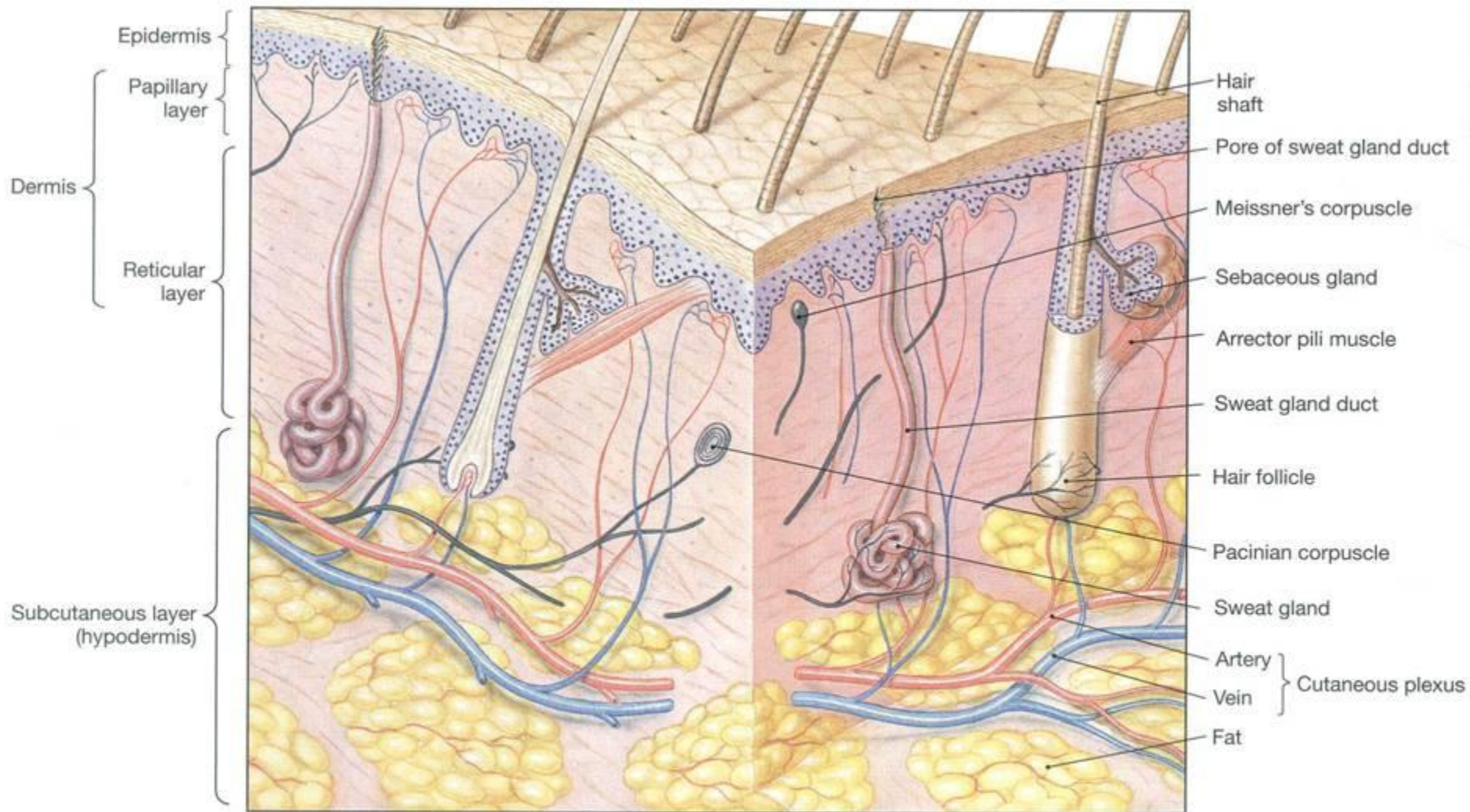


The Skin...

Epidermis - ectodermal; stratified squamous epithelium

Dermis - mesodermal; collagen, elastic fibers, papillary layer, and reticular layer

Hypodermis



Components of the Integumentary System. Relationships among the major components of the integumentary system (with the exception of nails, shown in Figure 4-15). The epidermis is a keratinized stratified squamous epithelium that overlies the dermis, a connective tissue region containing glands, hair follicles and sensory receptors. Underlying the dermis is the subcutaneous layer, which contains fat and blood vessels supplying the dermis.

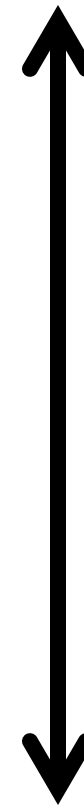
Detail on Epidermis:

Stratum corneum (dead)

Stratum lucidum

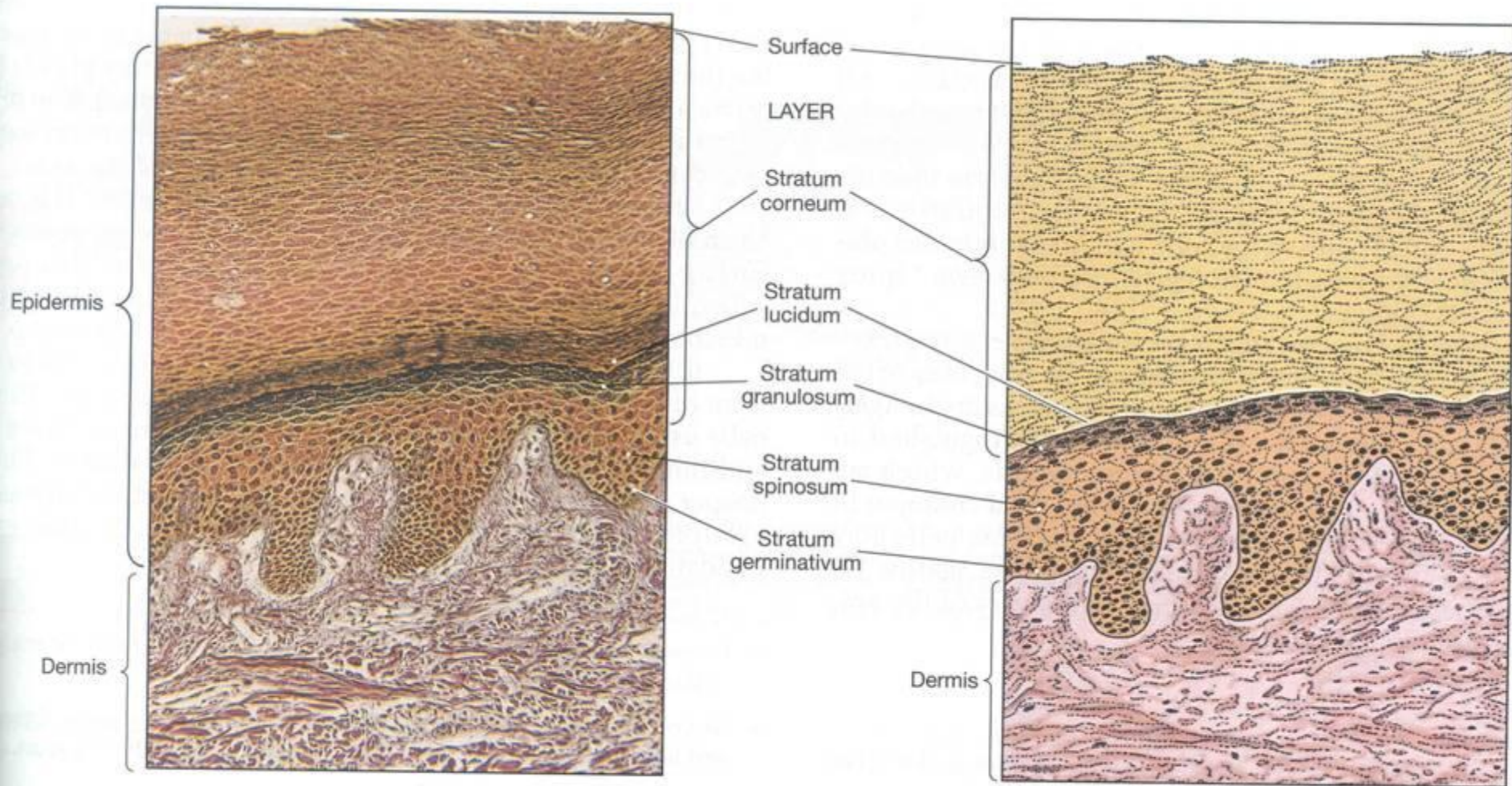
Stratum granulosum

Stratum spinosum



Superficial

Deep
(Dermis)



The Structure of the Epidermis. A light micrograph and corresponding diagrammatic sketch through a portion of the epidermis, showing the major stratified layers of epidermal cells. (LM $\times 200$)

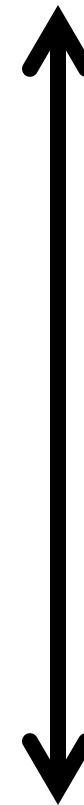
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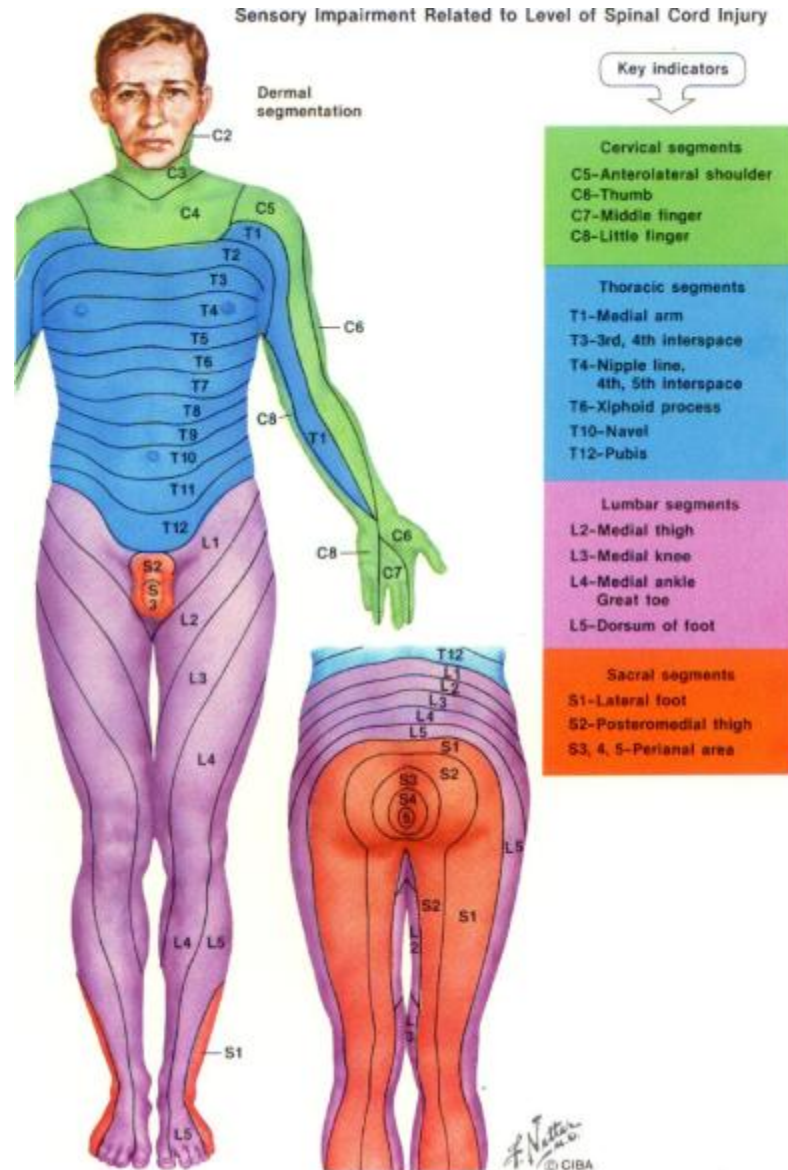
Stratum spinosum



Superficial

Deep
(Dermis)

Segmented Dermatome



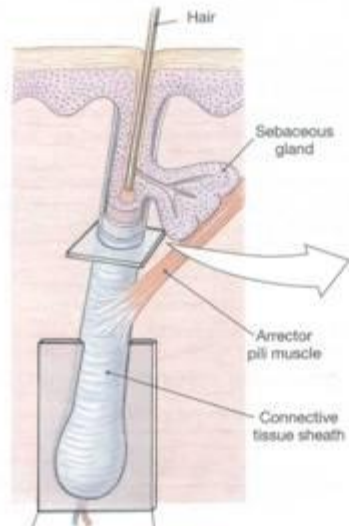
Subcutaneous Layer

(= Superficial Fascia = Hypodermis)

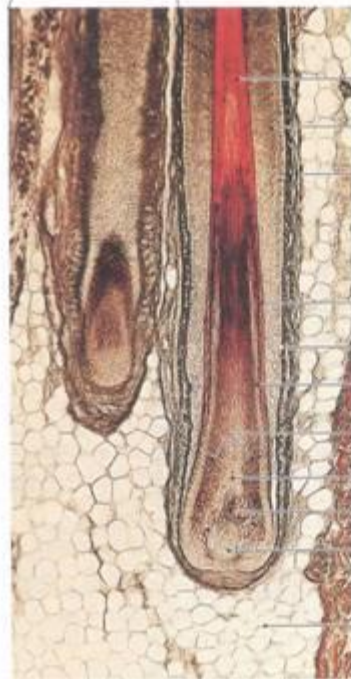
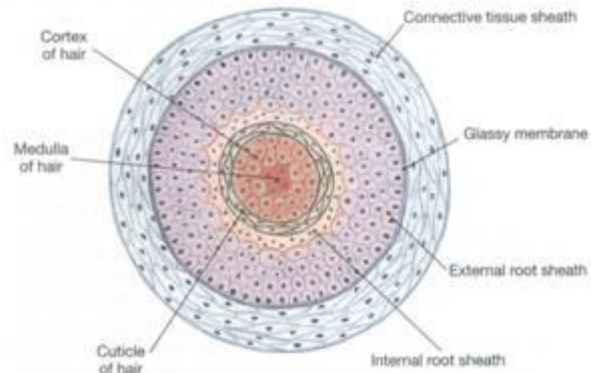
- Division between the Reticular Layer (Dermis) and Subcutaneous layer is indistinct
- Consists of Areolar and Adipose tissues, large number of blood vessels

Hair:

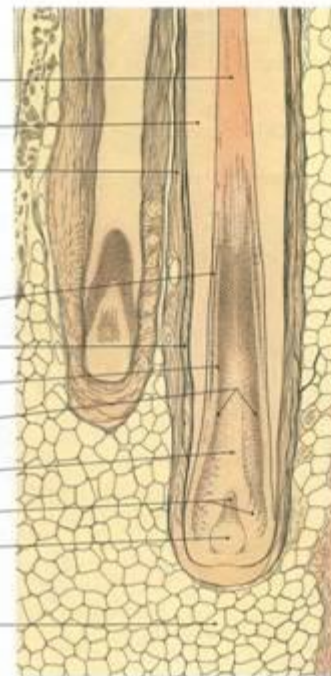
- Bulb
- Artery
- Vein
- Arrector Pila Muscle
- Gland
- Papilla
- Shaft



(a)



(b)



(c)

Hair Follicles. Hairs originate in hair follicles, which are complex organs. (a) A longitudinal section and a cross section through a hair follicle. Histological (b) and diagrammatic (c) sections along the longitudinal axis of a hair follicle. (LM $\times 60$)

Different Hair Shaft Shapes give different characteristics:

Round Cross-section = straight hair



Oval Cross-section = Wavy Hair

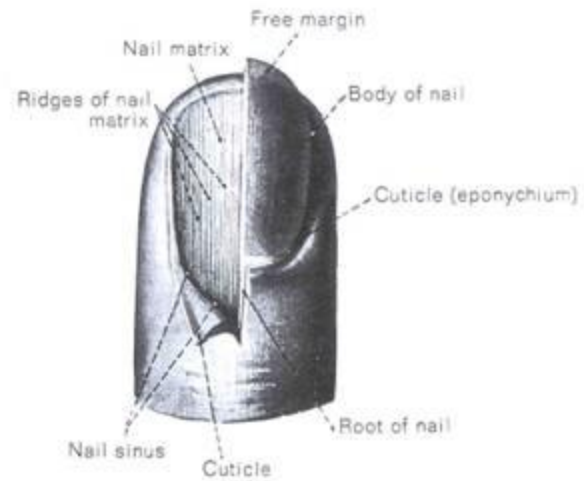


Flat Cross-section = Kinky Hair

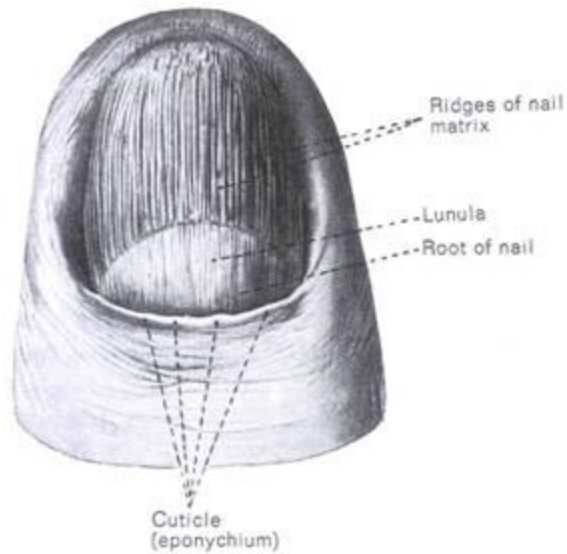




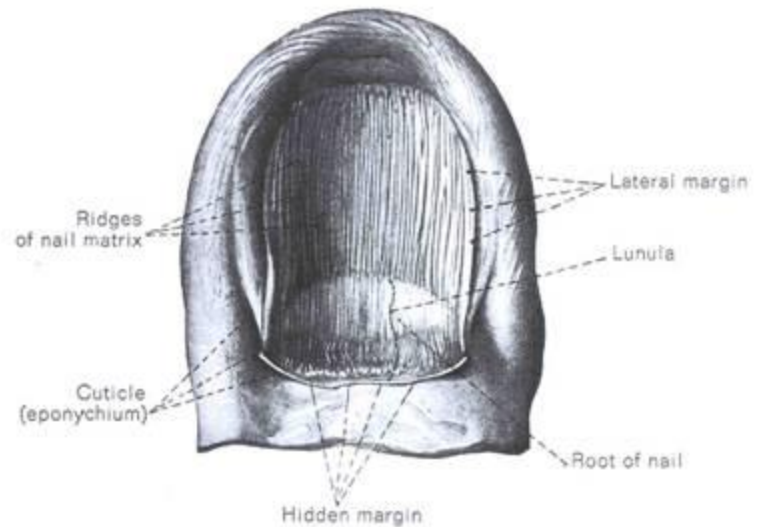
Finger Nail, Normal Position (Dorsal View)



Left Half of Finger Nail Bed Exposed



Nail Bed of Thumb after Removal of Nail



Nail Bed of Thumb and Reflection of Cuticle

Glands

- Eccrine
- Apocrine
- Mammary glands (Not reproductive organs!)

Eccrine Glands

- The predominant sweat glands of the body.
- Produce clearly, watery odorless liquid + salt.

Apocrine Glands

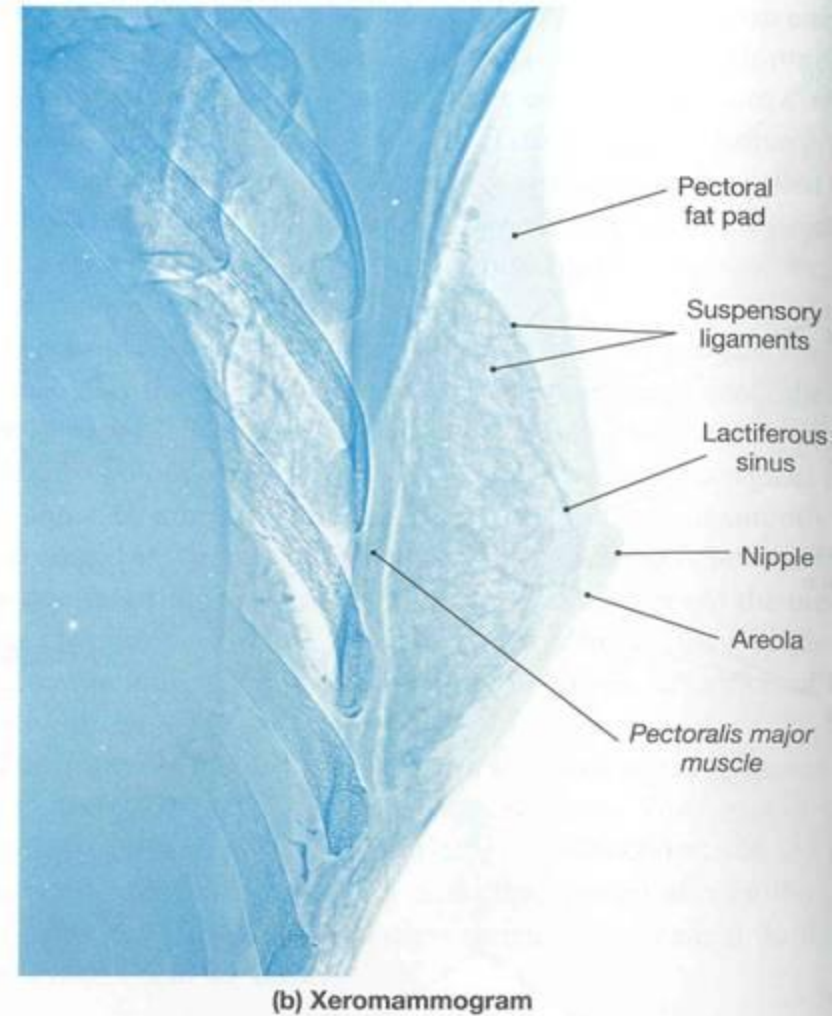
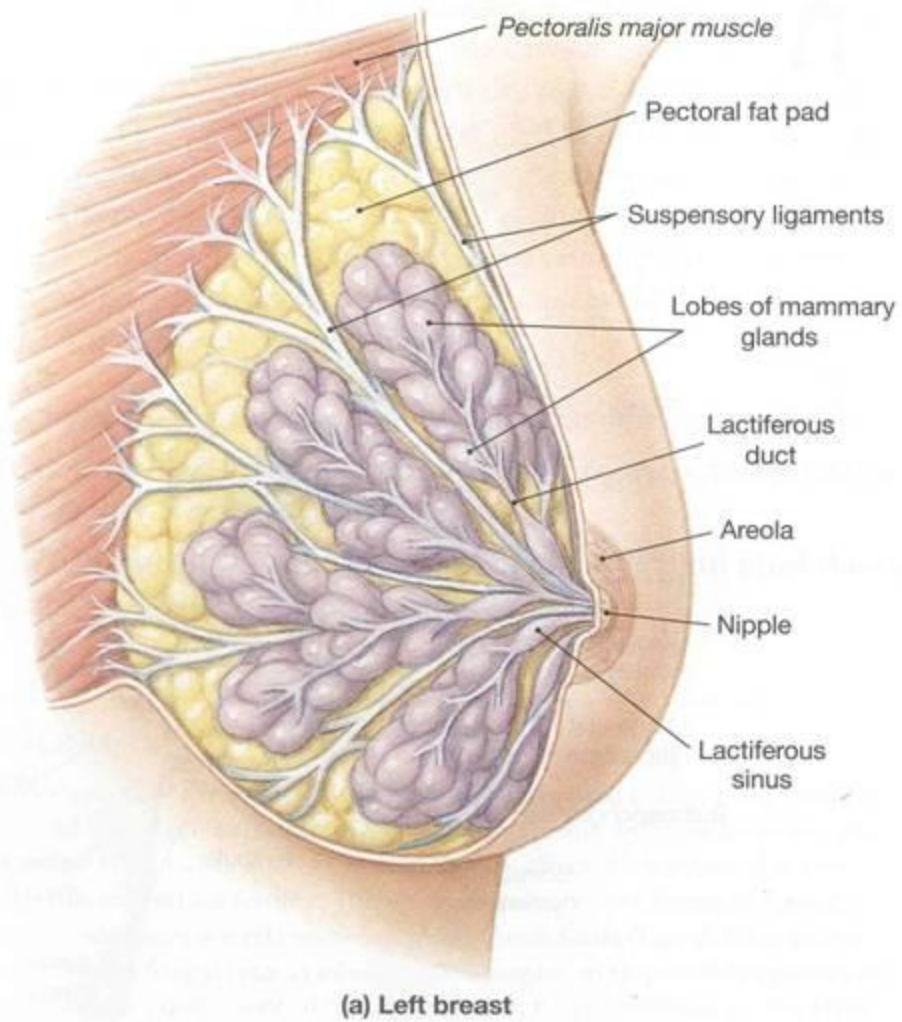
- Develop in association with hair follicles.
- Heavier, more oily secretion.
- Specialized versions include Moll's glands seen on the eyelids; the cerumen-producing (ear wax) glands of the external auditory canal; and the milk-producing glands of the breasts.

The scent produced by apocrine glands should not be confused with the unpleasant body odor produced by microorganisms that grow on moist sections of the skin.

Microorganisms create body odor by digesting sebum, the oily substance secreted by sebaceous glands in the skin of mammals. The presence of water, in the form of sweat from eccrine (simple) sweat glands, aids in this process.

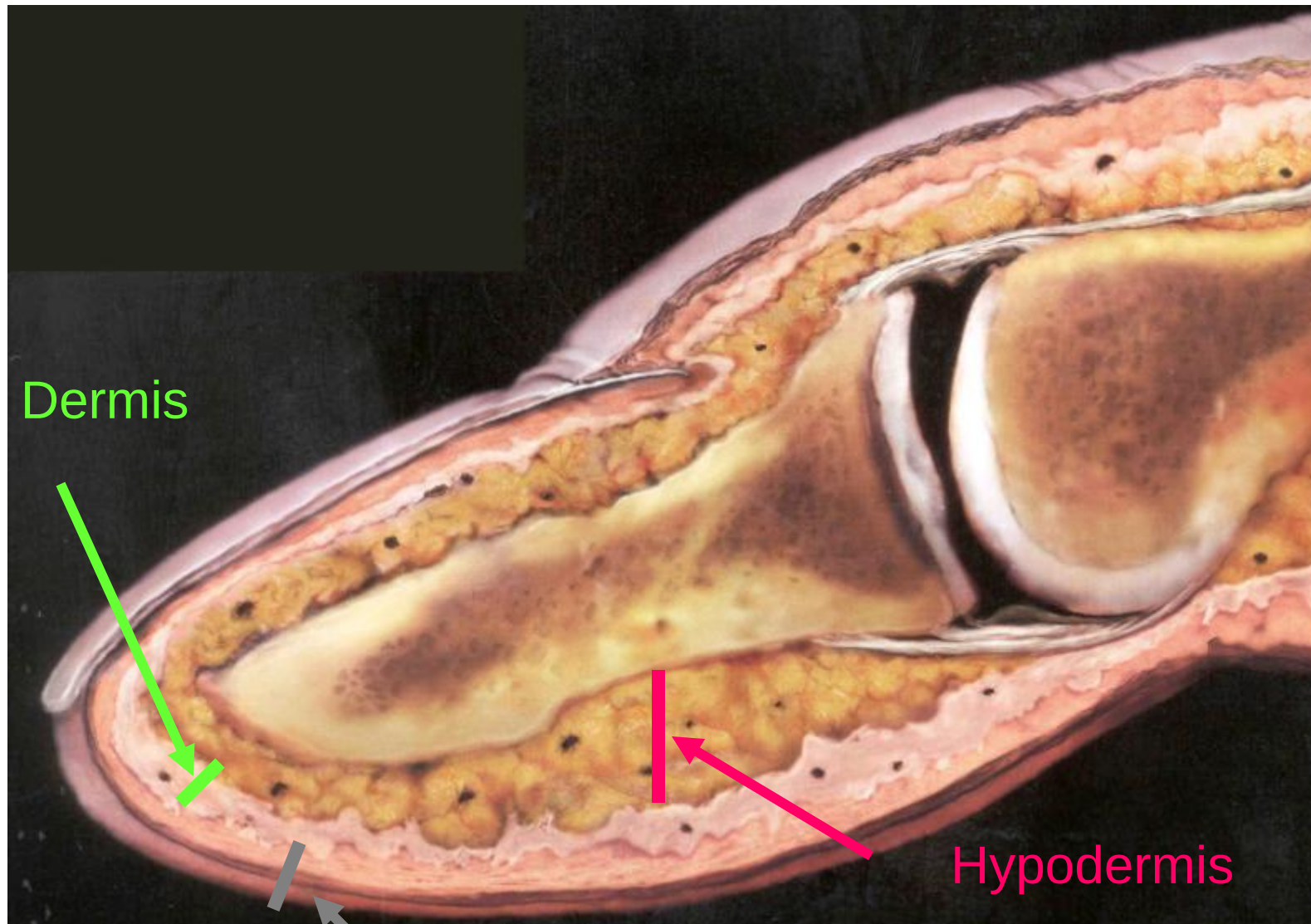
Eccrine glands are activated by heat, explaining why we sweat more profusely as ambient temperatures rise.

Apocrine glands react to stress and sexual activity, and respond by producing sweat with a personally characteristic -- but not (necessarily) unpleasant -- odor.



Mammary Gland – a skin gland, not a reproductive organ...





Dermis

Hypodermis

Epidermis

Support systems

- Support systems built of hard tissues, such as bone and cartilage
- Support systems produced by the manipulation of soft tissues

Soft tissue support -
structures which maintain
structural integrity without
the use of a hard, internal
skeleton.

- Constant volume
- Pressurize
- Hydrostatic skeleton

Tongue

- Muscle & Fluid-based structure
- Attached to what bones?

Coelom

- A space
- Stable & still base of support

The Skeleton

Cartilage

- Function
- Cartilage materials - chondrocytes
- Interstitial growth
- Perichondrium
- According to a scale from softest to hardest, where does cartilage belong, if other skeletal materials are bone, calcified cartilage, enamel, and dentin?

What is bone made of?

- Hydroxyapatite
- Bone organic content (Osteocytes)
- Bone mineral content

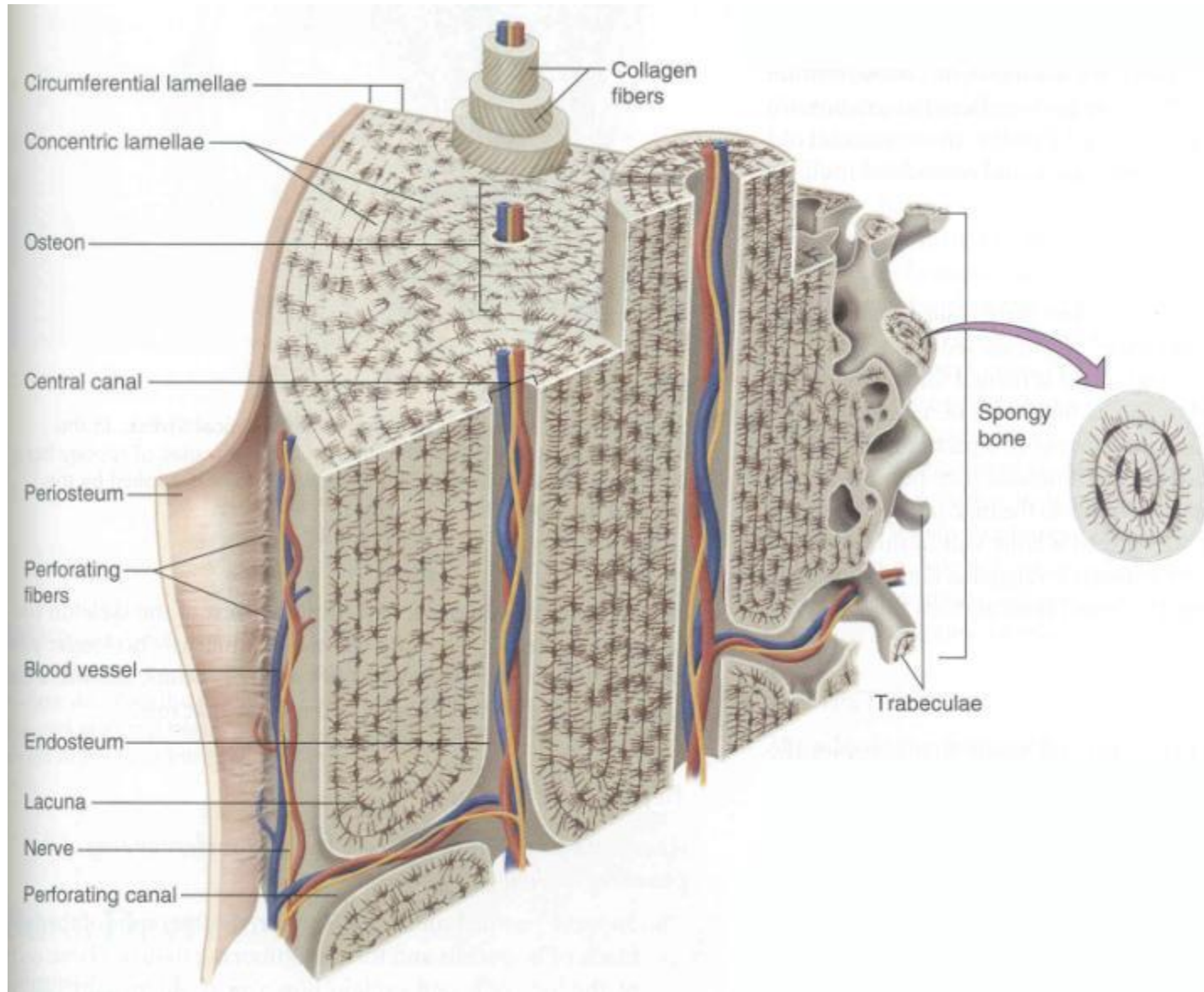
Hydroxyapatite:

What is bone made of?

Hydroxyapatite:

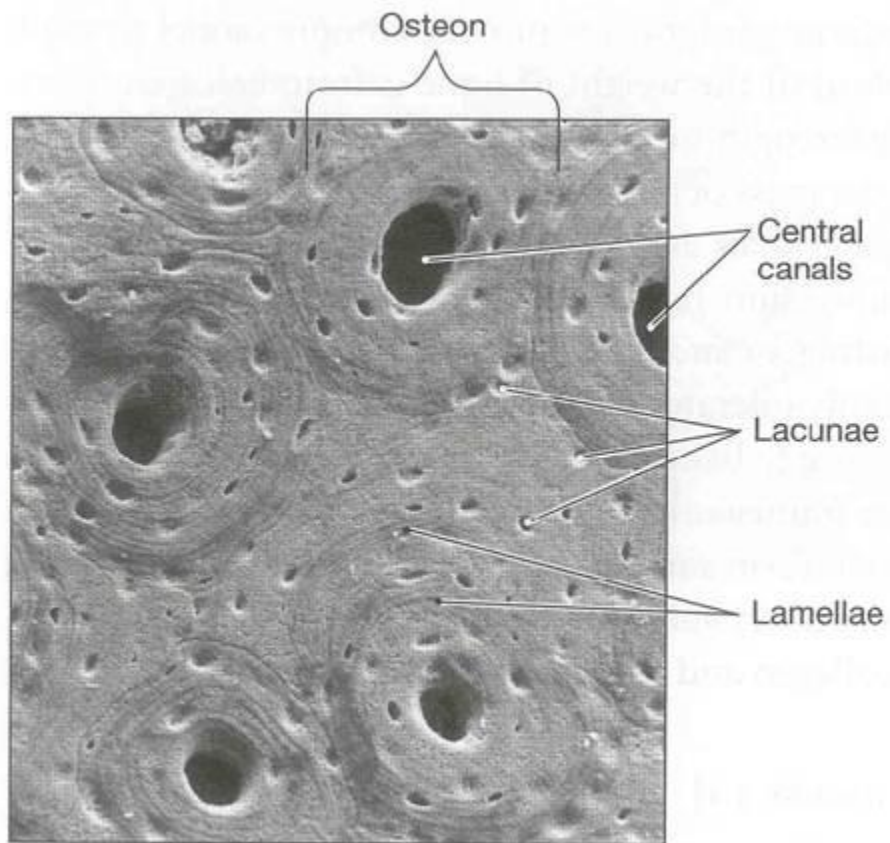


Bone structure

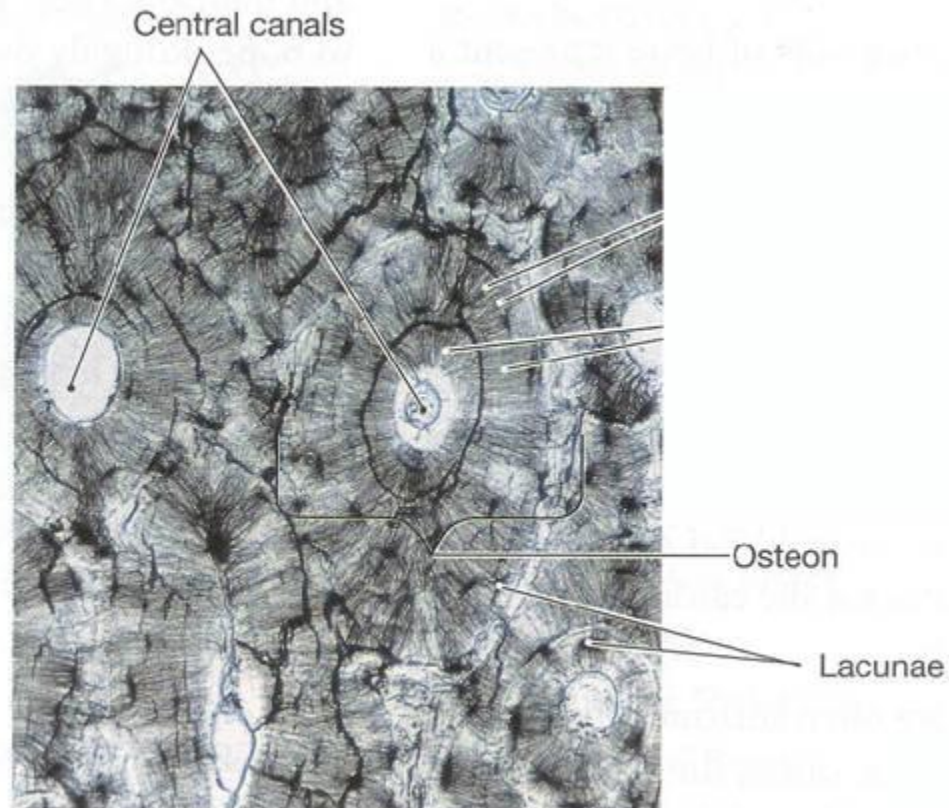


Haversian systems

- Haversian canals
- Lacunae
- Canaliculi



(b) SEM of osteons ($\times 182$)

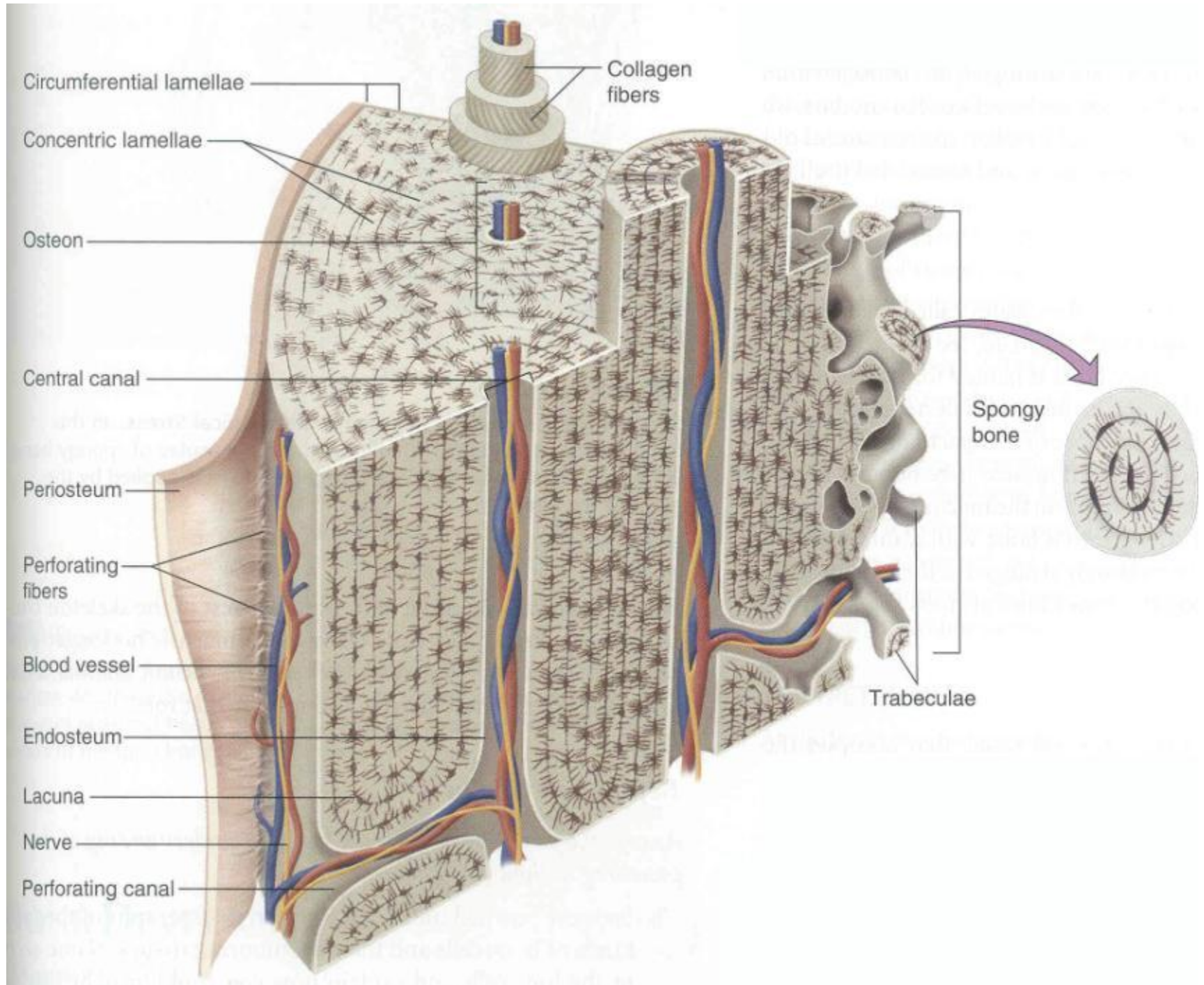


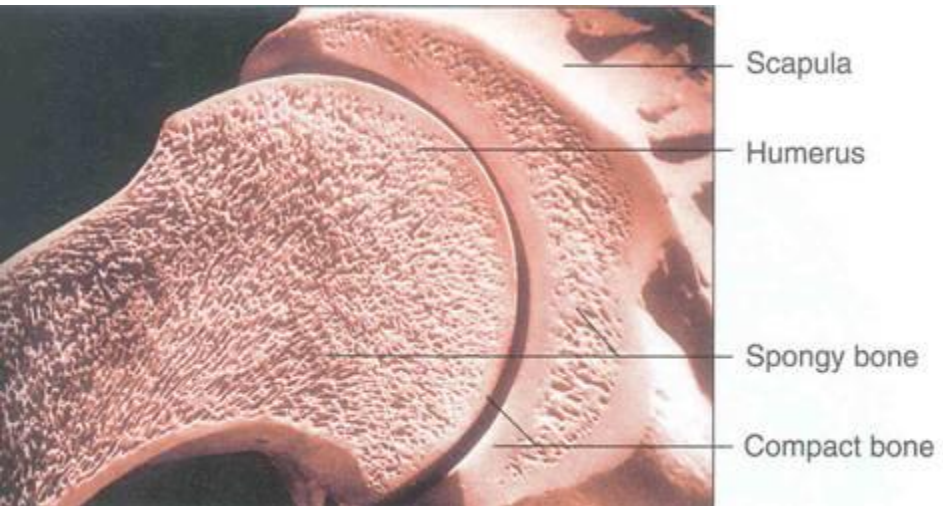
(c) Light micrograph of osteons ($\times 220$)

Compact Bone

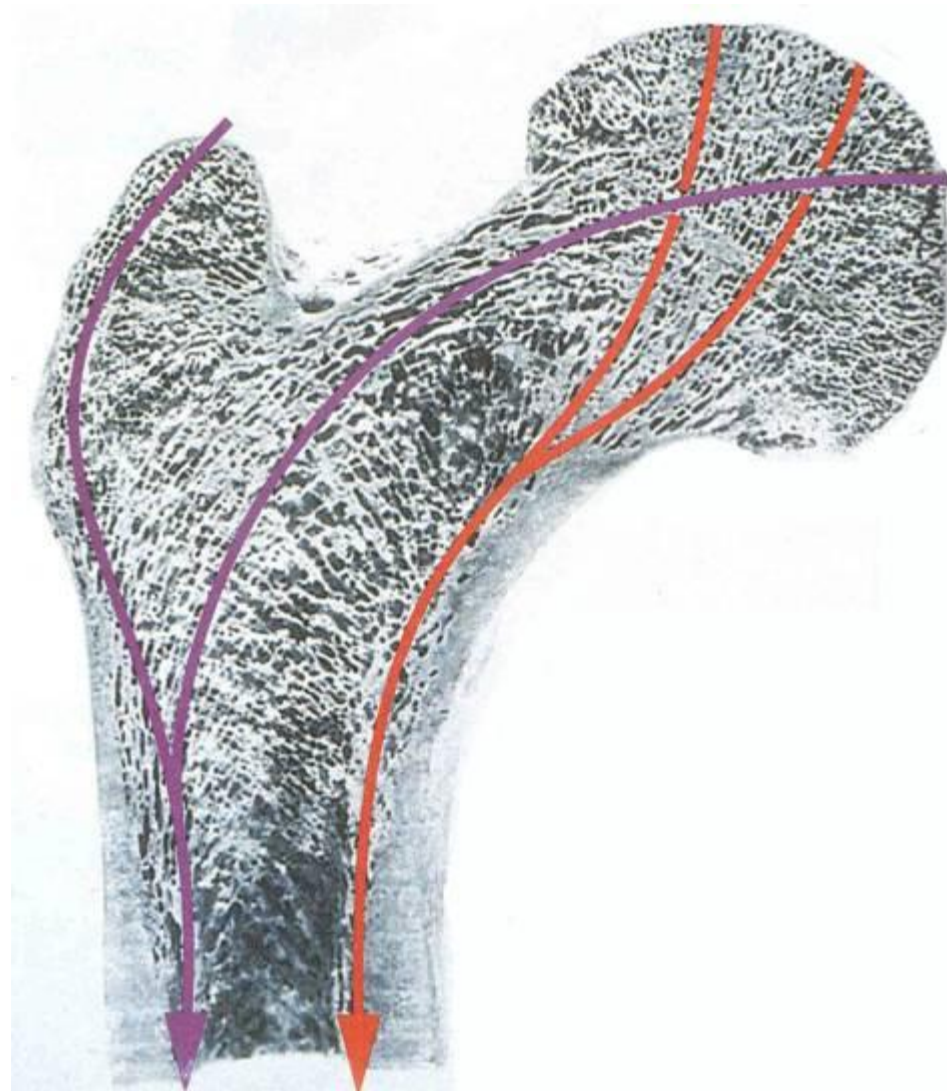
vs.

Spongy Bone
(Trabecular Bone)

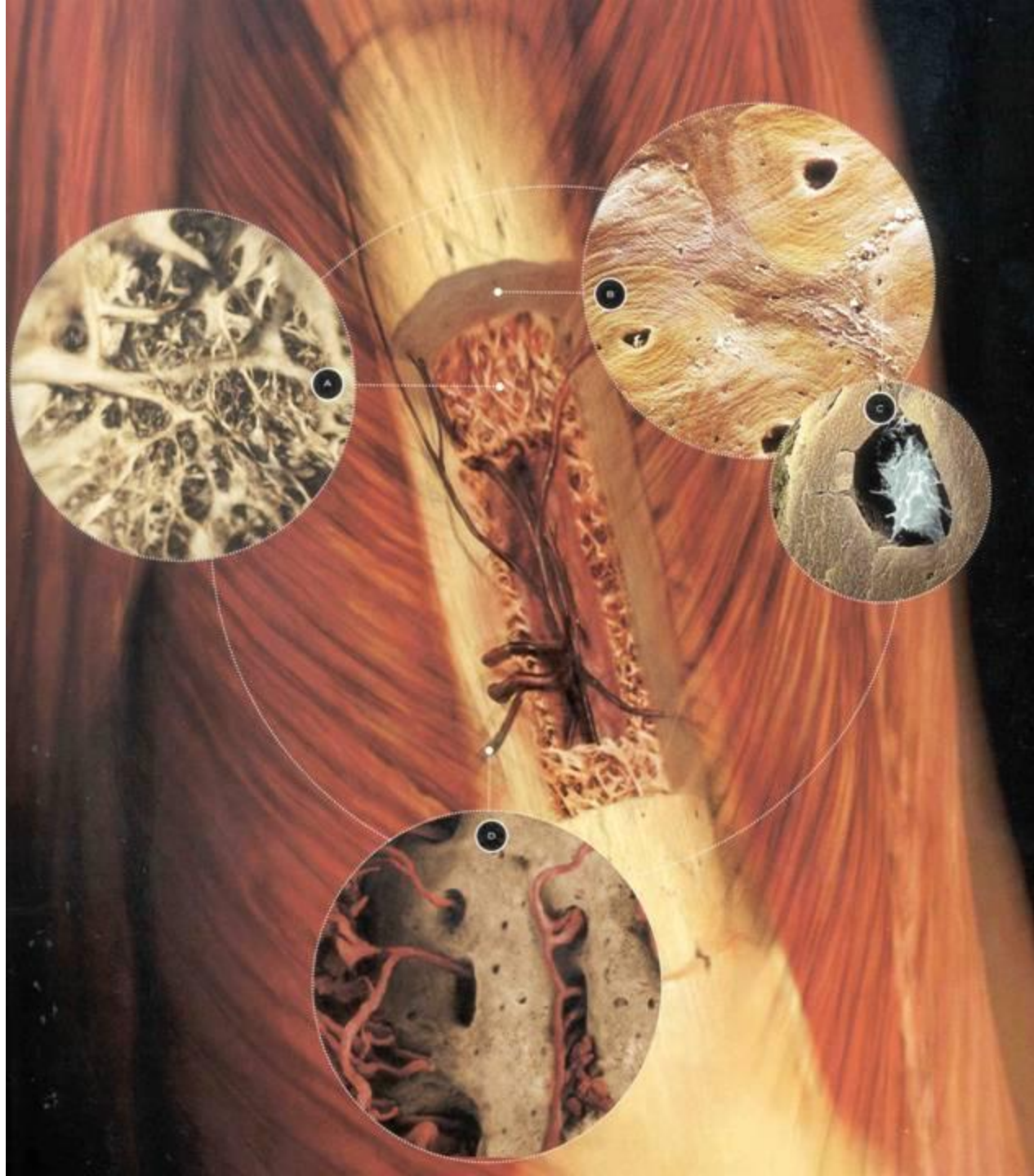




Shoulder Joint



Femur



Regional Classification of the Skeleton

- Endoskeleton vs. exoskeleton
- Visceral skeleton vs. Somatic Skeleton

Visceral skeleton

- Associated with
Splanchnopleure (gut)
- Origin

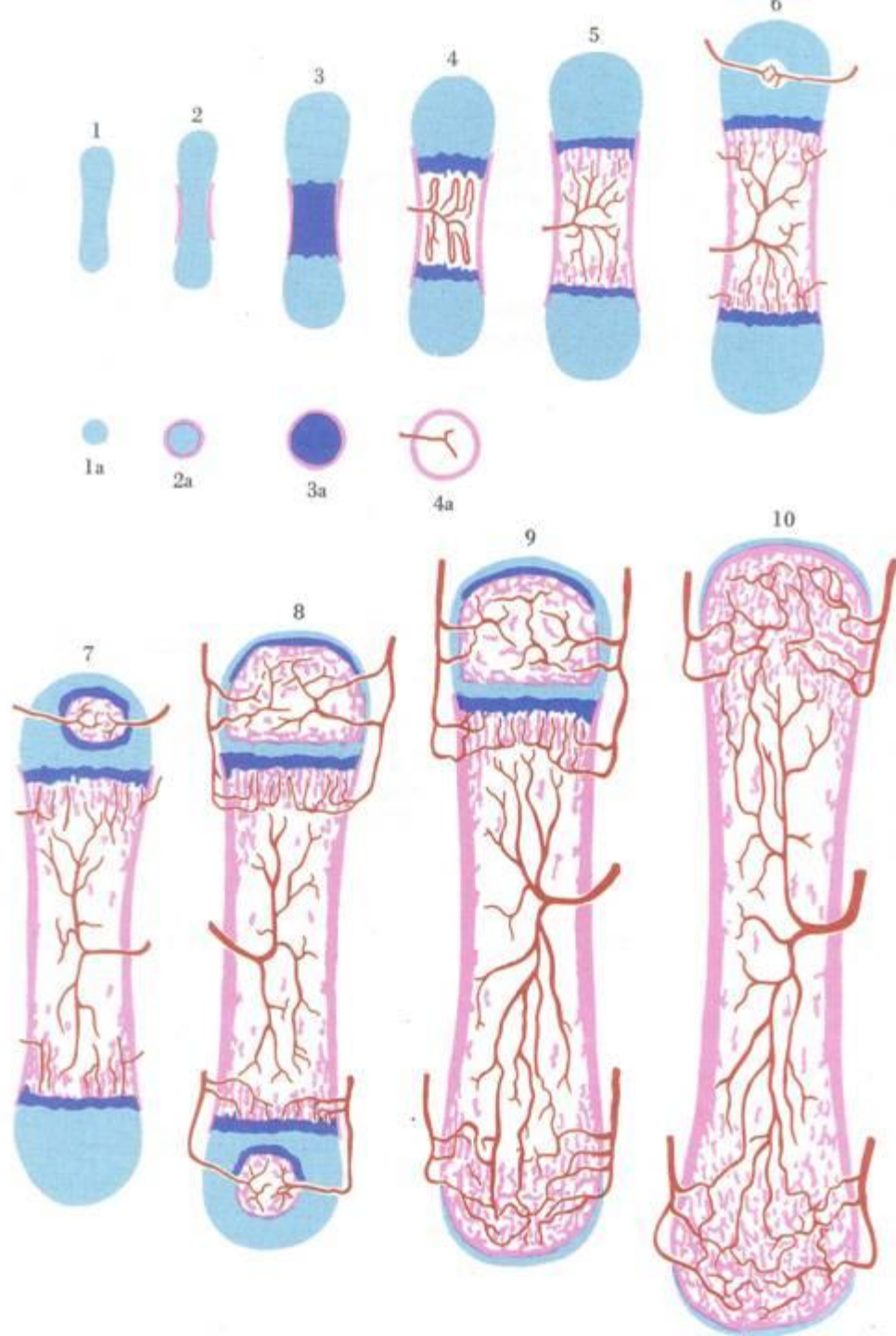
Somatic skeleton

Associated with Somatopleure

- Origin
- Axial skeleton
- Appendicular skeleton

Developmental Classification of the Skeleton

- Endochondral bones vs. dermal bones
- Endochondral - epiphysis & epiphyseal plates
- Dermal - "intramembranous bones"



Diaphysis

Epiphyseal
plate

Epiphysis

Epiphyseal
plates



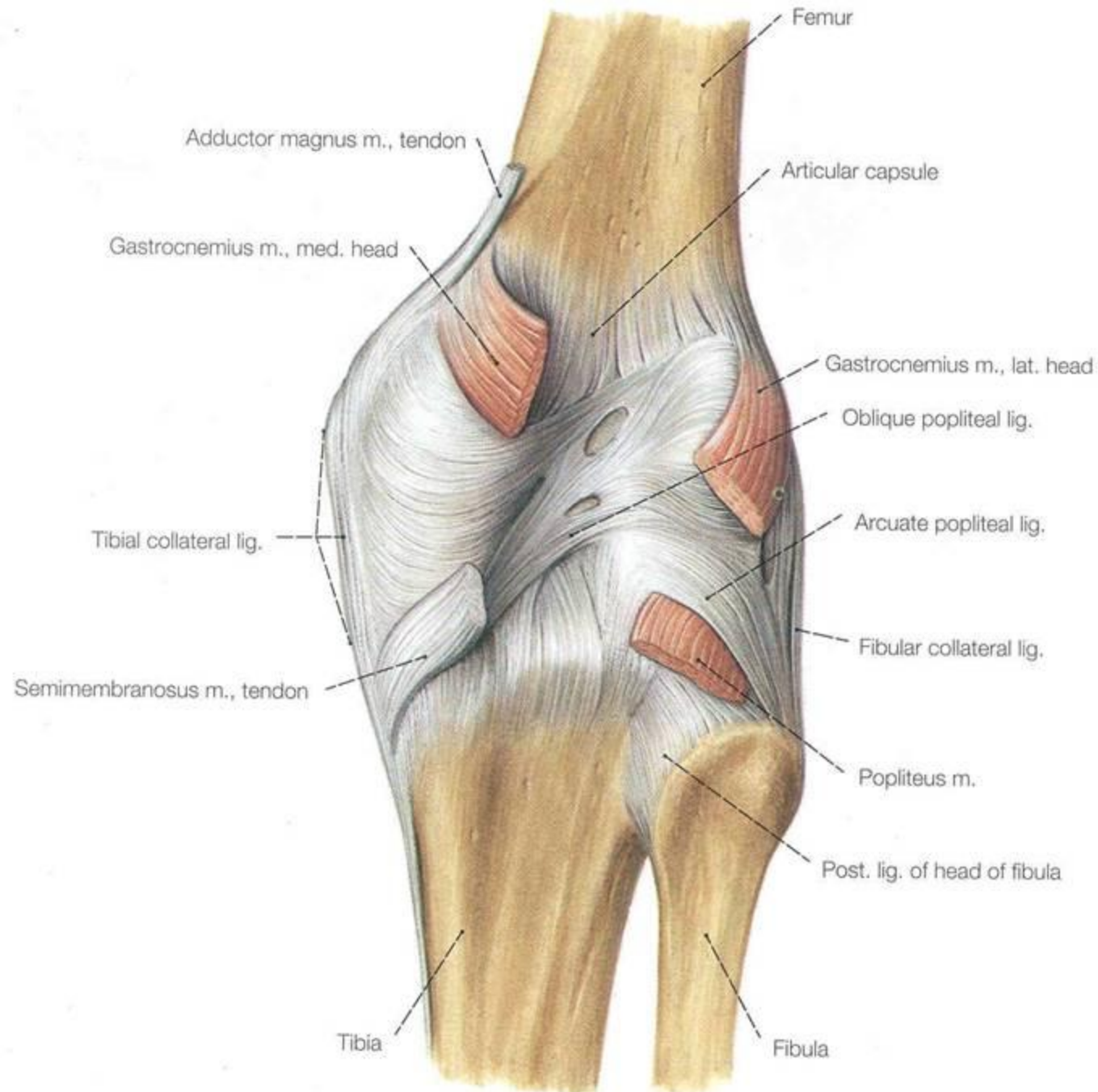
Bone Function

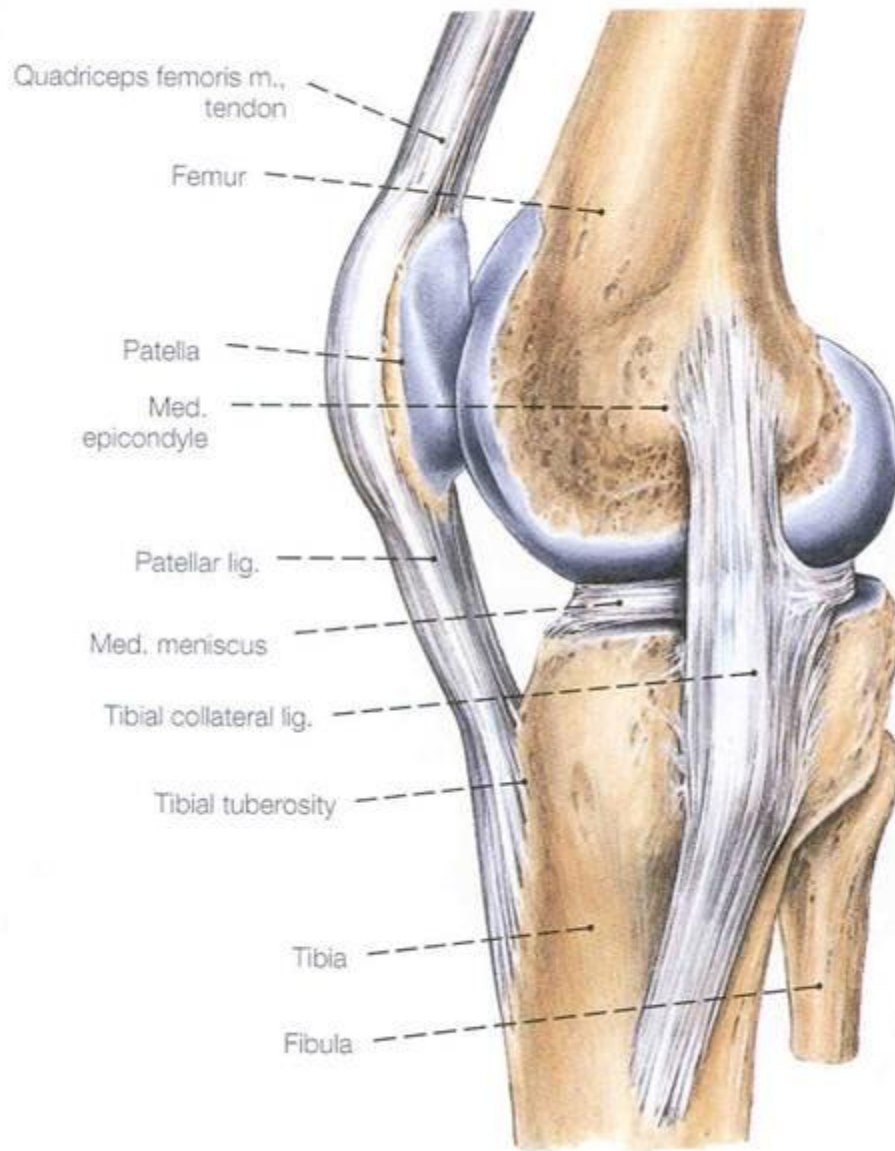
- Structural
- Red blood cell manufacture
- Homeopoietic tissue
- Red bone marrow vs. yellow bone marrow
- Mineral regulation
- Calcium levels
- Importance of phosphorus

Articulations

- Different types of bone attachments
- Ligaments
- The Joint Capsule

Joint Capsule of Knee



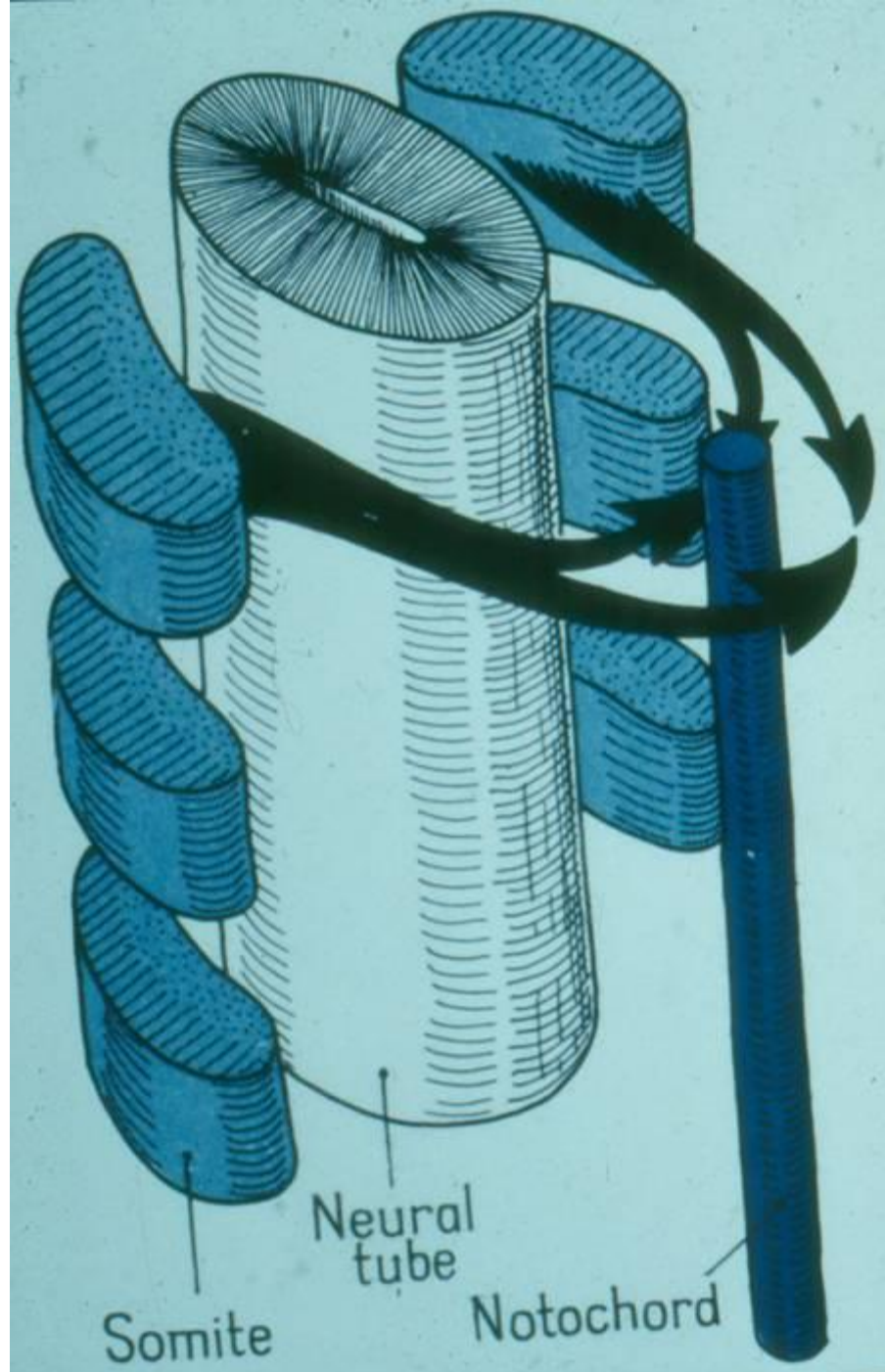


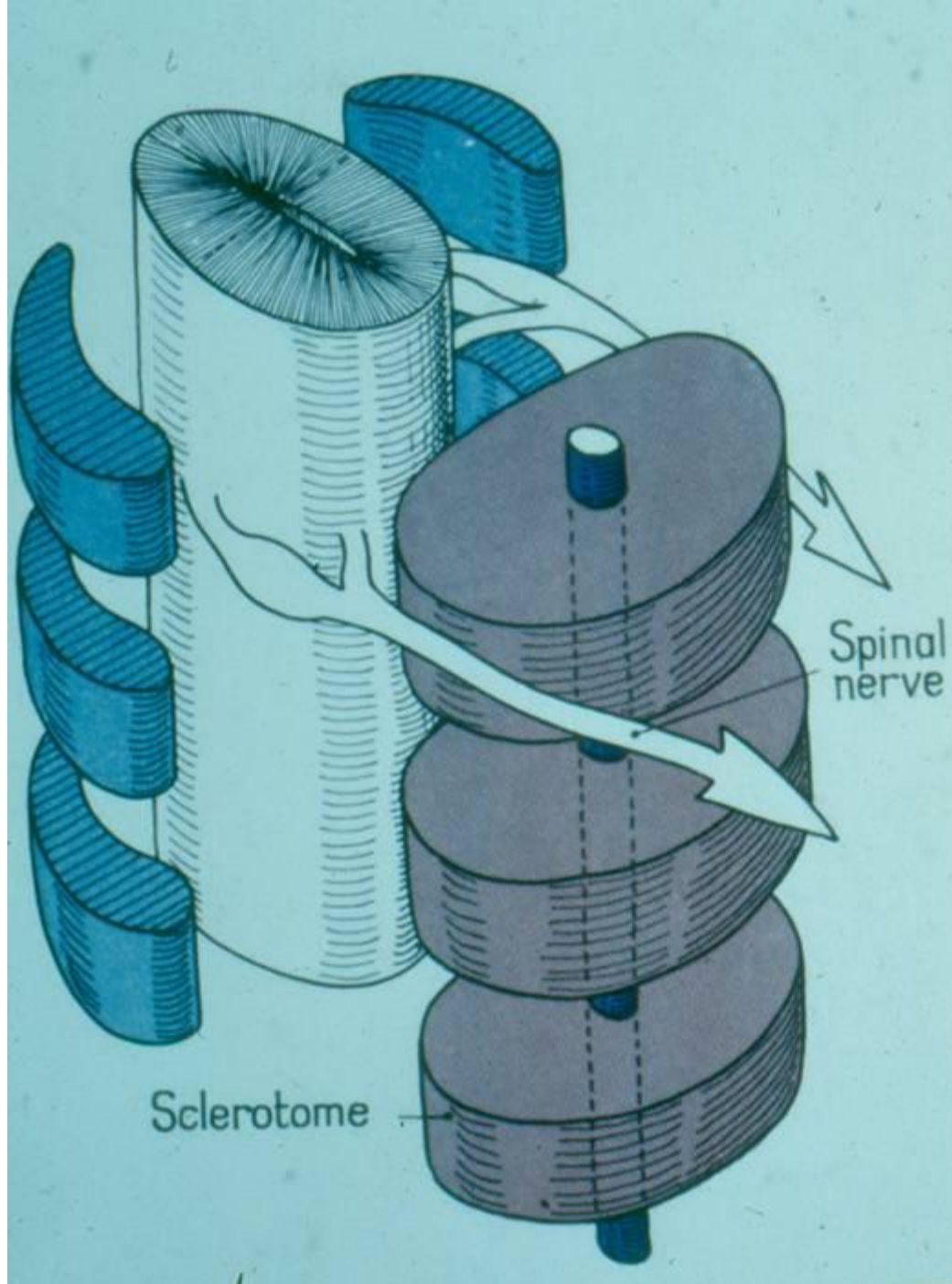
Examples of Major Ligaments of Knee

Movements and the Skeleton

- Flexion
- Extension
- Rotation
- Circumduction
- Abduction
- Adduction
- Protraction
- Retraction
- Depression
- Elevation
- Supination
- Pronation
- Opposition
- Reposition
- Inversion
- Eversion

Axial Skeleton





Cervical
vertebrae,
1st-7th

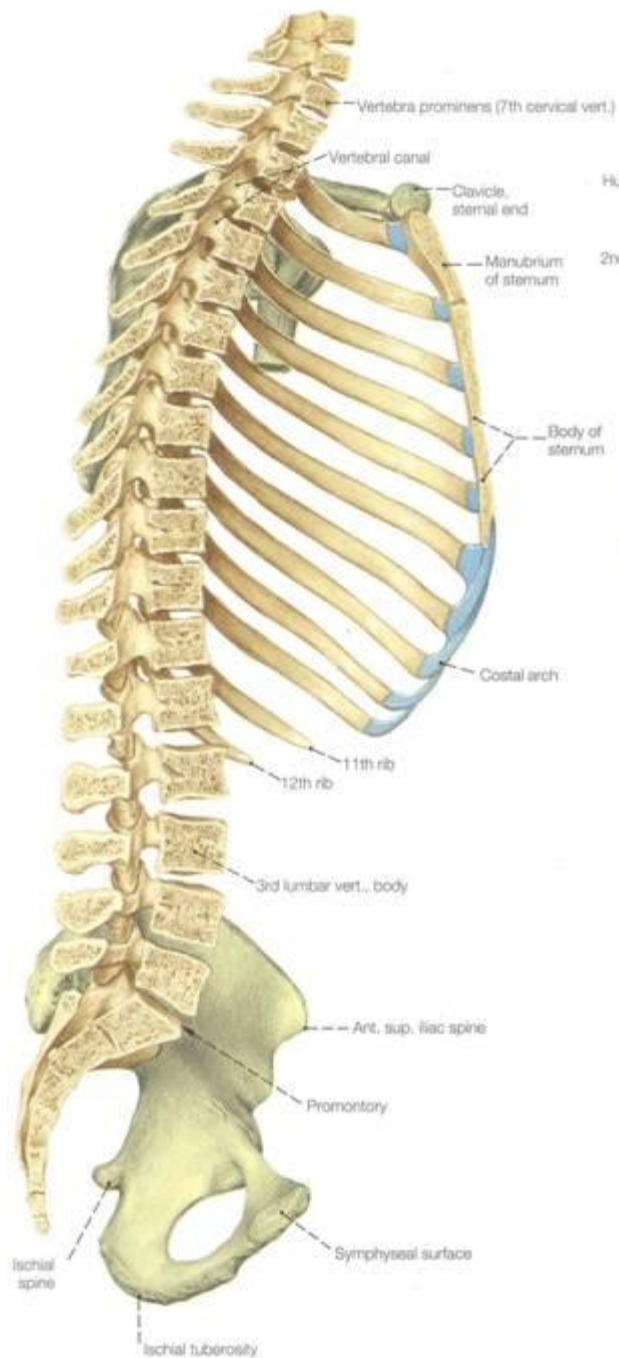
Thoracic
vertebrae,
1st-12th

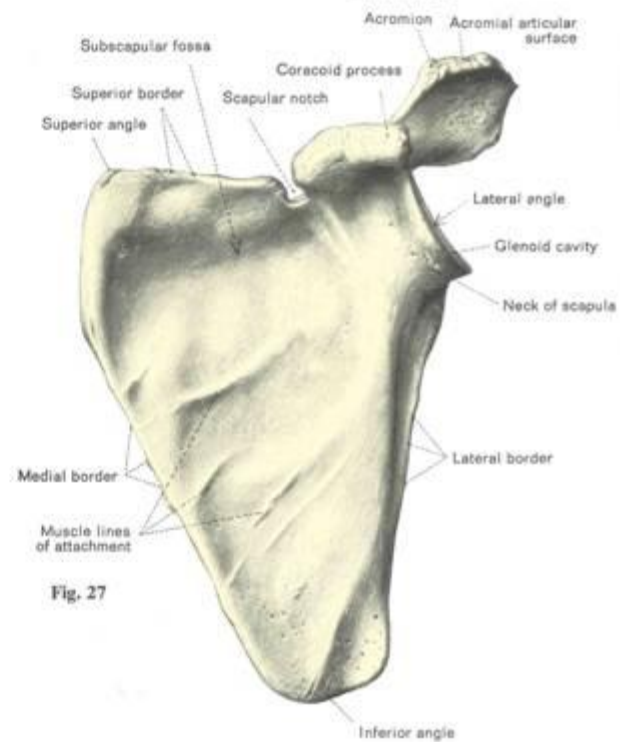
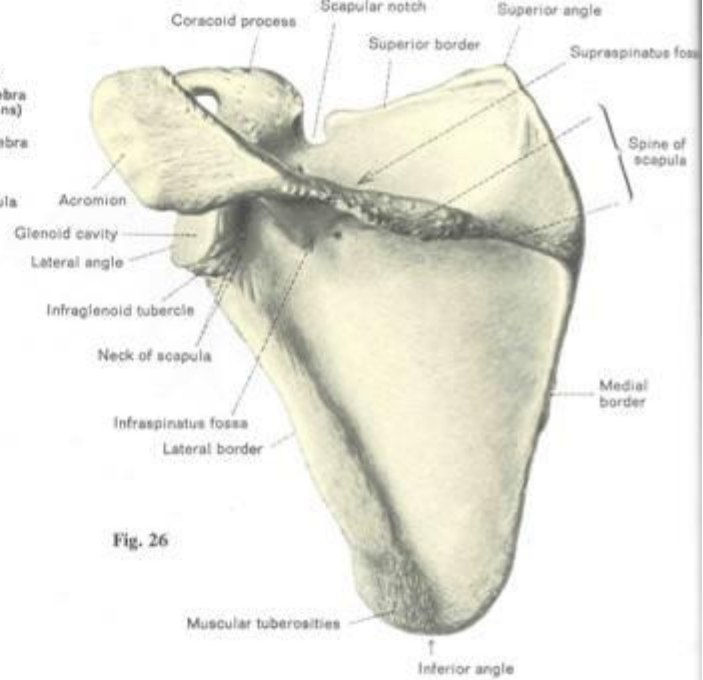
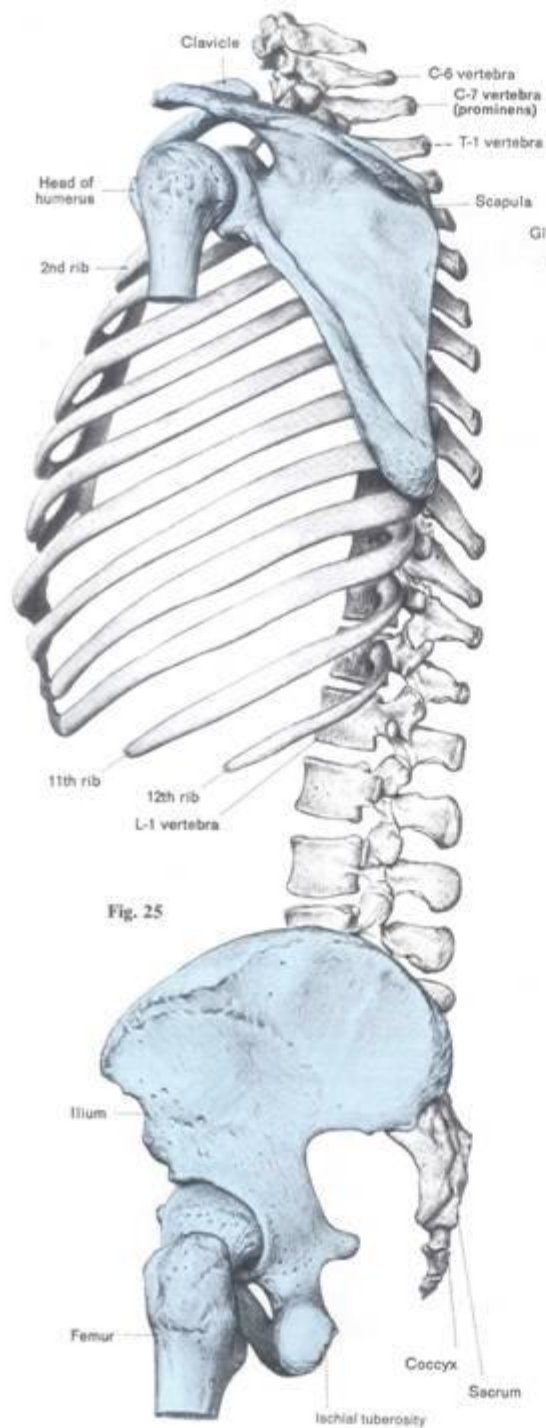
Lumbar
vertebrae,
1st-5th

Sacrum
(sacral
vertebrae,
1st-5th)

Coccyx
(coccygeal
vertebrae,
1st-4th)

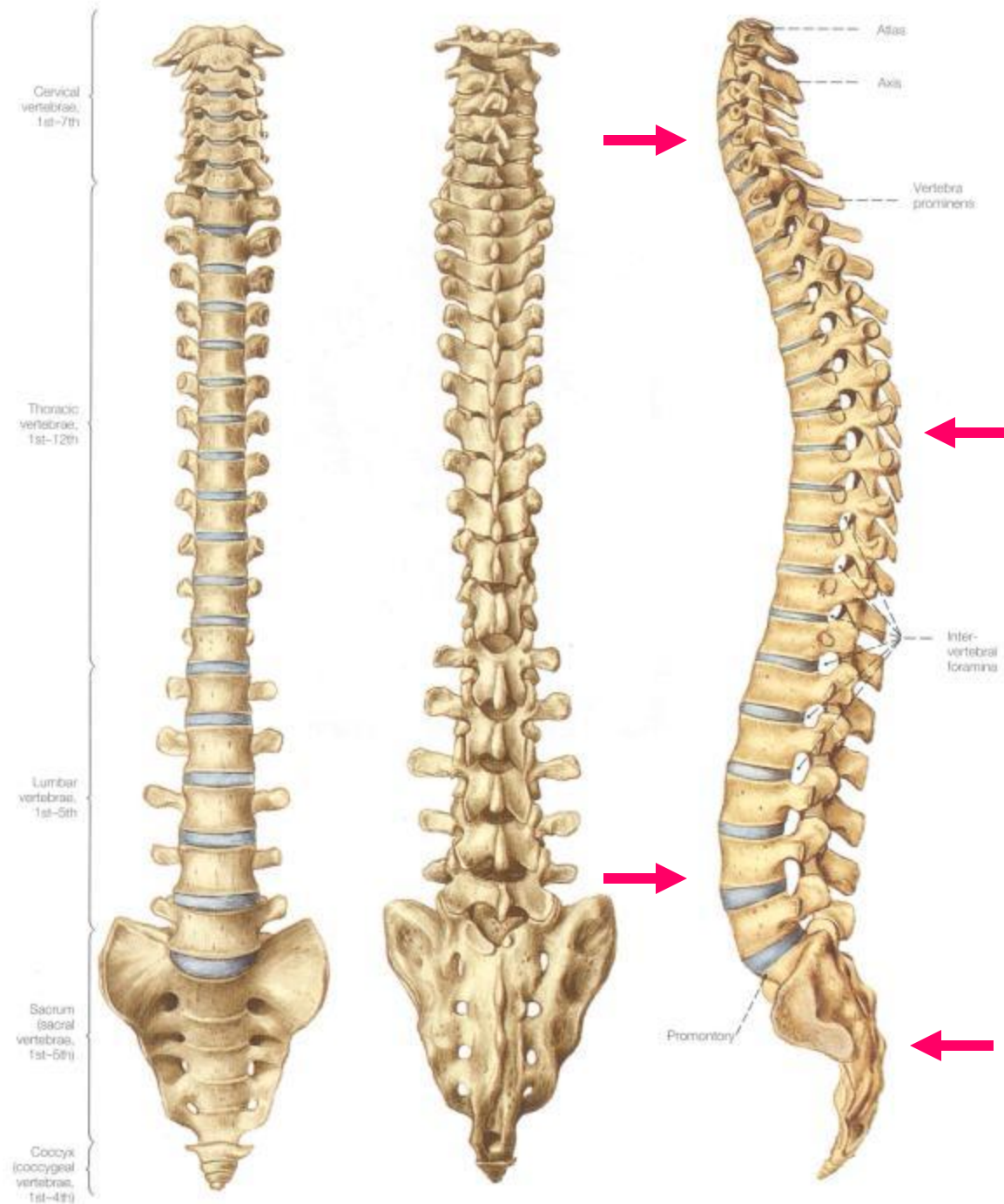






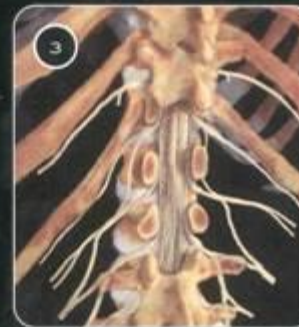
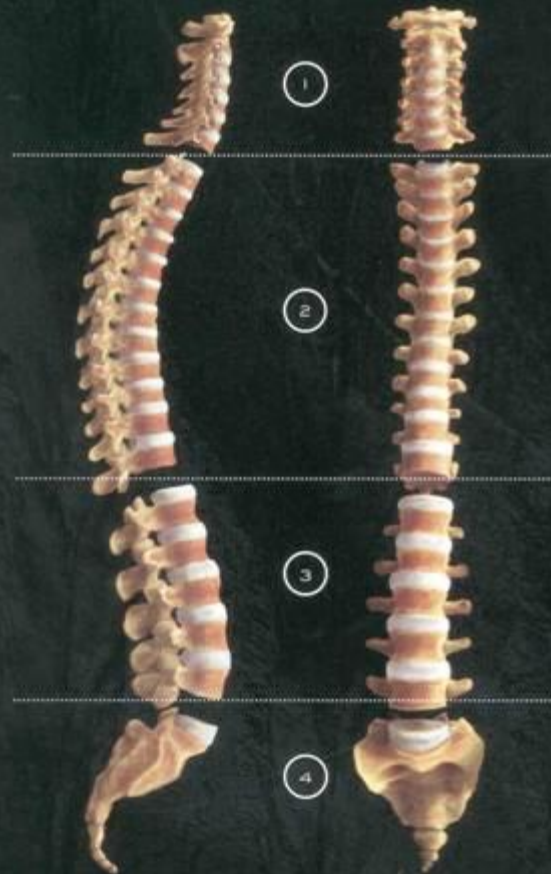


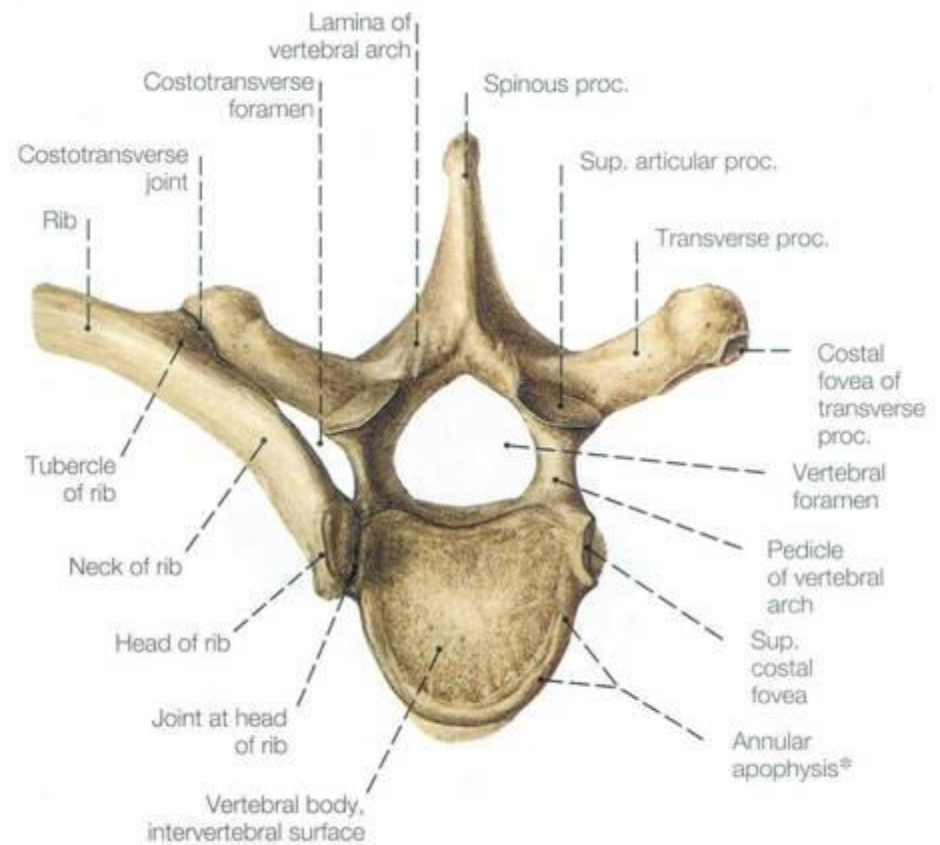
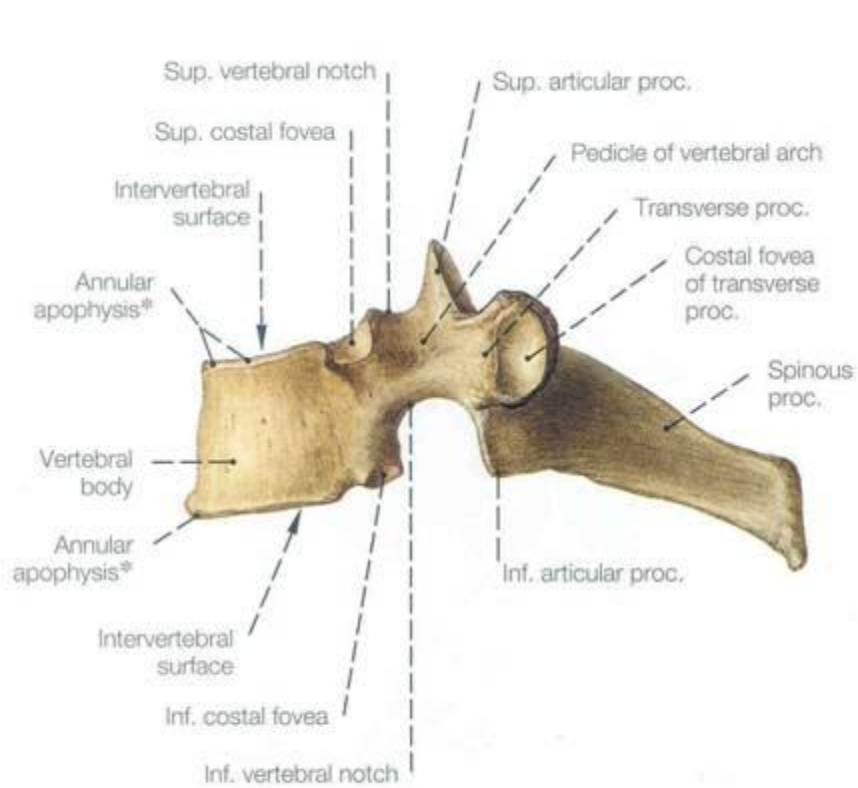
4 Distinct Curvatures of the Vertebral Column

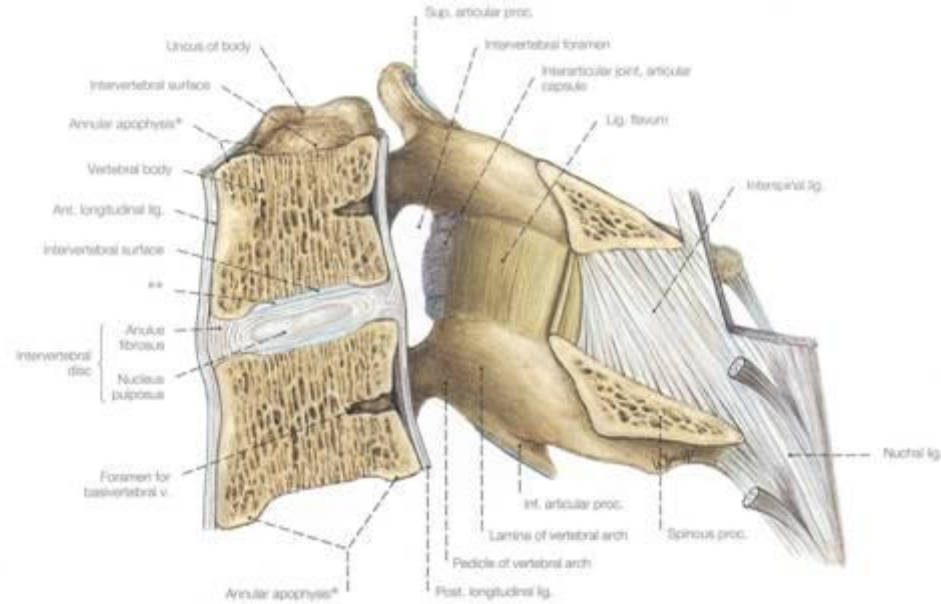


DIFFERENT REGIONS. DIFFERENT SHAPES

Each section of the spine is designed for a specific purpose. The flattened vertebrae on top support the head and neck; those behind the chest anchor the rib cage; and those at the base are thick, wide, and strong, to bear weight and provide stability.



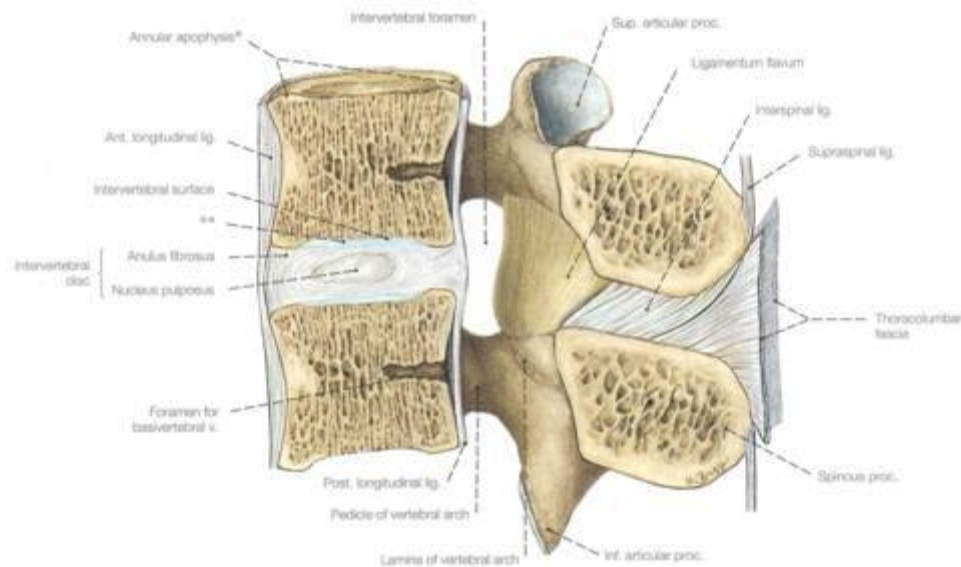




Cervical intervertebral joints,
schematic of a median section (180%).

* Rim of vertebral body

** Hyaline cartilaginous covering of the end plate,
a nonossified portion of the epiphysis of the
vertebral body



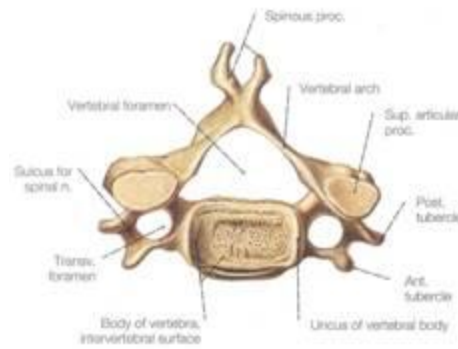
Lumbar intervertebral joints,
schematic of a median section (100%).

* Rim of vertebral body

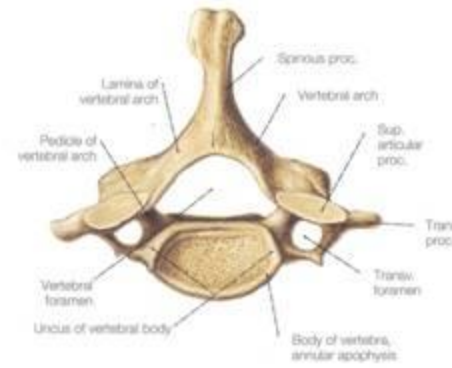
** Hyaline cartilaginous covering of the endplate,
a nonossified portion of the epiphysis of the
vertebral body

Cervical vertebrae:

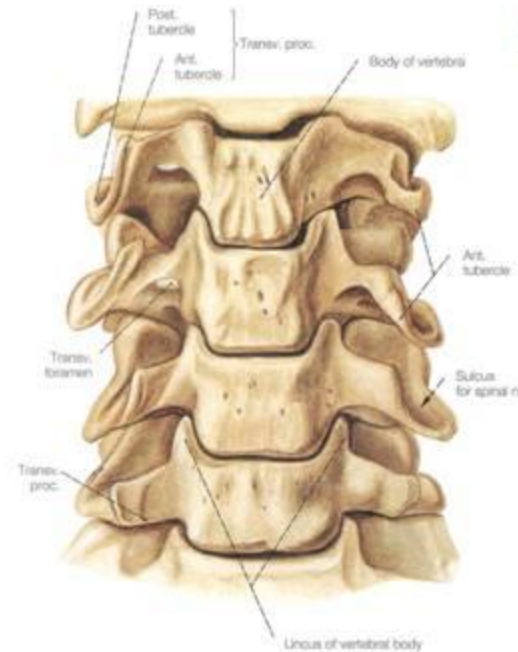
- Transverse foramen
- Vertebral artery



Fifth cervical vertebra, viewed from above (100%).
The spinous processes of the second to sixth cervical vertebrae are generally split (i.e., bifid).



Seventh cervical vertebra, viewed from above (100%).
The seventh cervical vertebra is generally distinguished on the basis of its protruding spinous process and is known as the vertebra prominens. Actually, the spinous process of the first thoracic vertebra protrudes even further.



The second to seventh cervical vertebrae, ventral view (120%).

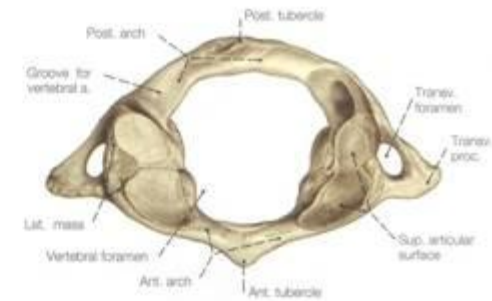


The first to seventh cervical vertebrae, laterodorsal view (110%).

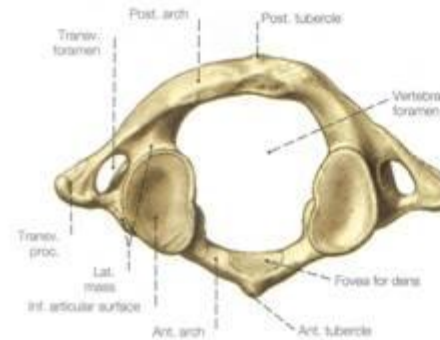
Atlas and Axis Vertebrae



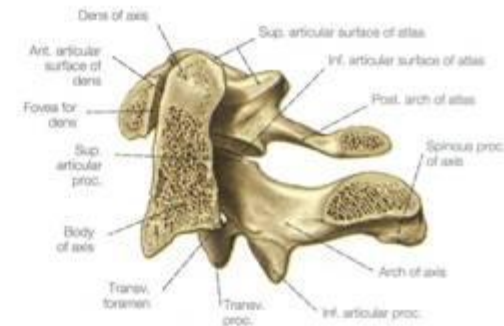
The occipital bone. Segment showing the foramen magnum and the articular surfaces of the atlanto-occipital joint.



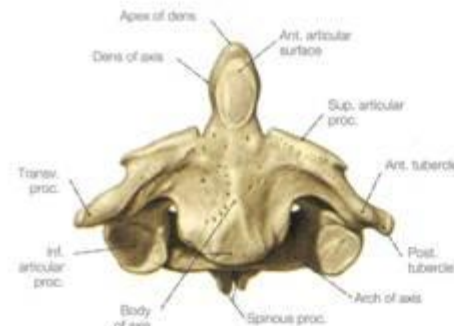
First cervical vertebra, atlas, viewed from above (85%). The arterial vertebral canal shown on the left side is a variant. The superior articular surfaces of the atlas are frequently divided.



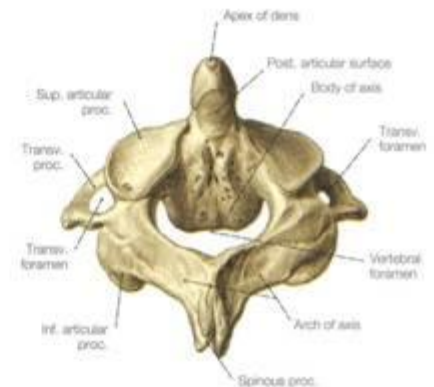
First cervical vertebra, atlas, viewed from below (85%).



First and second cervical vertebrae, atlas and axis, median view of a median sagittal section (90%).

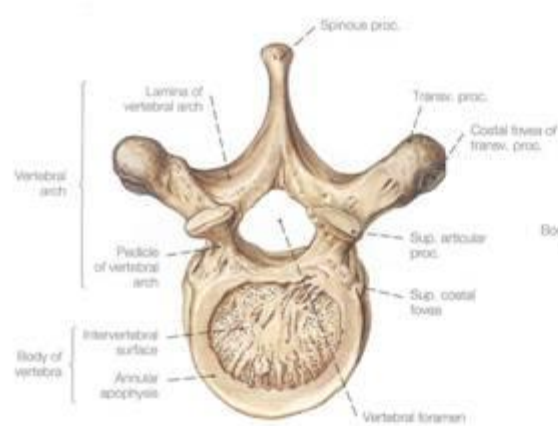


Second cervical vertebra, axis, ventral view (90%).

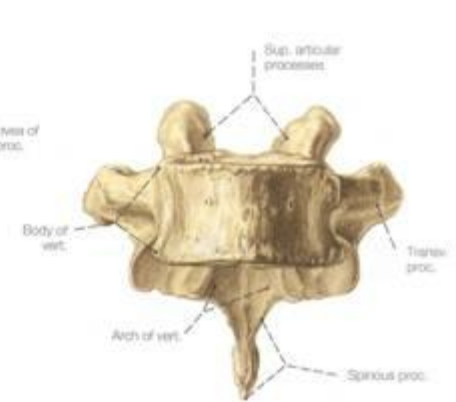


Second cervical vertebra, axis, dorsal view from above (90%).

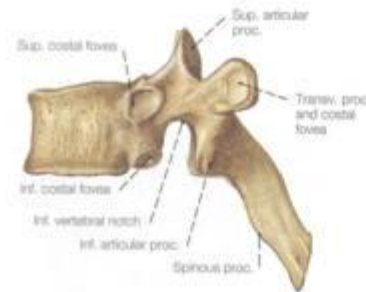
Thoracic vertebrae



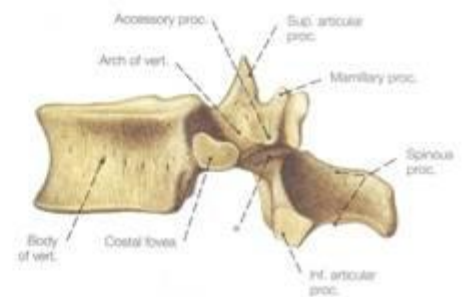
Tenth thoracic vertebra, viewed from above (90%).



Tenth thoracic vertebra, ventral view (90%).

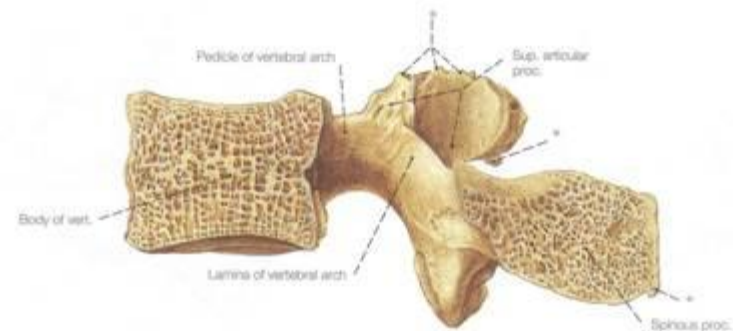


Sixth thoracic vertebra, viewed laterally from the left (90%).



Twelfth thoracic vertebra, viewed laterally from the left (80%).

* Region of the vertebral arch between the superior and inferior articular processes ("isthmus" = interarticular portion)

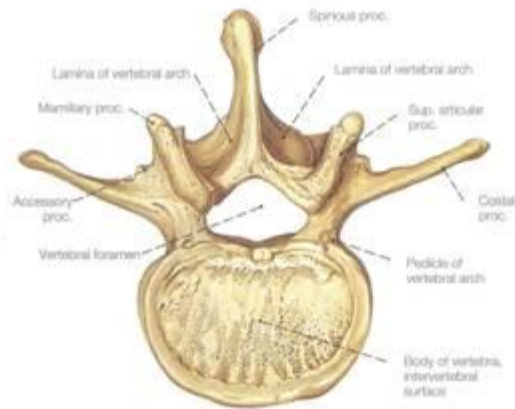


Third lumbar vertebra, medial view of a median sagittal section (110%). Specimen from an elderly person.

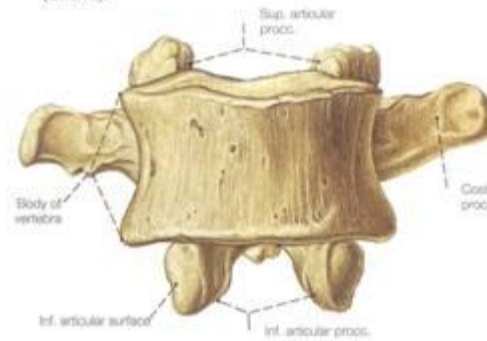
* Ossification of the ligamentous insertions



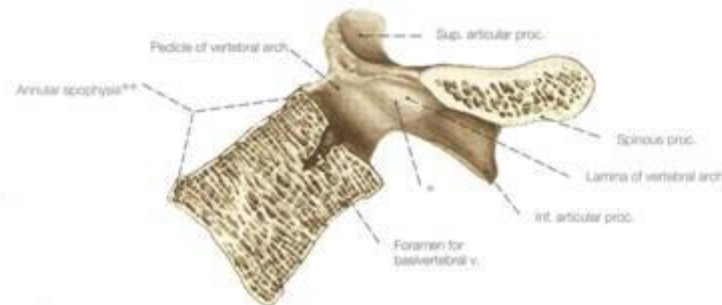
The tenth to twelfth thoracic vertebrae and the first and second lumbar vertebrae, laterodorsal view (70%).



Fourth lumbar vertebra, viewed from above (100%).



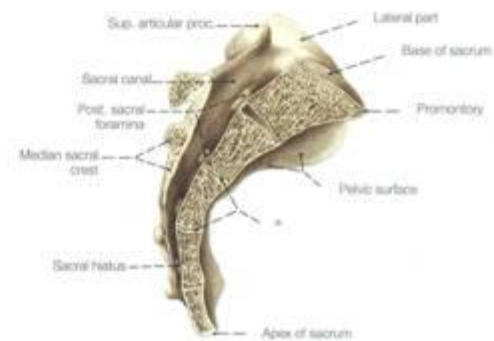
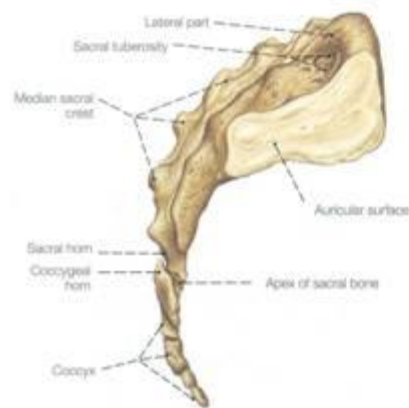
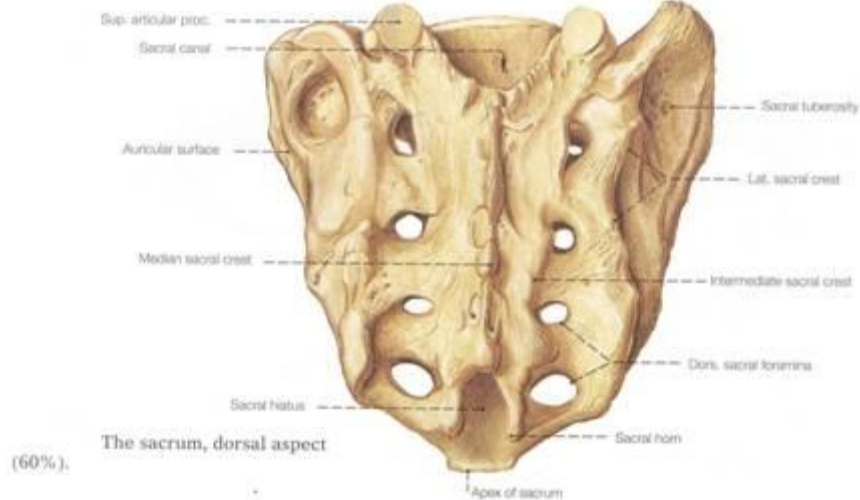
Fourth lumbar vertebra, ventral view (100%).



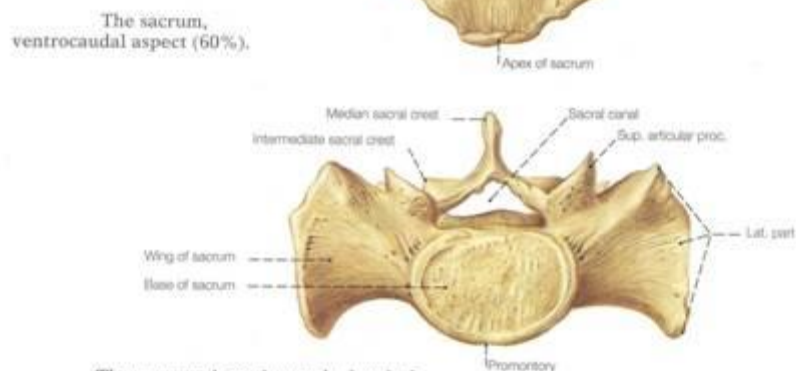
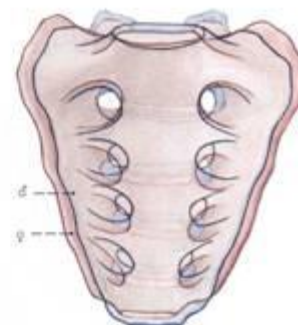
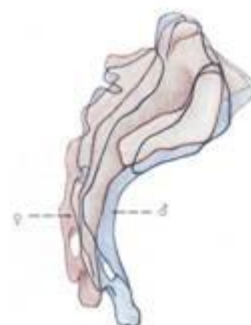
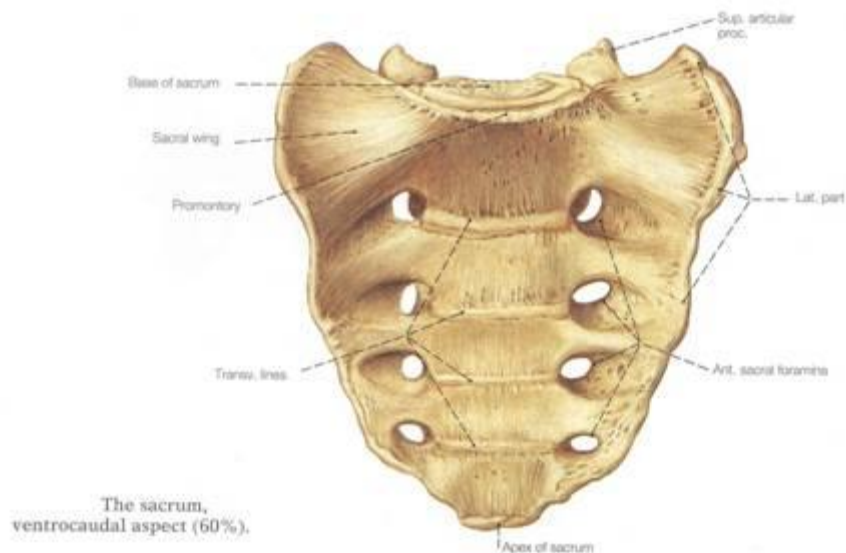
Fifth lumbar vertebra, medial view of median sagittal section (100%). Note the characteristic wedge-shape of the body of the 5th lumbar vertebra.

* The region of the vertebral arch between the superior and inferior articular processes where, possibly due to excessive local flexion loads, a cleft bridged by connective tissue (spondylolysis) can form at the fifth (more seldom at the fourth) lumbar vertebra with subsequent slippage of the body of one vertebra on the vertebra below it (spondylolisthesis).

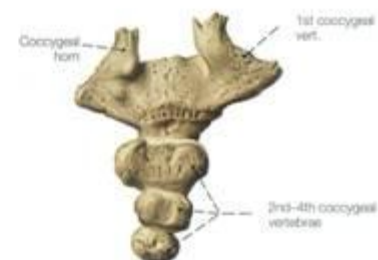
** In this specimen, the anterior border is pathologically oblique.

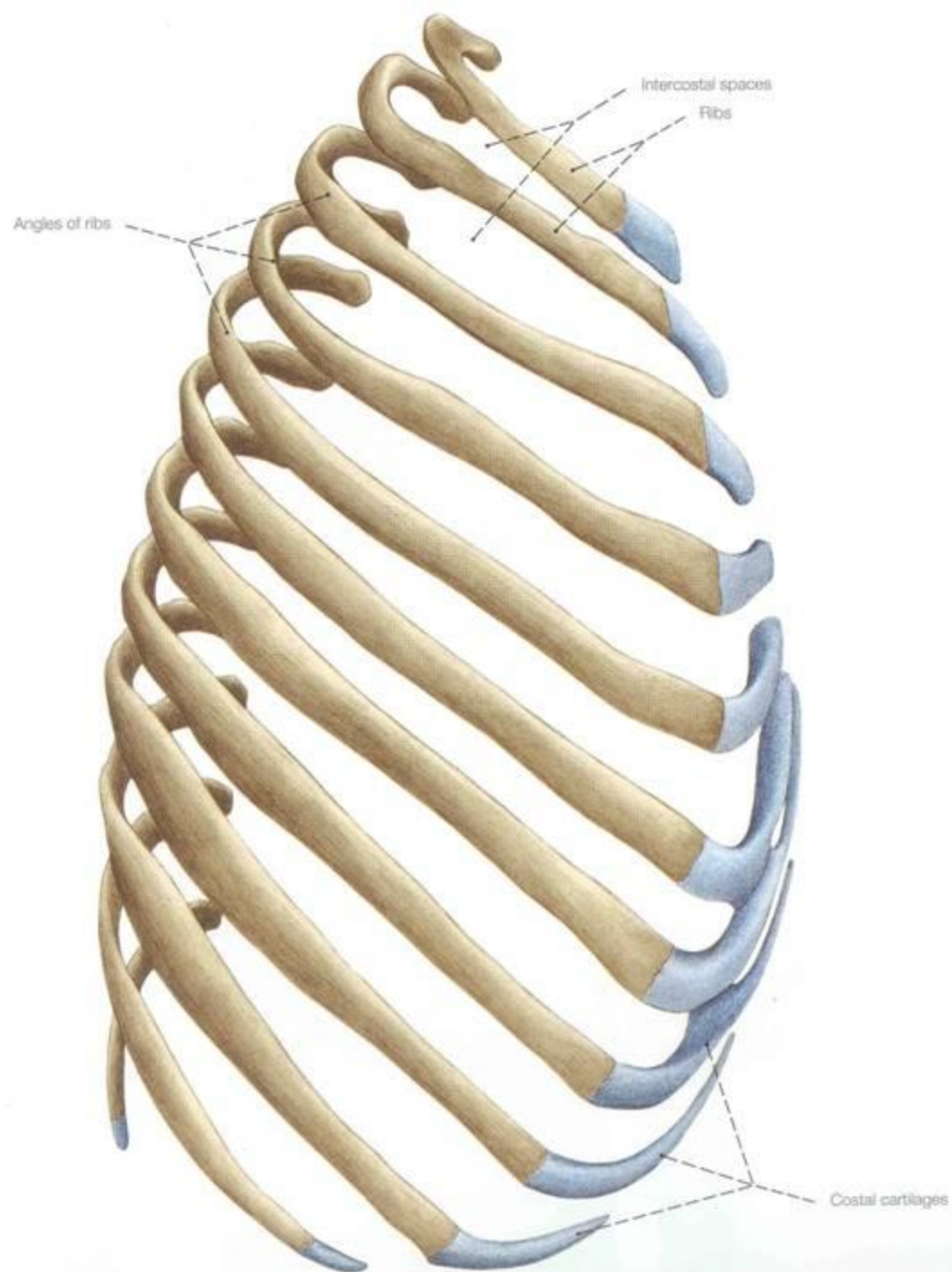


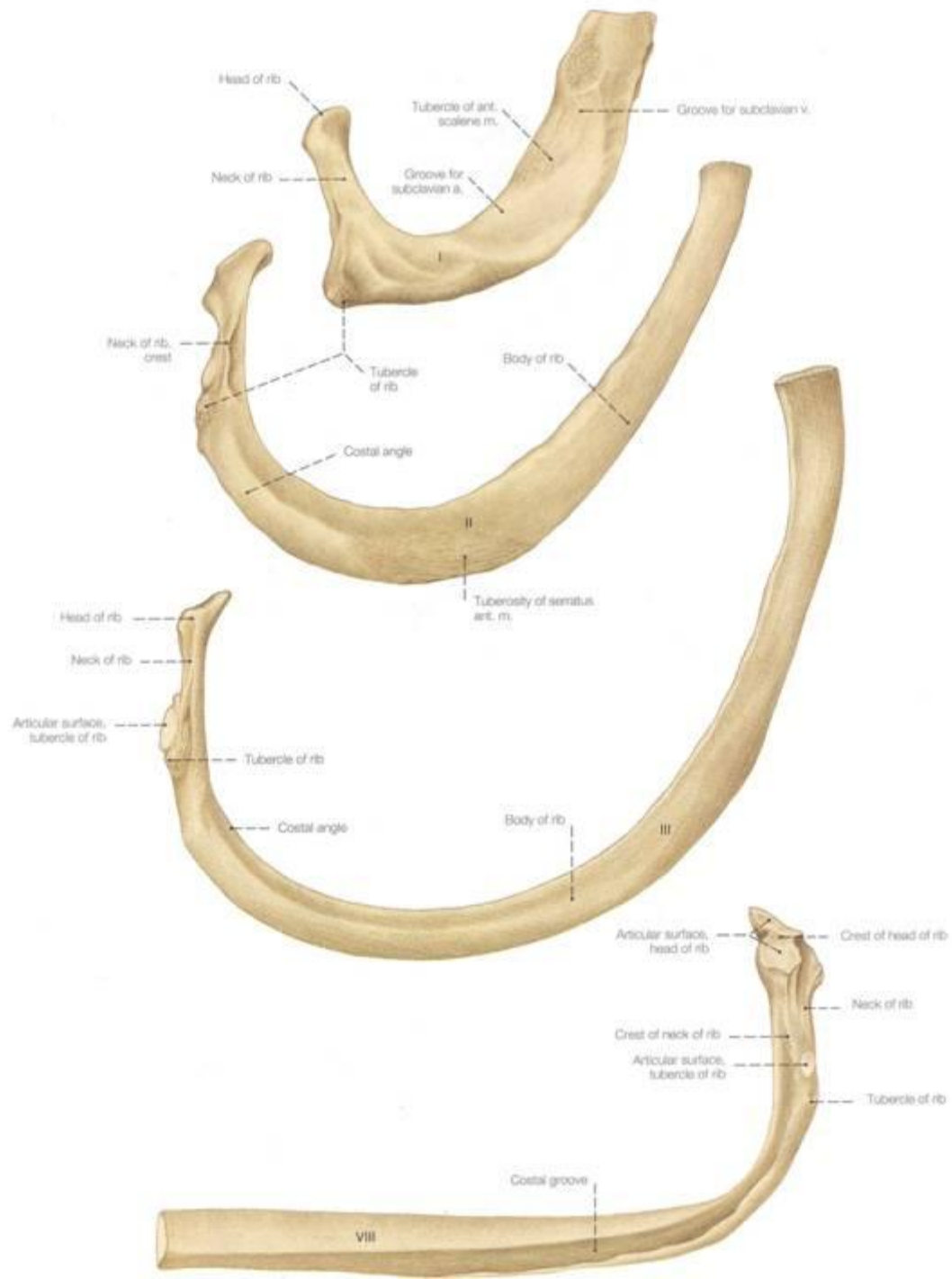
* Remnants of intervertebral disc tissue persist in adults.

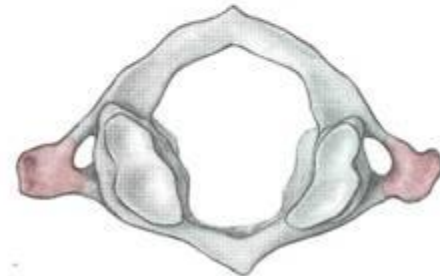
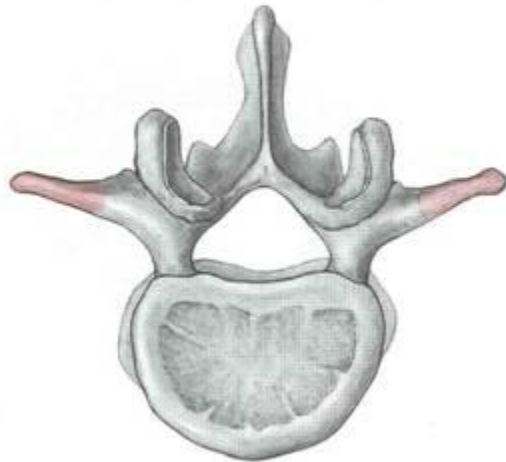
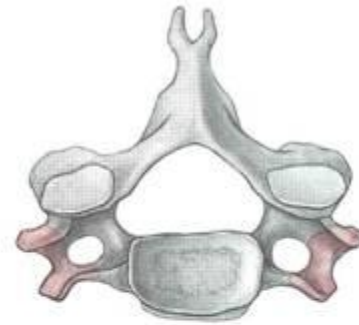
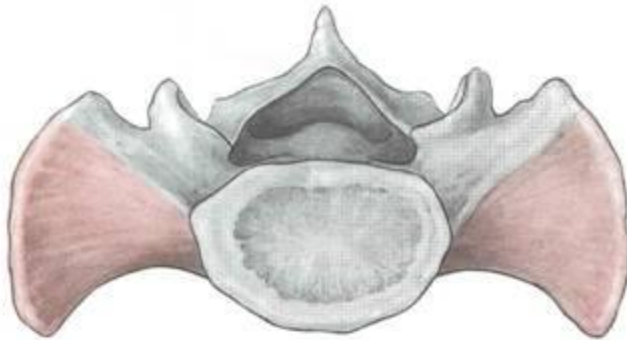
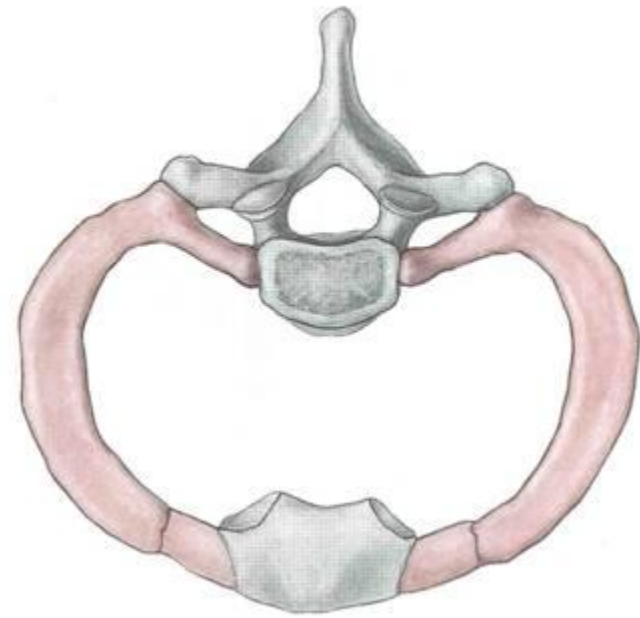


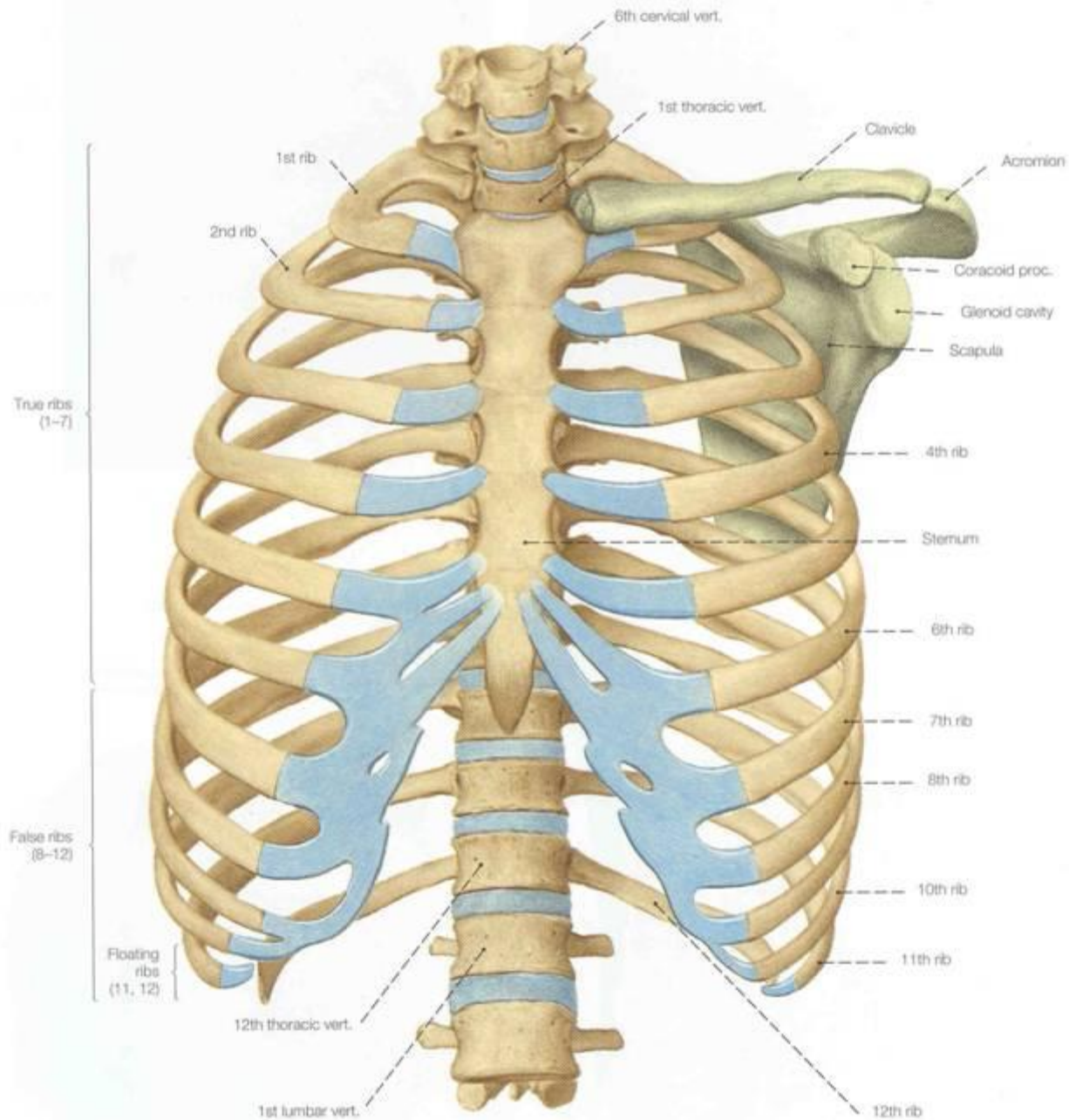
Despite variations in the formation of the intervertebral discs, all postsacral vertebral elements are jointly termed the coccyx.

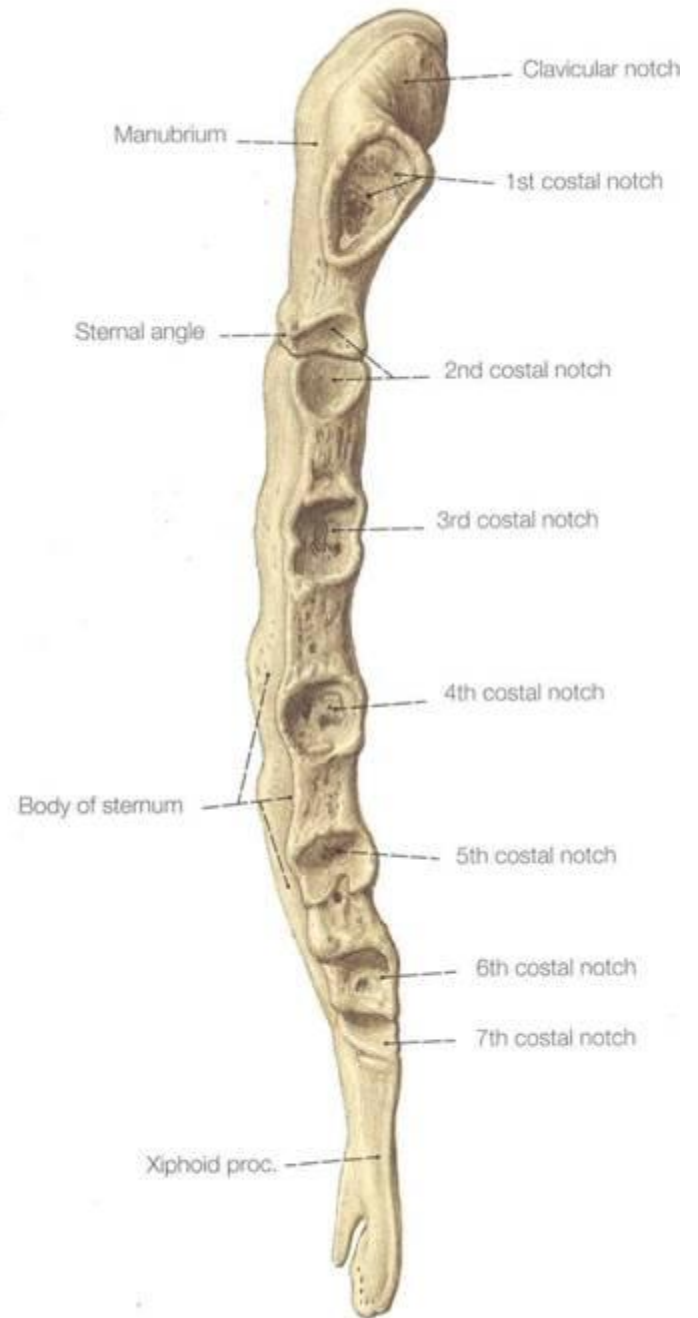
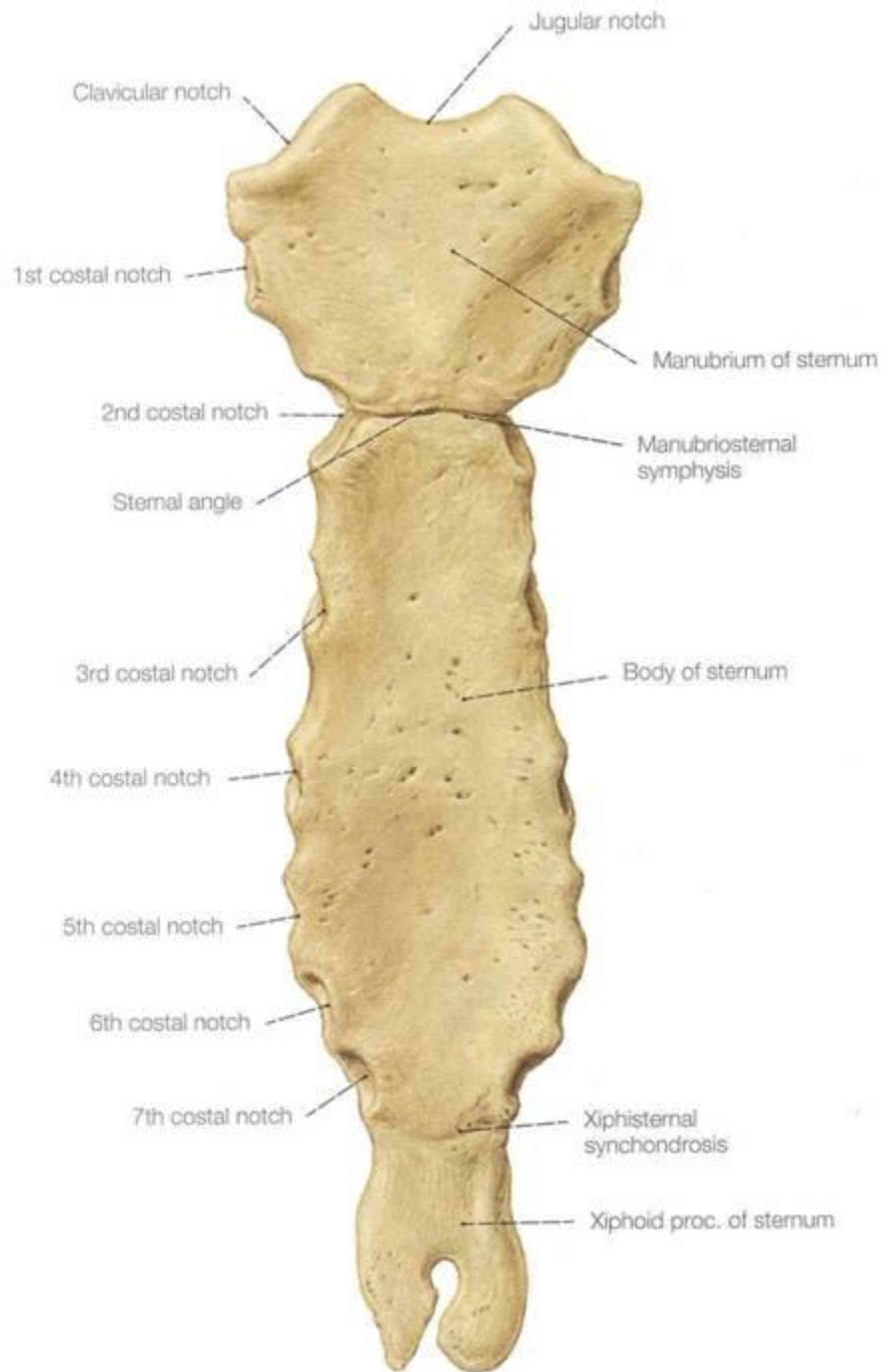


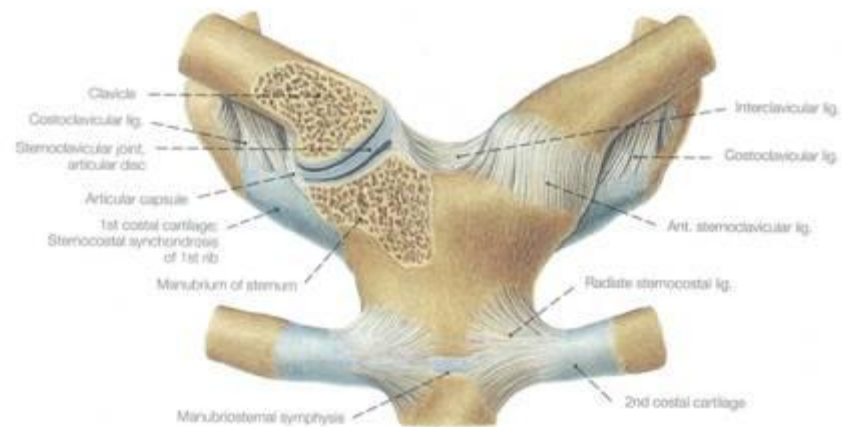
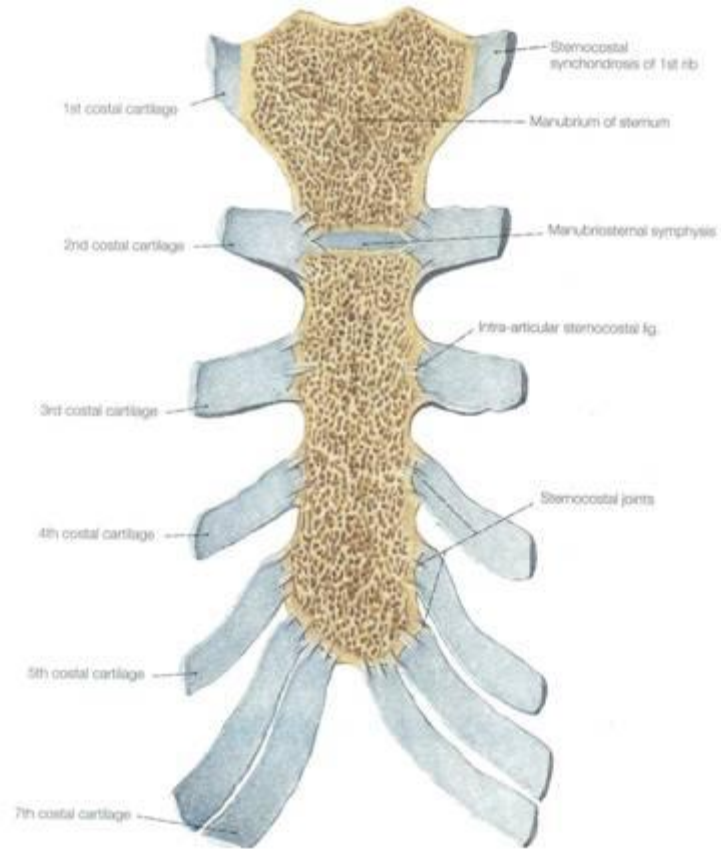












Functions of the Axial Skeleton

- Support
- Protection
- Respiration

- Characteristic number of vertebrae in each region
- Segmental spinal nerves
- Number system for the spinal nerves
- (See pages 68-69 of your lab manual.)

