

The Skeletal System

The Skeletal System

- Parts of the skeletal system include:
 - Bones (skeleton)
 - Joints
 - Cartilages
 - Ligaments
- Divided into two divisions:
 1. Axial skeleton (skull, ribs and vertebra)
 2. Appendicular skeleton (pelvis, extremities)

Functions of Bones

- Support of the body
- Protection of soft organs
- Movement due to attached skeletal muscles
- Storage of minerals and fats
- Blood cell formation

Bones of the Human Body

- The adult skeleton has 206 bones
- Two basic types of bone tissue
 - Compact bone
 - Homogeneous
 - Spongy bone
 - Small needle-like pieces of bone
 - Many open spaces

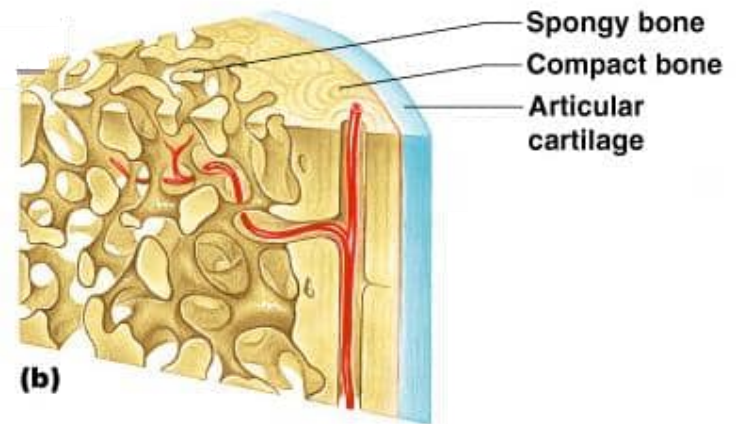


Figure 5.2b

Classification of Bones on the Basis of Shape

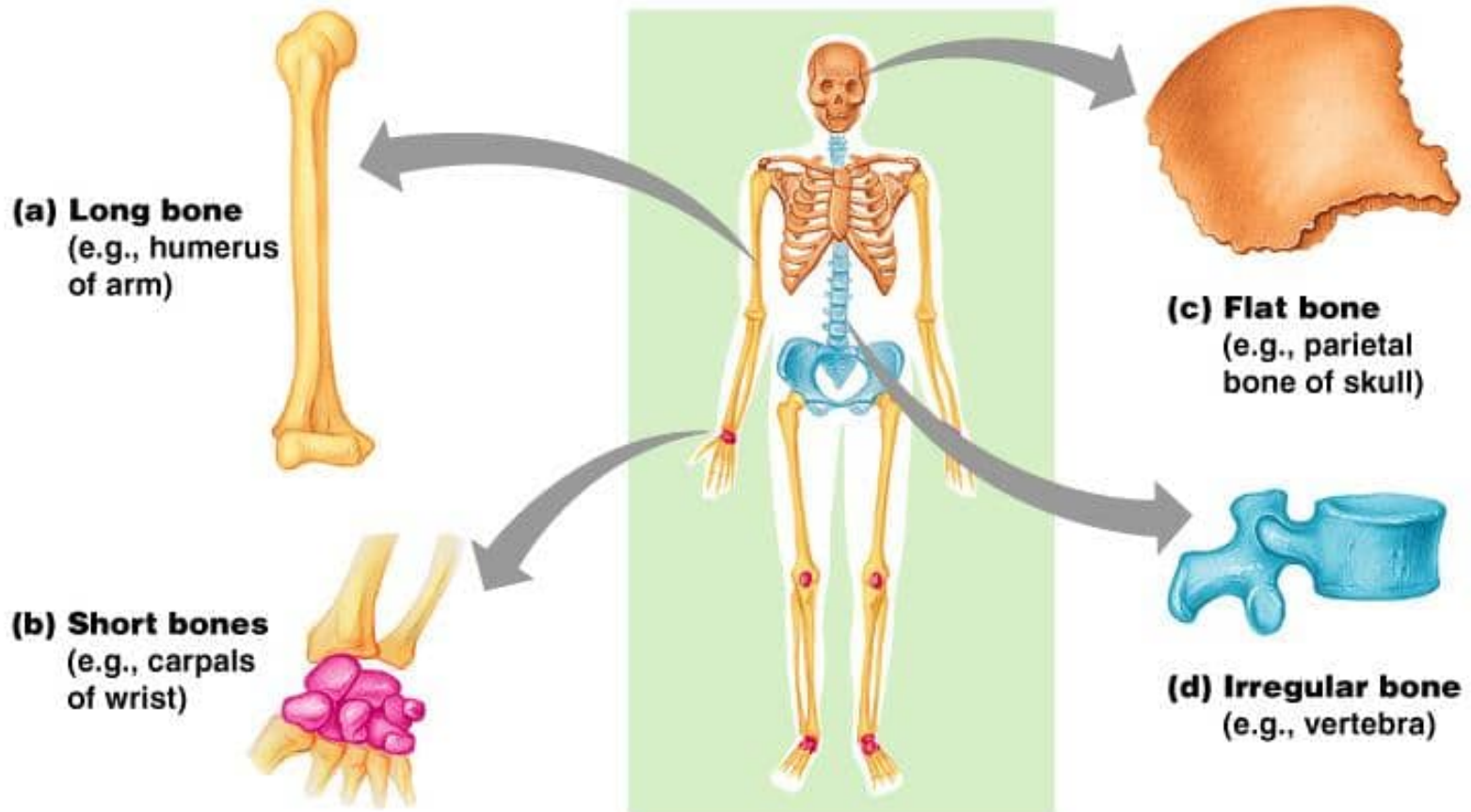


Figure 5.1

Classification of Bones

- Long bones
 - Typically longer than wide
 - Have a shaft with heads at both ends
 - Contain mostly compact bone
 - Examples: Femur, humerus
- Short bones
 - Generally cube-shape
 - Contain mostly spongy bone
 - Examples: Carpals, tarsals

Classification of Bones

- Flat bones
 - Thin and flattened, usually curved
 - Thin layers of compact bone around a layer of spongy bone
 - Examples: Skull, ribs, sternum
- Irregular bones
 - Irregular in shape
 - Do not fit into other bone classification categories
 - Example: Vertebrae and hip

Gross Anatomy of a Long Bone

- Diaphysis
 - Shaft
 - Composed of compact bone
- Epiphysis
 - Ends of the bone
 - Composed mostly of spongy bone

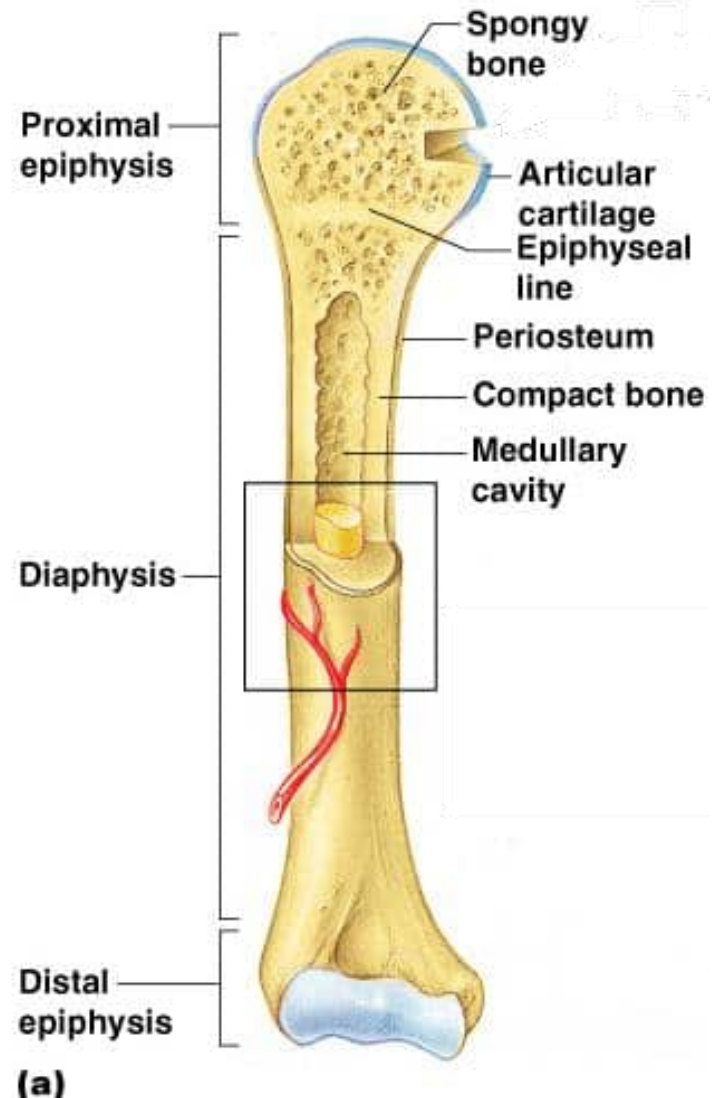


Figure 5.2a

Structures of a Long Bone

- Periosteum
 - Outside covering of the diaphysis
 - Fibrous connective tissue membrane
- Sharpey's fibers
 - Secure periosteum to underlying bone
- Arteries
 - Supply bone cells with nutrients

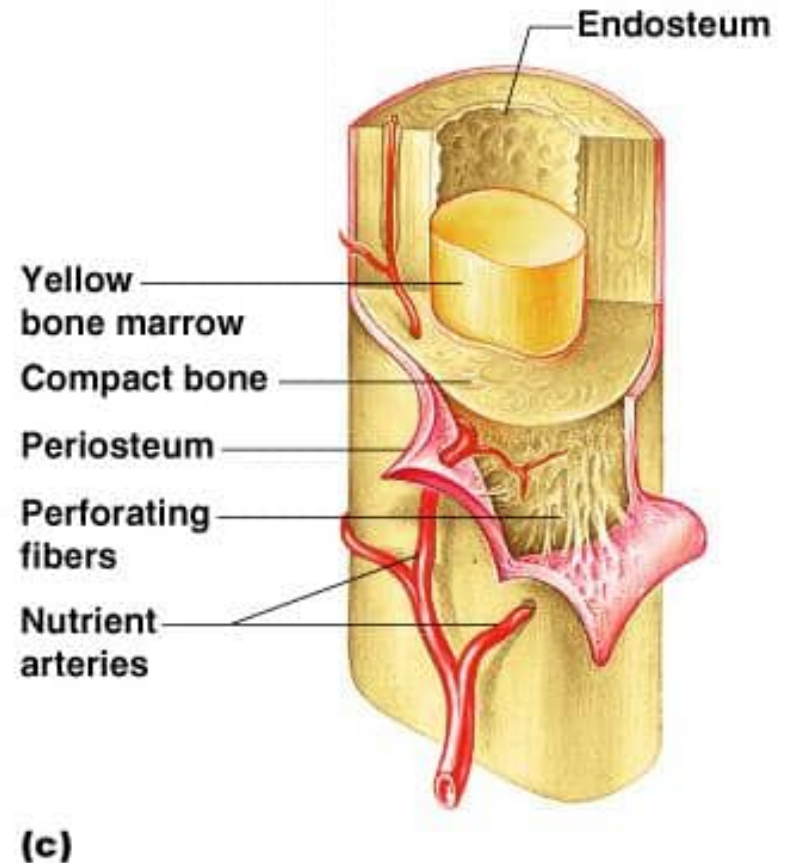
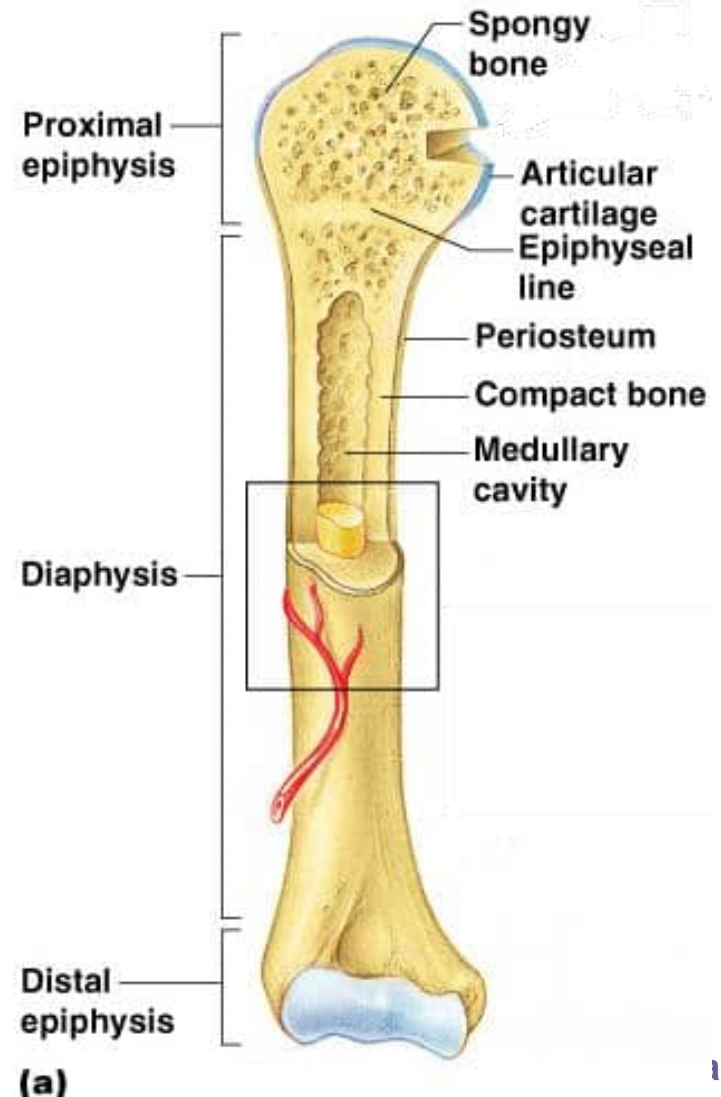


Figure 5.2c

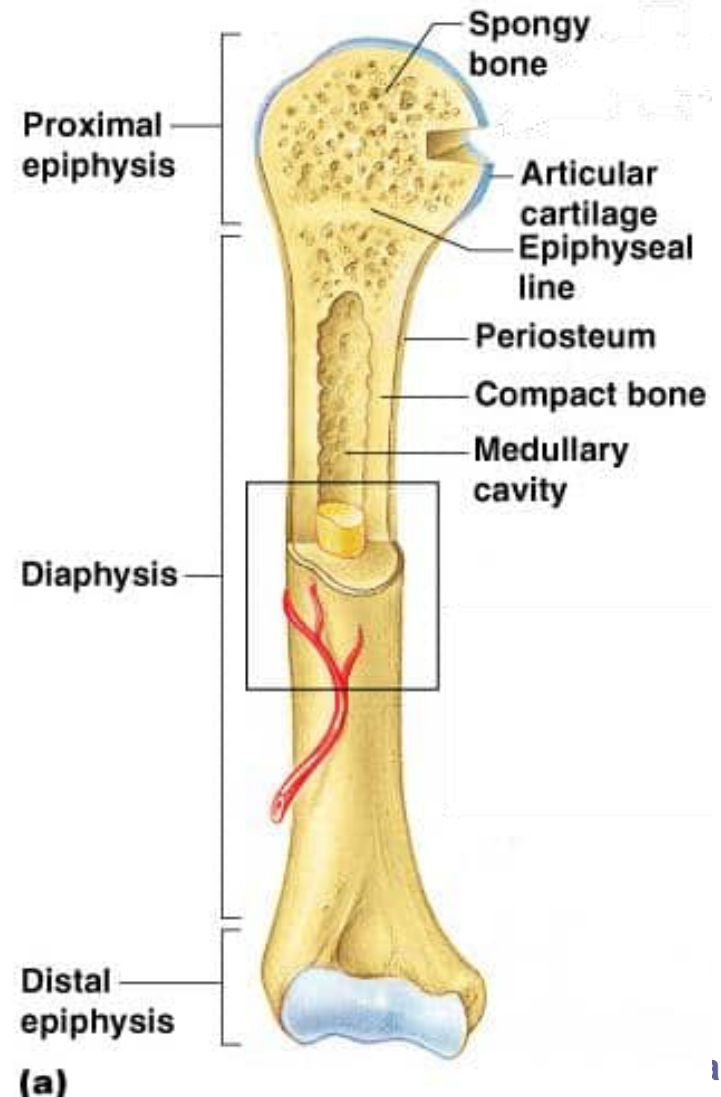
Structures of a Long Bone

- Articular cartilage
 - Covers the external surface of the epiphyses
 - Made of hyaline cartilage
 - Decreases friction at joint surfaces



Structures of a Long Bone

- Medullary cavity
 - Cavity of the shaft
 - Contains yellow marrow (mostly fat) in adults
 - Contains red marrow (for blood cell formation) in infants

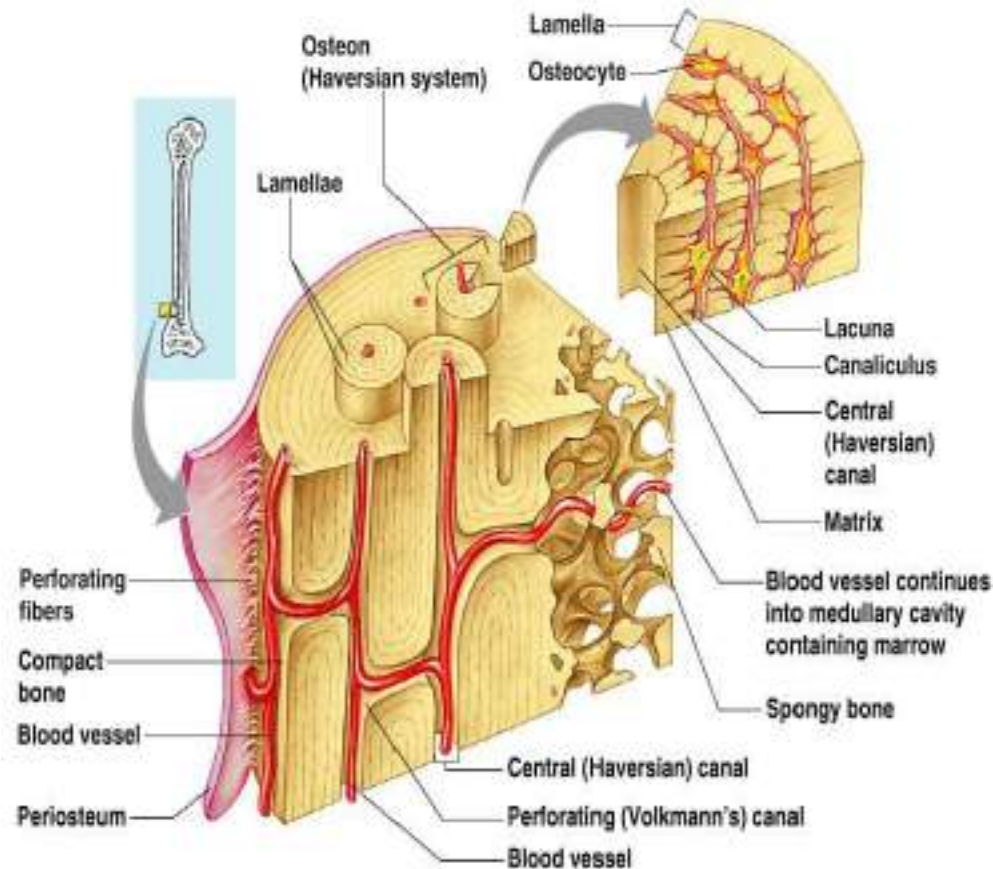


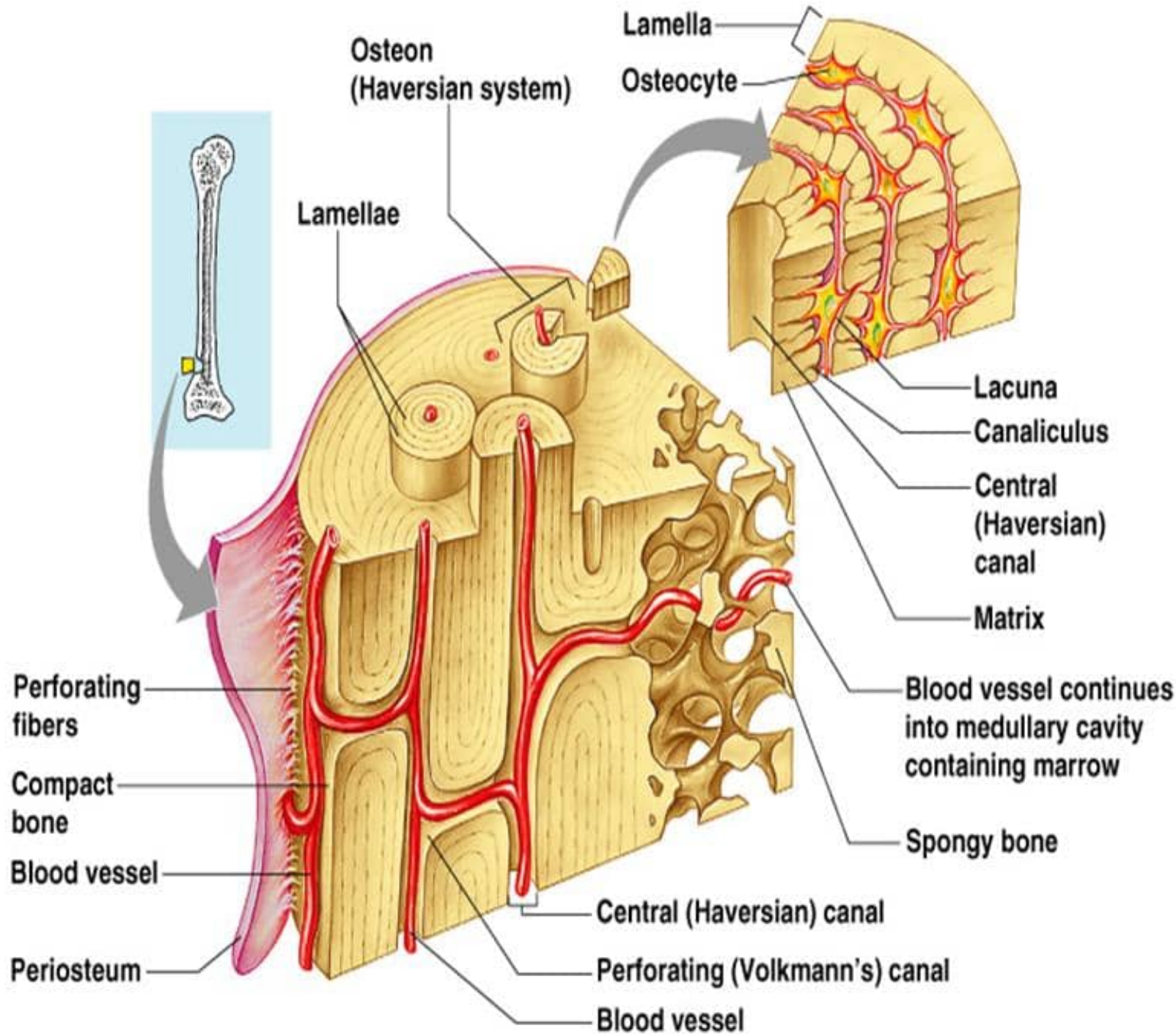
Bone Markings

- Surface features of bones
 - Projections and processes – grow out from the bone surface
 - Depressions or cavities – indentations
- Sites of attachments for muscles, tendons, and ligaments
- Passages for nerves and blood vessels

Microscopic Anatomy of Bone

- Osteon (Haversian System)
 - A unit of bone
- Central (Haversian) canal
 - Carries blood vessels and nerves
- Perforating (Volkman's) canal
 - Canal perpendicular to the central canal
 - Carries blood vessels and nerves



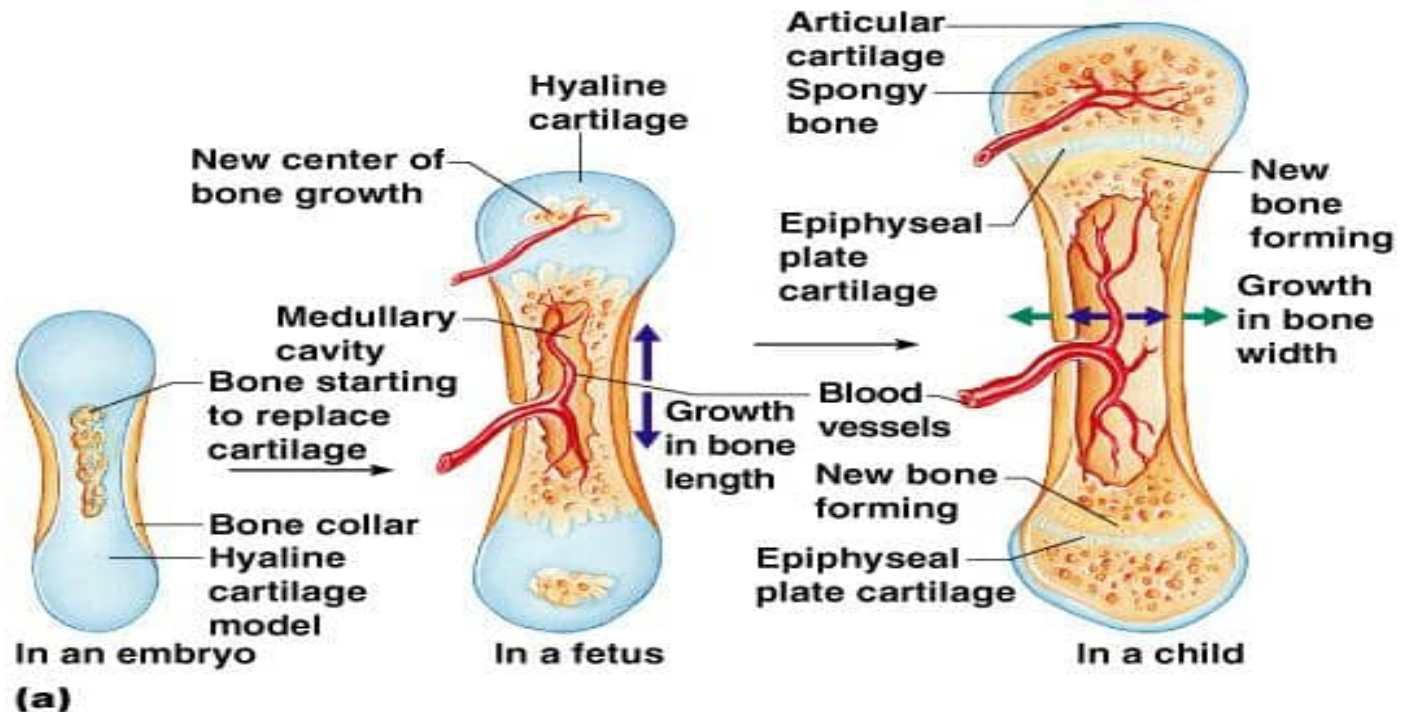


Changes in the Human Skeleton

- In embryos, the skeleton is primarily hyaline cartilage
- During development, much of this cartilage is replaced by bone
- Cartilage remains in isolated areas
 - Bridge of the nose
 - Parts of ribs
 - Joints

Bone Growth

- Bones are remodeled and lengthened until growth stops
 - Bones change shape somewhat
 - Bones grow in width



The Skeletal System (B)

The Axial Skeleton

- Forms the longitudinal part of the body
- Divided into three parts
 - Skull
 - Vertebral column
 - Bony thorax

The Axial Skeleton

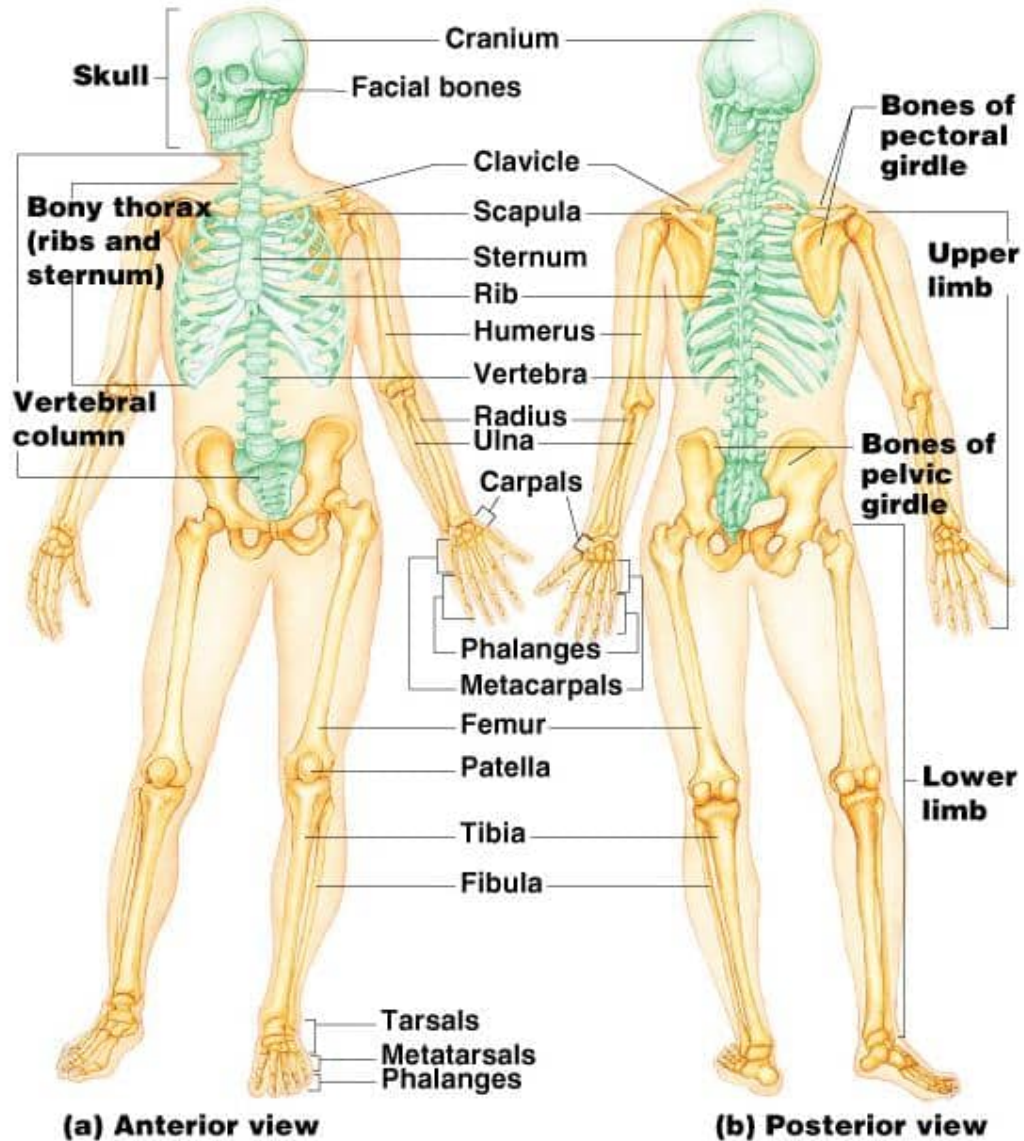


Figure 5.6

The Skull

- Two sets of bones
 - Cranium
 - Facial bones
- Bones are joined by sutures
- Only the mandible is attached by a freely movable joint

The Skull

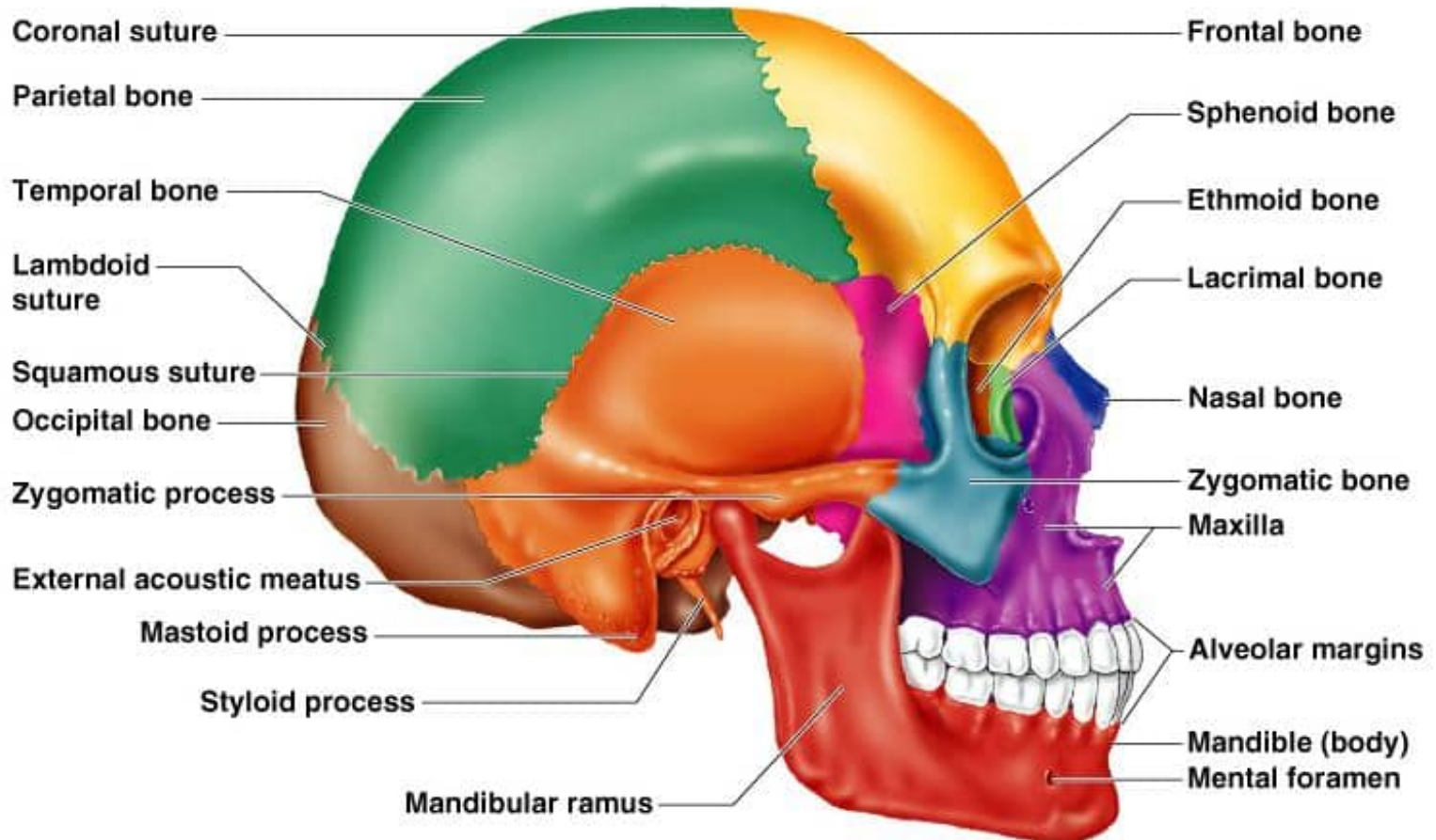


Figure 5.7

Bones of the Skull

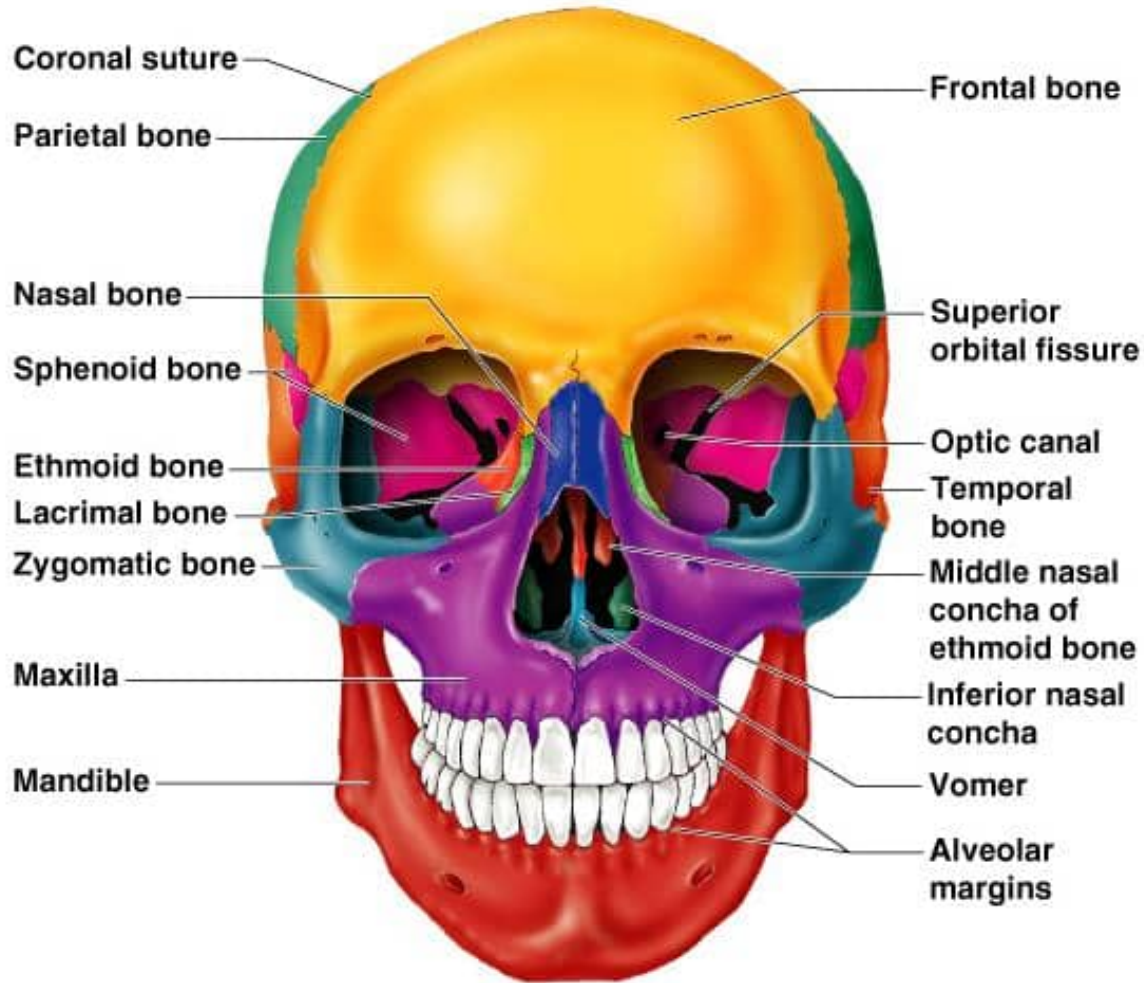


Figure 5.11

Human Skull, Superior View

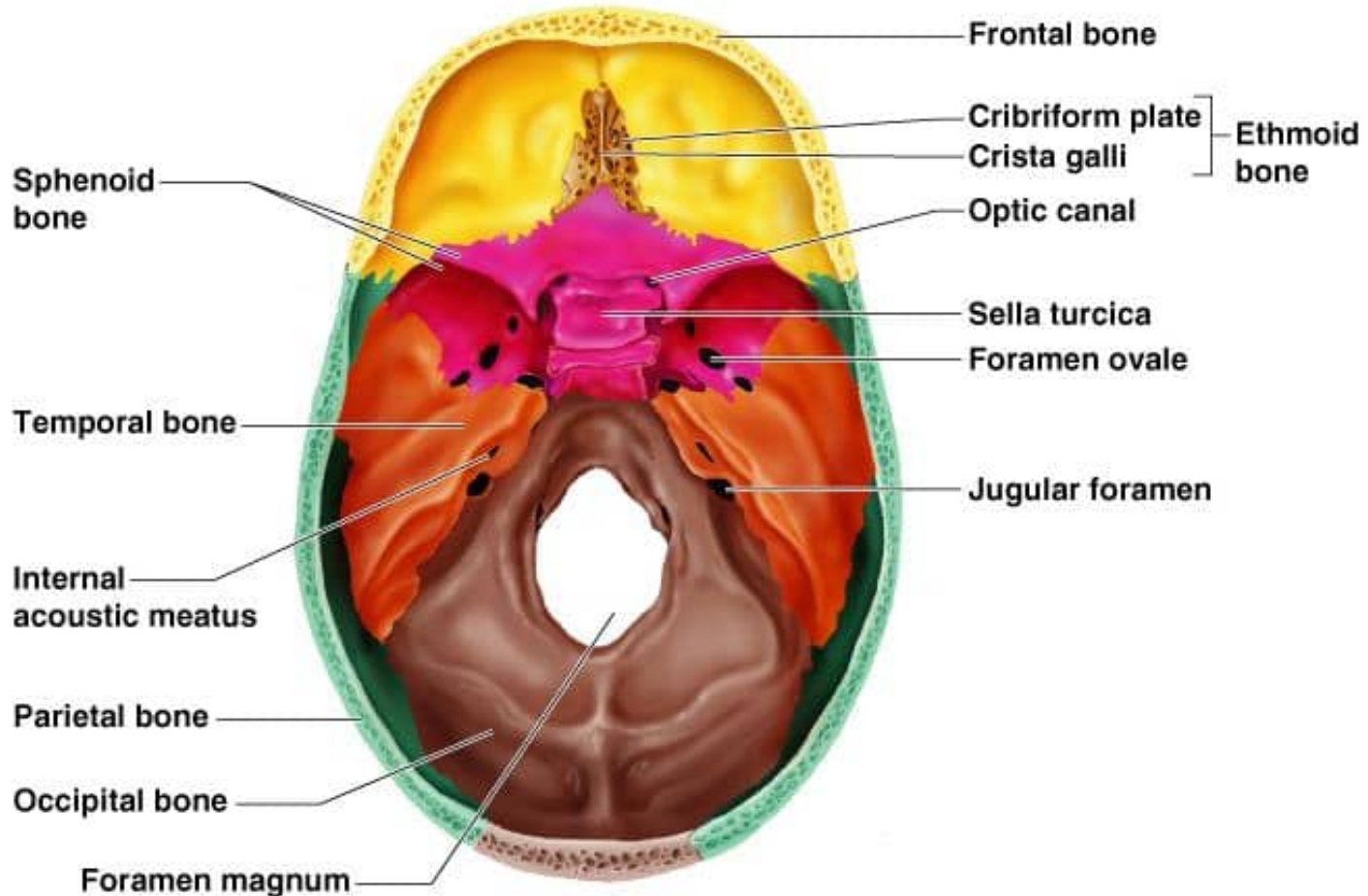


Figure 5.8

Human Skull, Inferior View

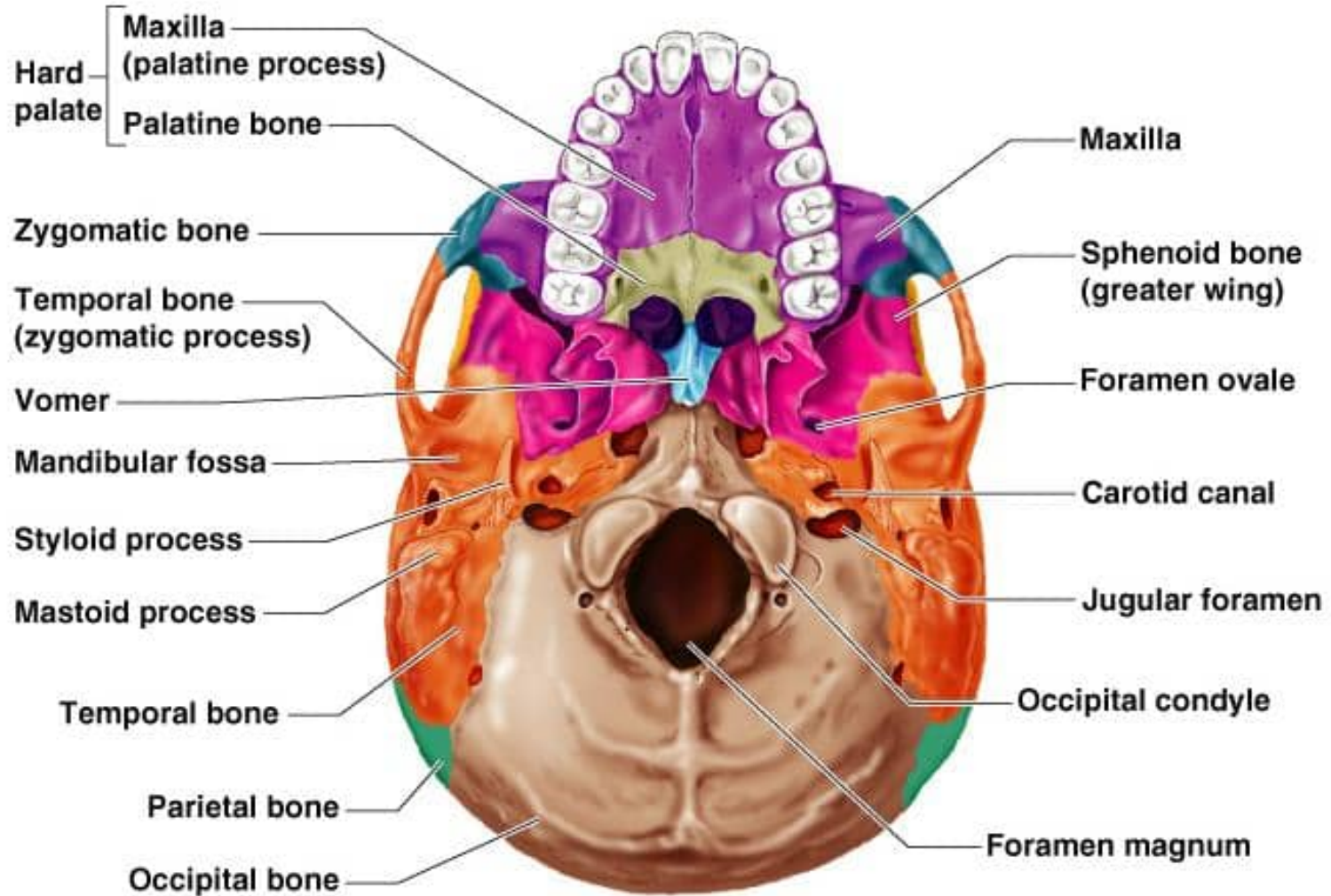


Figure 5.9

The Skeletal System (C)

Paranasal Sinuses

- Hollow portions of bones surrounding the

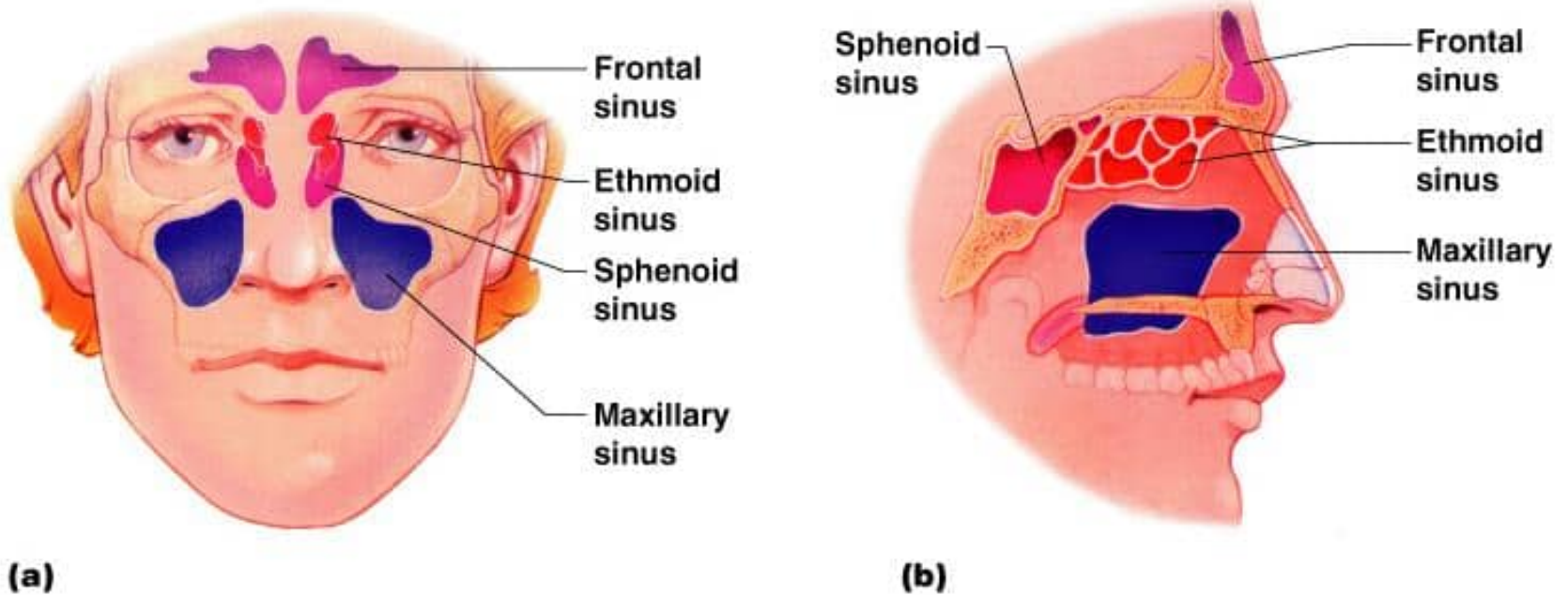


Figure 5.10

Paranasal Sinuses

- Functions of paranasal sinuses
 - Lighten the skull
 - Give resonance and amplification to voice

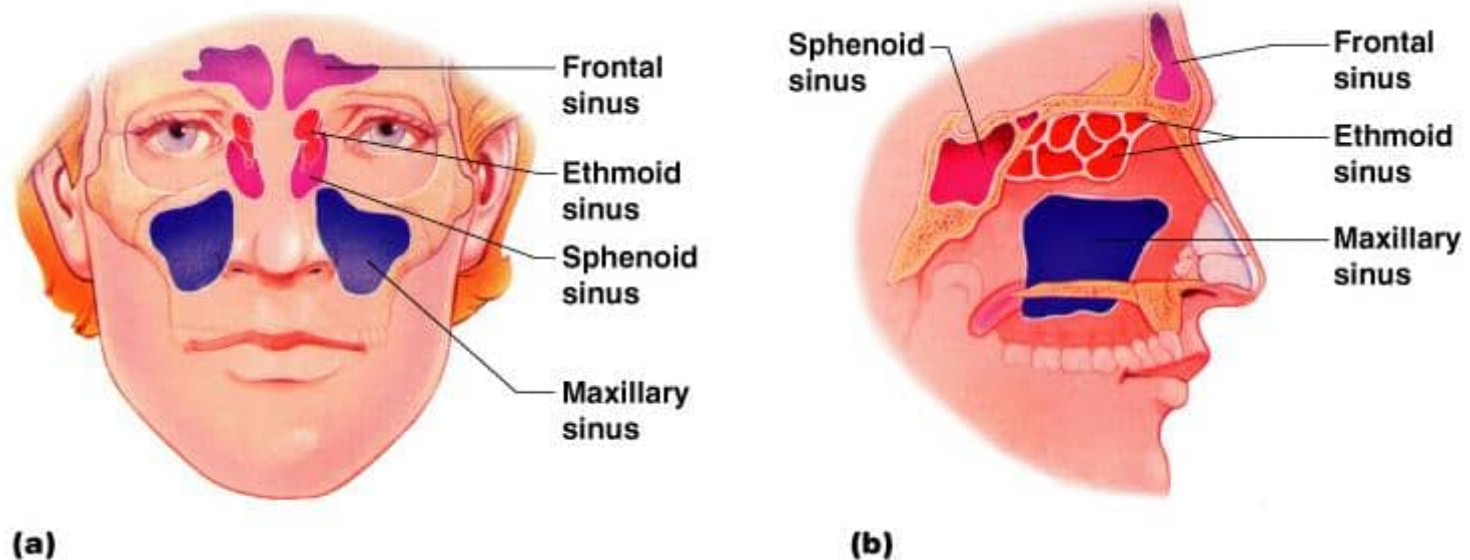
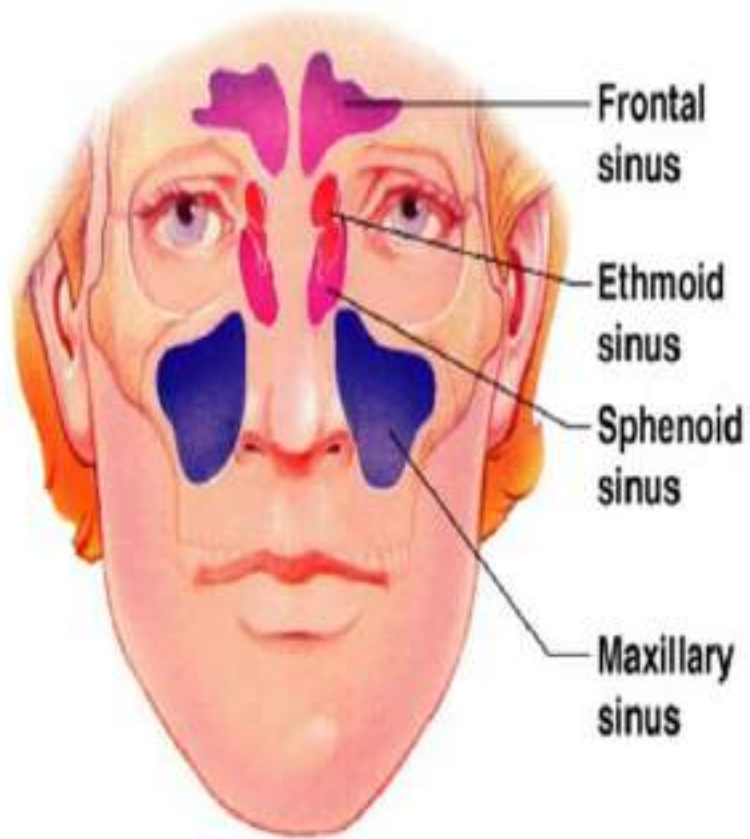
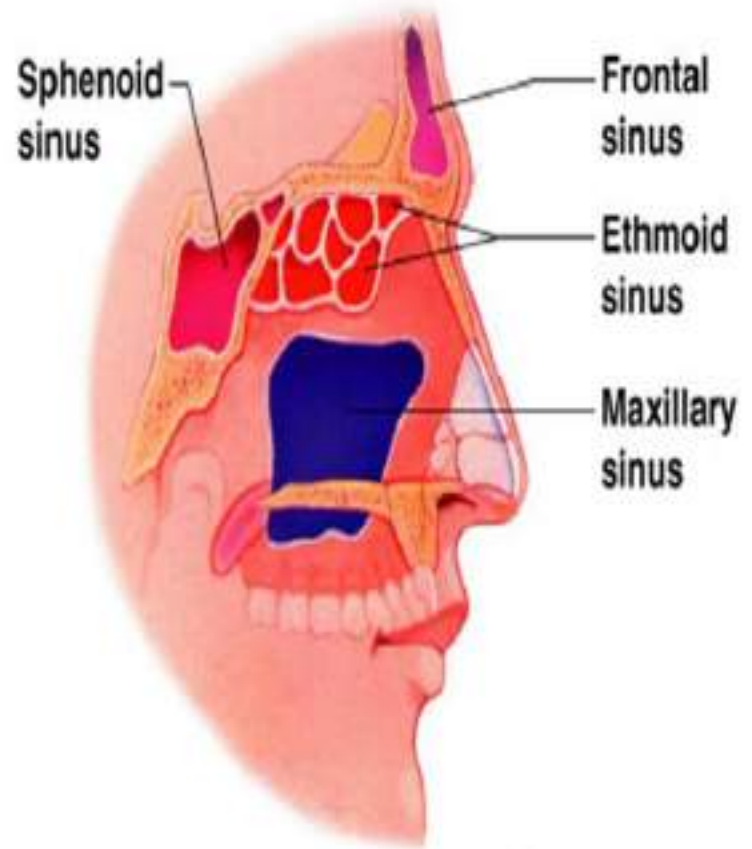


Figure 5.10



(a)



(b)

The Hyoid Bone

- The only bone that does not articulate with another bone
- Serves as a moveable base for the tongue

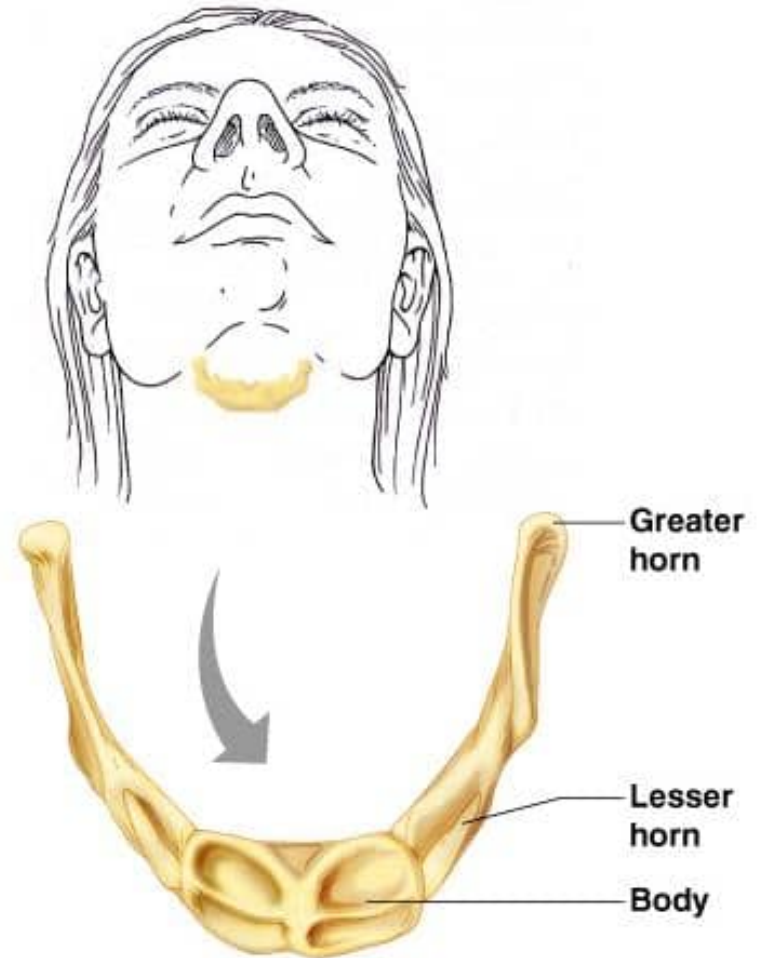


Figure 5.12

The Fetal Skull

- The fetal skull is large compared to the infants total body length

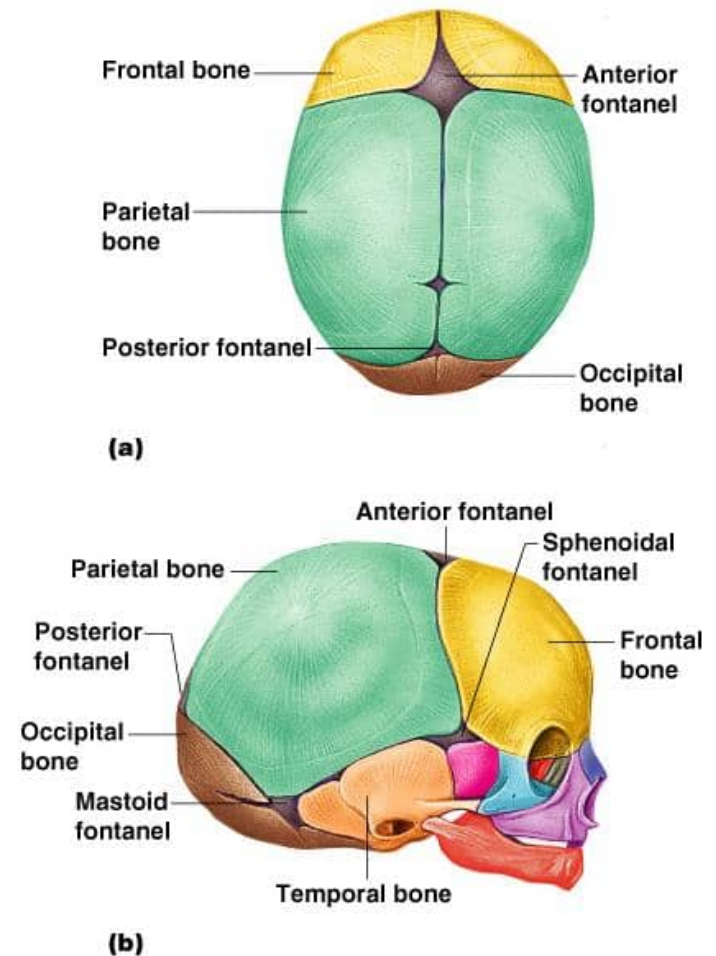


Figure 5.13

The Fetal Skull

- Fontanelles – fibrous membranes connecting the cranial bones
 - Allow the brain to grow
 - Convert to bone within 24 months after birth

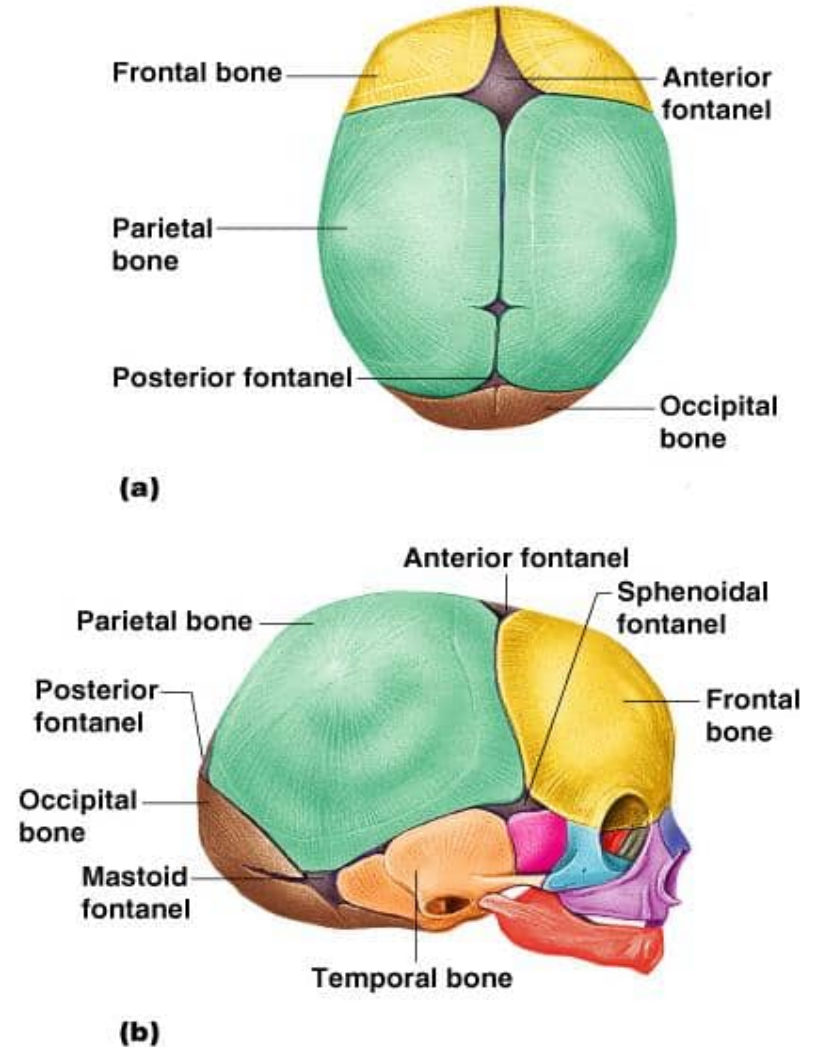


Figure 5.13

The Vertebrae

- Vertebrae separated by intervertebral discs
- The spine has a normal curvature
- Each vertebrae is given a name according to its location

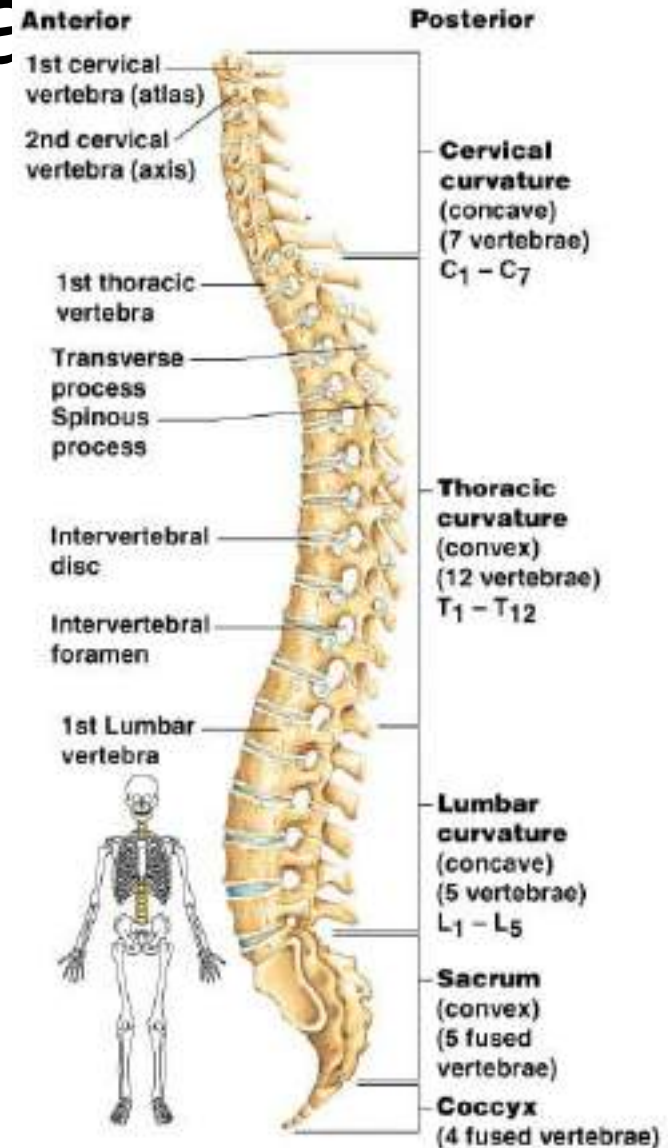
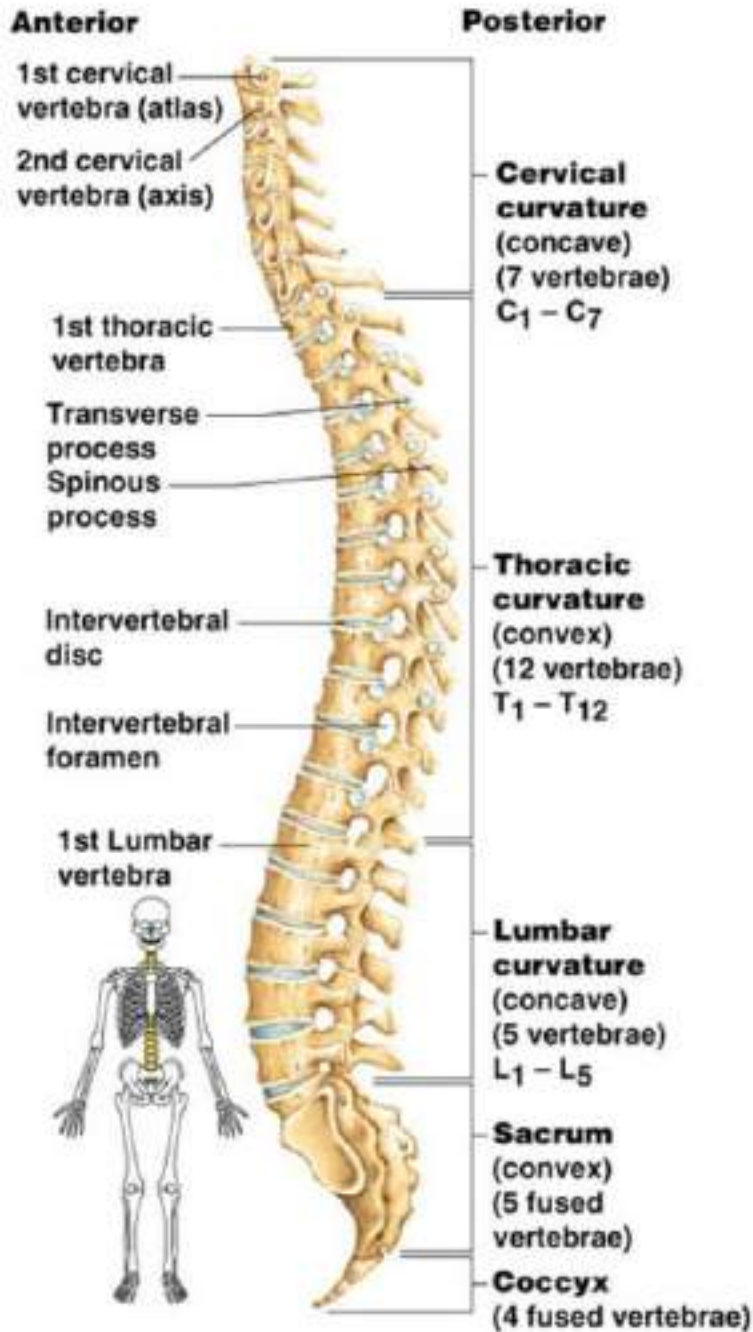


Figure 5.14



Structure of a Typical Vertebrae

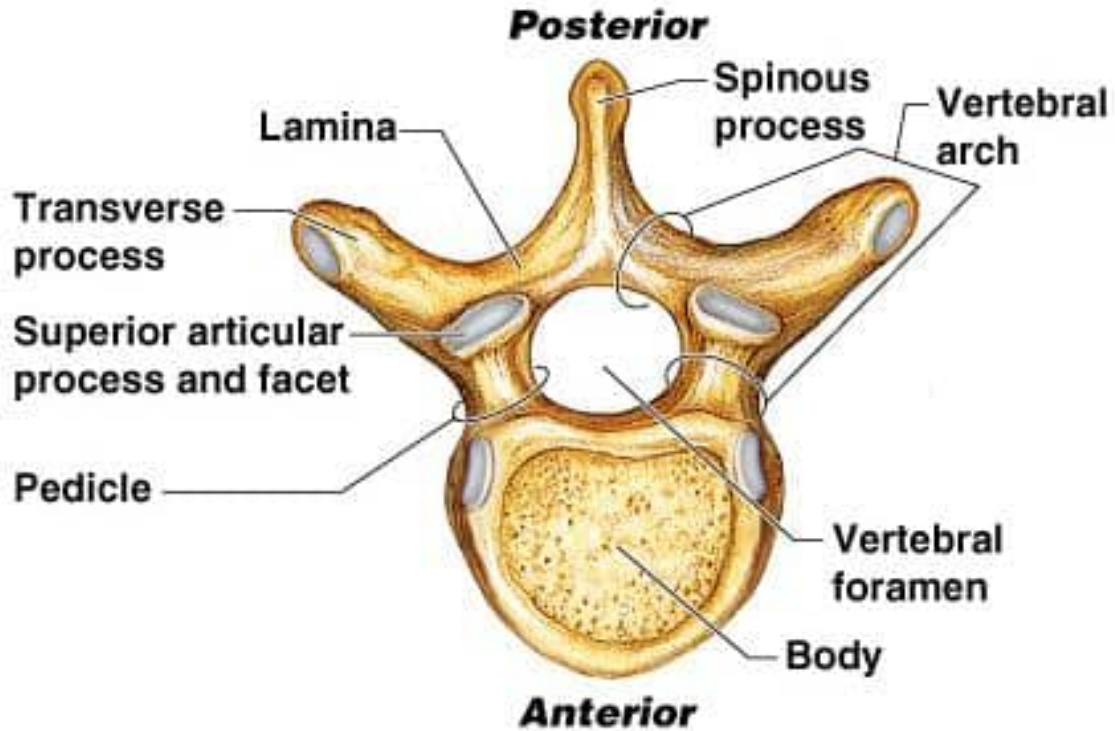
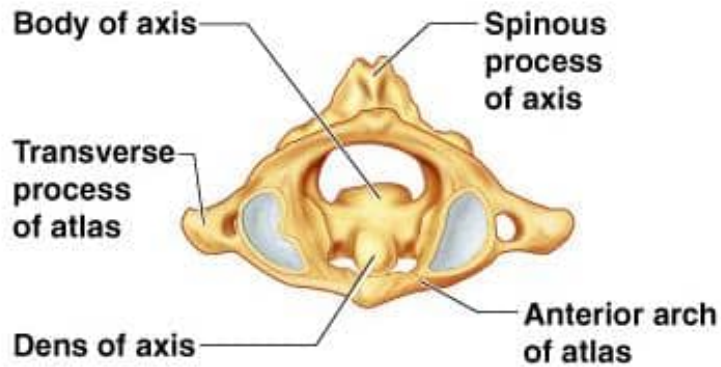
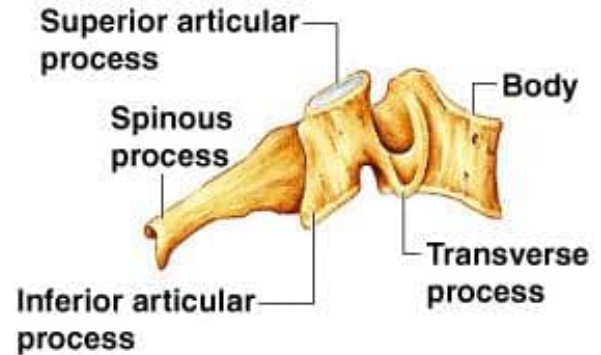
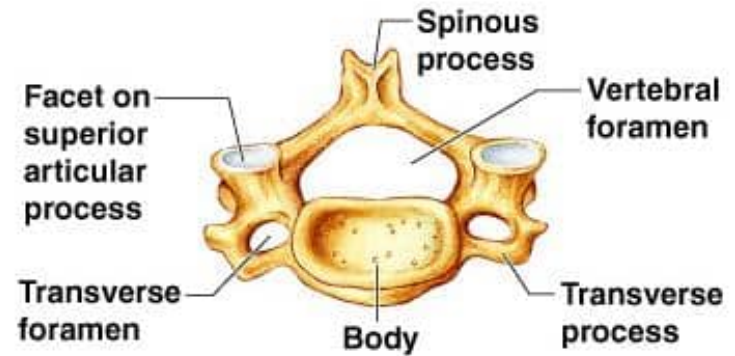


Figure 5.16

Regional Characteristics of



(a)



(b)



Figure 5.17a–b

Regional Characteristics of

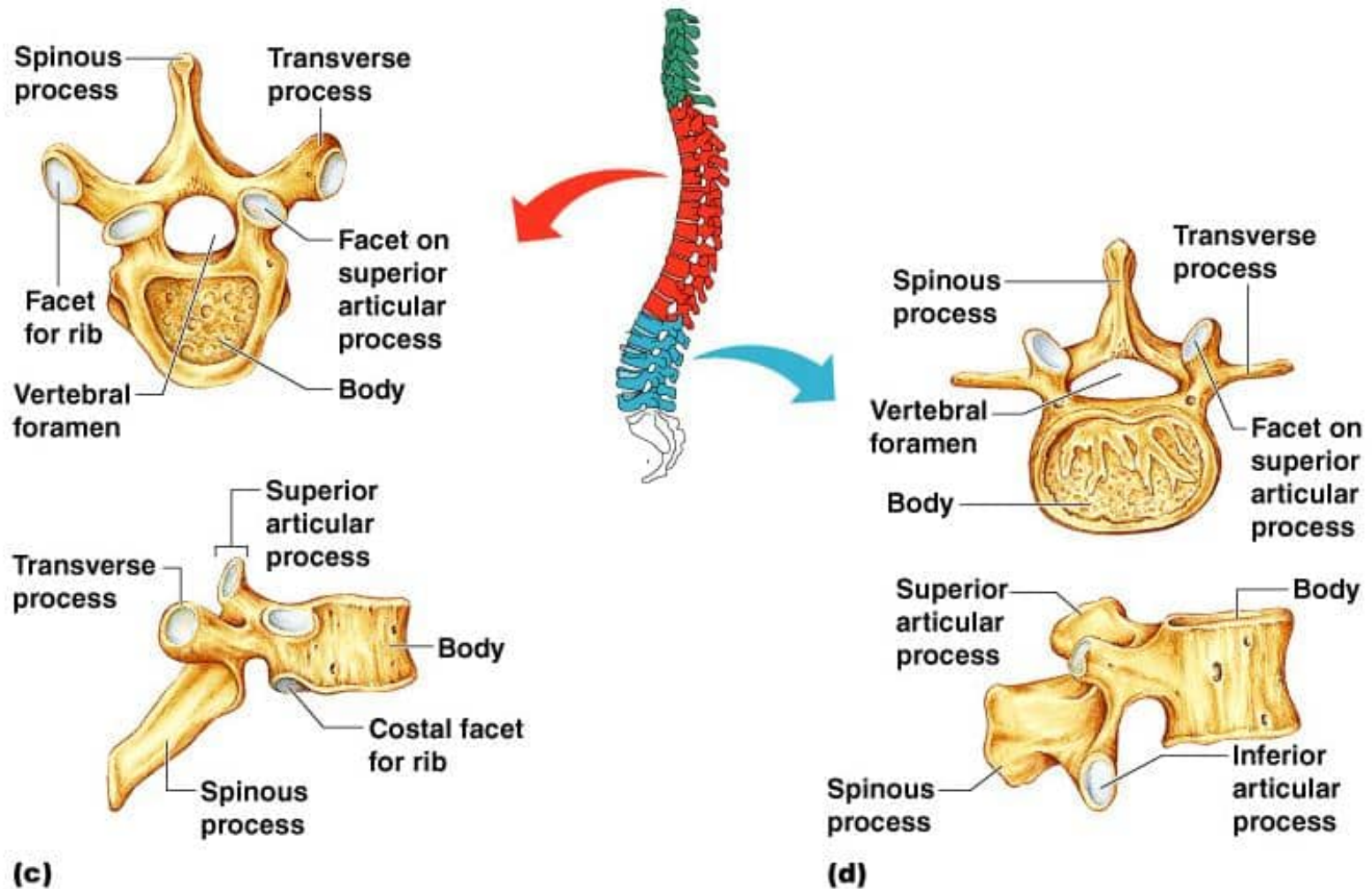
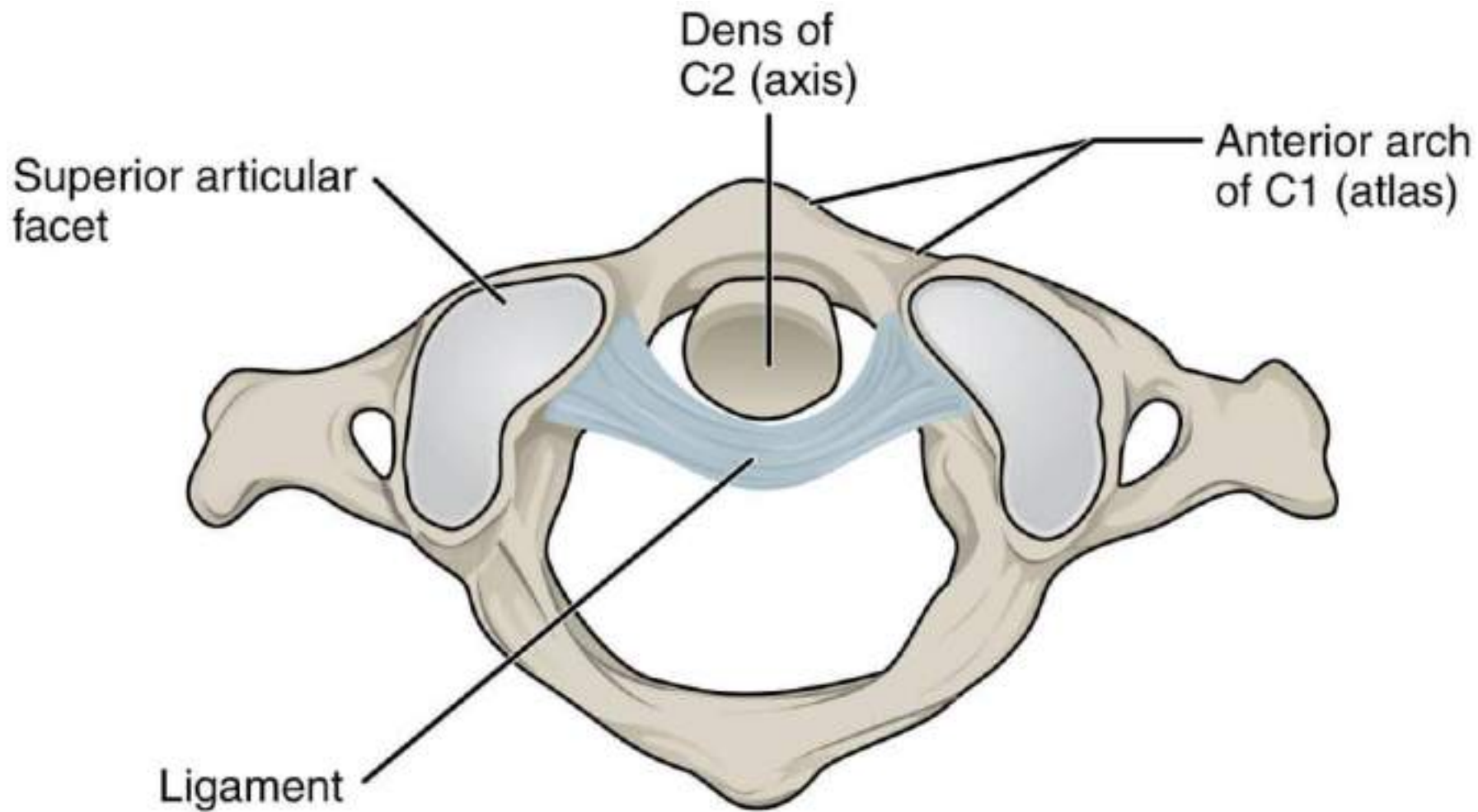
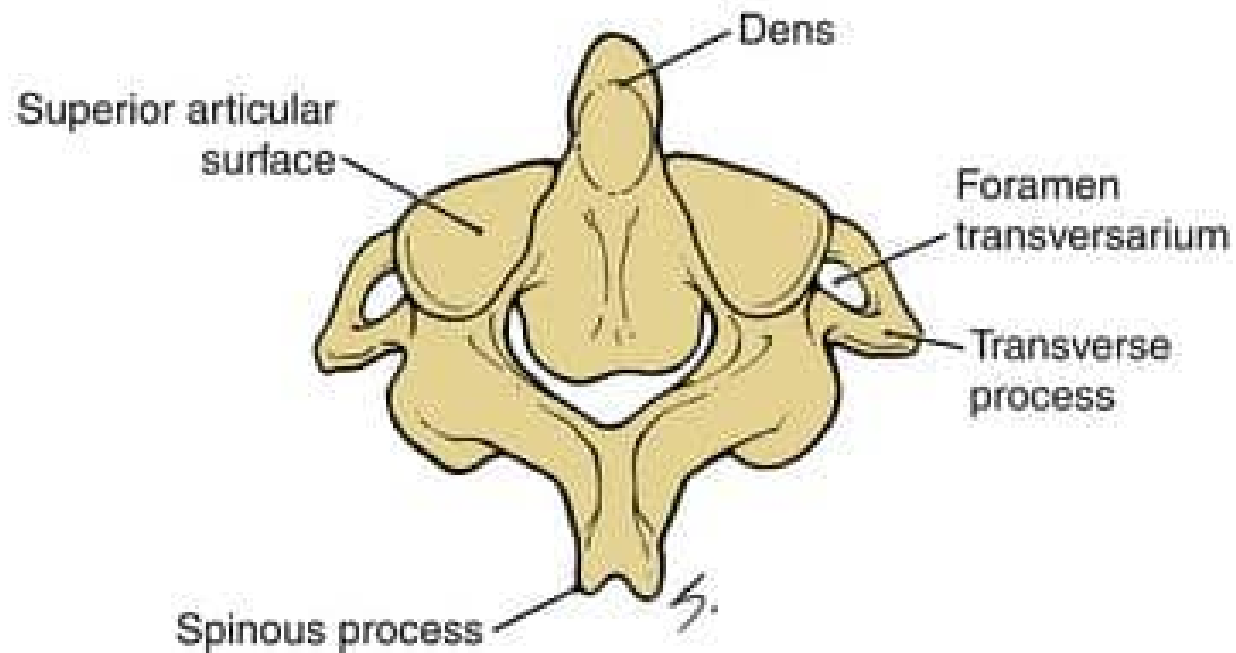
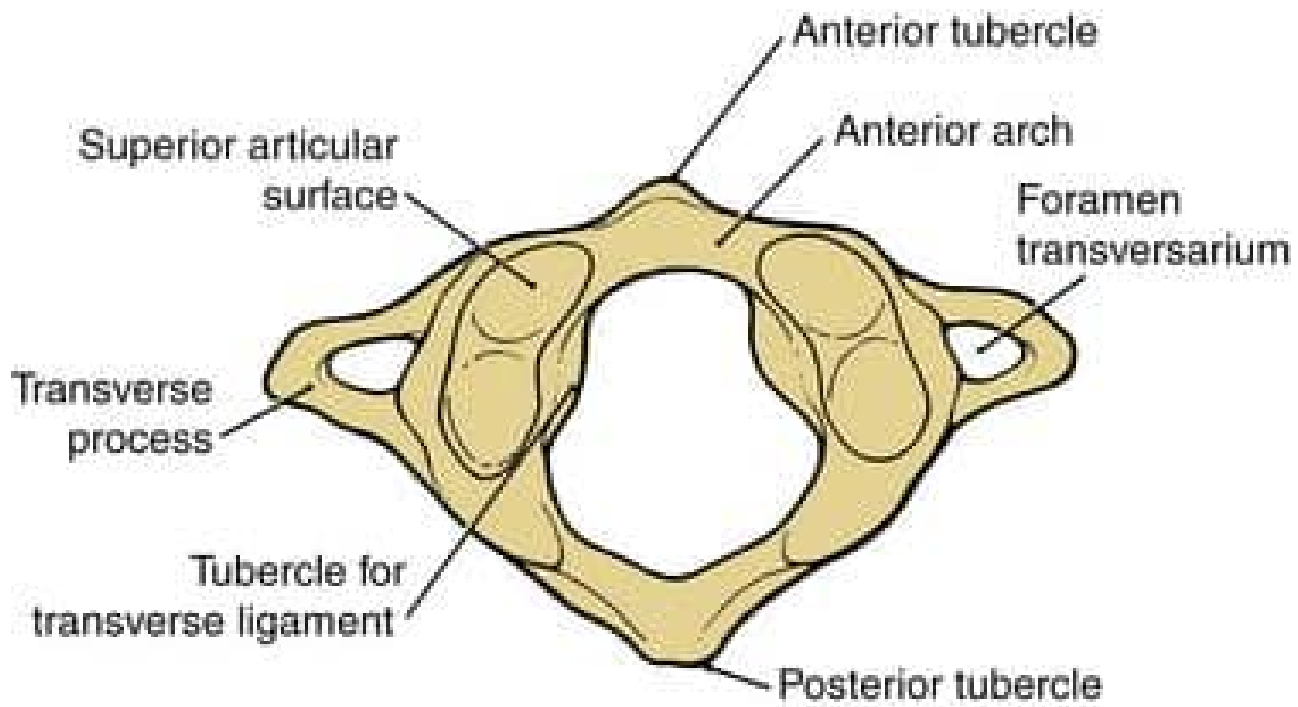


Figure 5.17c-d



Superior view of atlas



Atlas and Axis Articulation

Axis of rotation

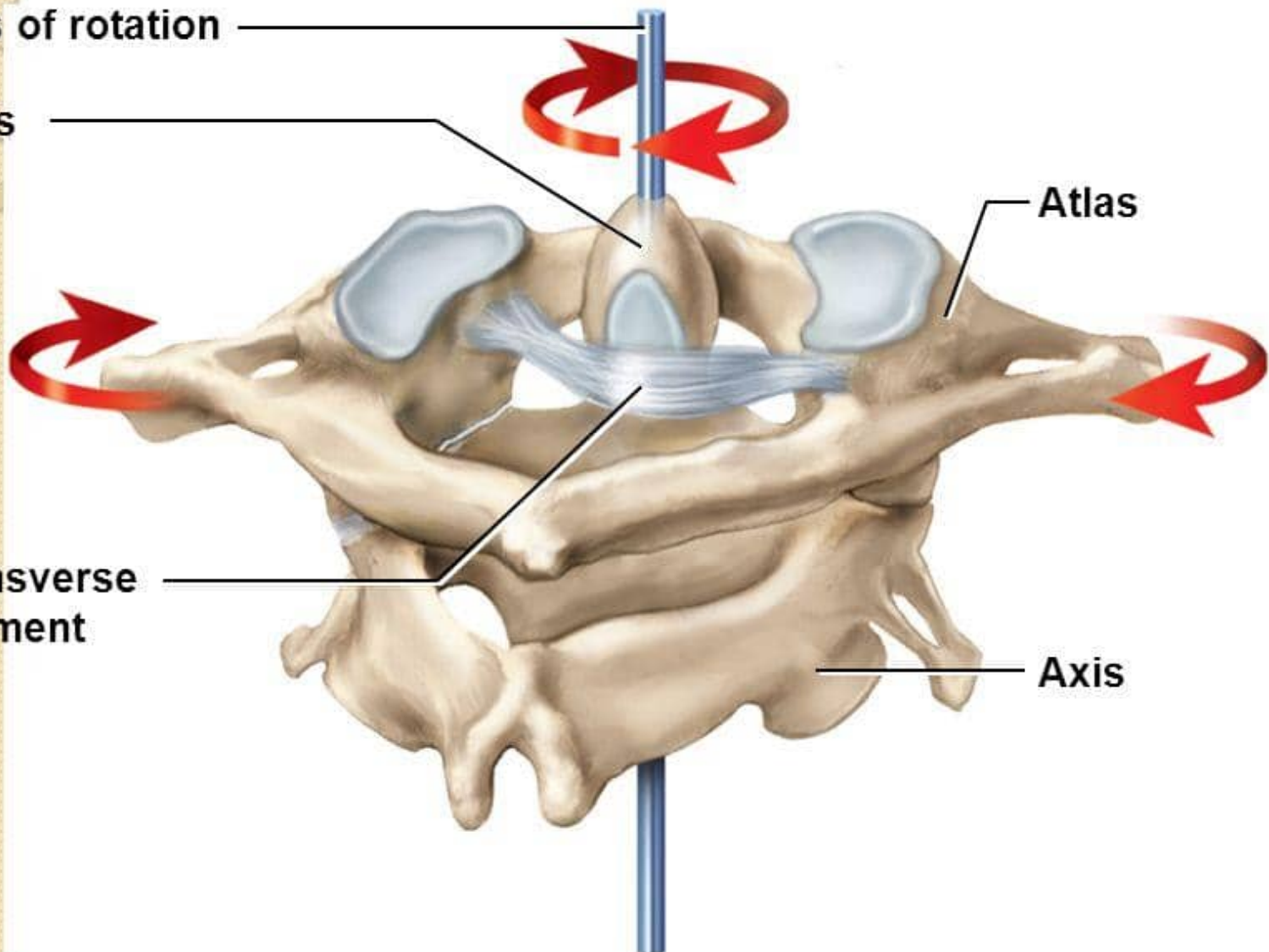
Dens

Atlas

Transverse ligament

Axis

Atlantoaxial joint



The Skeletal System (d)

The Bony Thorax

- Forms a cage to protect respiratory organs

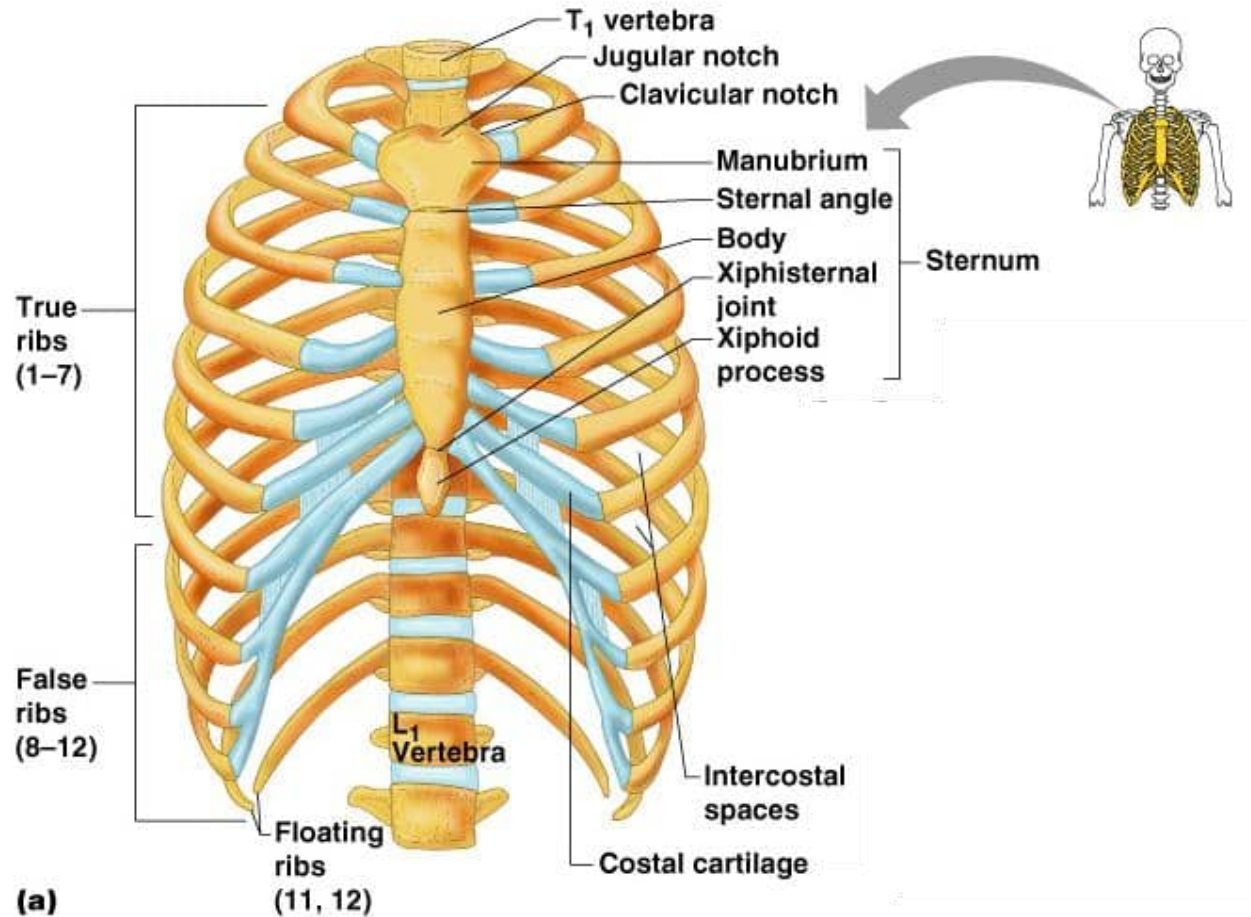


Figure 5.19a

The Bony Thorax

- Made-up of three parts
 - Sternum
 - Ribs
 - Thoracic vertebrae

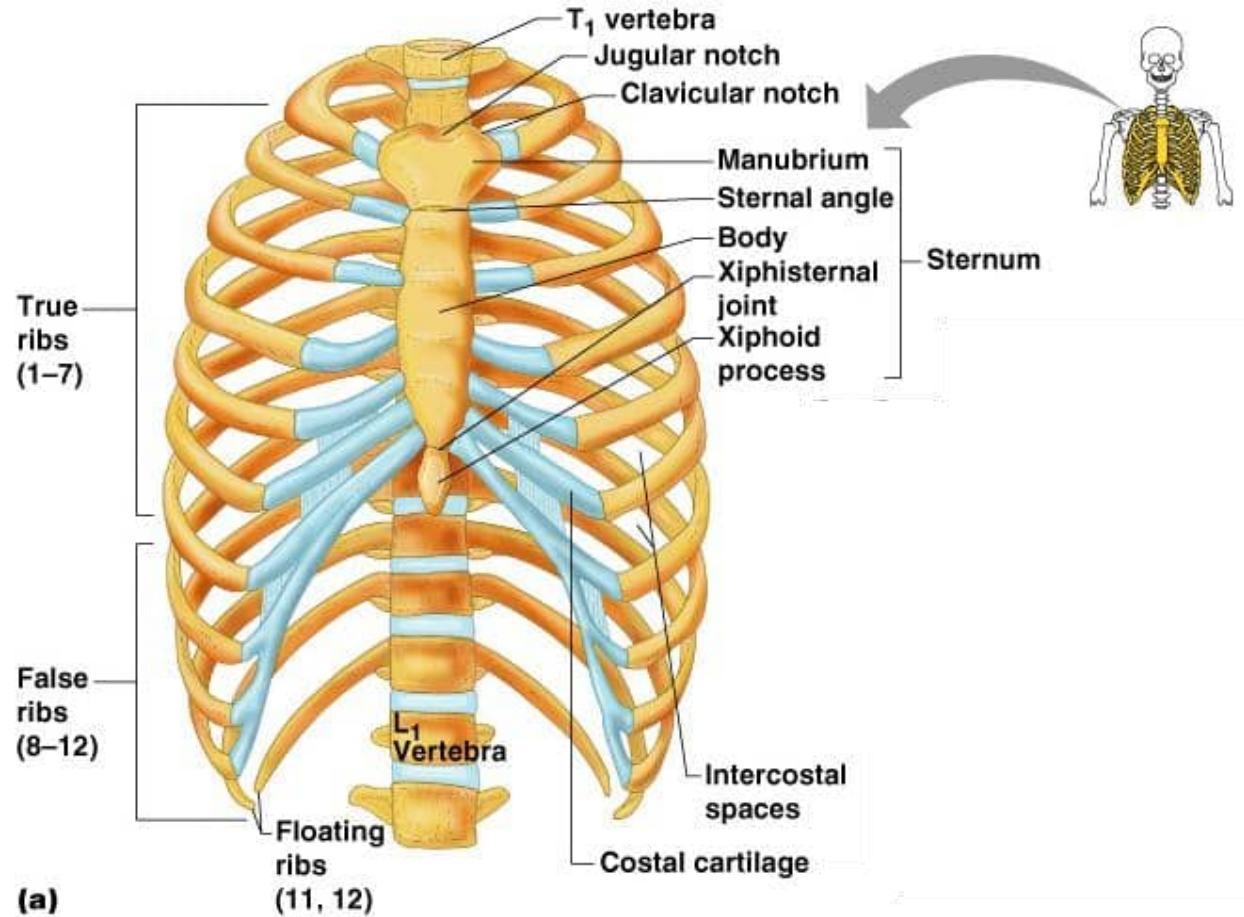
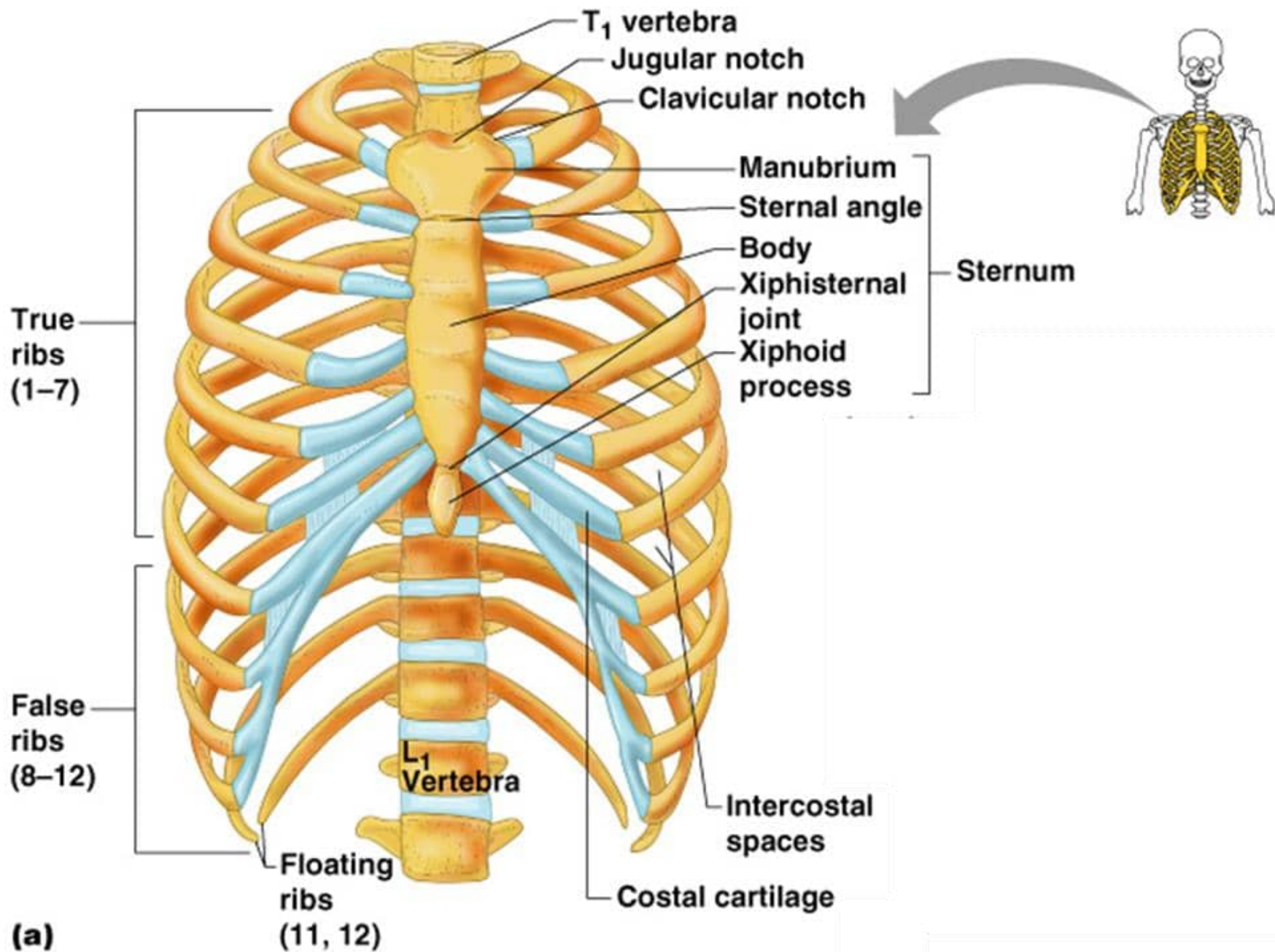


Figure 5.19a



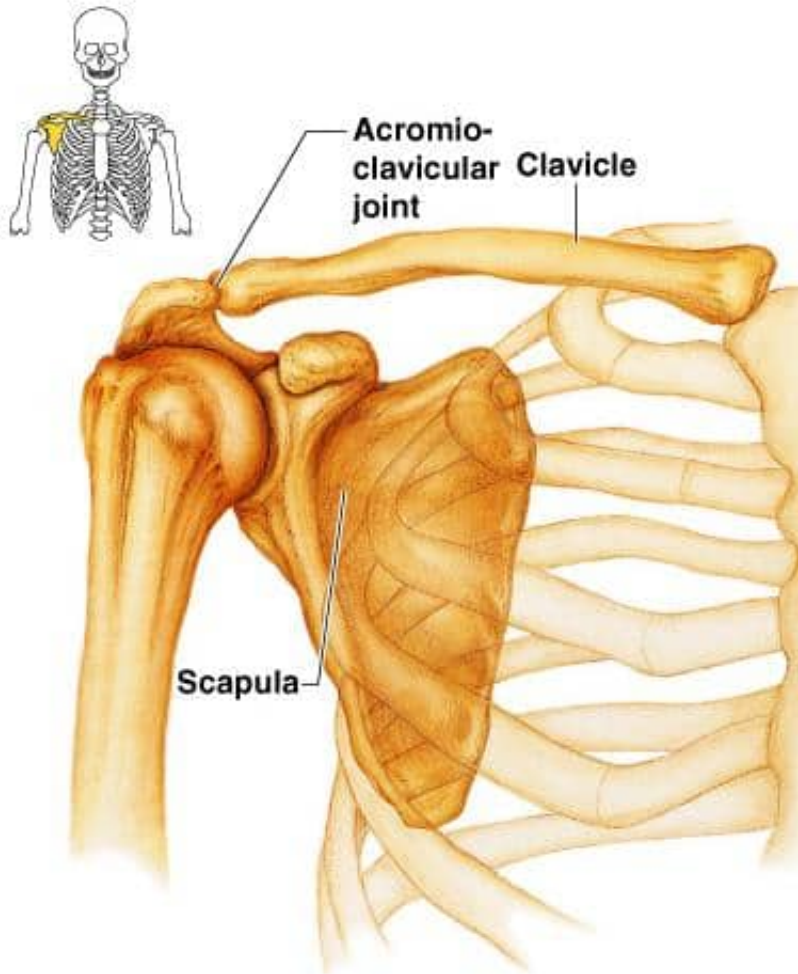
The Appendicular Skeleton

- Limbs (appendages)
- Pectoral girdle
- Pelvic girdle

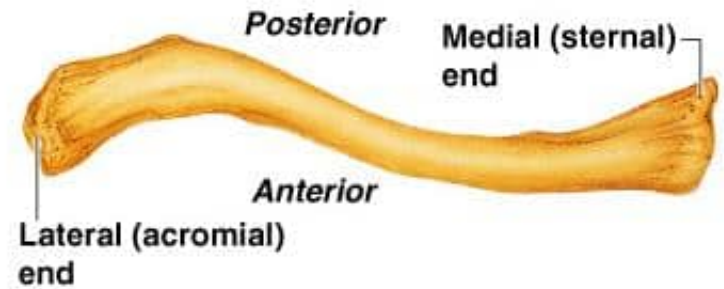
The Pectoral (Shoulder) Girdle

- Composed of two bones
 - Clavicle – collarbone
 - Scapula – shoulder blade
- These bones allow the upper limb to have exceptionally free movement

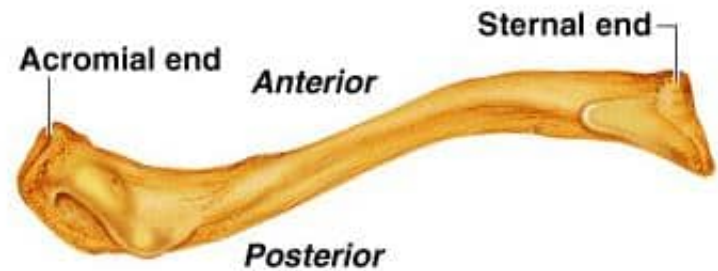
Bones of the Shoulder Girdle



(a) Articulated shoulder (pectoral) girdle



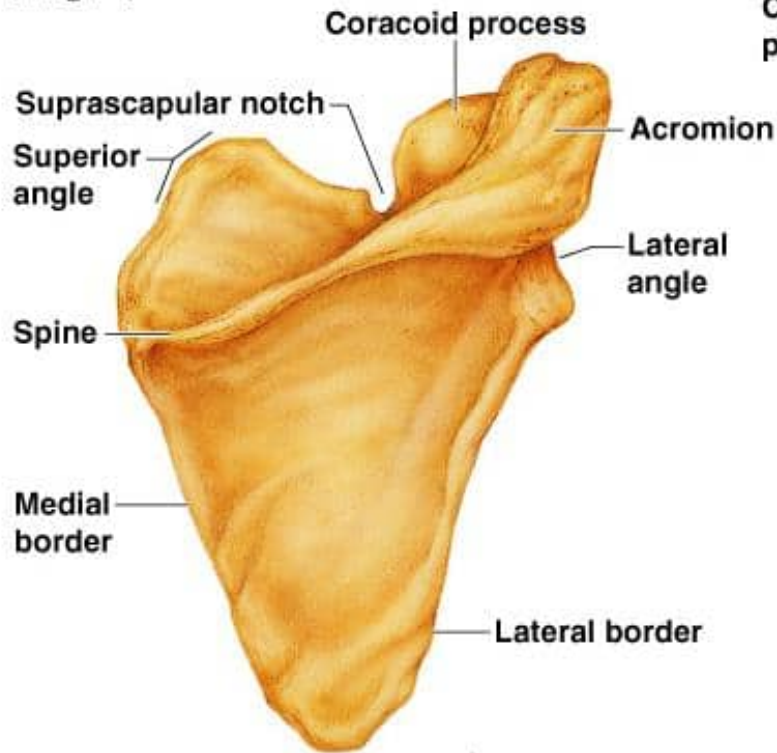
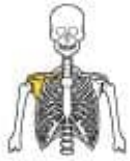
Superior view



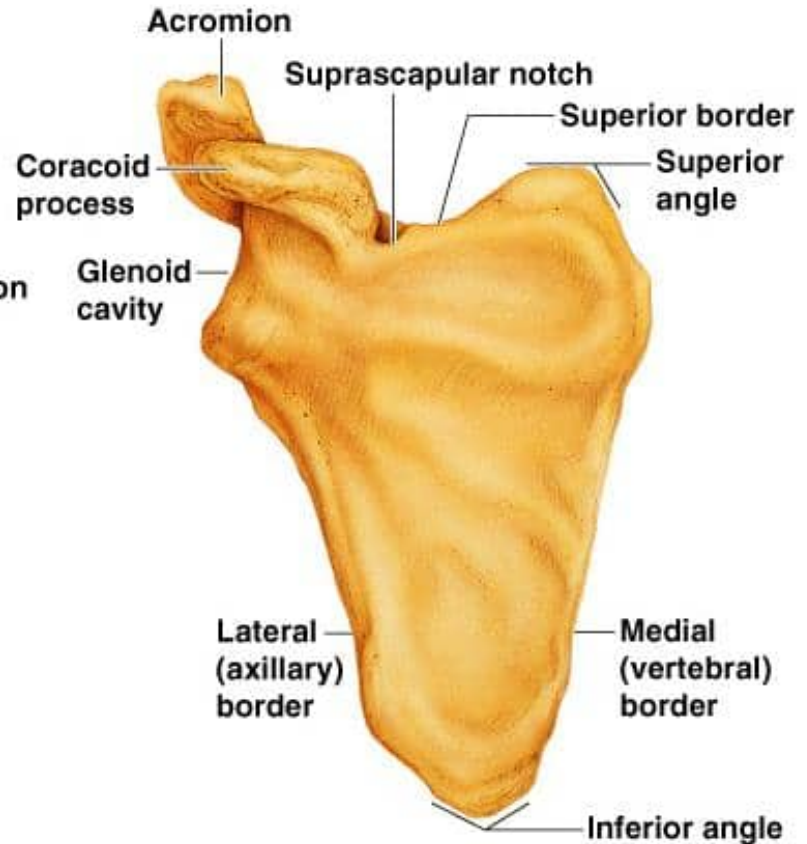
Inferior view

(b) Right clavicle

Bones of the Shoulder Girdle



(c) Right scapula, posterior aspect



(d) Right scapula, anterior aspect

Bones of the Inner Limb

- The arm is formed by a single bone
 - Humerus

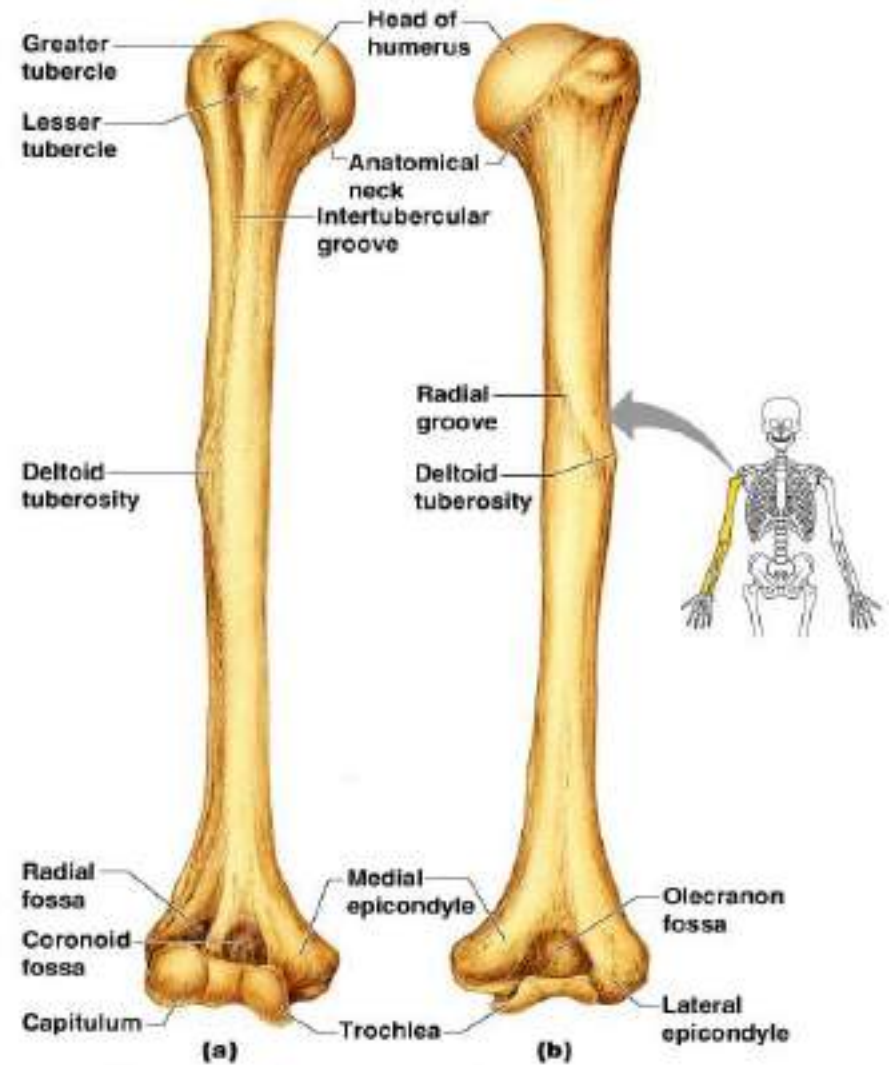
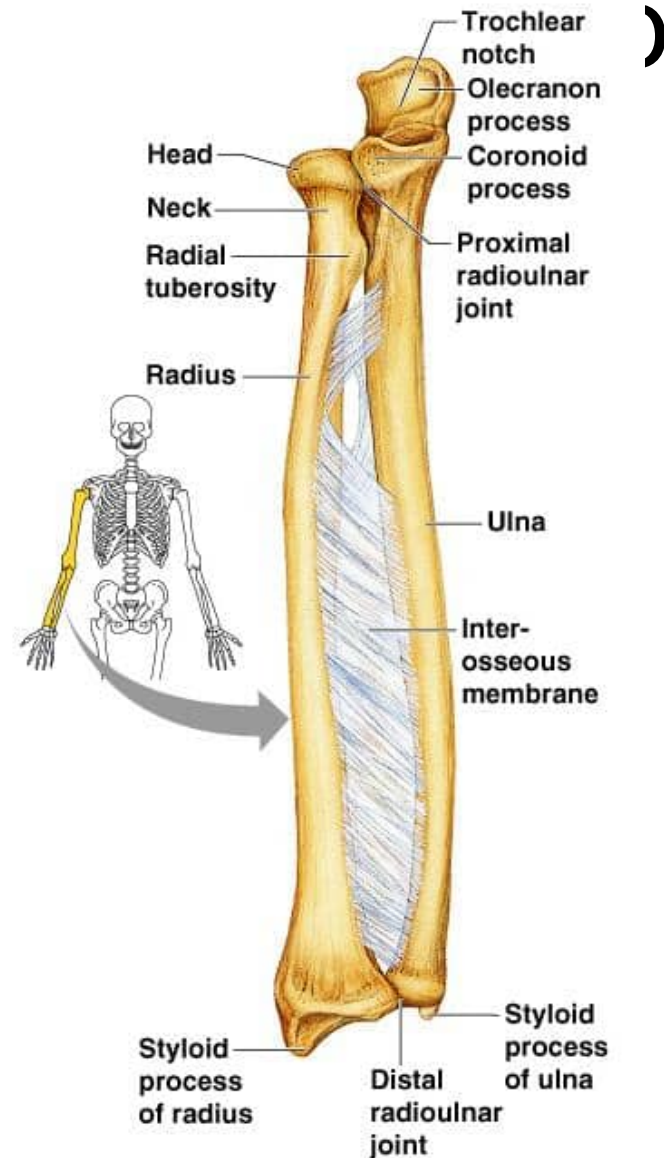


Figure 5.21a–b

Bones of the

- The forearm has two bones
 - Ulna
 - Radius



(c)

Figure 5.21c

Bones of the Upper Limb

- The hand
 - Carpals – wrist
 - Metacarpals – palm
 - Phalanges – fingers

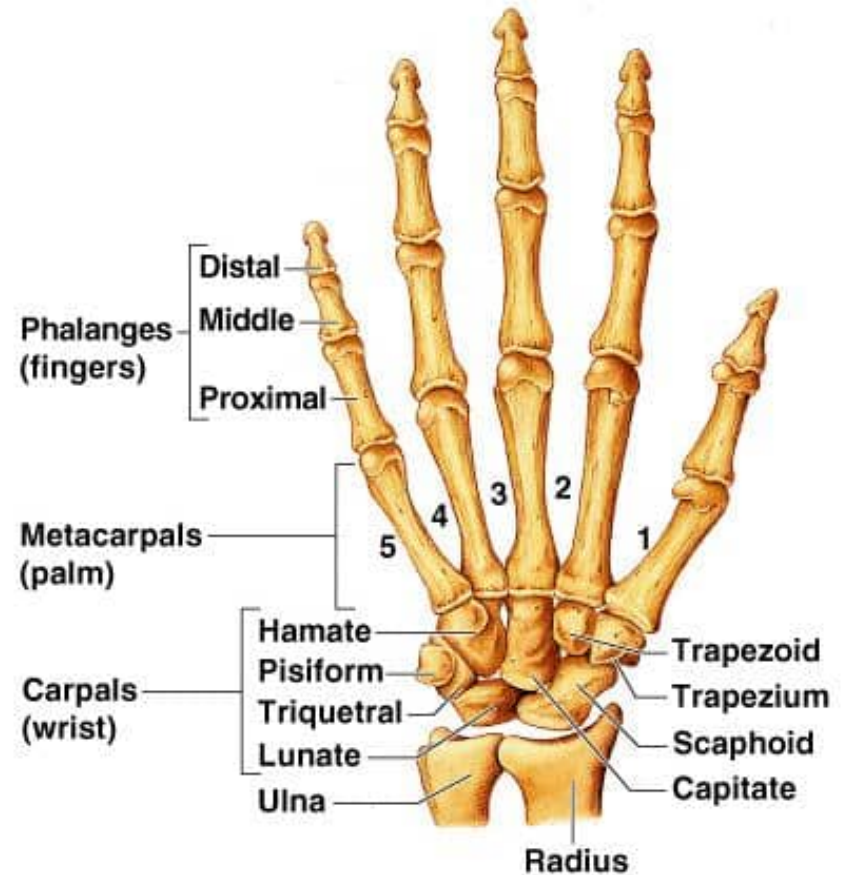
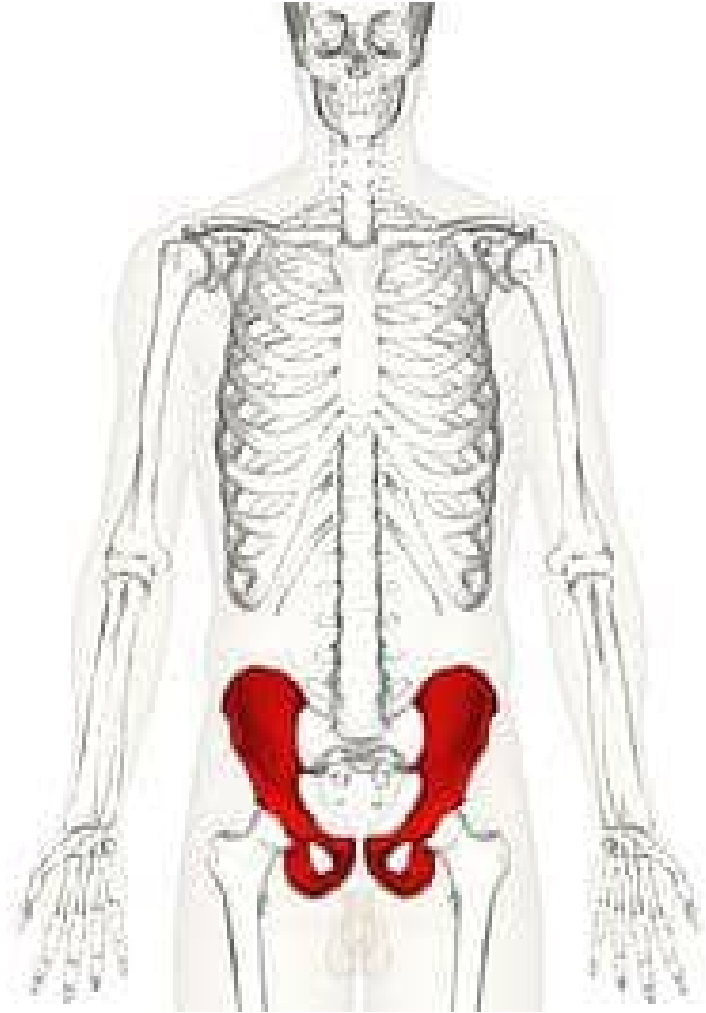


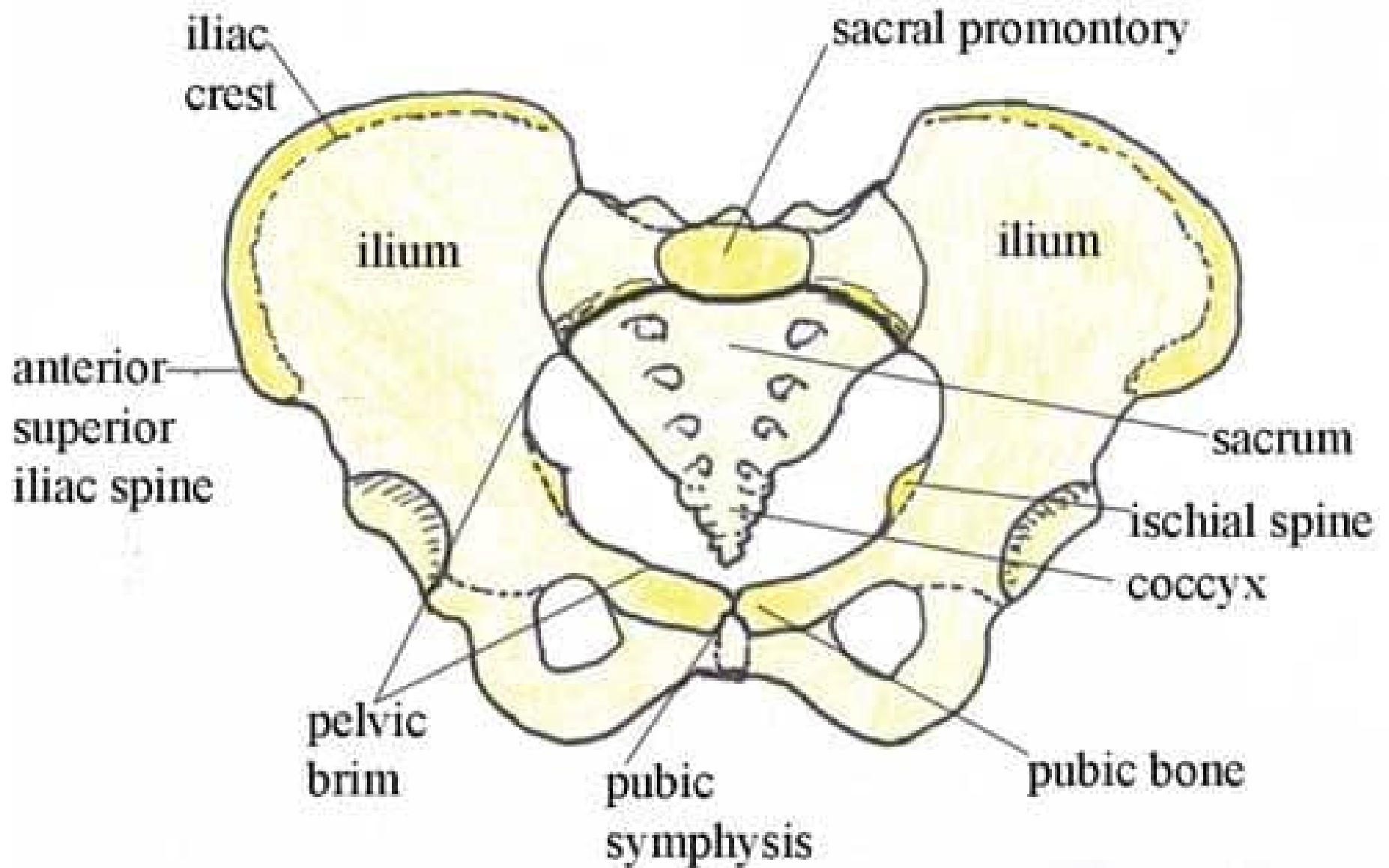
Figure 5.22

Bones of the Pelvic Girdle

- Hip bones
- Composed of three pair of fused bones
 - Ilium
 - Ischium
 - Pubic bone
- The total weight of the upper body rests on the pelvis
- Protects several organs
 - Reproductive organs
 - Urinary bladder
 - Part of the large intestine

The Skeletal System (e)





The Pelvis

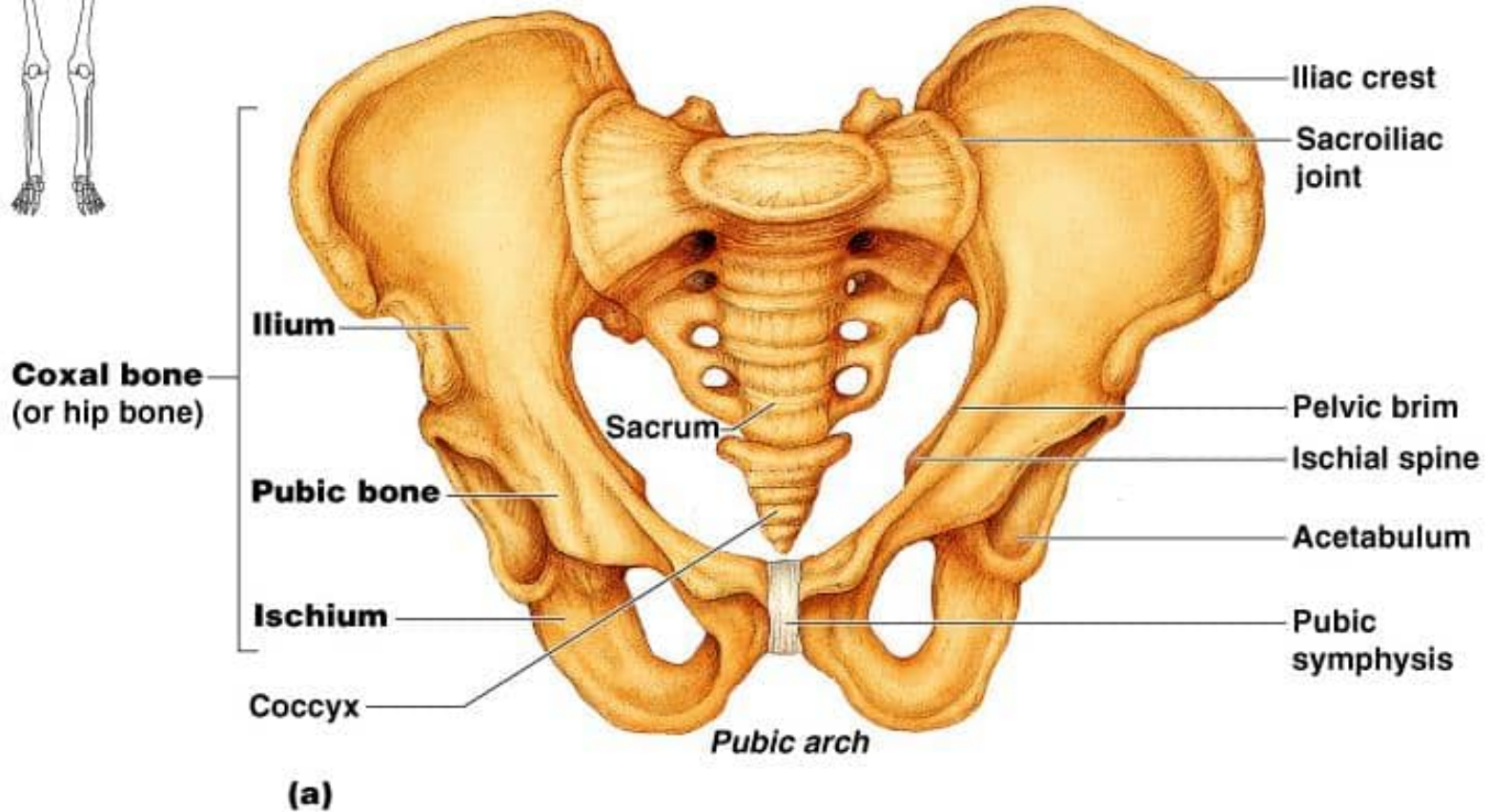
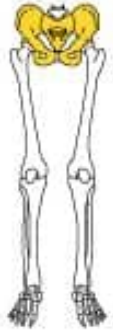


Figure 5.23a

The Pelvis: Right Coxal Bone

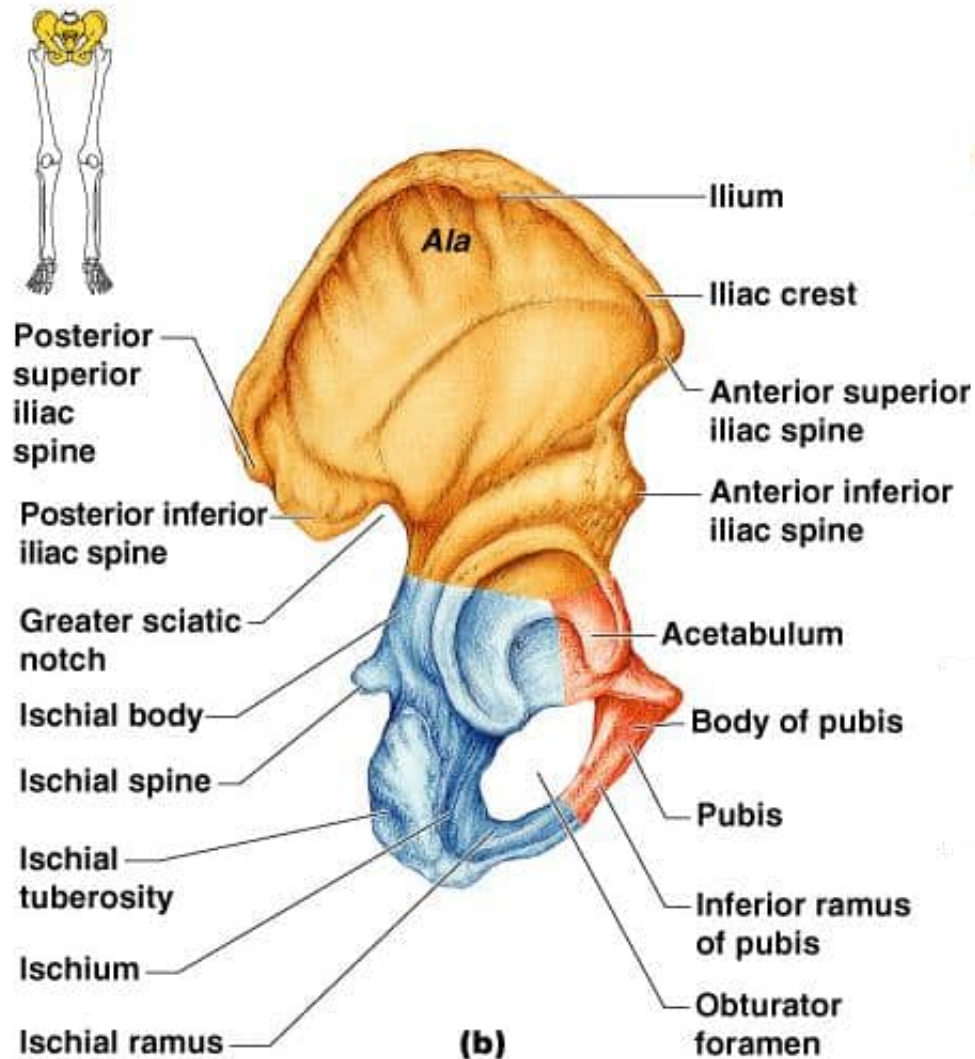
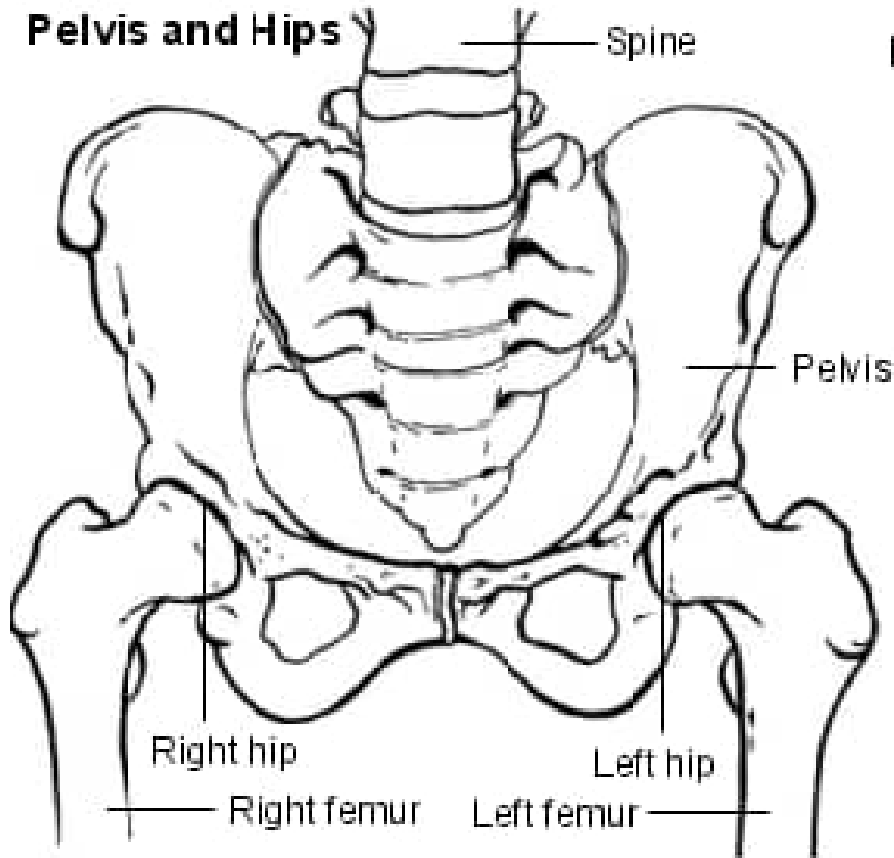
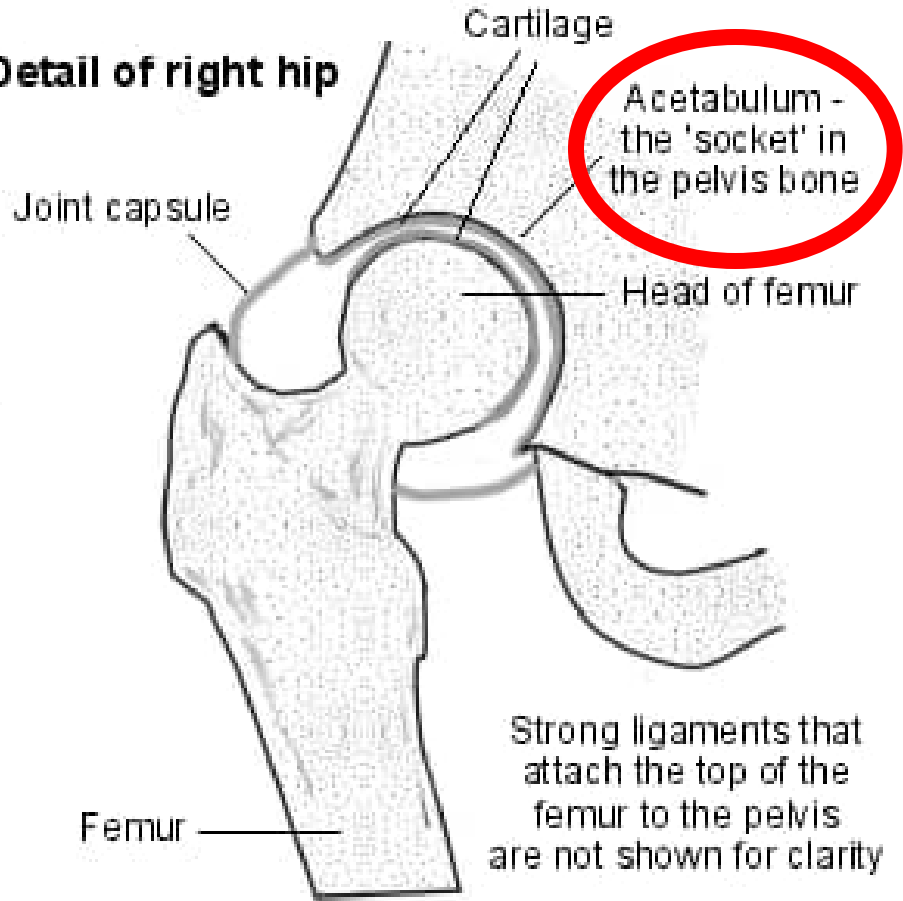


Figure 5.23b

Pelvis and Hips

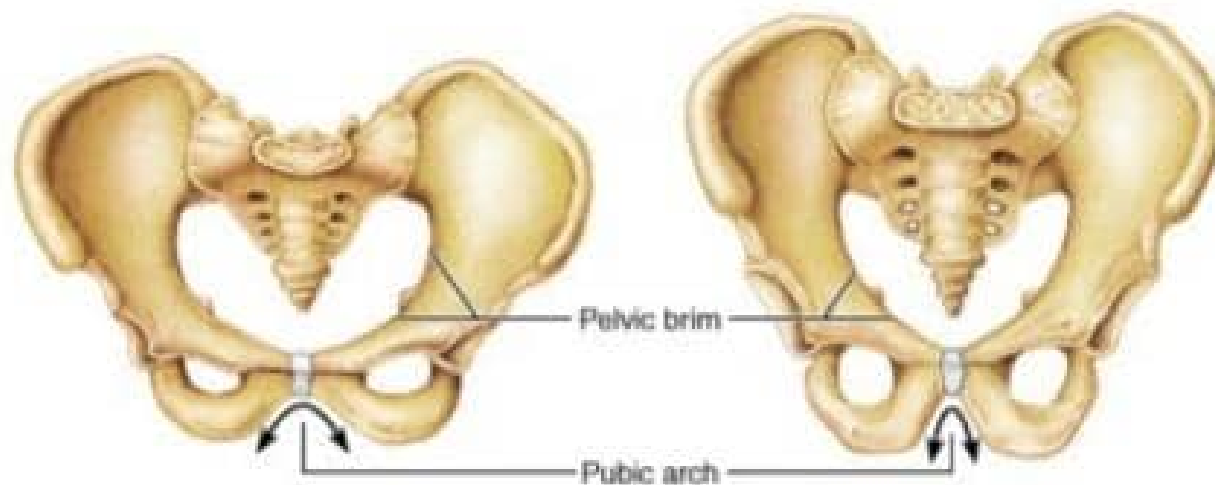


Detail of right hip



FEMALE

MALE



- Bones are lighter, thinner
- False pelvis is shallow
- Pelvic cavity is wide & shallow
- Pelvic inlet round/oval
- Pelvic outlet comparatively large
- Subpubic angle large
- Coccyx more flexible, straighter
- Ischial tuberosities more everted

- Bones heavier, thicker
- False pelvis is deep
- Pelvic cavity is narrow & deep
- Pelvic inlet heart-shaped + smaller
- Pelvic outlet comparatively small
- Subpubic angle more acute
- Coccyx less flexible, more curved
- Ischial tuberosities longer, face more medially

Bones of the Lower Limbs

- The thigh has one bone
 - Femur – thigh bone

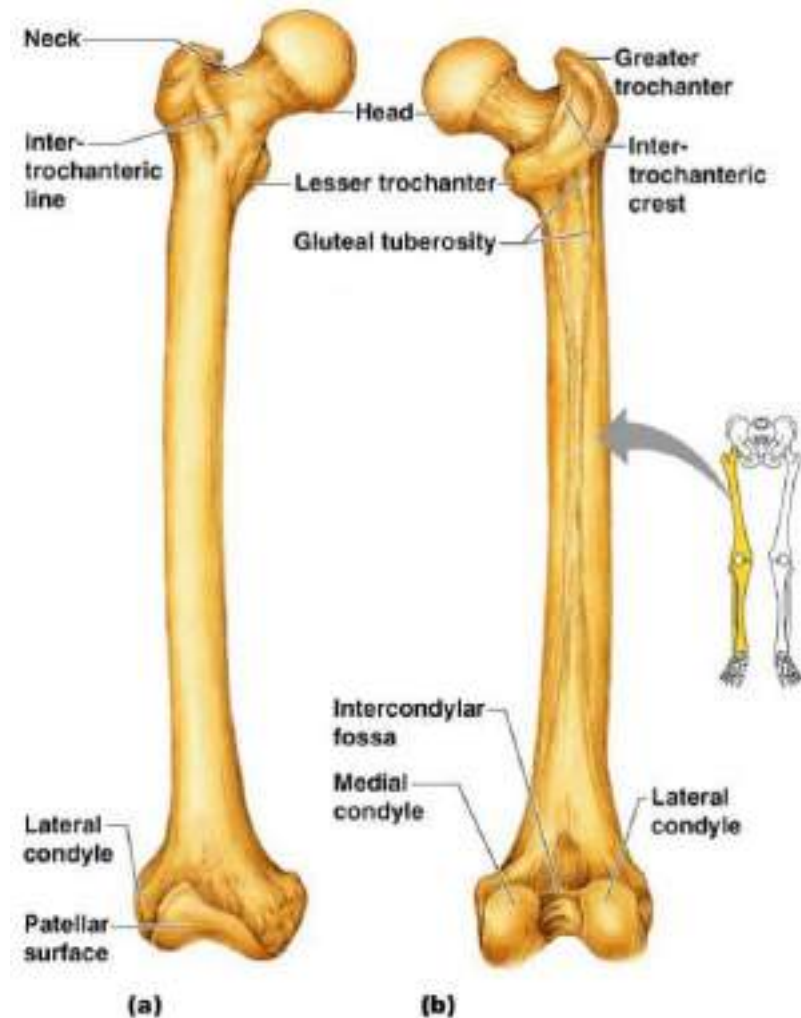


Figure 5.24a–b

Bones of the Lower Limbs

- The leg has two bones
 - Tibia
 - Fibula

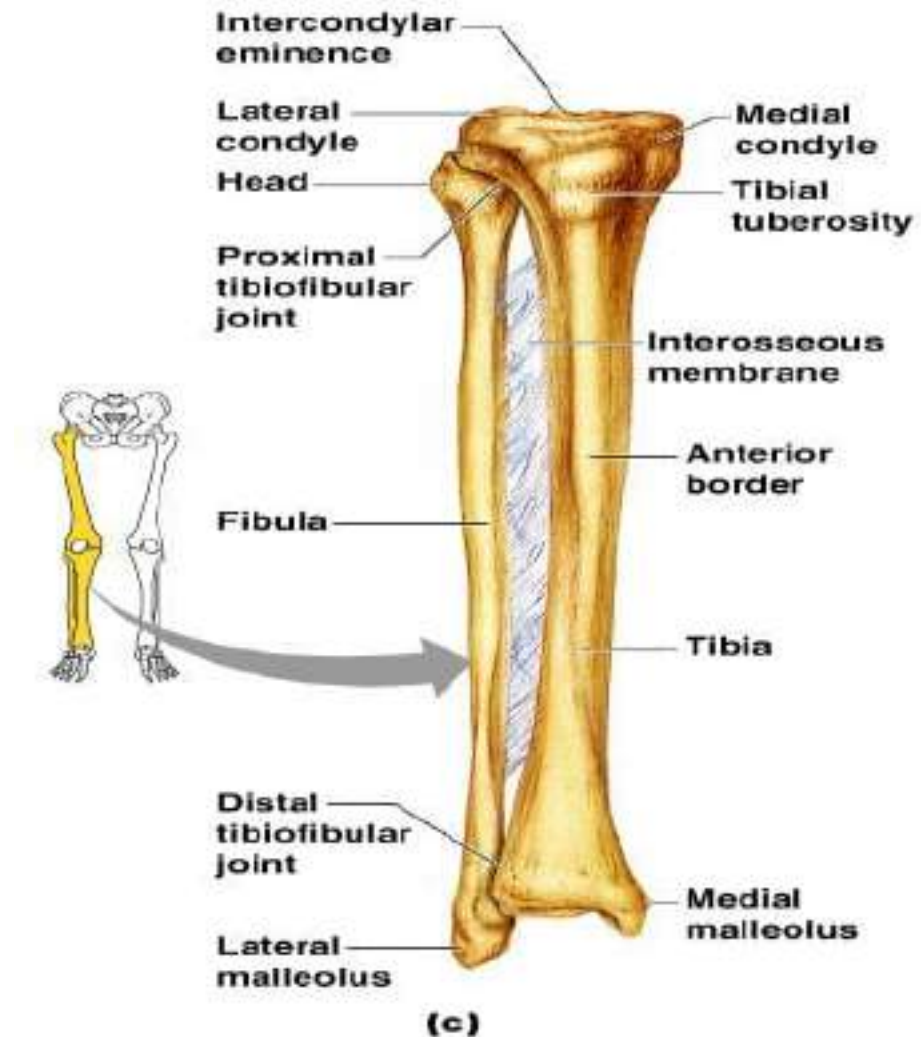


Figure 5.24c

Bones of the Lower Limbs

- The foot
 - Tarsus – ankle
 - Metatarsals – sole
 - Phalanges – toes



Arches of the Foot

- Bones of the foot are arranged to form three strong arches
 - Two longitudinal
 - One transverse



Figure 5.26

Joints

- Articulations of bones
- Functions of joints
 - Hold bones together
 - Allow for mobility
- Ways joints are classified
 - Functionally
 - Structurally

Functional Classification of Joints

- Synarthroses – immovable joints
- Amphiarthroses – slightly moveable joints
- Diarthroses – freely moveable joints

The Skeletal System (f)

Structural Classification of Joints

- Fibrous joints
 - Generally immovable
- Cartilaginous joints
 - Immovable or slightly moveable
- Synovial joints
 - Freely moveable

Fibrous Joints

- Bones united by fibrous tissue
- Examples
 - Sutures
 - Syndesmoses
 - Allows more movement than sutures
 - Example: distal end of tibia and fibula

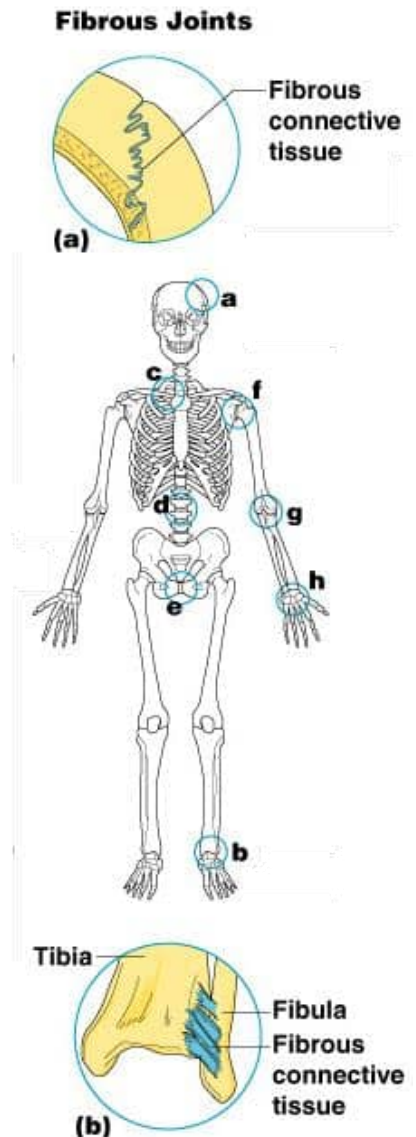


Figure 5.27a–b

Cartilaginous Joints

- Bones connected by cartilage
- Examples
 - Pubic symphysis
 - Intervertebral joints

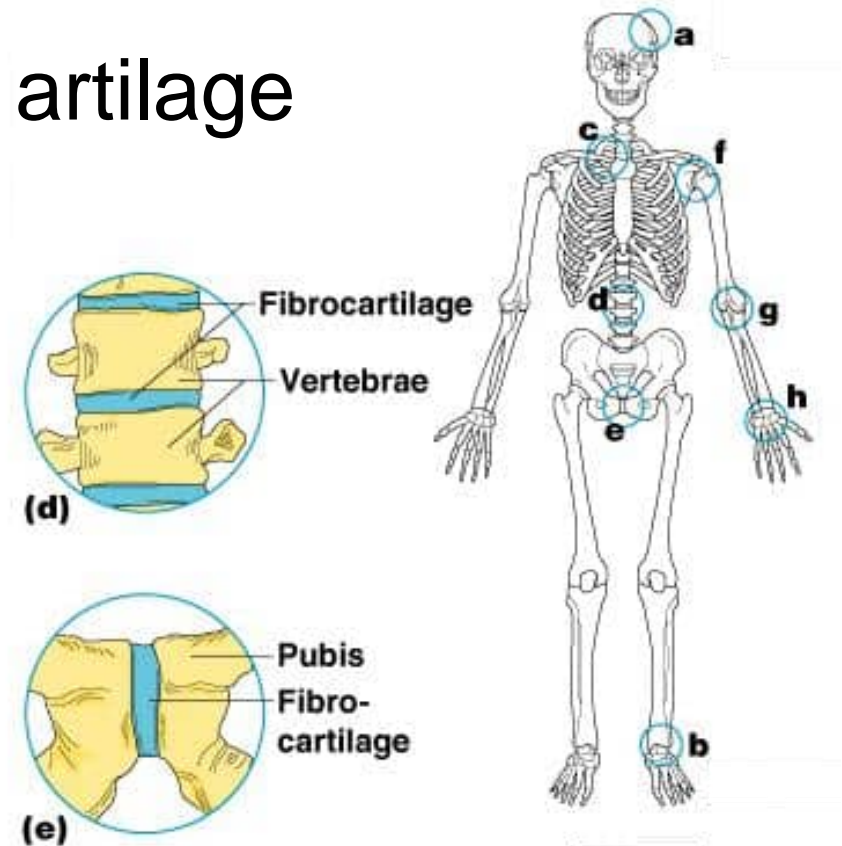


Figure 5.27d–e

Synovial Joints

- Articulating bones are separated by a joint cavity
- Synovial fluid is found in the joint cavity

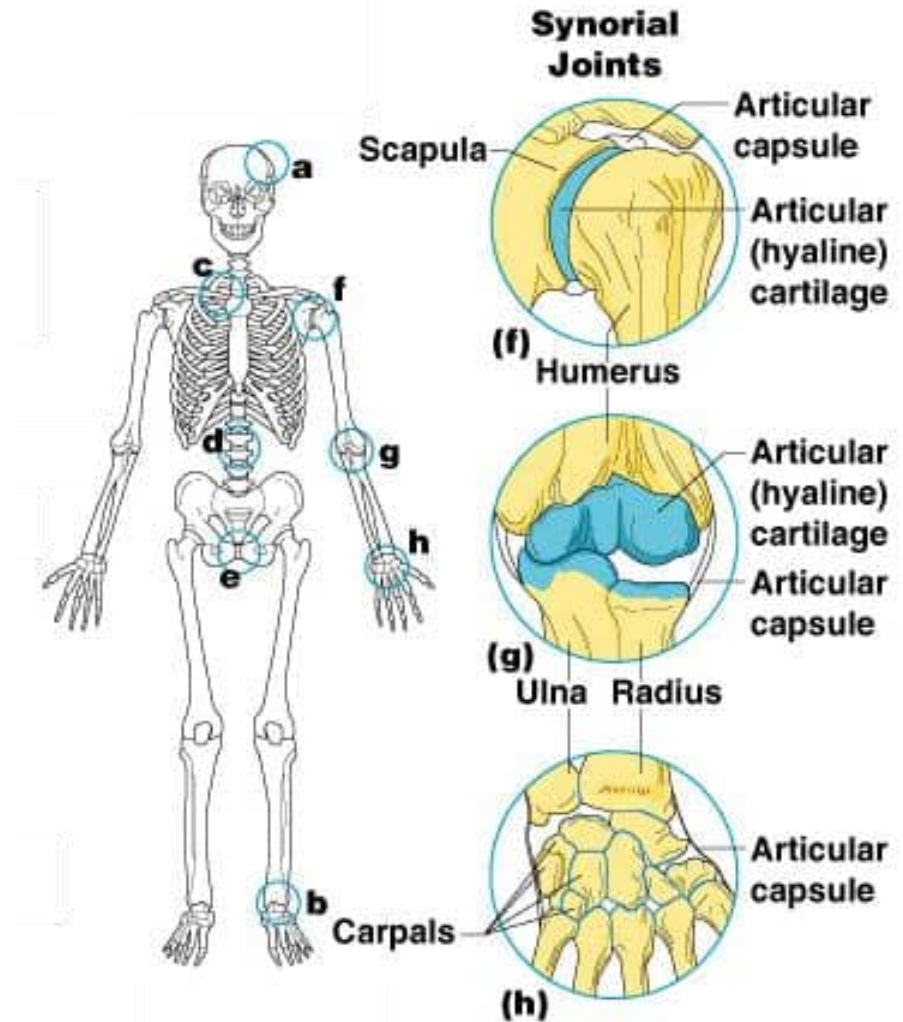


Figure 5.24f–h

Features of Synovial Joints

- Articular cartilage (hyaline cartilage) covers the ends of bones
- Joint surfaces are enclosed by a fibrous articular capsule
- Have a joint cavity filled with synovial fluid
- Ligaments reinforce the joint

Structures Associated with the Synovial Joint

- Bursae – flattened fibrous sacs
 - Lined with synovial membranes
 - Filled with synovial fluid
 - Not actually part of the joint
- Tendon sheath
 - Elongated bursa that wraps around a tendon

The Synovial Joint

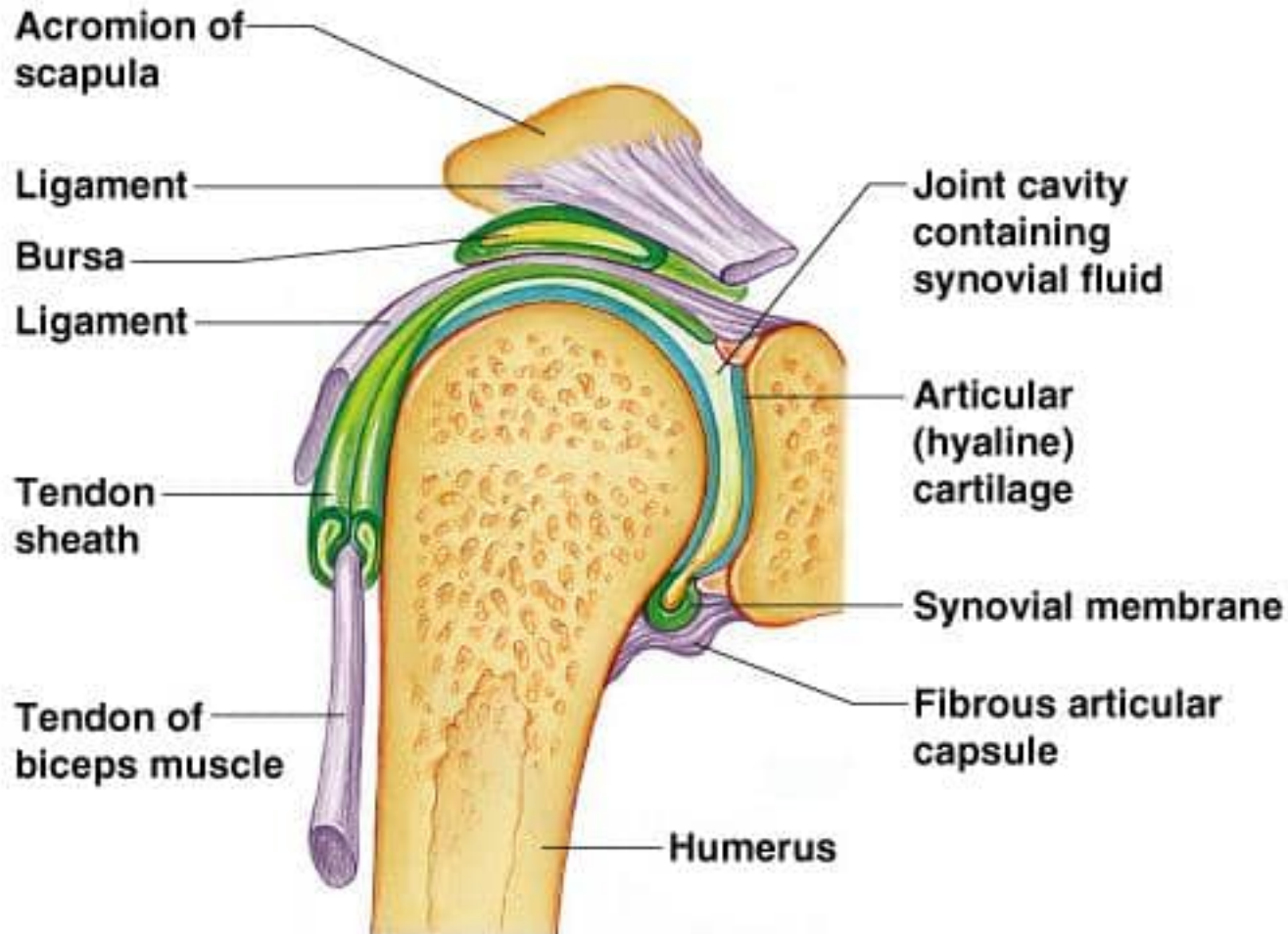


Figure 5.28

Types of Synovial Joints Based on Shape

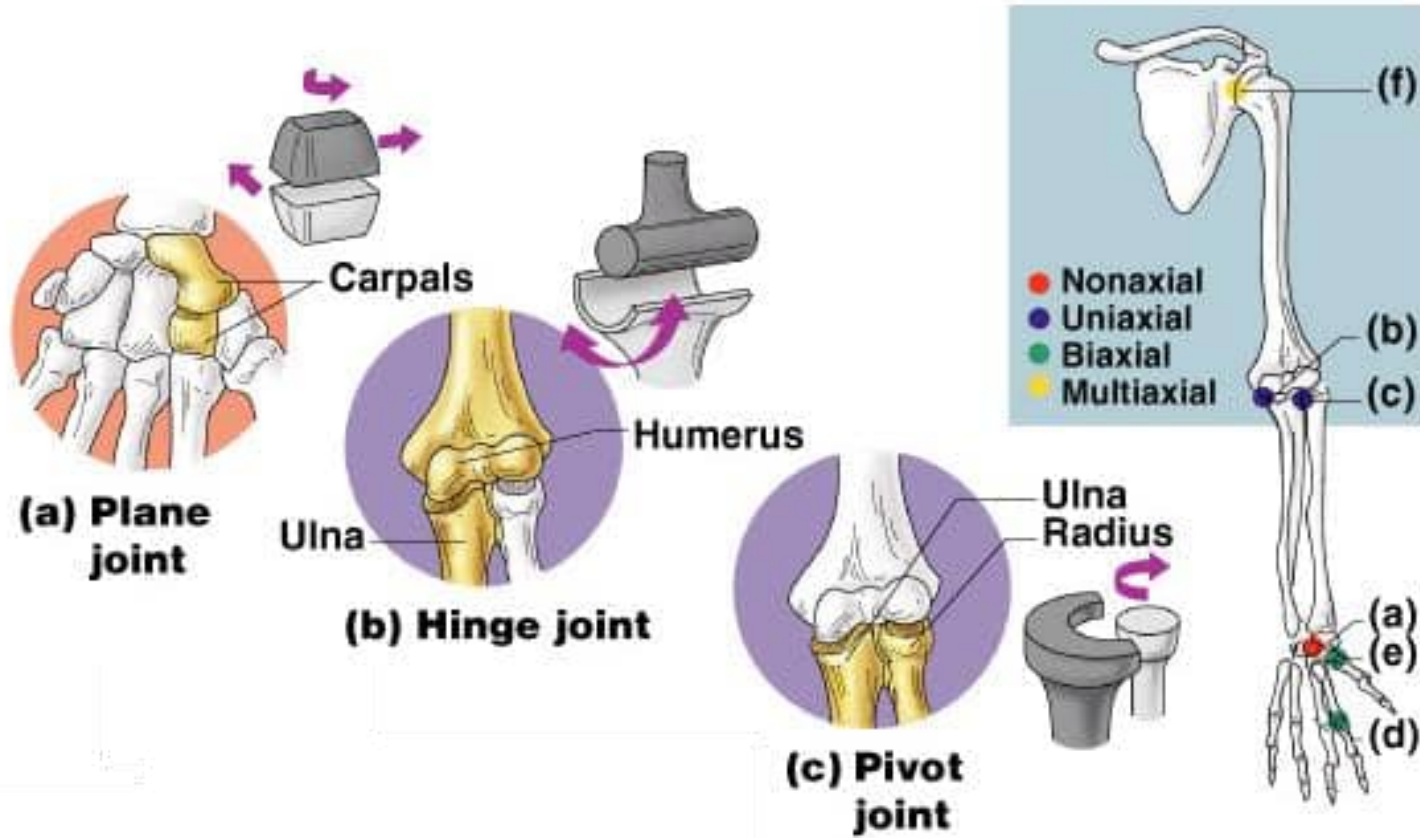


Figure 5.29a-c

Types of Synovial Joints Based on \$

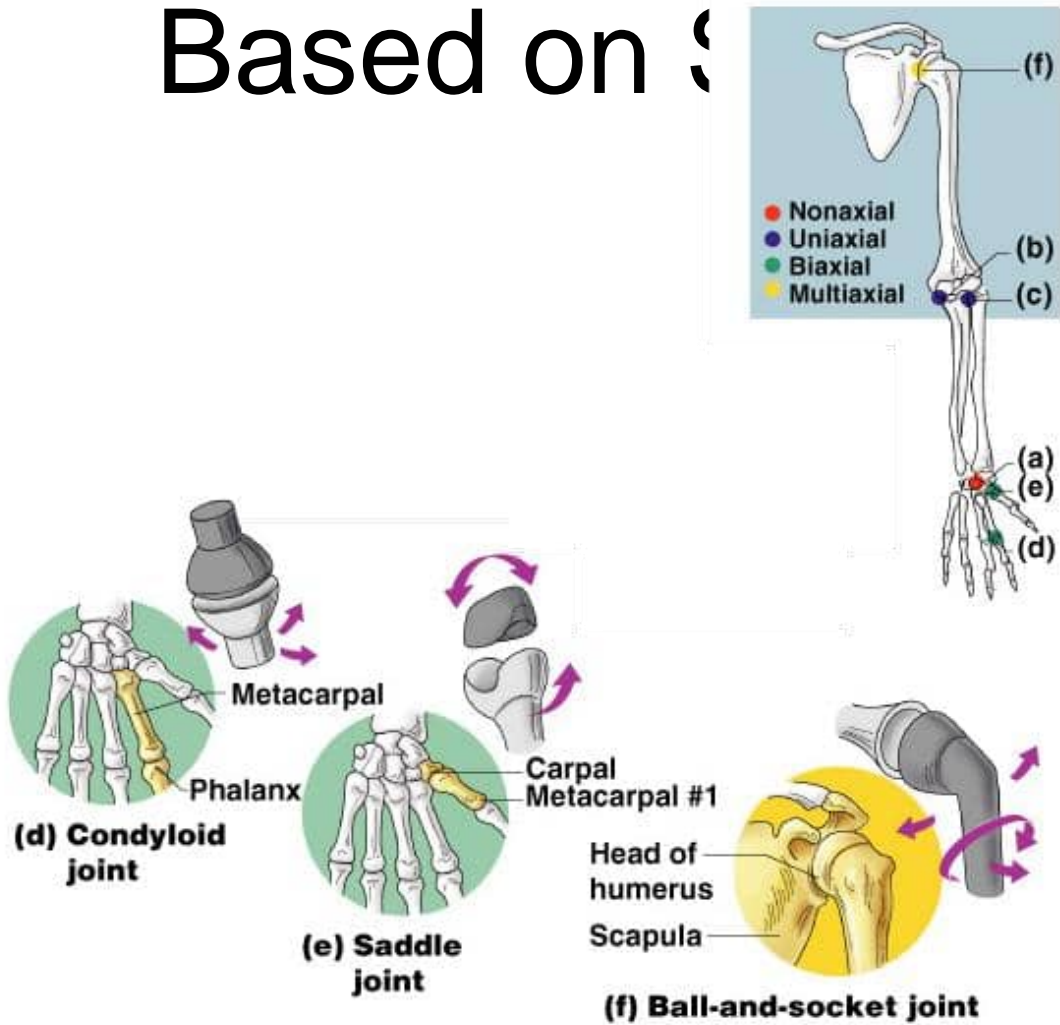


Figure 5.29d-f

Inflammatory Conditions Associated with Joints

- Bursitis – inflammation of a bursa usually caused by a blow or friction
- Tendonitis – inflammation of tendon sheaths
- Arthritis – inflammatory or degenerative diseases of joints
 - Over 100 different types
 - The most widespread crippling disease in the United States

Clinical Forms of Arthritis

- Osteoarthritis
 - Most common chronic arthritis
 - Probably related to normal aging processes
- Rheumatoid arthritis
 - An autoimmune disease – the immune system attacks the joints
 - Symptoms begin with bilateral inflammation of certain joints
 - Often leads to deformities

Clinical Forms of Arthritis

- Gouty Arthritis
 - Inflammation of joints is caused by a deposition of urate crystals from the blood
 - Can usually be controlled with diet

Developmental Aspects of the Skeletal System

- At birth, the skull bones are incomplete
- Bones are joined by fibrous membranes – fontanelles
- Fontanelles are completely replaced with bone within two years after birth