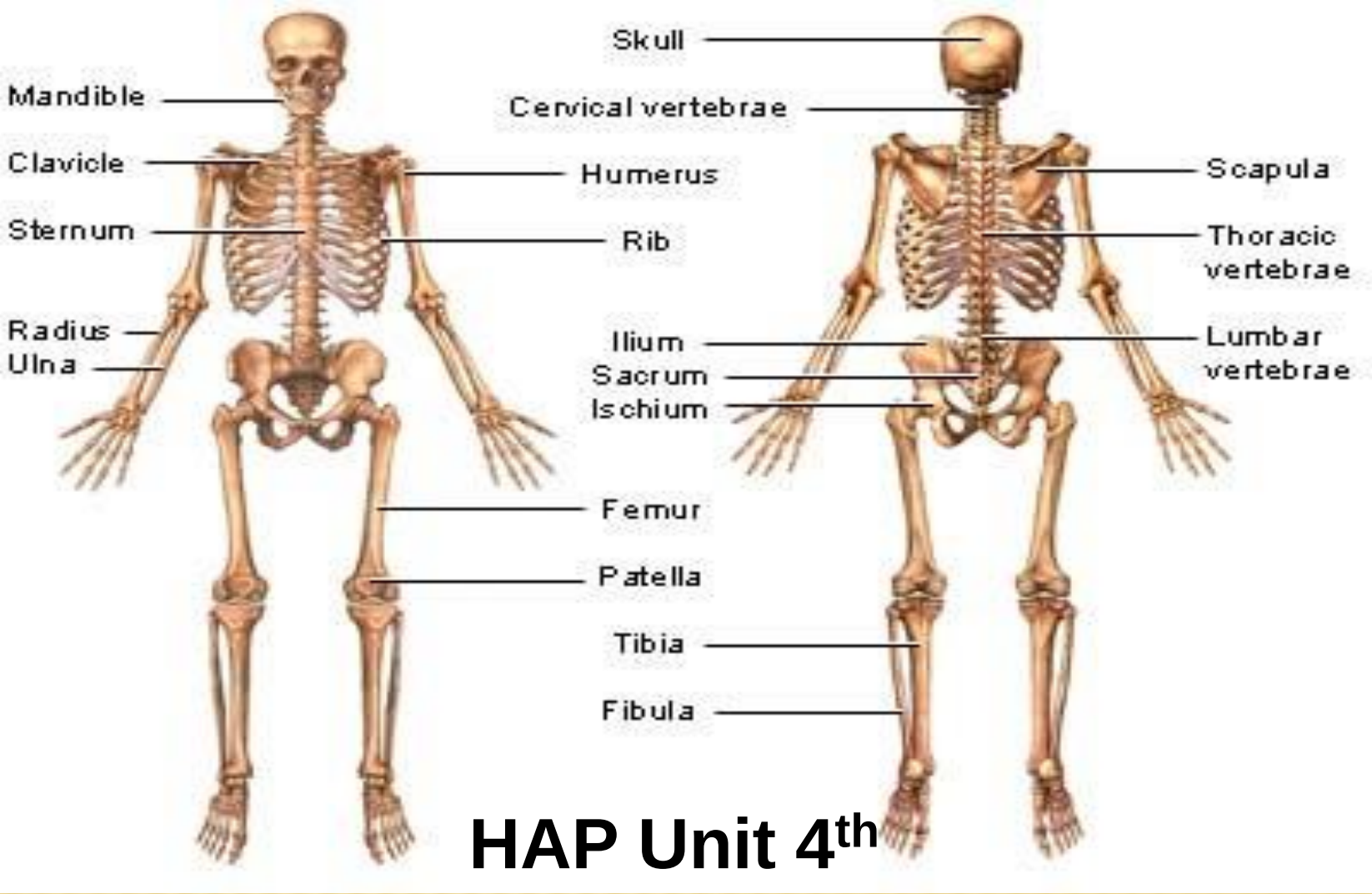
THE SKELETAL SYSTEM



HAP Unit 4th

THE SKELETAL SYSTEM

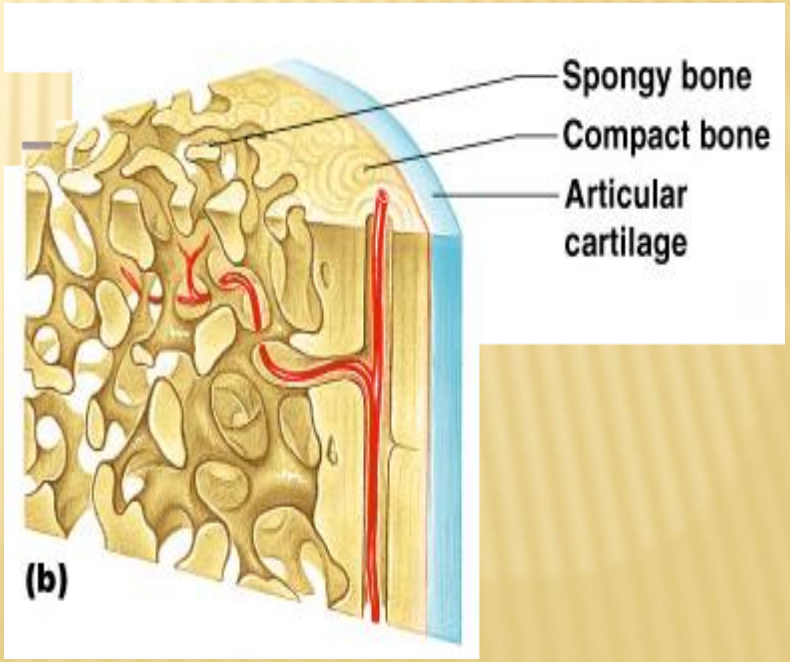
- Parts of the skeletal system include:
  - Bones (skeleton)
  - Joints
  - Cartilages
  - Ligaments
- Divided into two divisions:
  1. Axial skeleton (skull, ribs and vertebra)
  2. Appendicular skeleton (pelvis, extremities)

FUNCTIONS OF BONES

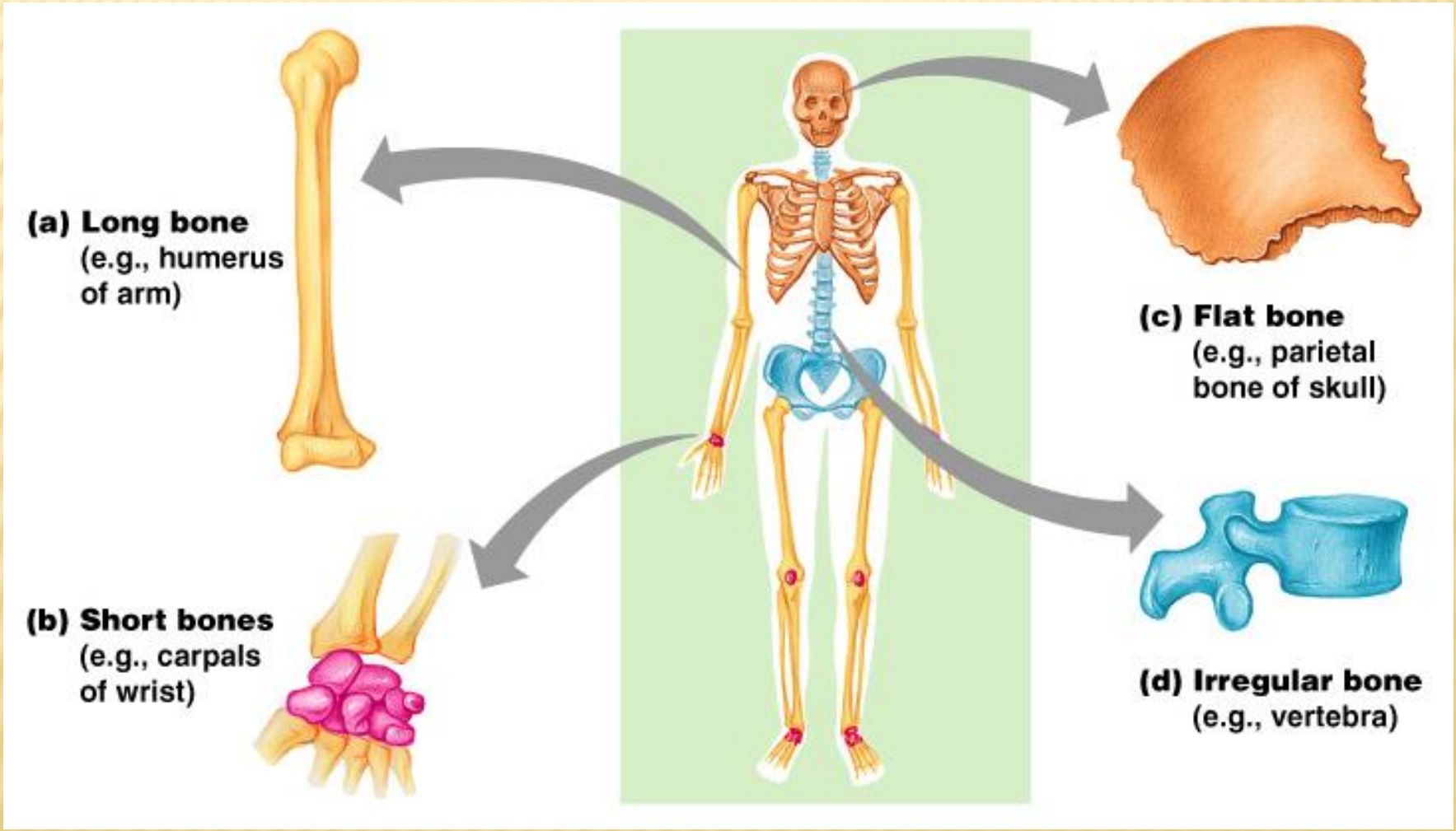
- Support of the body
- Protection of soft organs
- Movement due to attached skeletal muscles
- Storage of minerals and fats
- Blood cell formation

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



CLASSIFICATION OF BONES ON THE BASIS OF SHAPE



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

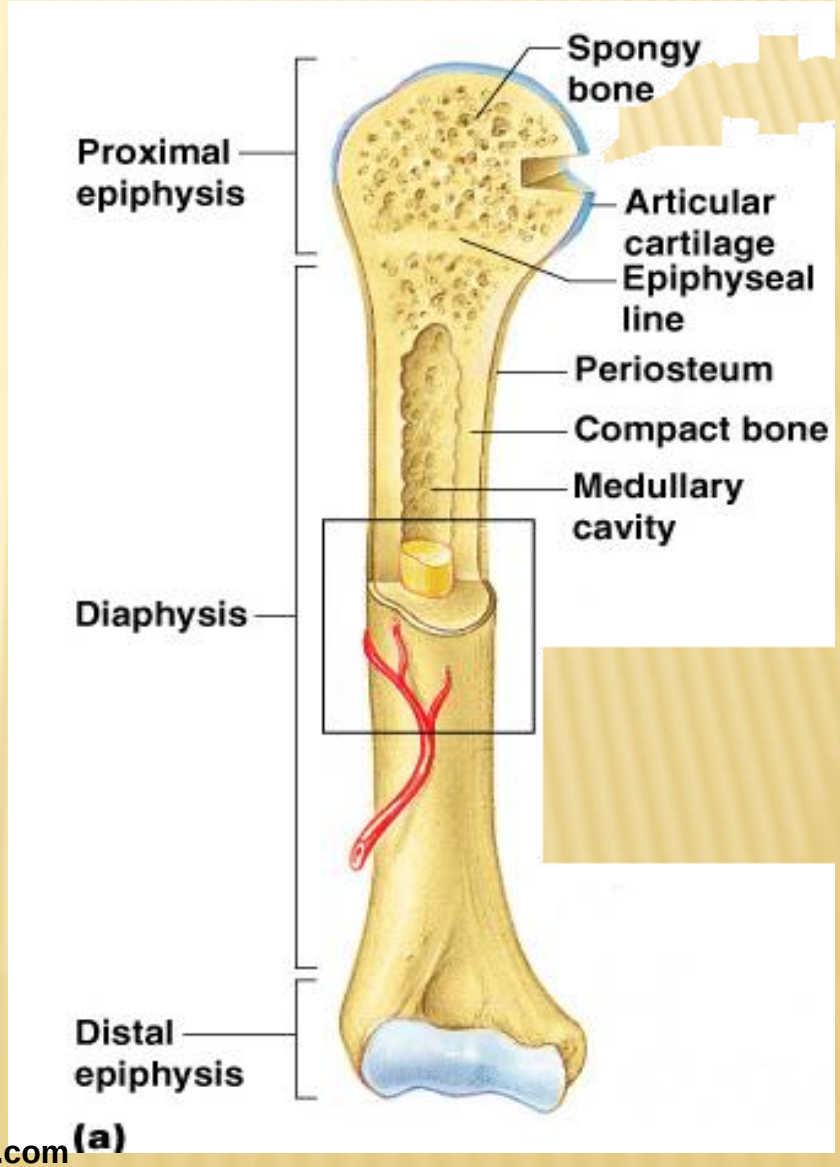
CLASSIFICATION OF BONES

- 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



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

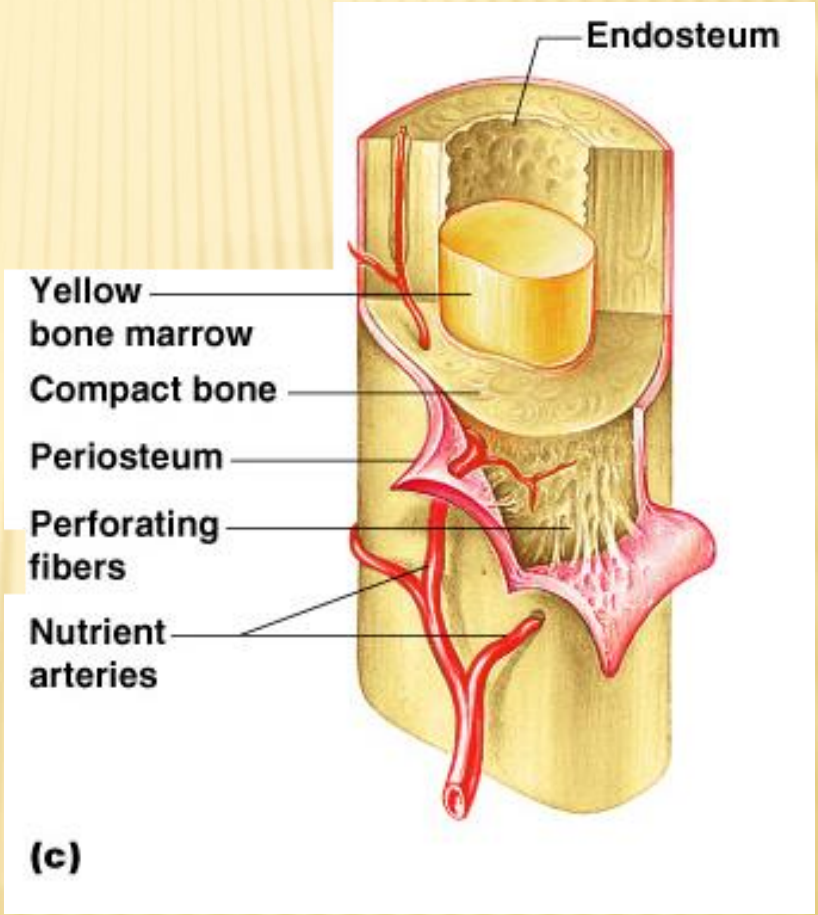
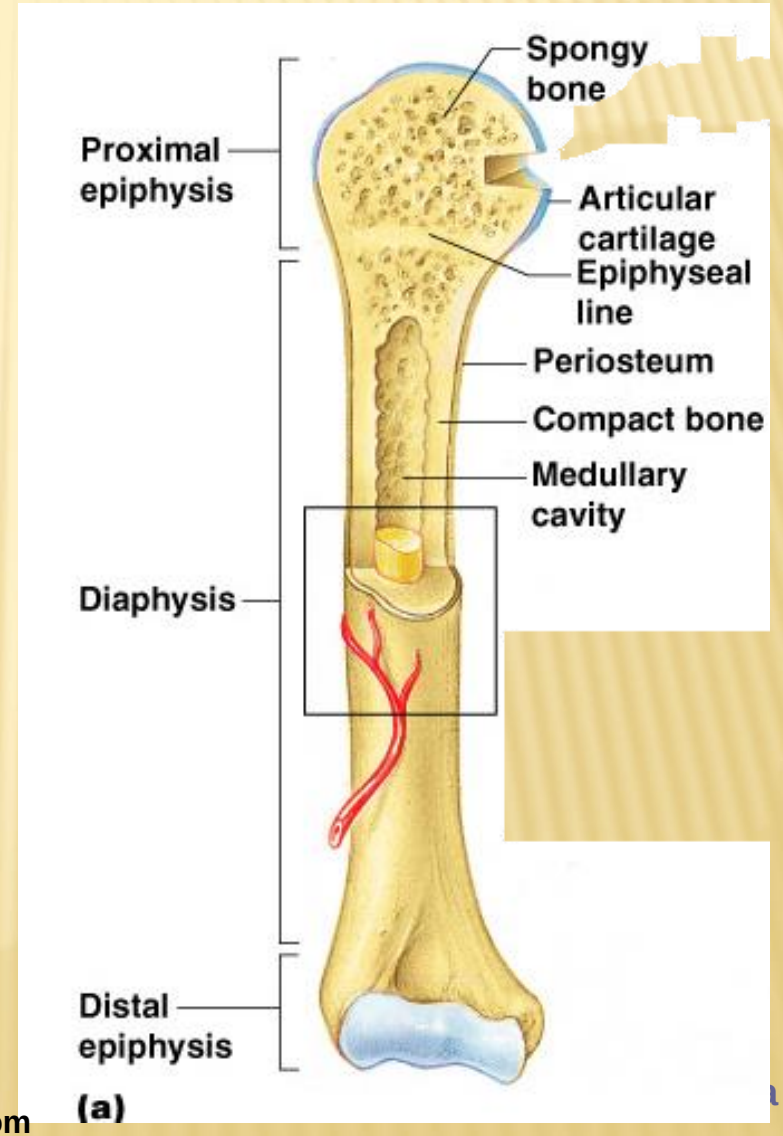


Figure 5.2c

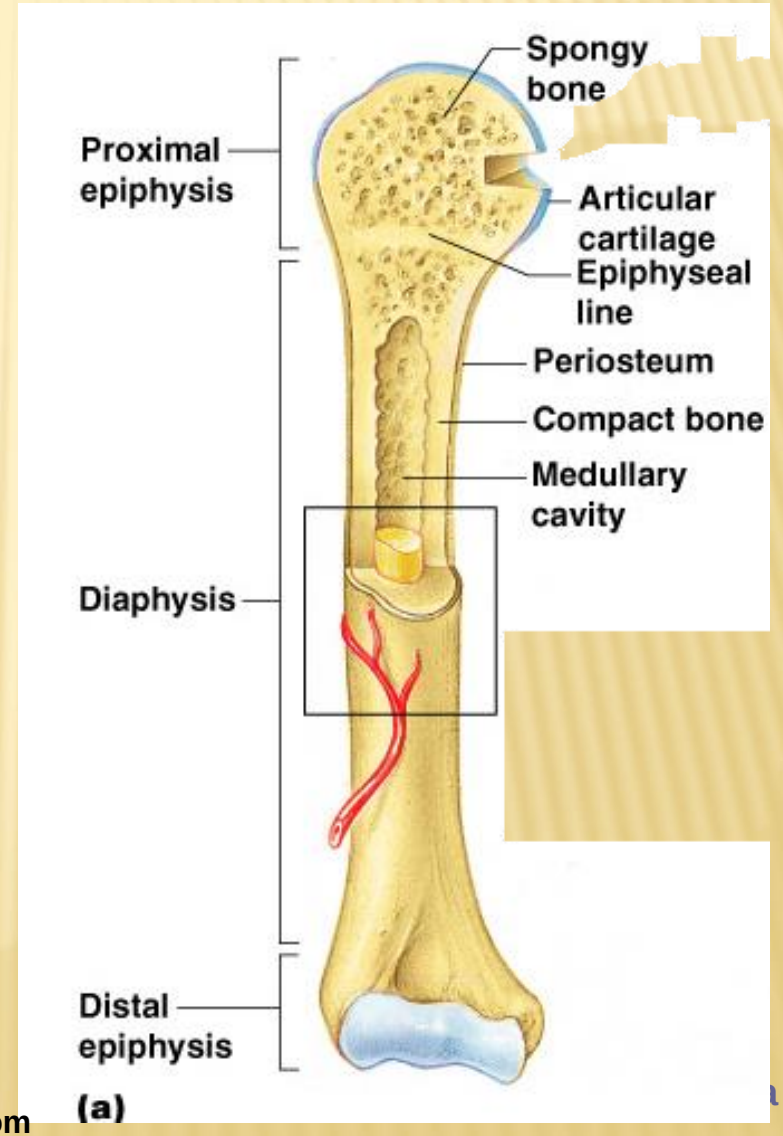
STRUCTURES OF A LONG BONE

- 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

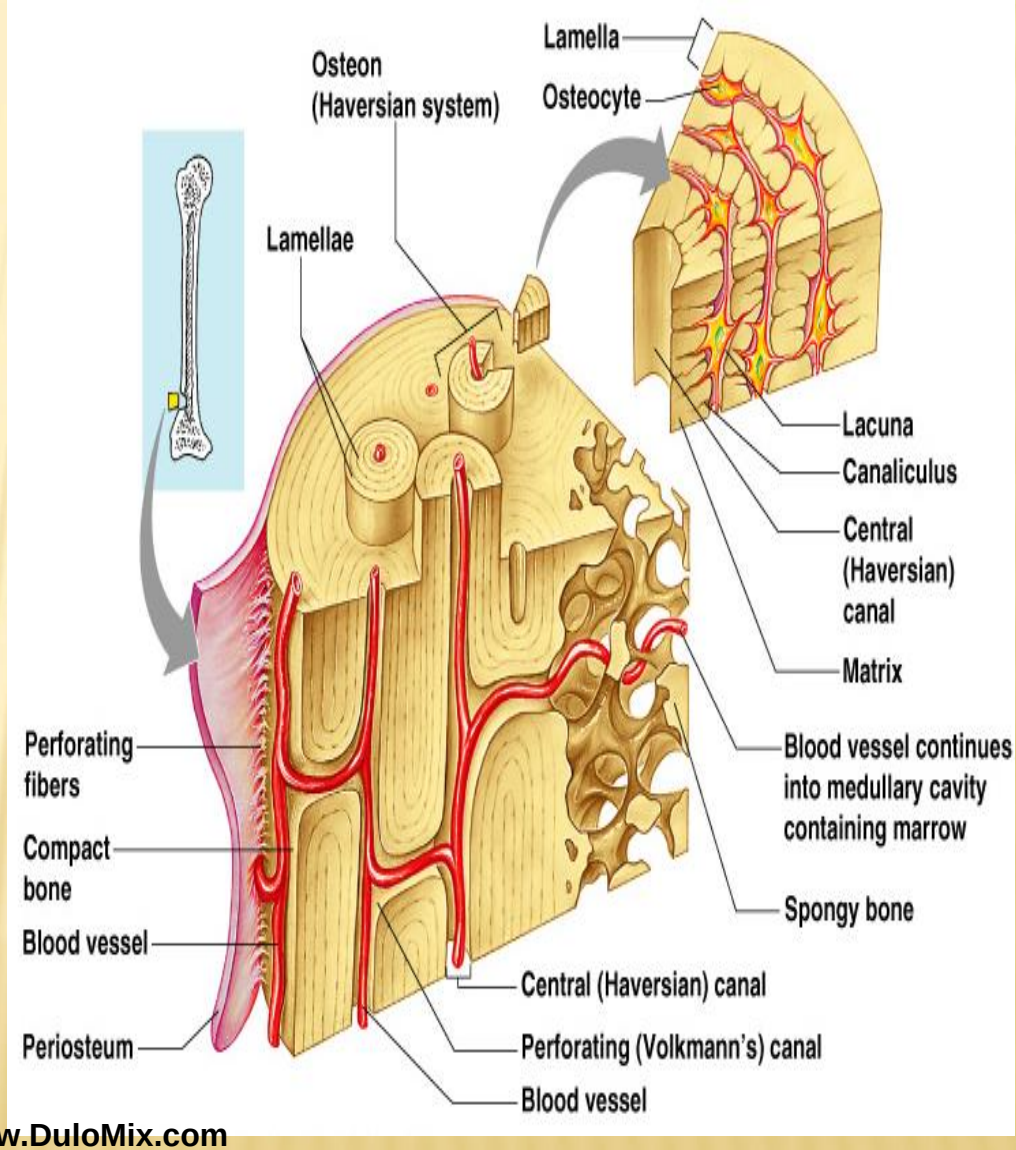


BONE MARKINGS

- 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

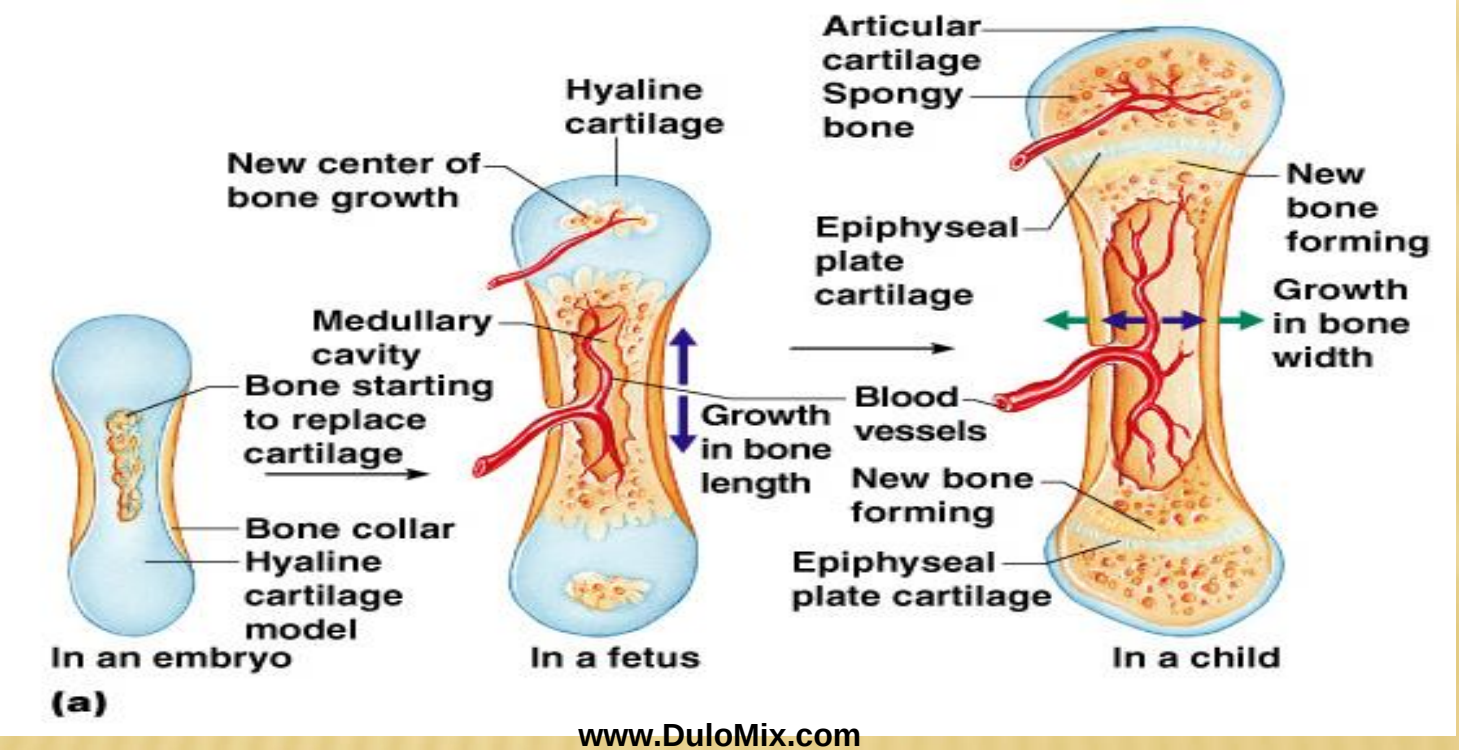
- In embryos, the skeleton is primarily hyaline cartilage
- During development, much of this cartilage is replaced by bone
- Cartilage remains in isolated areas
  - Bridge of the nose
  - Parts of ribs
  - Joints

BONE GROWTH

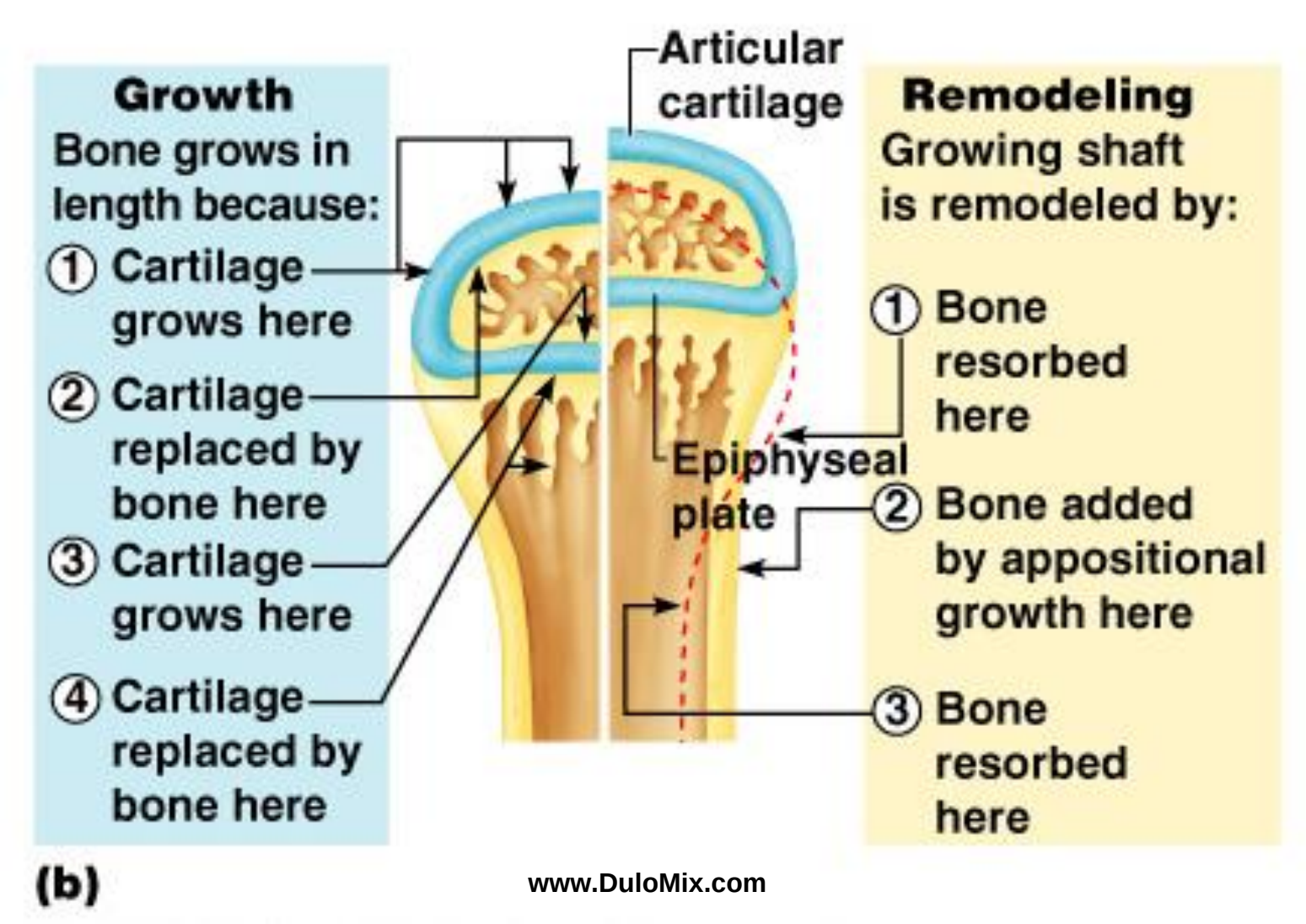
- Epiphyseal plates allow for growth of long bone during childhood
  - New cartilage is continuously formed
  - Older cartilage becomes ossified
    - Cartilage is broken down
    - Bone replaces cartilage

BONE GROWTH

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



LONG BONE FORMATION AND GROWTH



e 5.4b

TYPES OF BONE CELLS

- Osteocytes
  - Mature bone cells
- Osteoblasts
  - Bone-forming cells
- Osteoclasts
  - Bone-destroying cells
  - Break down bone matrix for remodeling and release of calcium
- Bone remodeling is a process by both osteoblasts and osteoclasts

THE SKELETAL SYSTEM (B)

BONE FRACTURES

- A break in a bone
- Types of bone fractures
  - Closed (simple) fracture – break that does not penetrate the skin
  - Open (compound) fracture – broken bone penetrates through the skin
- Bone fractures are treated by reduction and immobilization
  - Realignment of the bone

COMMON TYPES OF FRACTURES

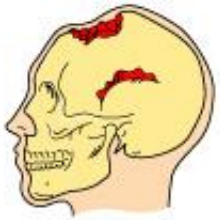
Fracture type	Illustration	Description	Comment
Comminuted		Bone breaks into many fragments.	Particularly common in the aged, whose bones are more brittle.
Compression		Bone is crushed.	Common in porous bones (i.e., osteoporotic bones).
Depressed		Broken bone portion is pressed inward.	Typical of skull fracture.
Impacted		Broken bone ends are forced into each other.	Commonly occurs when one attempts to break a fall with outstretched arms.
Spiral		Ragged break occurs when excessive twisting forces are applied to a bone.	Common sports fracture.
Greenstick		Bone breaks incompletely, much in the way a green twig breaks.	Common in children, whose bones are more flexible than those of adults.

Table 5.2

REPAIR OF BONE FRACTURES

- Hematoma (blood-filled swelling) is formed
- Break is splinted by fibrocartilage to form a callus
- Fibrocartilage callus is replaced by a bony callus
- Bony callus is remodeled to form a permanent patch

STAGES IN THE HEALING OF A BONE FRACTURE

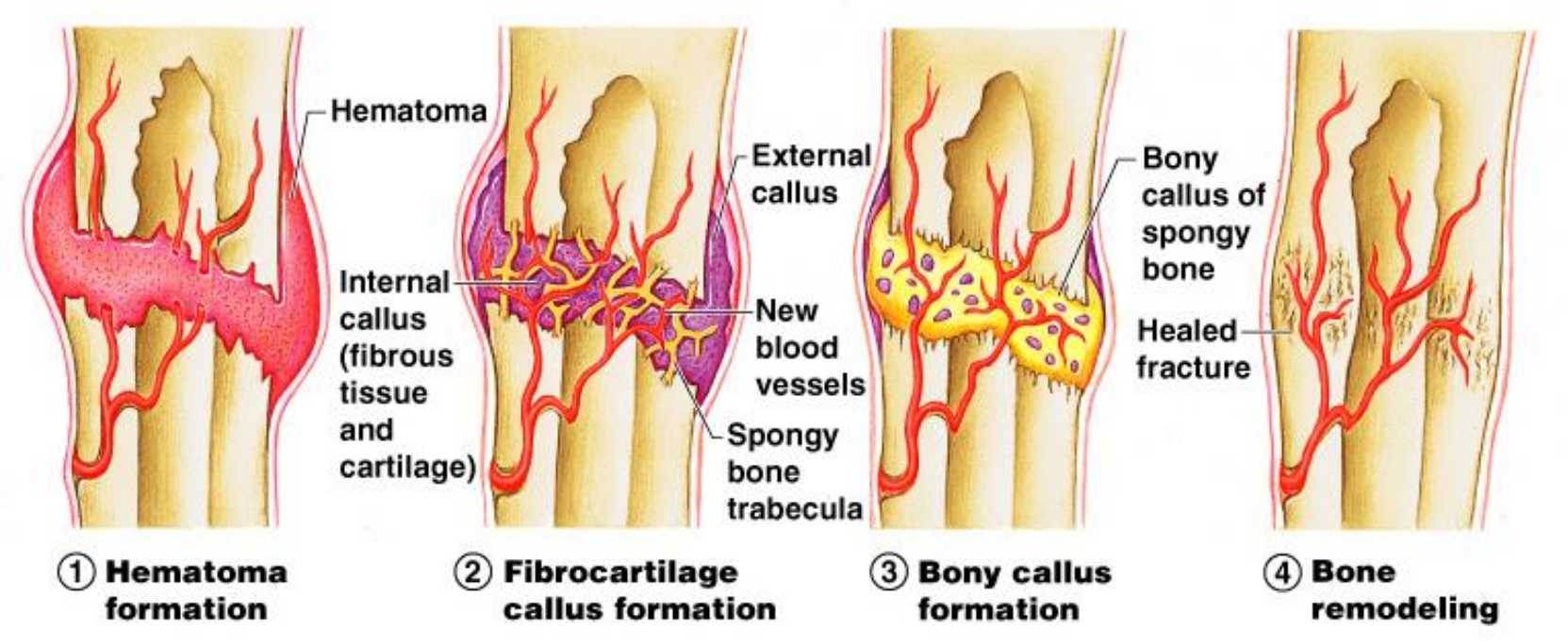
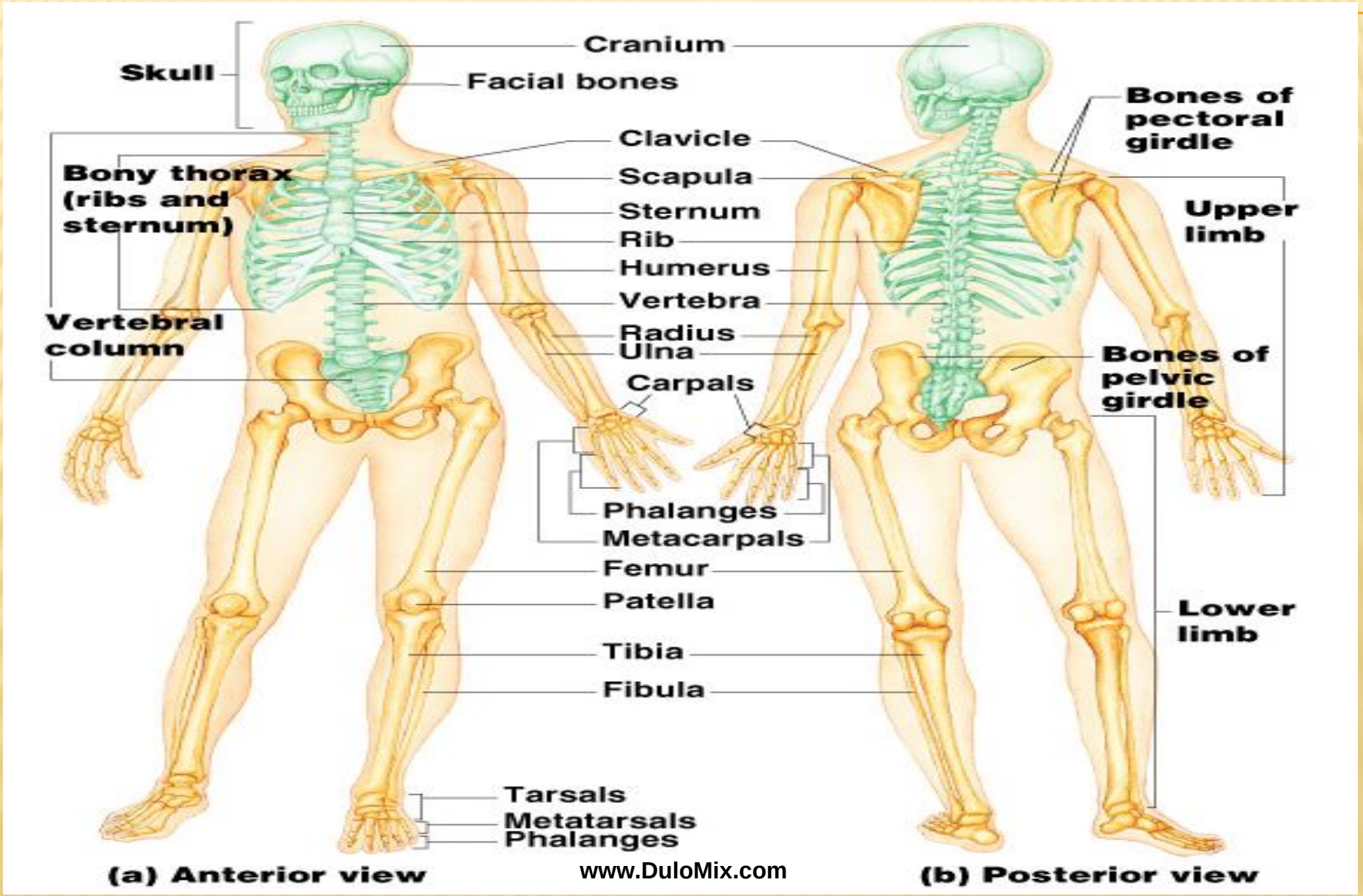


Figure 5.5

THE AXIAL SKELETON

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

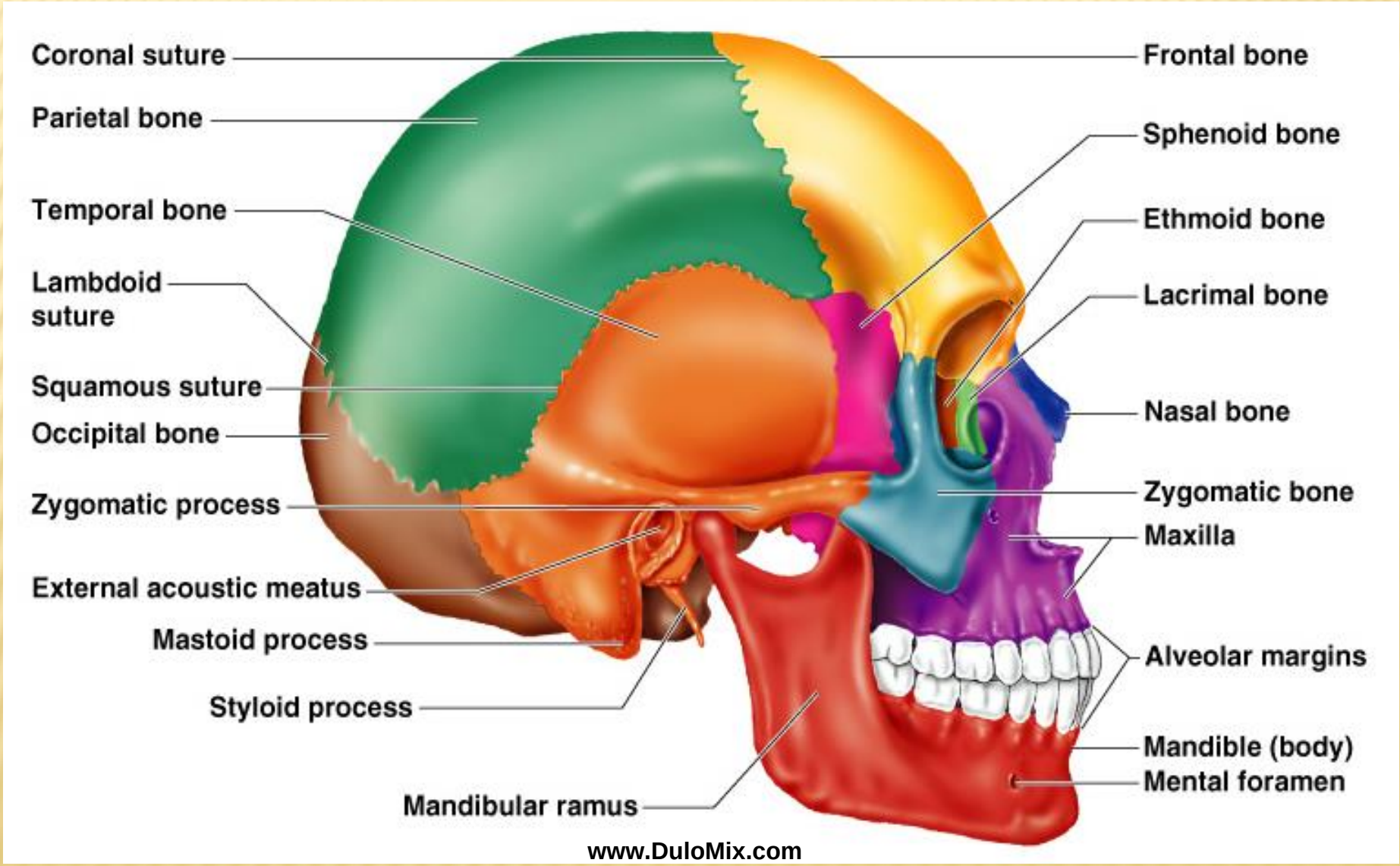
THE AXIAL SKELETON



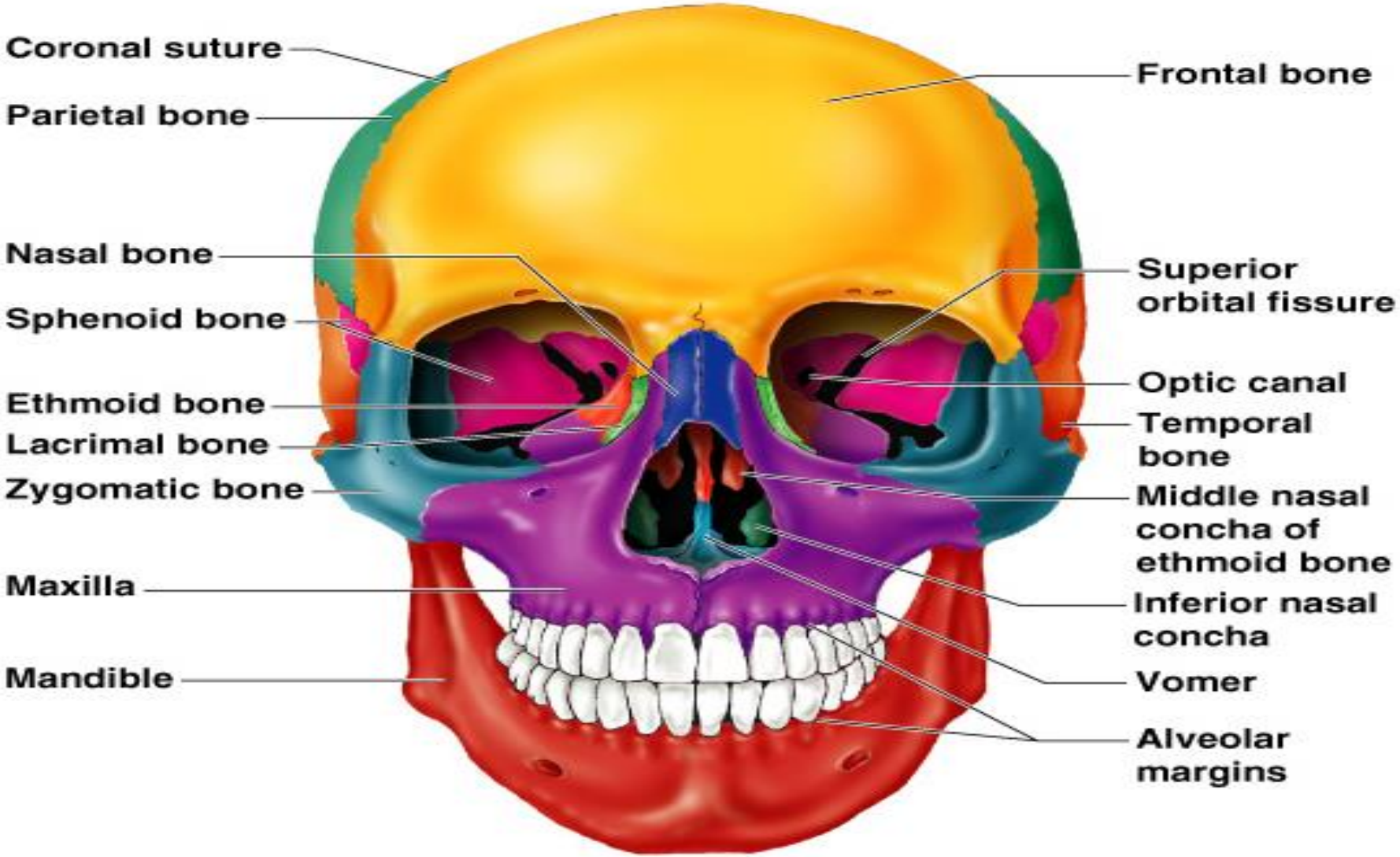
THE SKULL

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

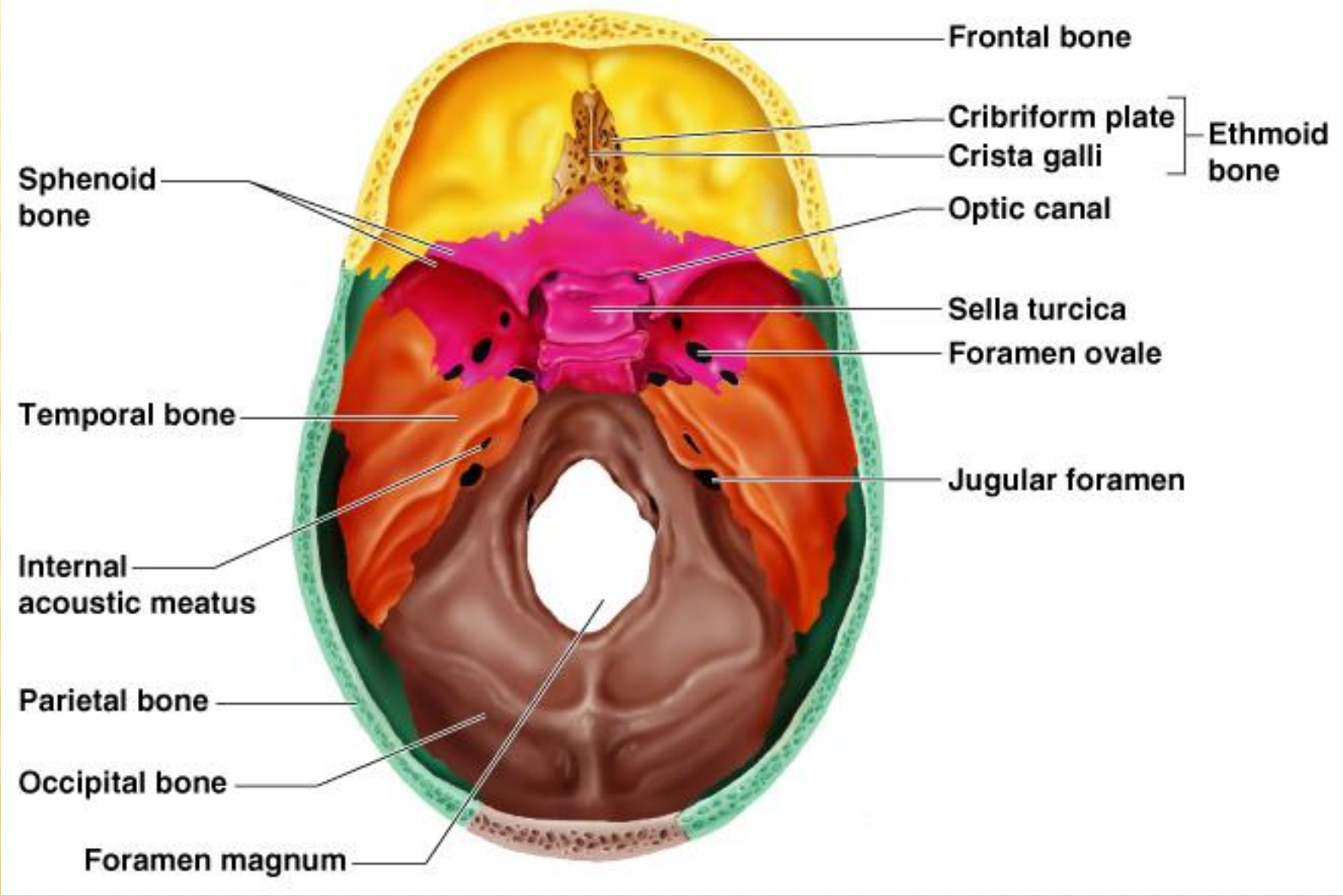
THE SKULL



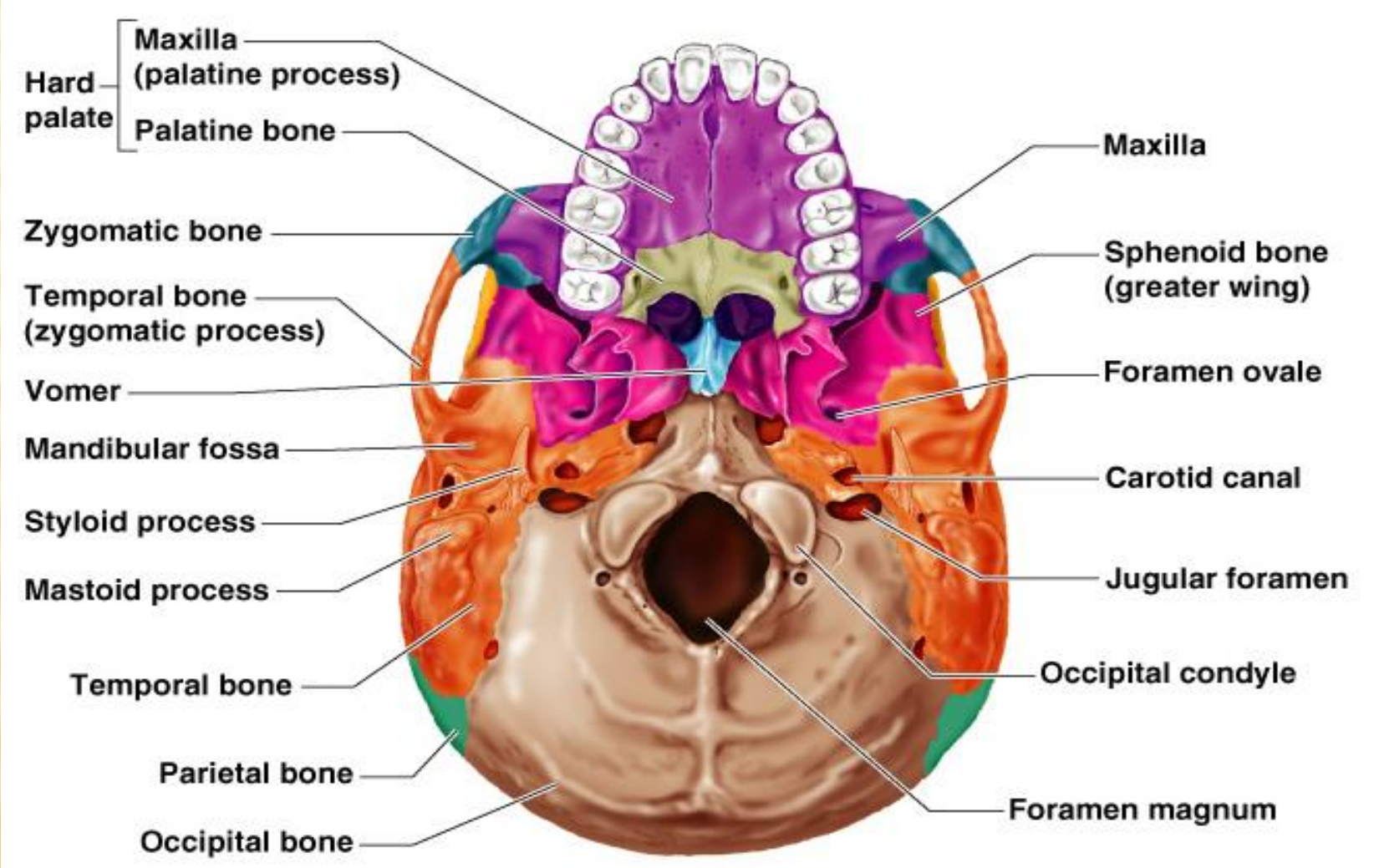
BONES OF THE SKULL



HUMAN SKULL, SUPERIOR VIEW



HUMAN SKULL, INFERIOR VIEW



THE SKELETAL SYSTEM (C)

PARANASAL SINUSES

- Hollow portions of bones surrounding the nasal

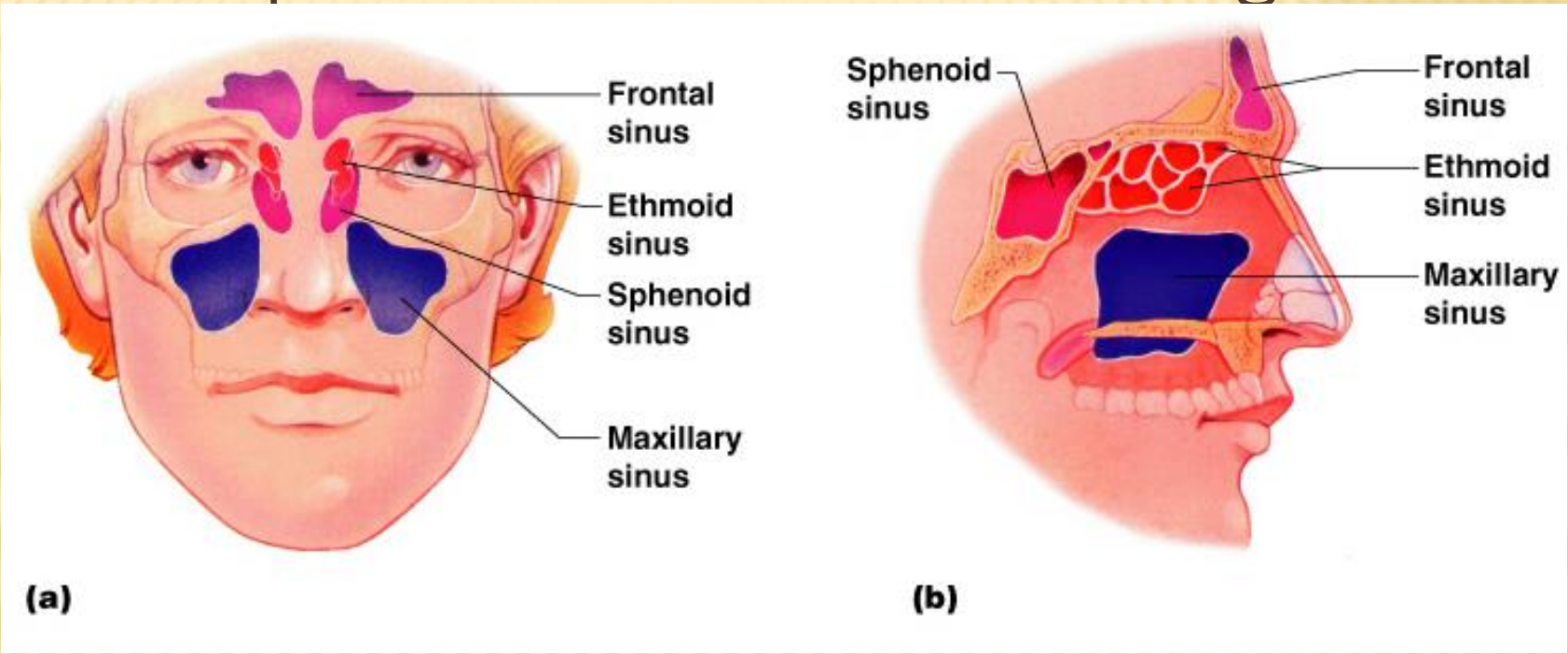
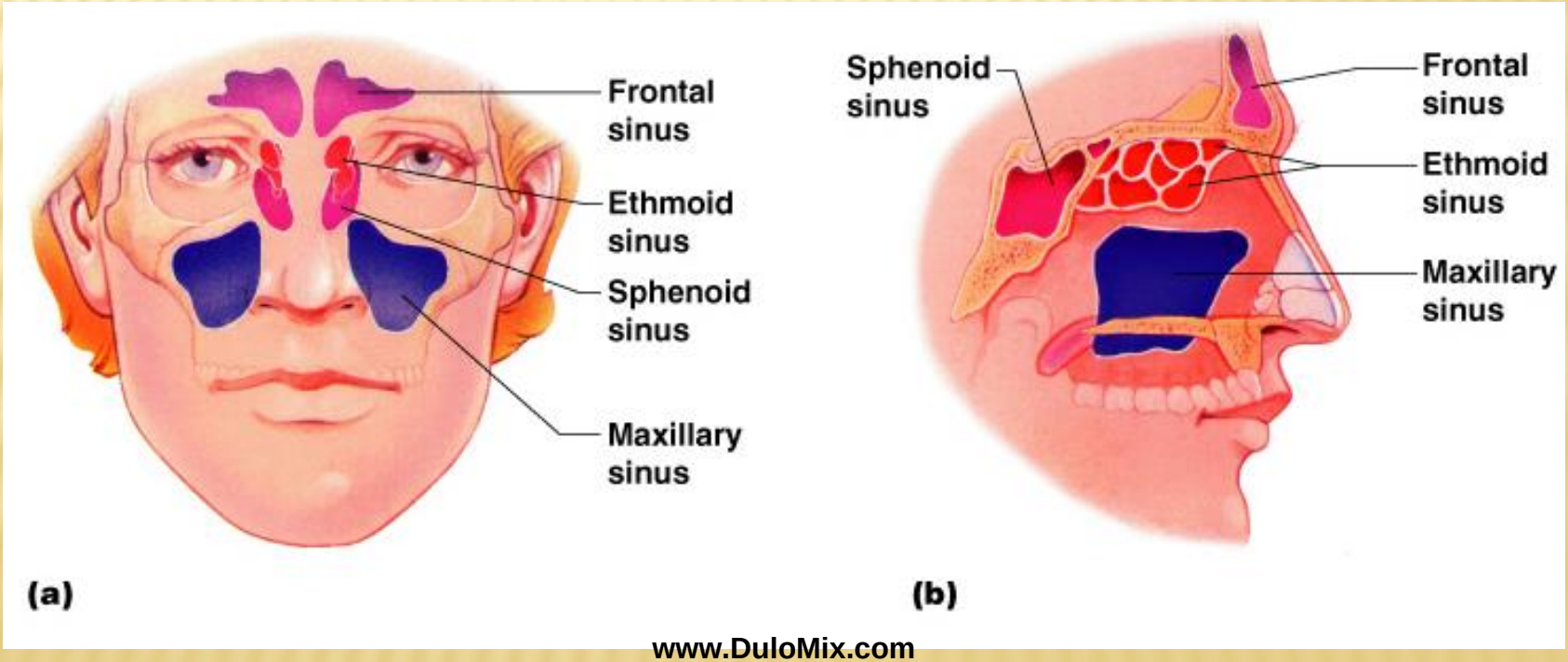


Figure 5.10

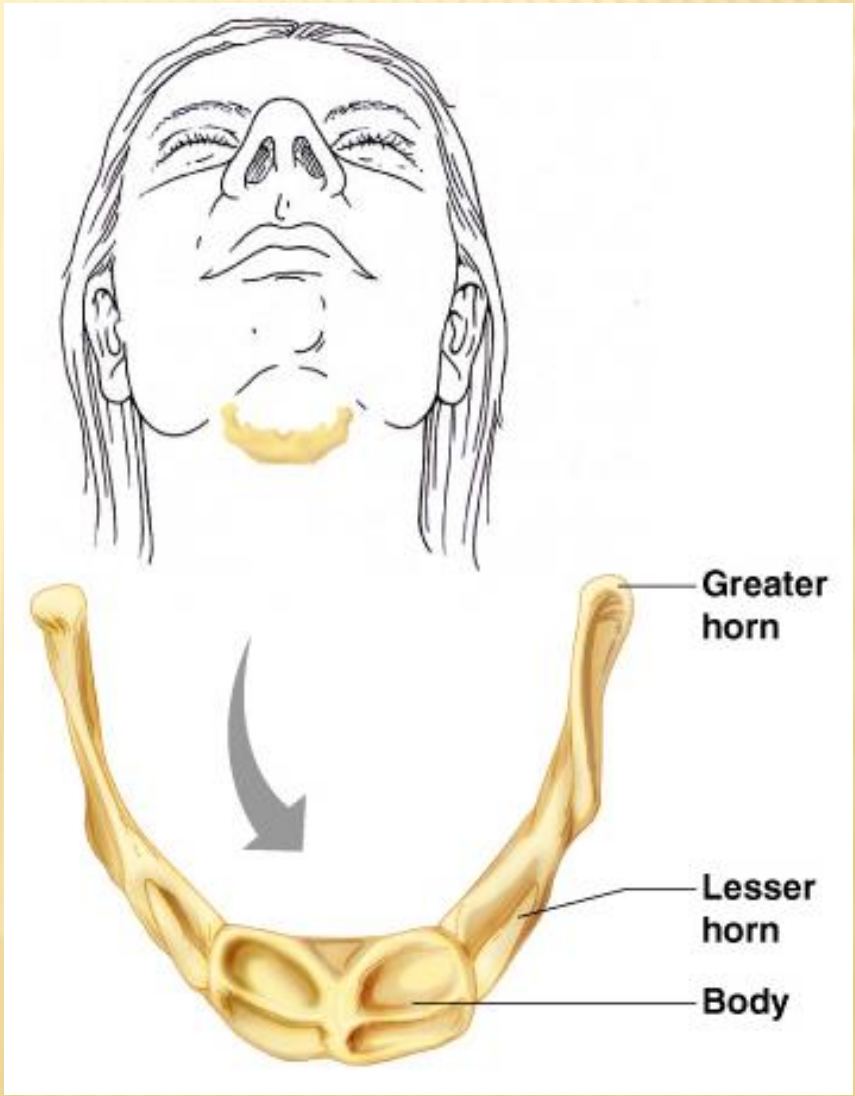
PARANASAL SINUSES

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



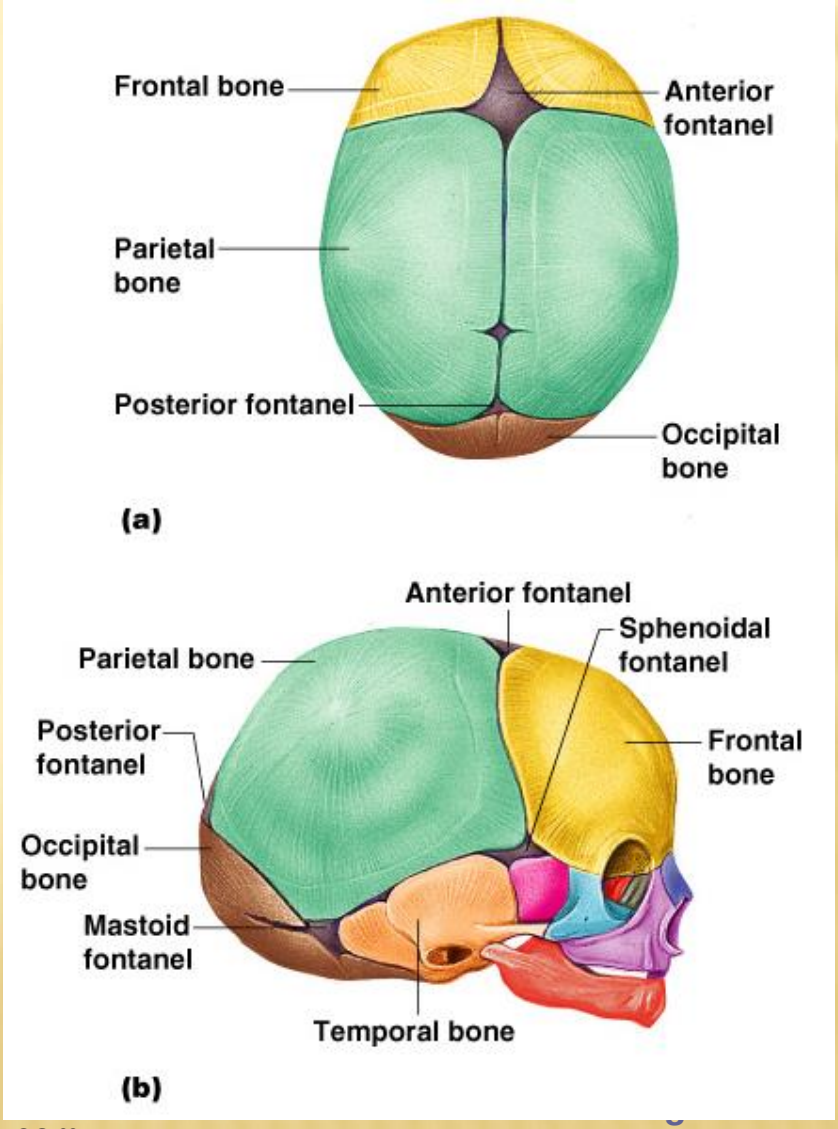
THE HYOID BONE

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



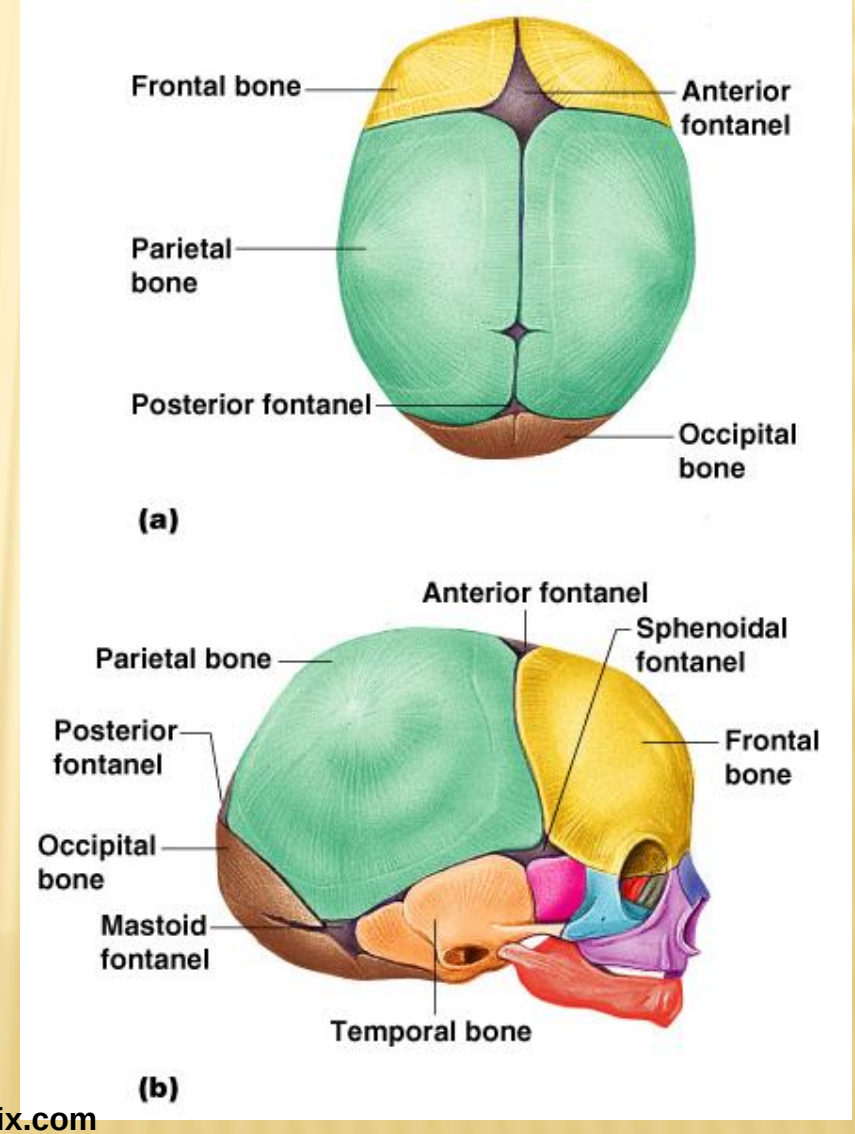
THE FETAL SKULL

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



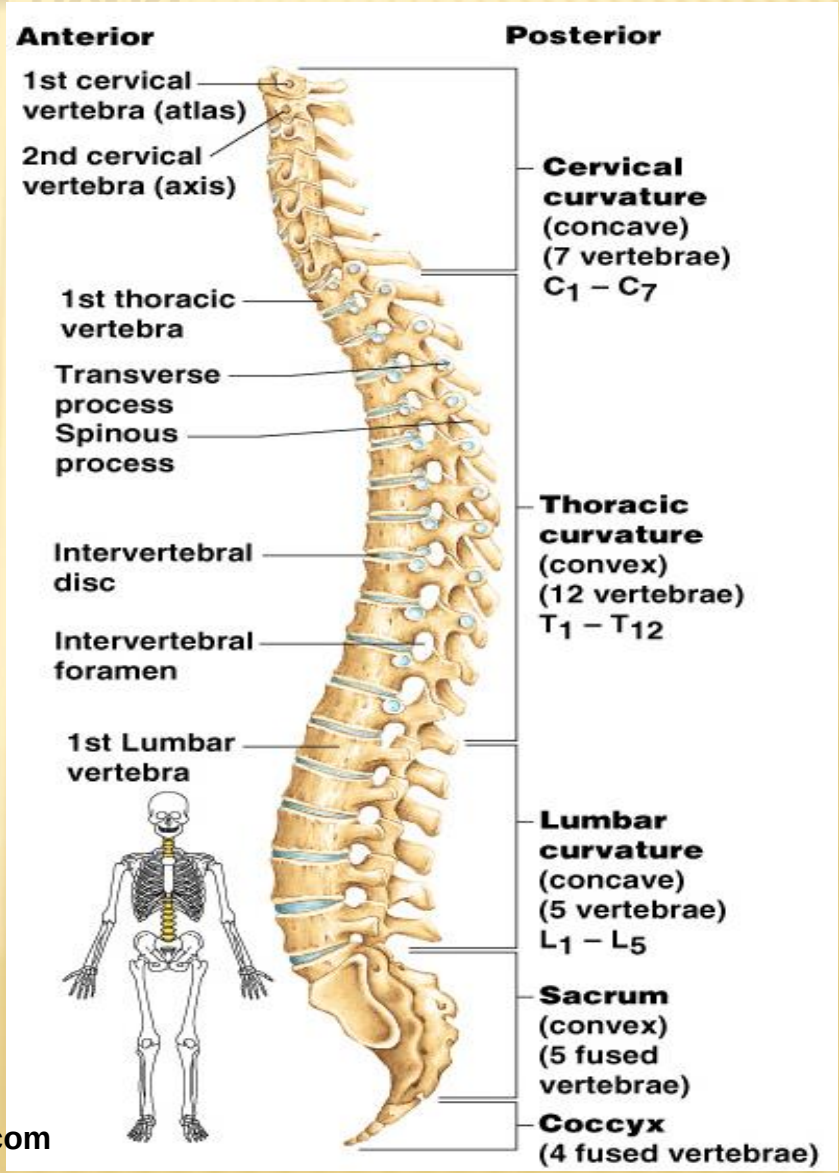
THE FETAL SKULL

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



THE VERTEBRAL COLUMN

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



STRUCTURE OF A TYPICAL VERTEBRAE

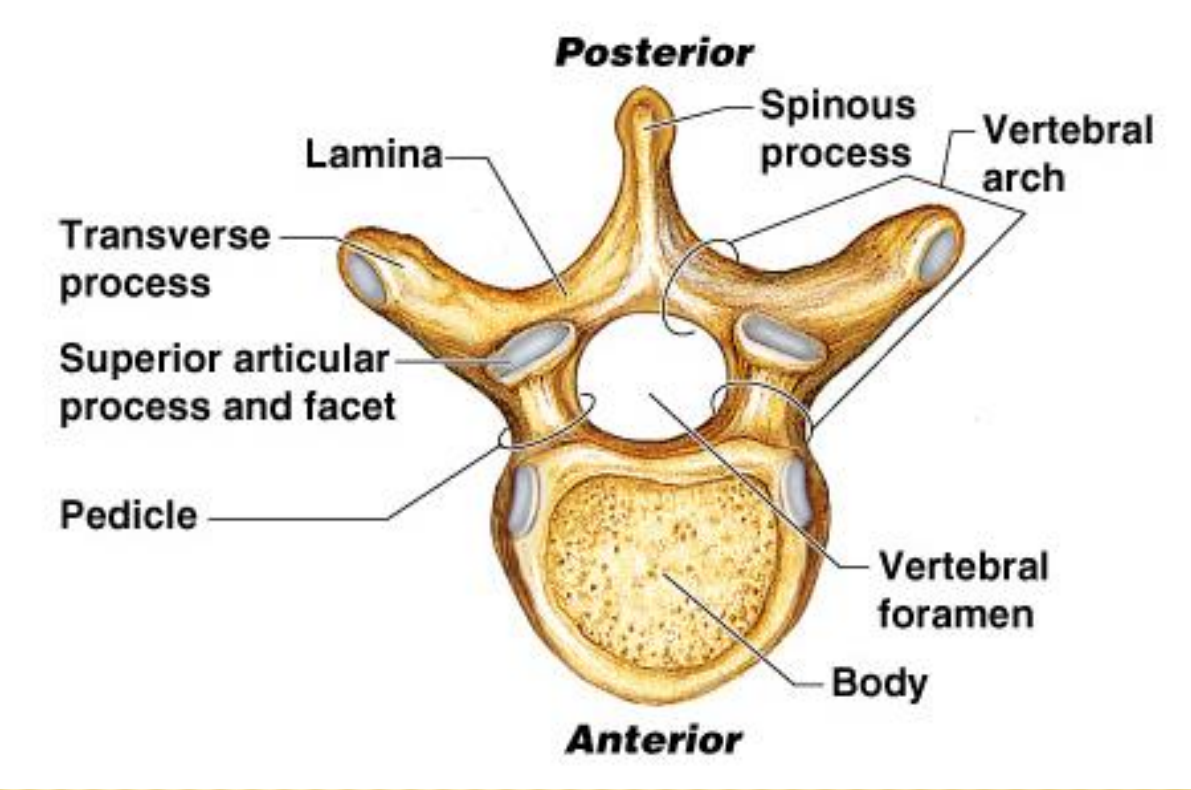


Figure 5.16

REGIONAL CHARACTERISTICS OF VERTEBRAE

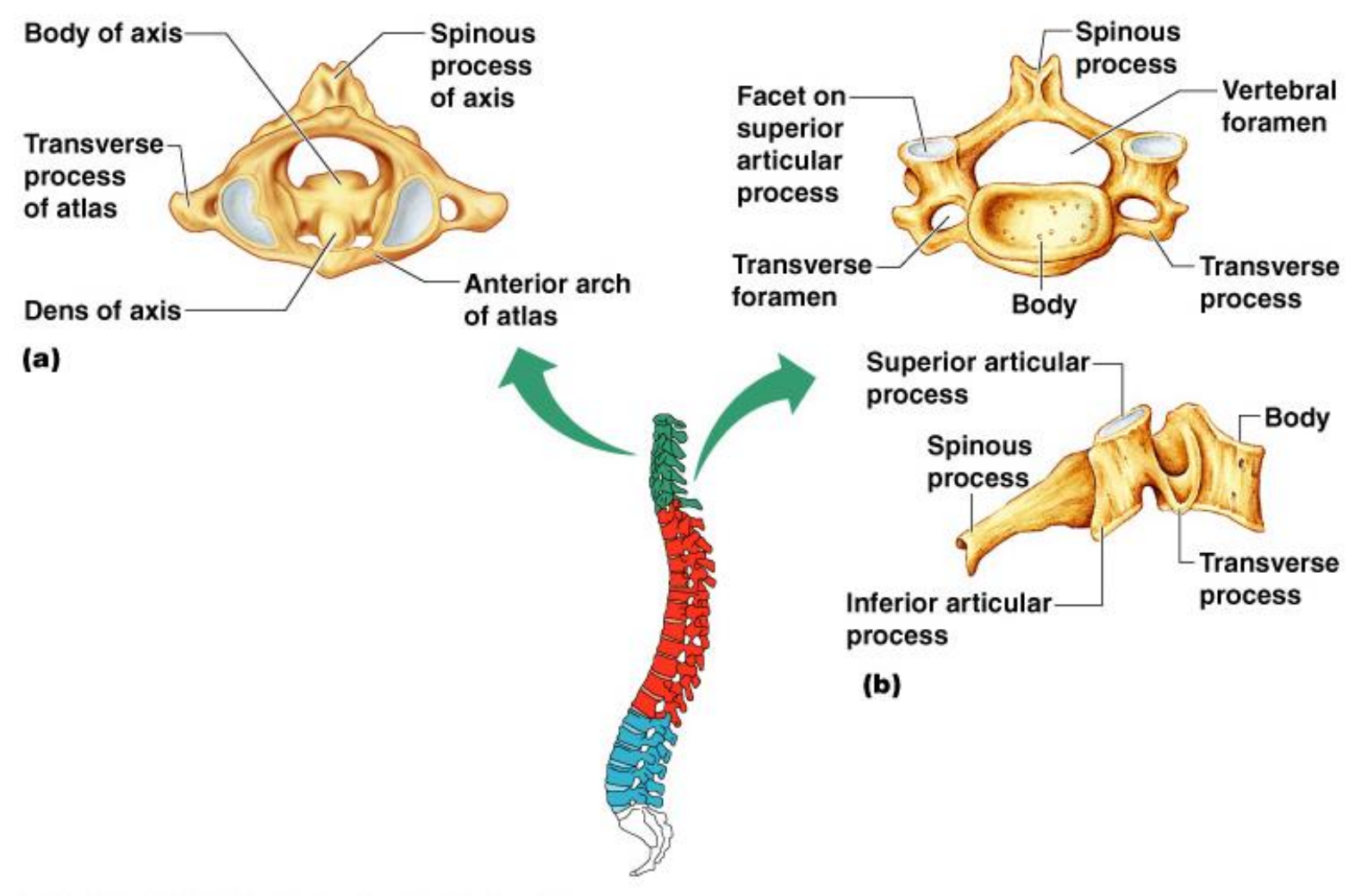


Figure 5.17a–b

REGIONAL CHARACTERISTICS OF VERTEBRAE

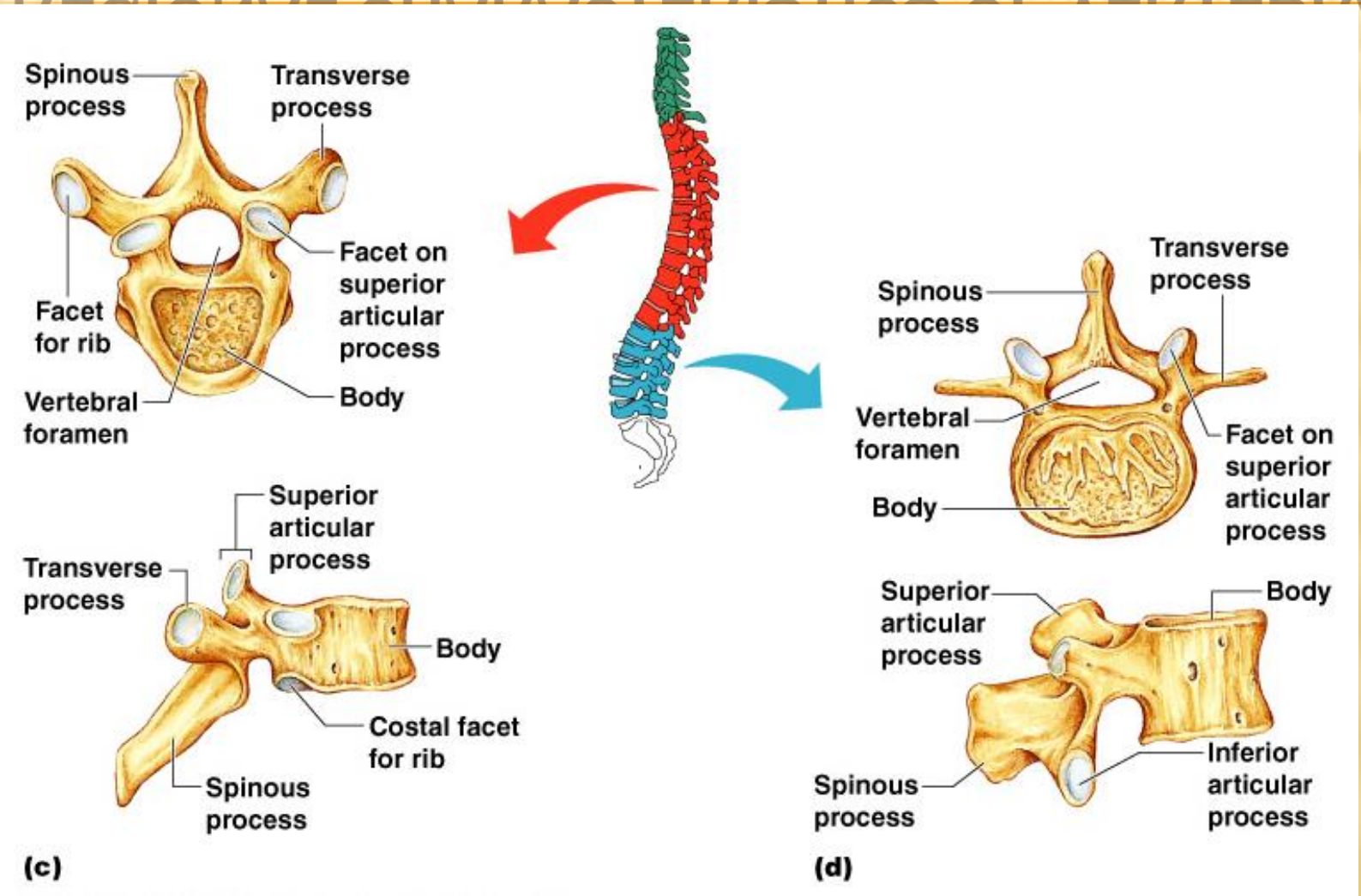
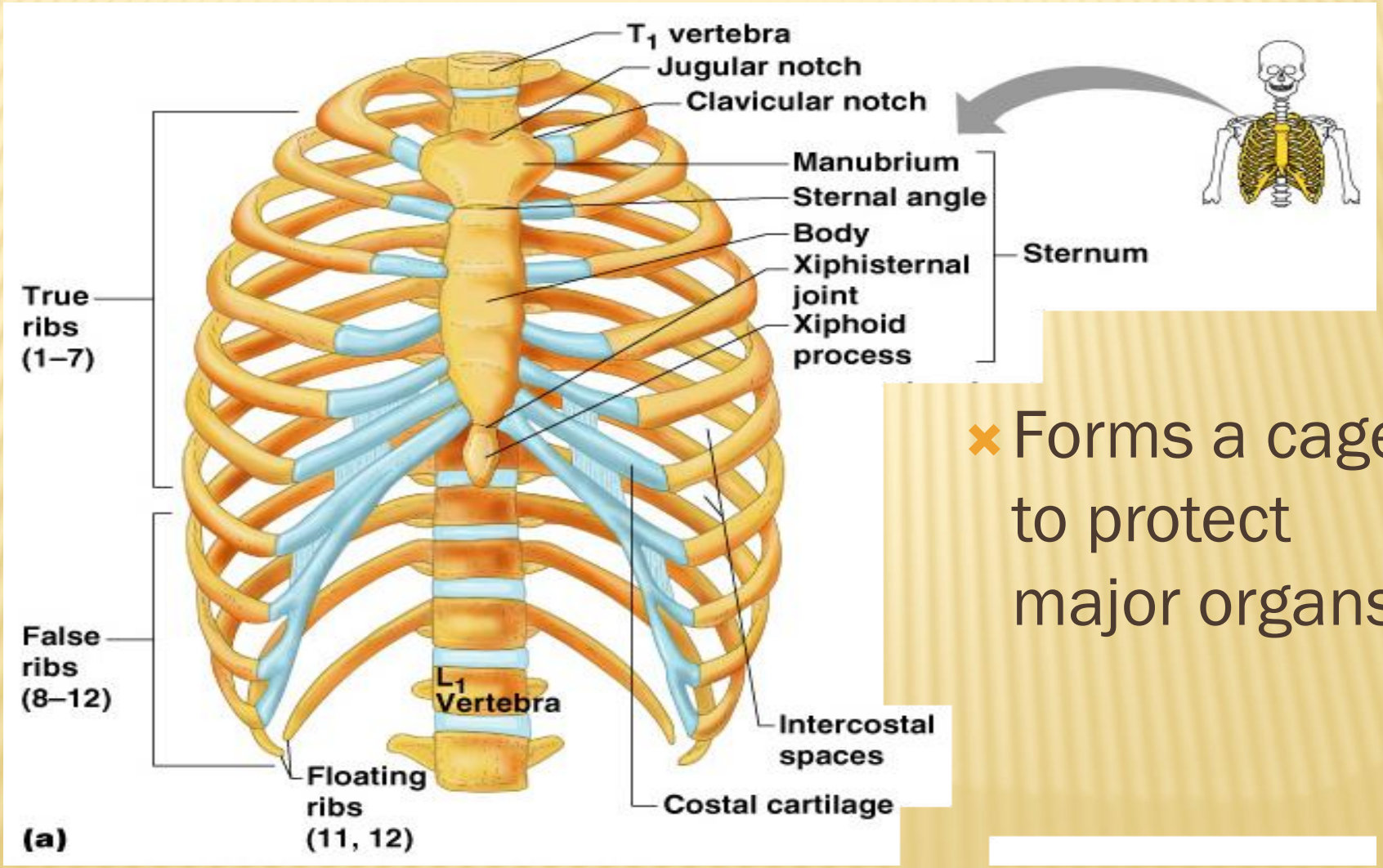


Figure 5.17c–d

THE SKELETAL SYSTEM (D)

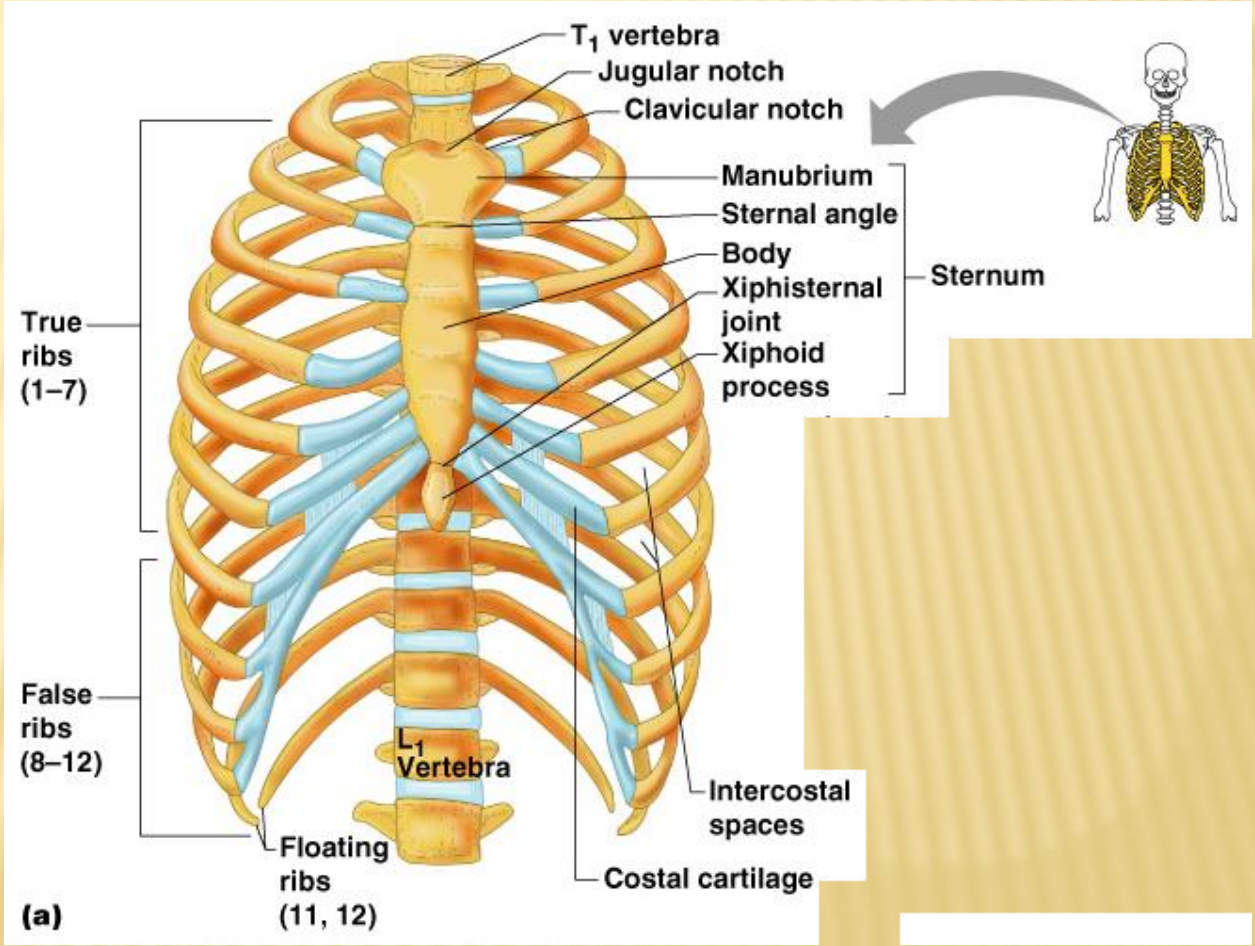
THE BONY THORAX



- Forms a cage to protect major organs

THE BONY THORAX

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



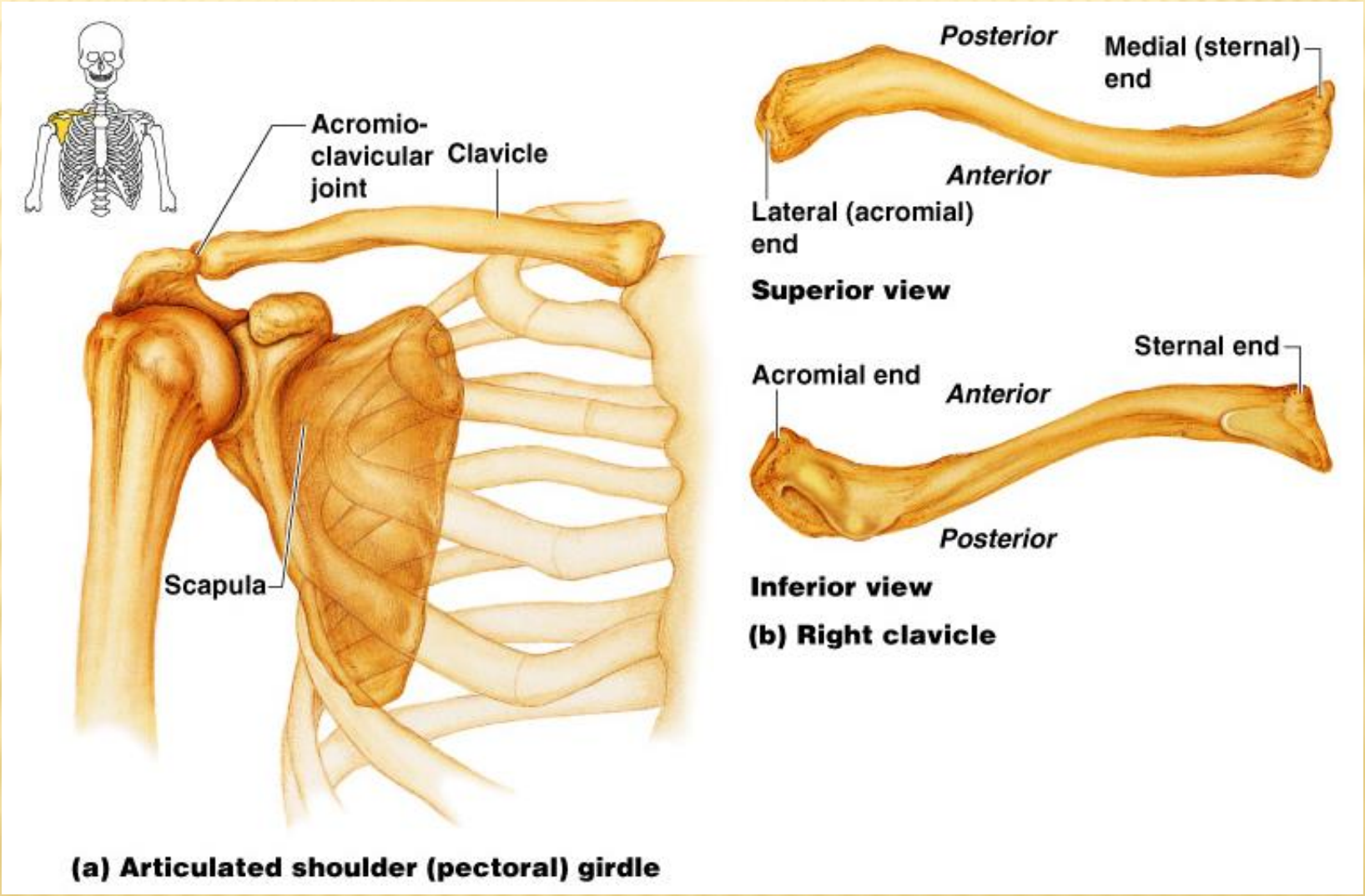
THE APPENDICULAR SKELETON

- Limbs (appendages)
- Pectoral girdle
- Pelvic girdle

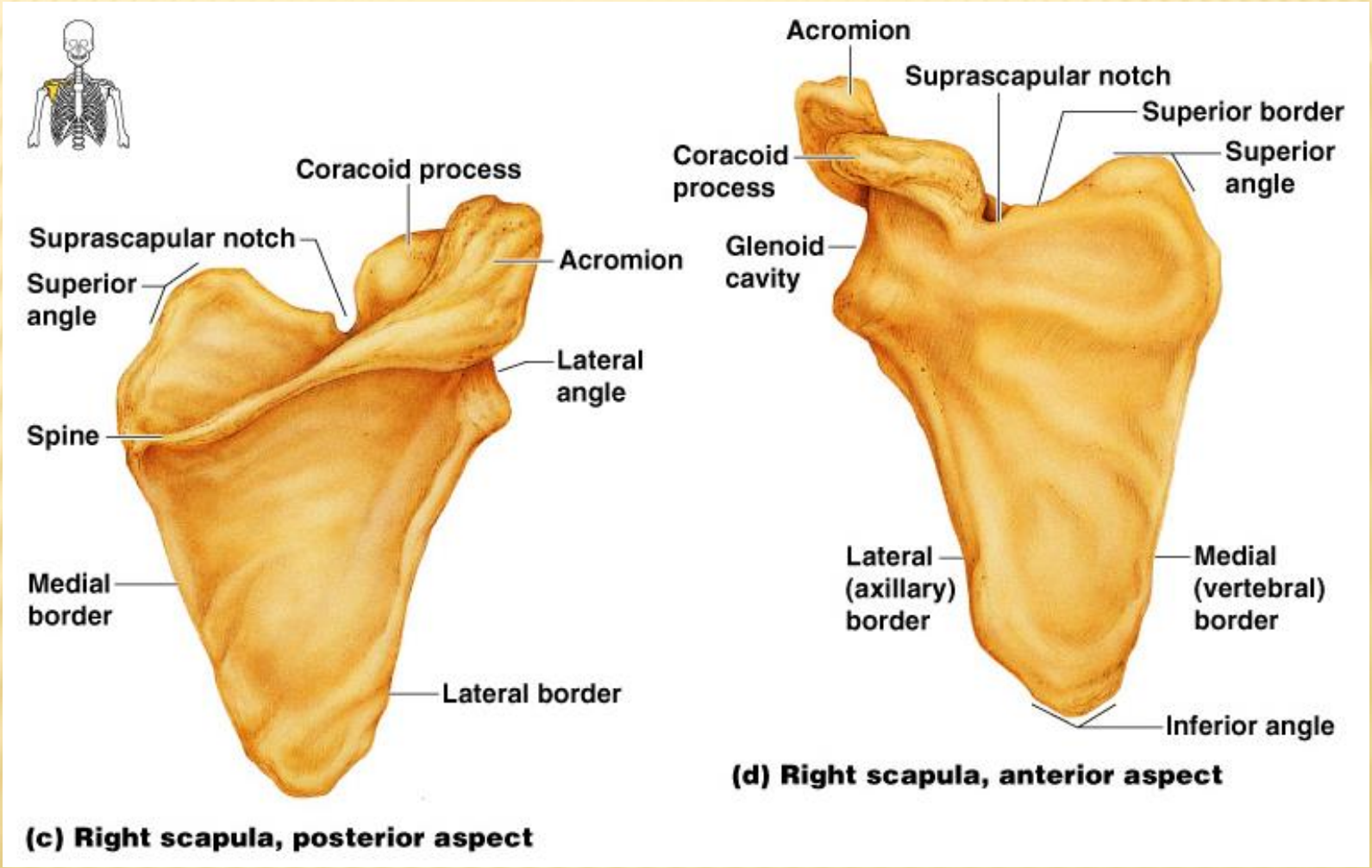
THE PECTORAL (SHOULDER) GIRDLE

- 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

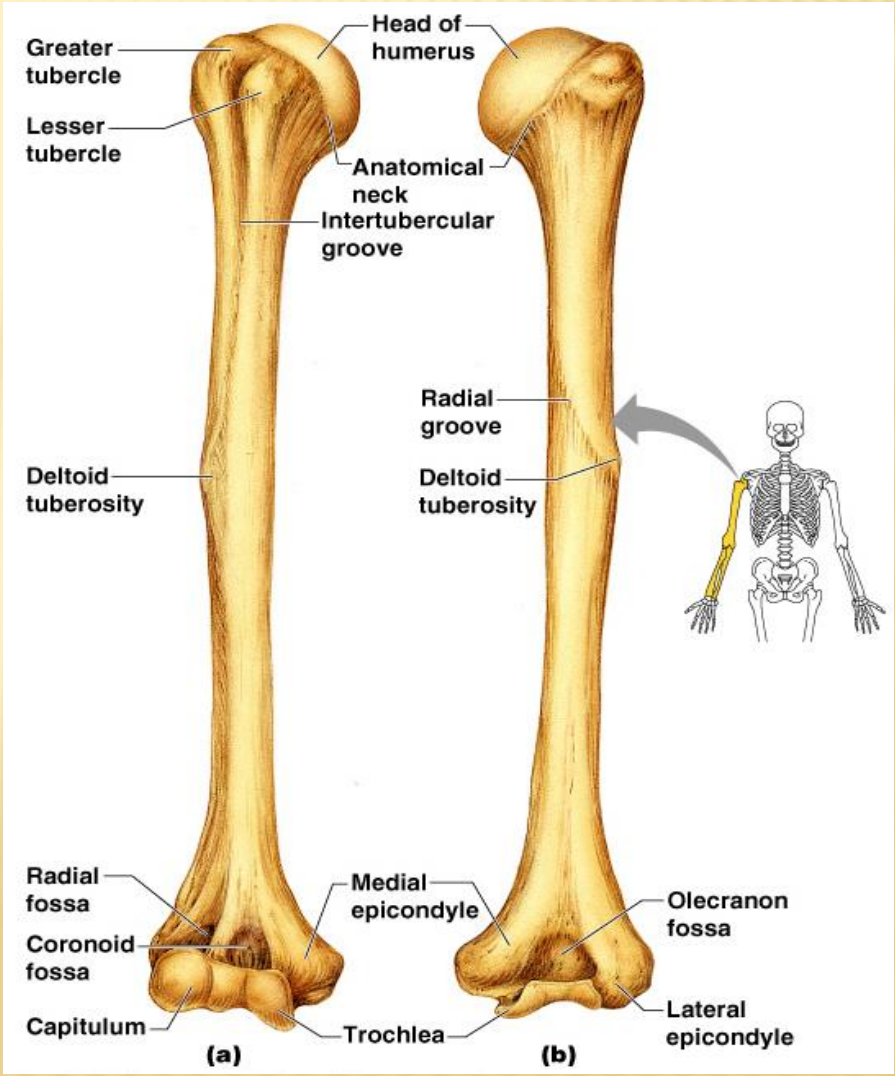


BONES OF THE SHOULDER GIRDLE



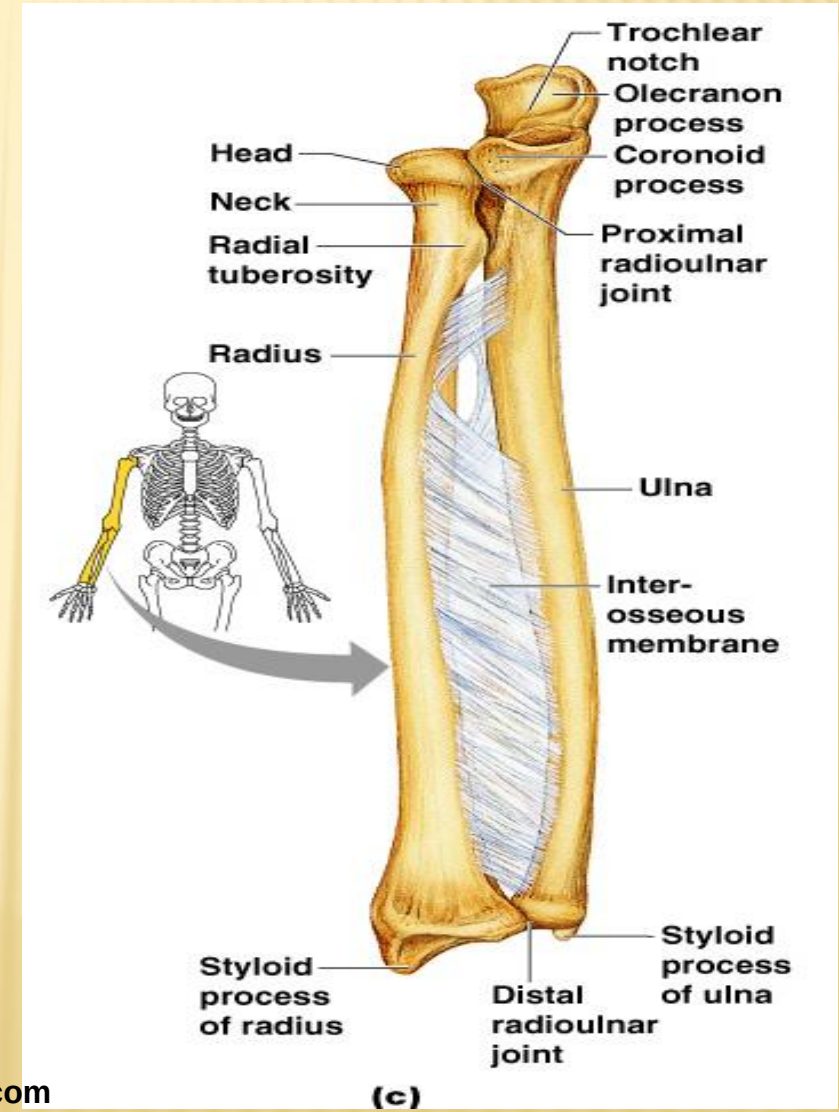
BONES OF THE UPPER LIMB

- The arm is formed by a single bone
  - Humerus



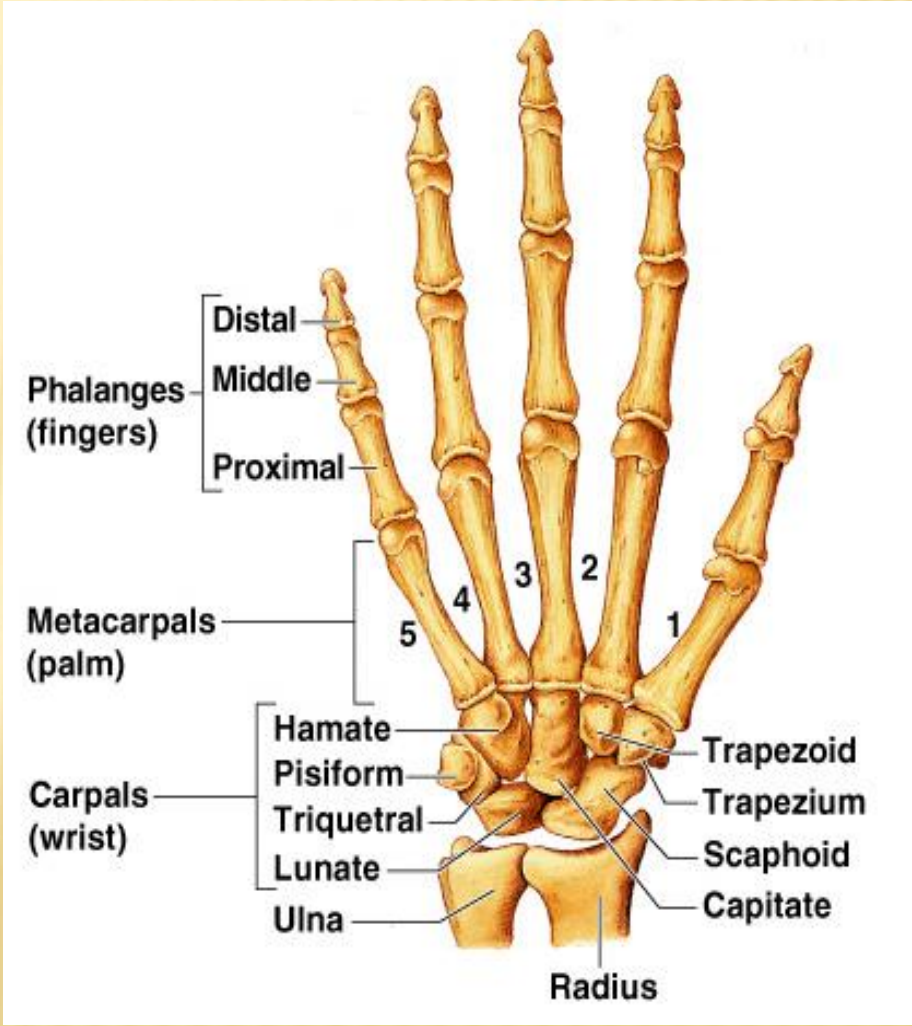
BONES OF THE UPPER LIMB

- The forearm has two bones
  - Ulna
  - Radius



BONES OF THE UPPER LIMB

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

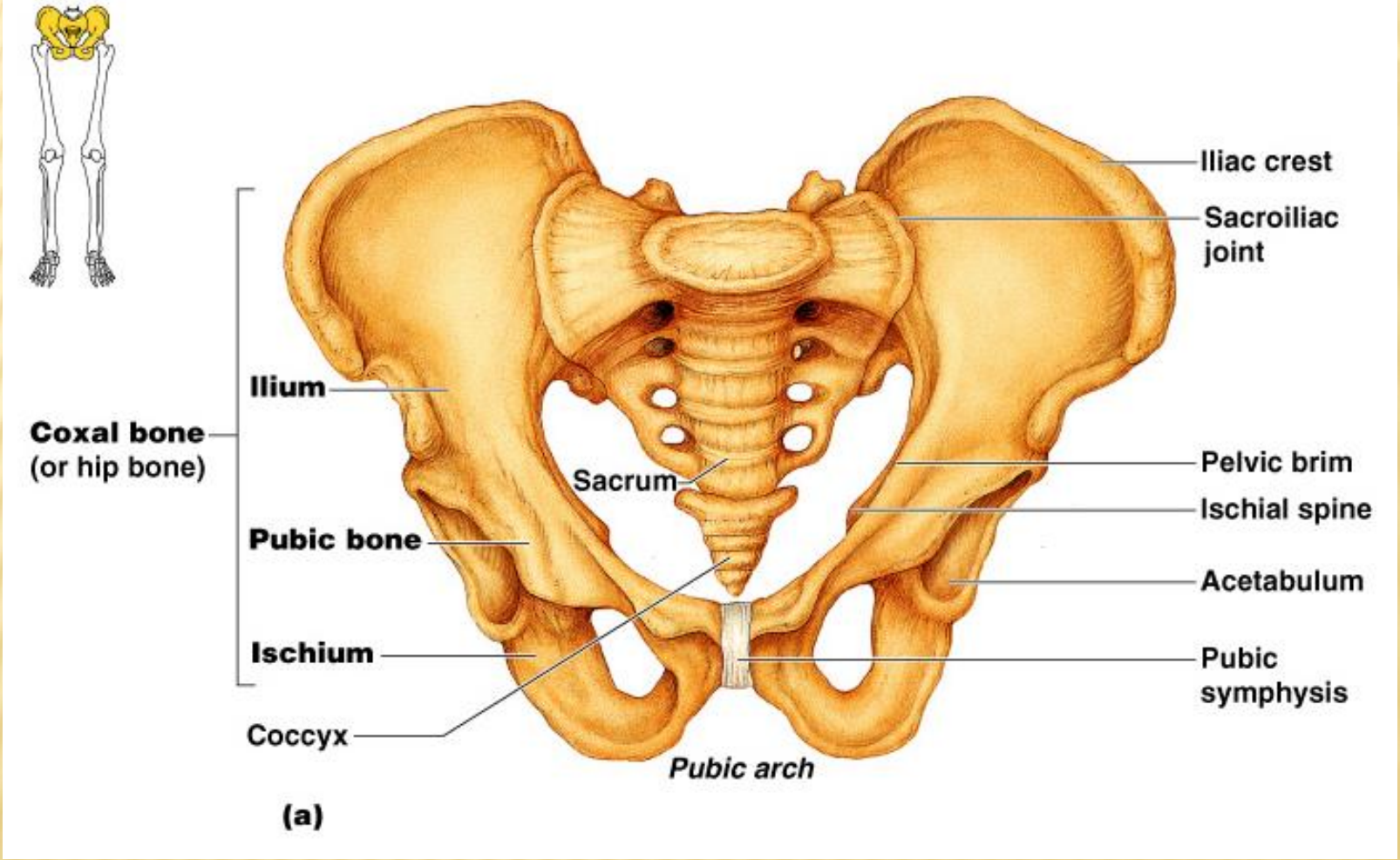


BONES OF THE PELVIC GIRDLE

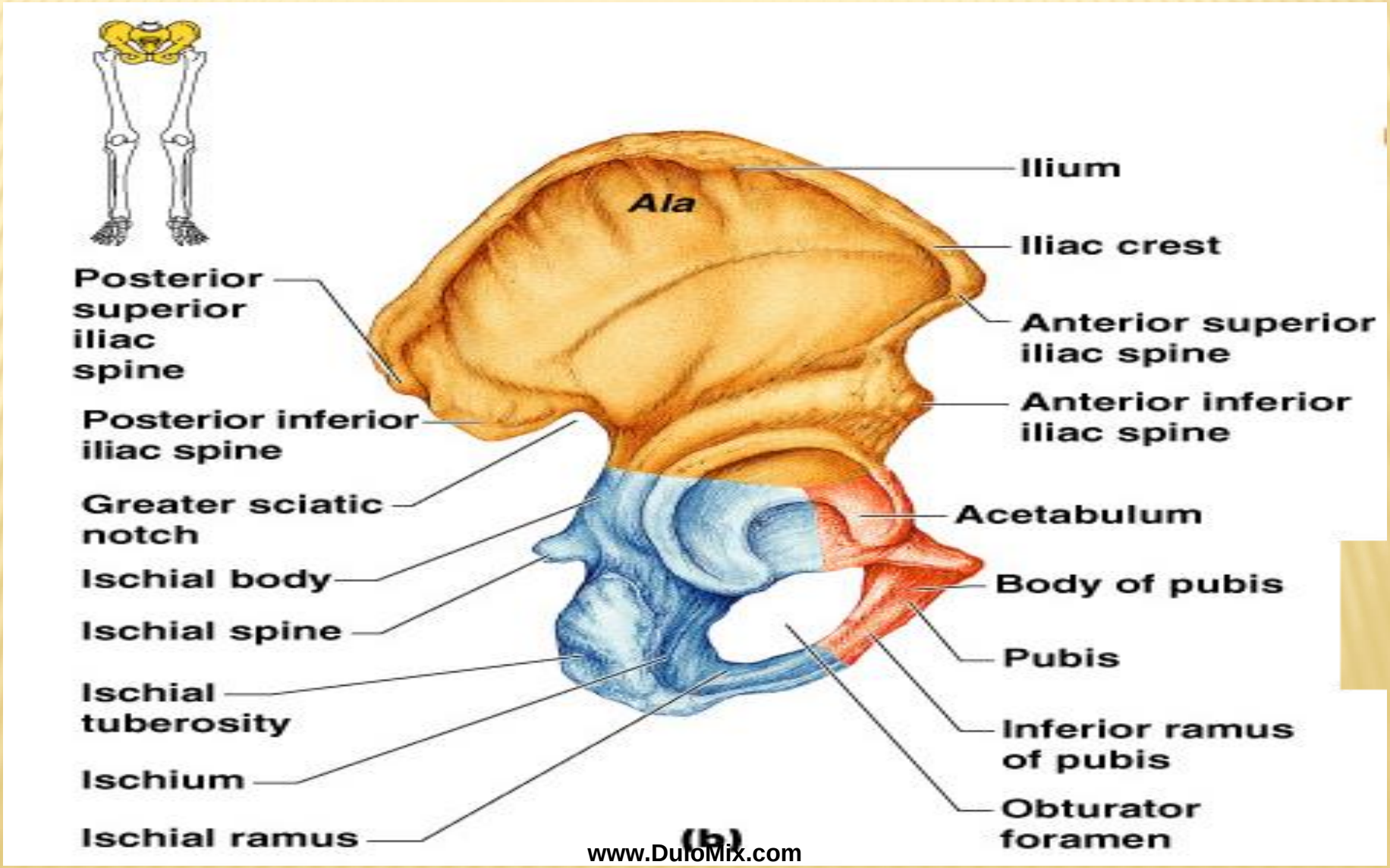
- Hip bones
- Composed of three pair of fused bones
  - Ilium
  - Ischium
  - Pubic bone
- The total weight of the upper body rests on the pelvis
- Protects several organs
  - Reproductive organs
  - Urinary bladder
  - Part of the large intestine

THE SKELETAL SYSTEM (E)

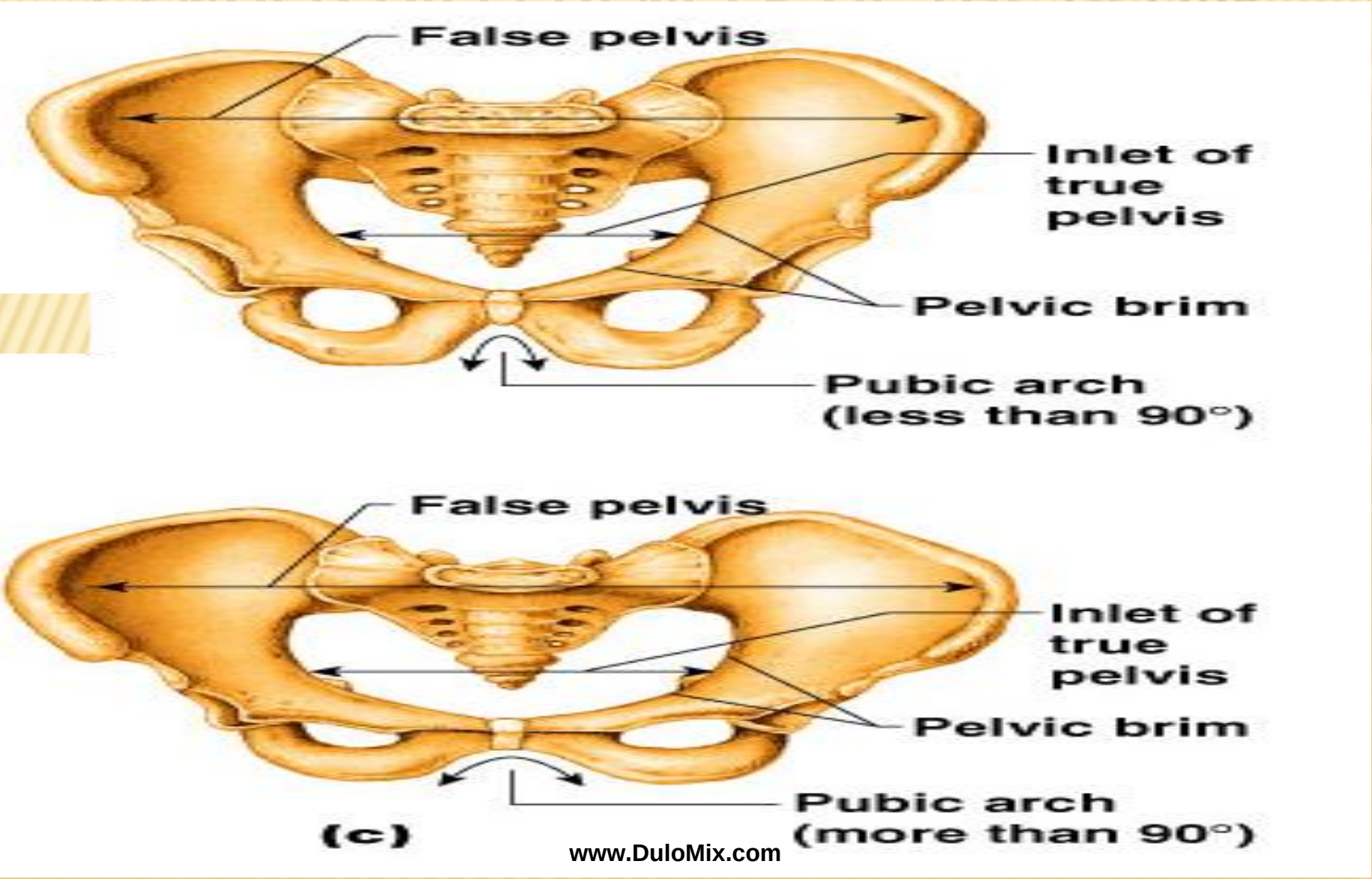
THE PELVIS



THE PELVIS: RIGHT COXAL BONE

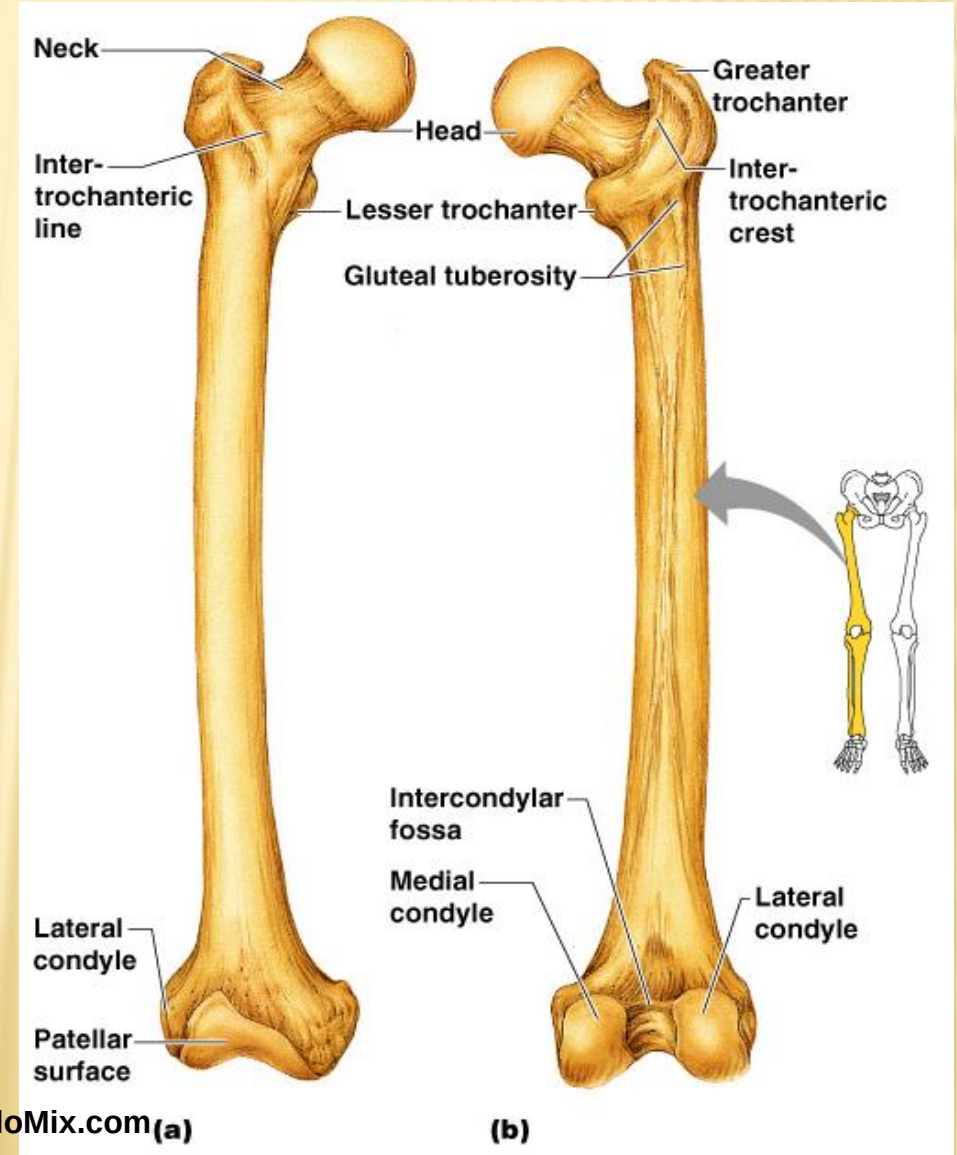


GENDER DIFFERENCES OF THE PELVIS



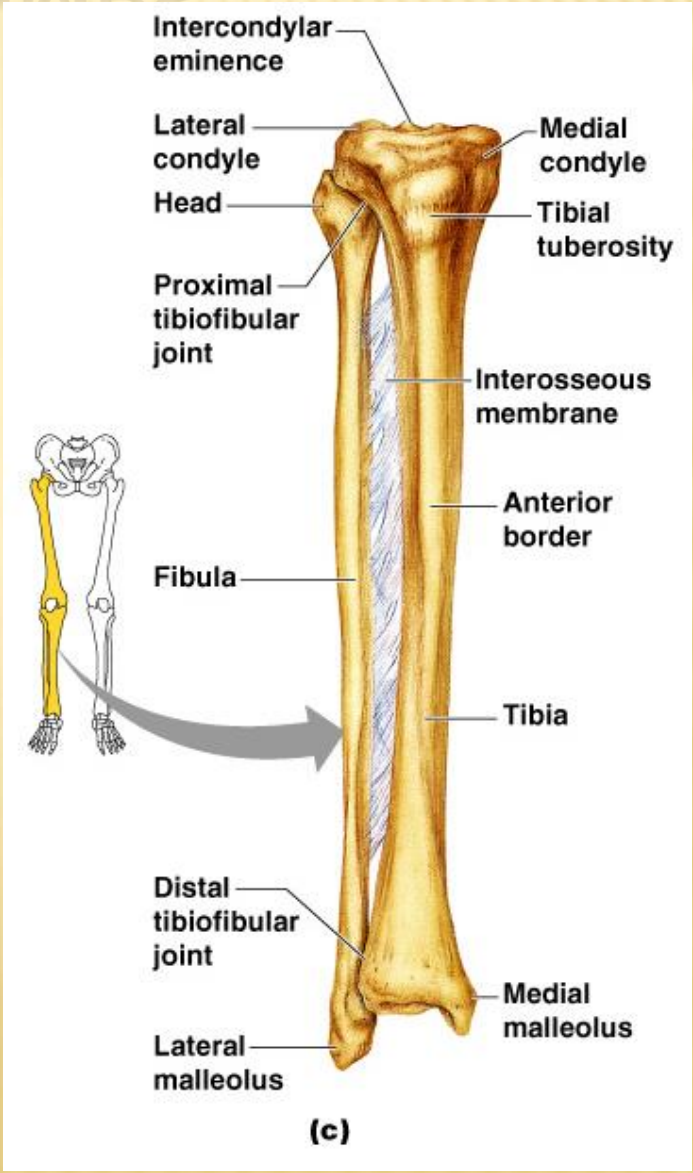
BONES OF THE LOWER LIMBS

- The thigh has one bone
  - Femur – thigh bone



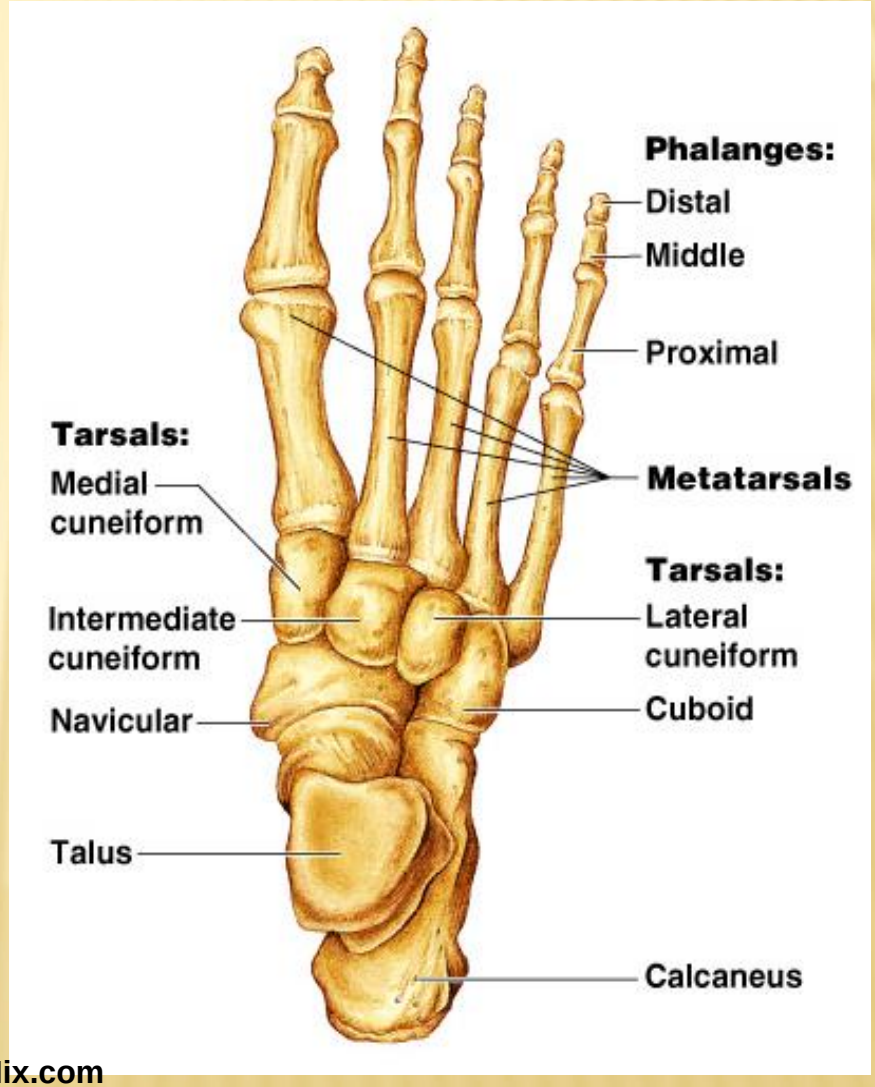
BONES OF THE LOWER LIMBS

- The leg has two bones
  - Tibia
  - Fibula



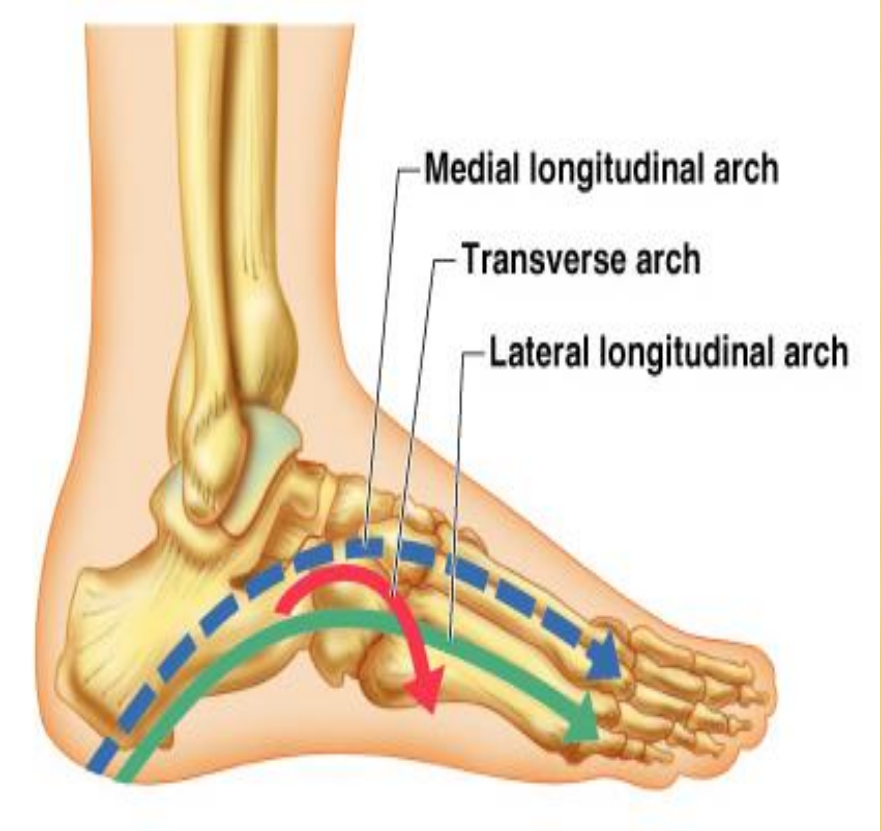
BONES OF THE LOWER LIMBS

- 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



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

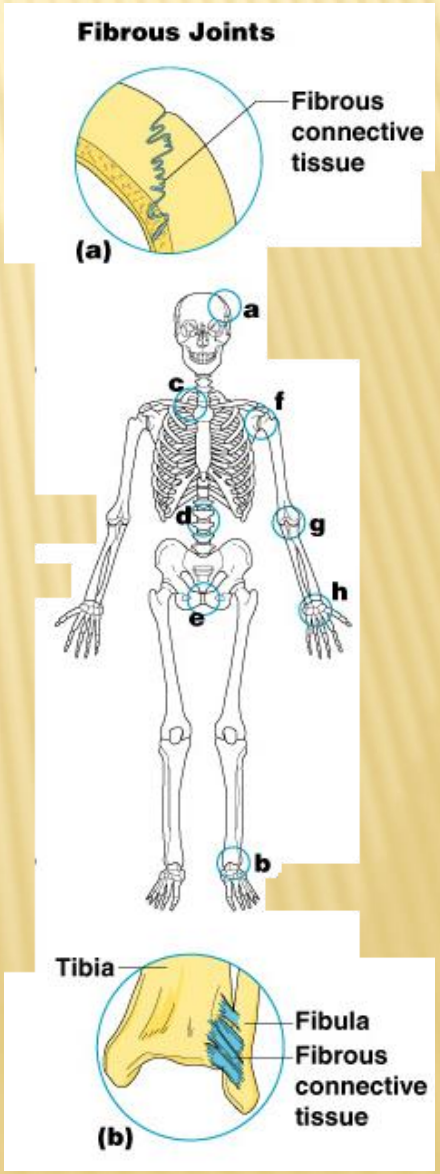
THE SKELETAL SYSTEM (F)

STRUCTURAL CLASSIFICATION OF JOINTS

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

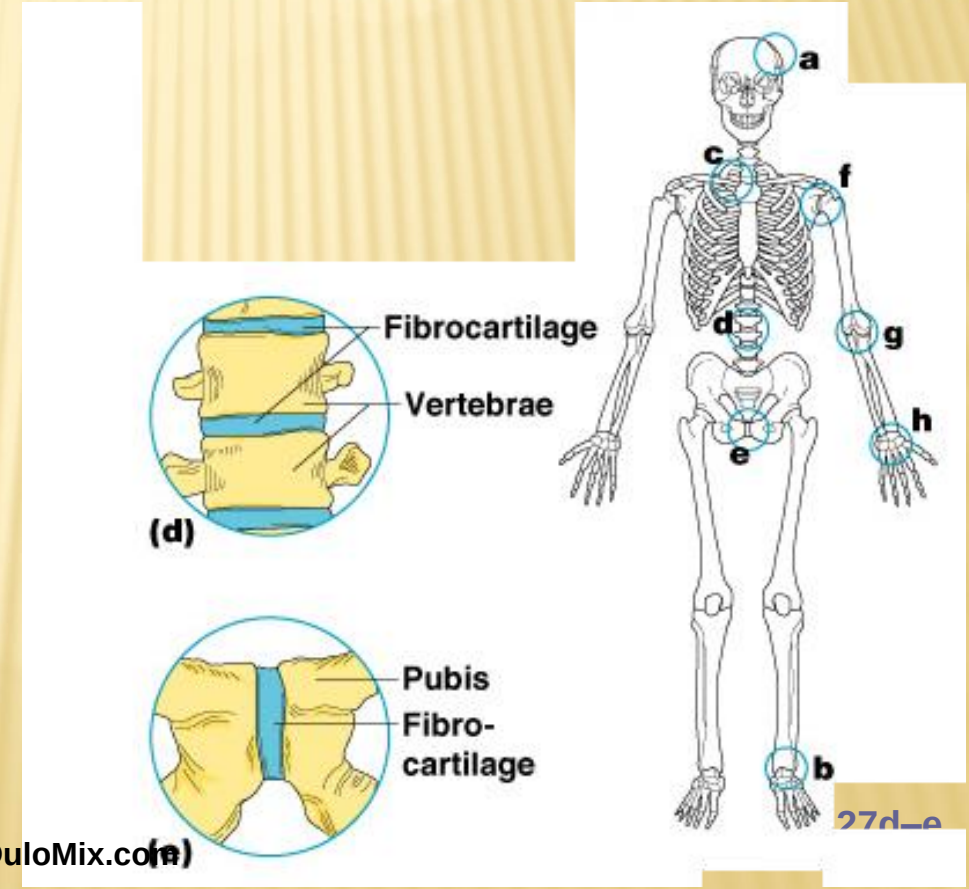
FIBROUS JOINTS

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



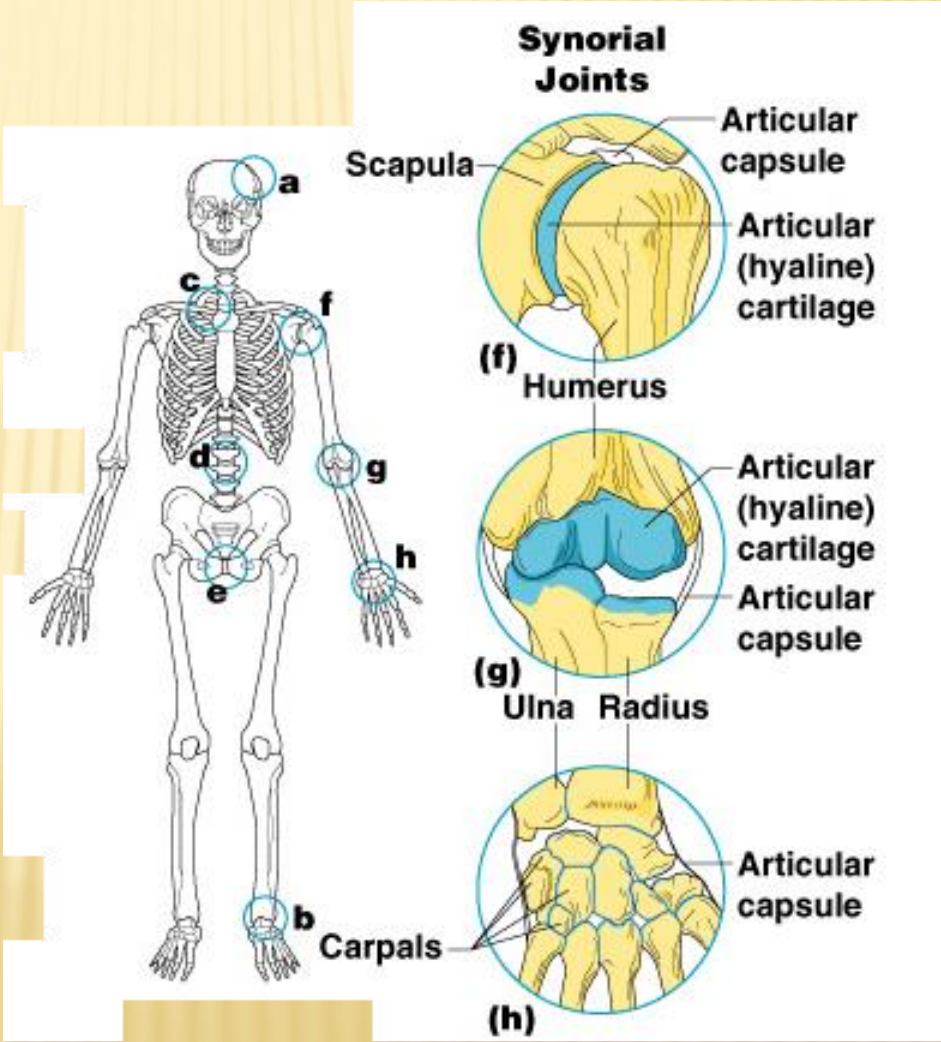
CARTILAGINOUS JOINTS

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



SYNOVIAL JOINTS

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



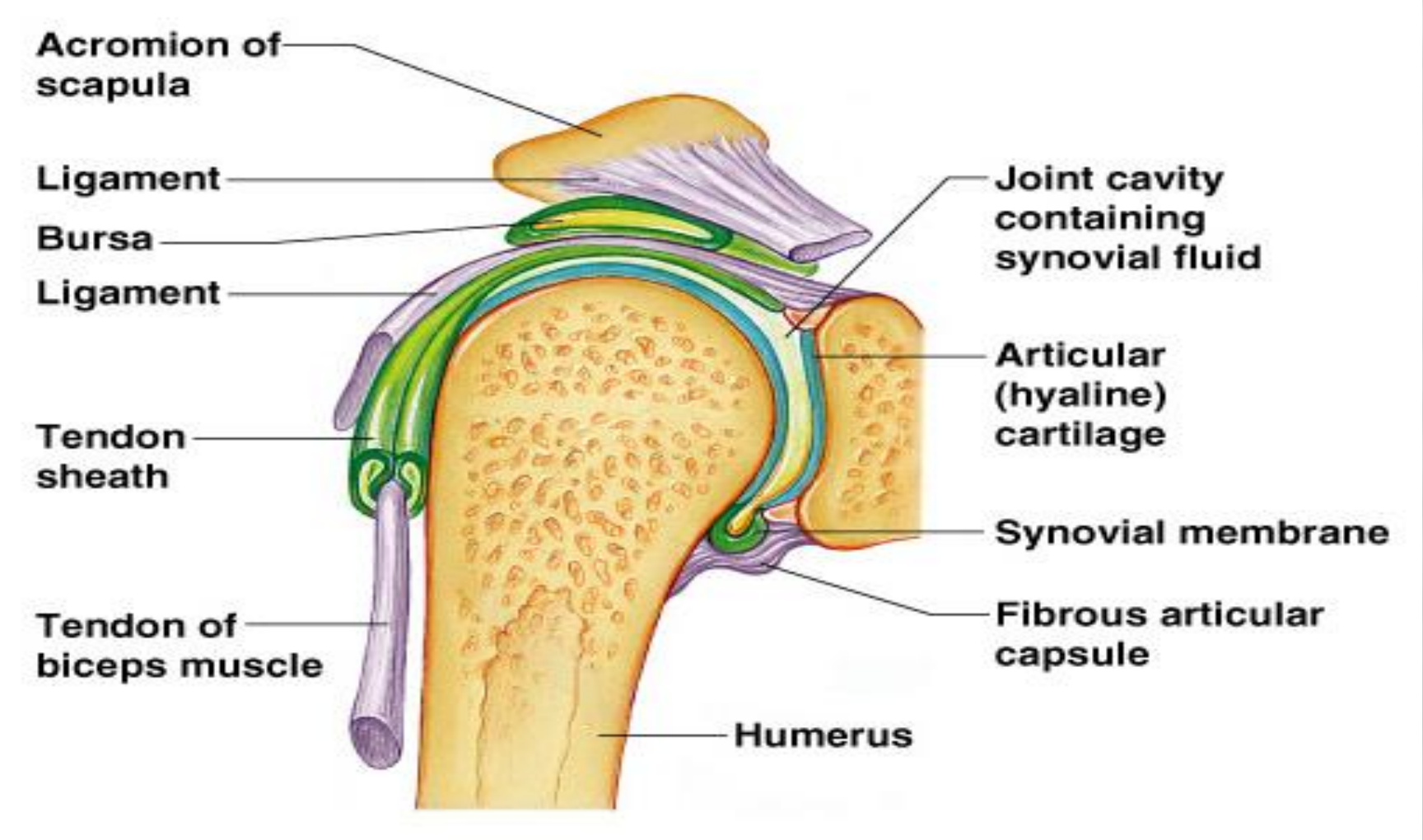
FEATURES OF SYNOVIAL JOINTS

- 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

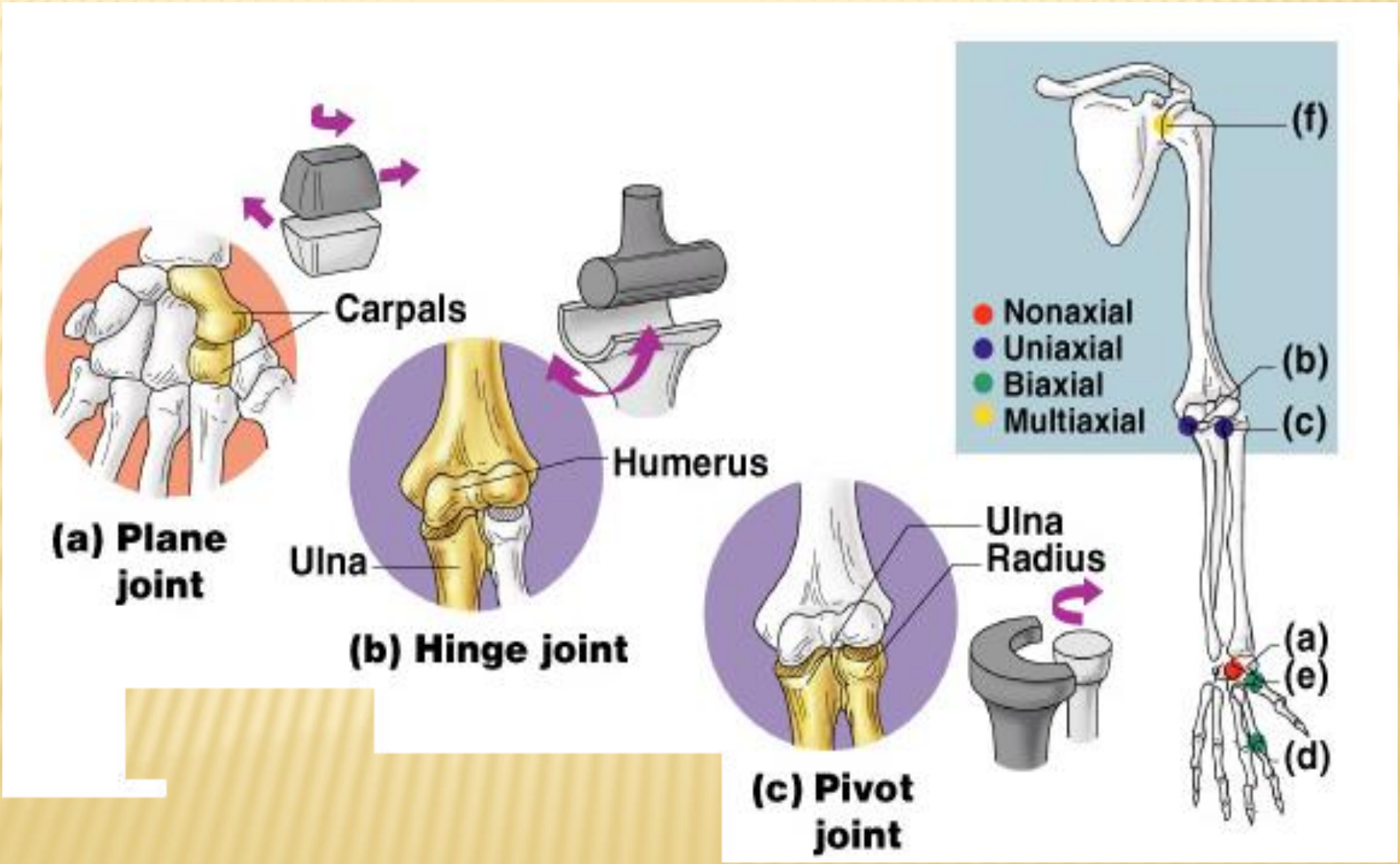
STRUCTURES ASSOCIATED WITH THE SYNOVIAL JOINT

- 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

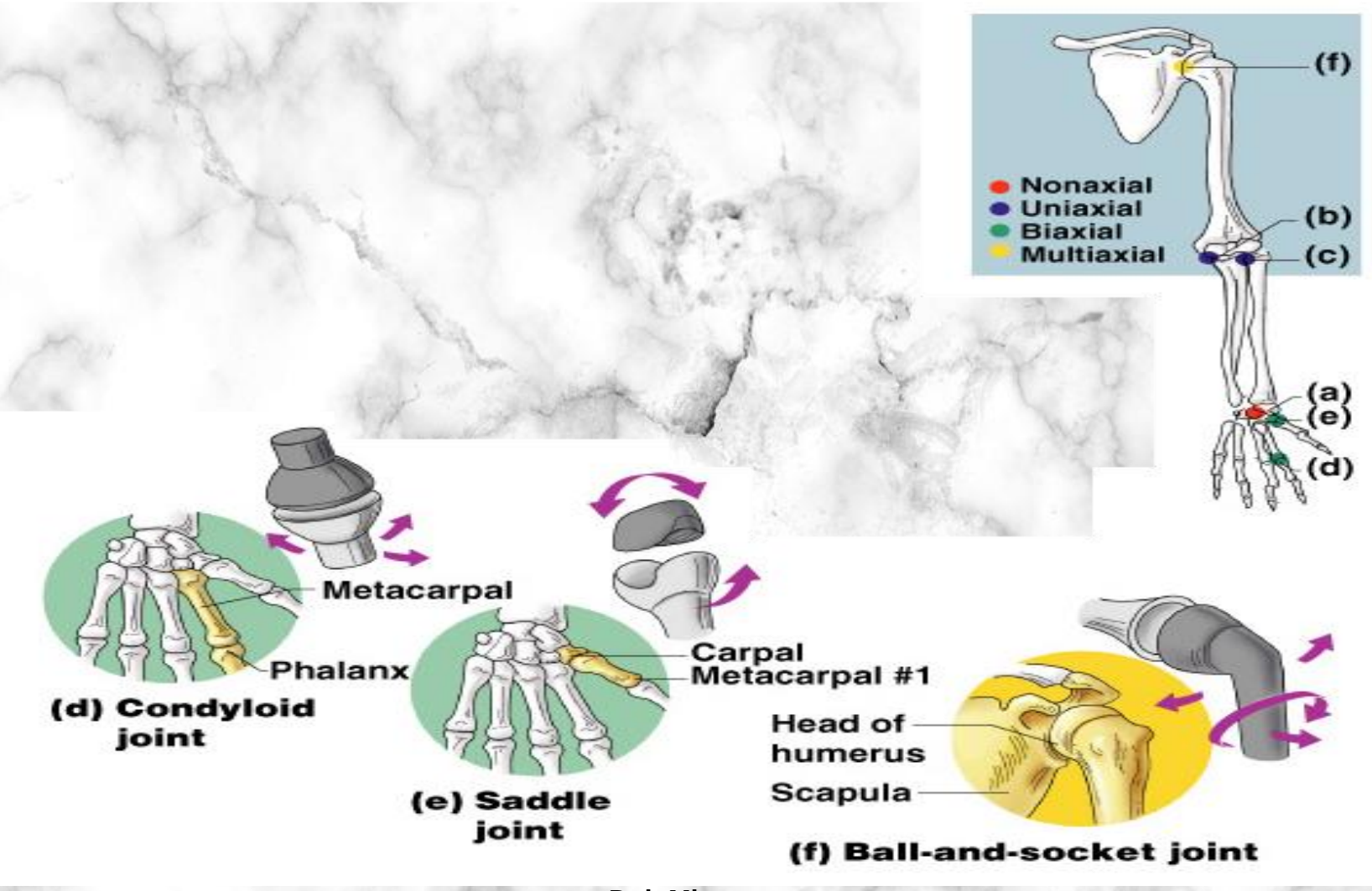
THE SYNOVIAL JOINT



TYPES OF SYNOVIAL JOINTS BASED ON SHAPE



TYPES OF SYNOVIAL JOINTS BASED ON SHAPE



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