

PowerPoint® Lecture Slides

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CHAPTER 5

The Skeletal System

- Title

- Classification of Bones and Gross Anatomy of Long Bones

- Essential Question

- Describe how bones are classified. Describe the gross anatomy of long bones.

The Skeletal System

- Parts of the skeletal system
 - Bones (skeleton)
 - Joints
 - Cartilages
 - Ligaments
- Two subdivisions of the skeleton
 - Axial skeleton
 - Appendicular skeleton

Functions of Bones

- Support the body
- Protect soft organs
 - Skull and vertebrae for brain and spinal cord
 - Rib cage for thoracic cavity organs
- Allow movement due to attached skeletal muscles
- Store minerals and fats
 - Calcium and phosphorus
 - Fat in the internal marrow cavity
- Blood cell formation (hematopoiesis)

Bones of the Human Body

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

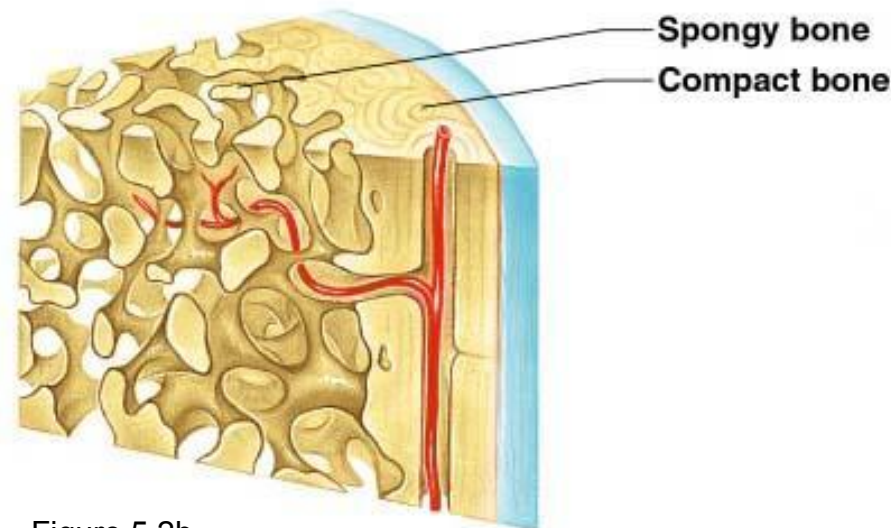
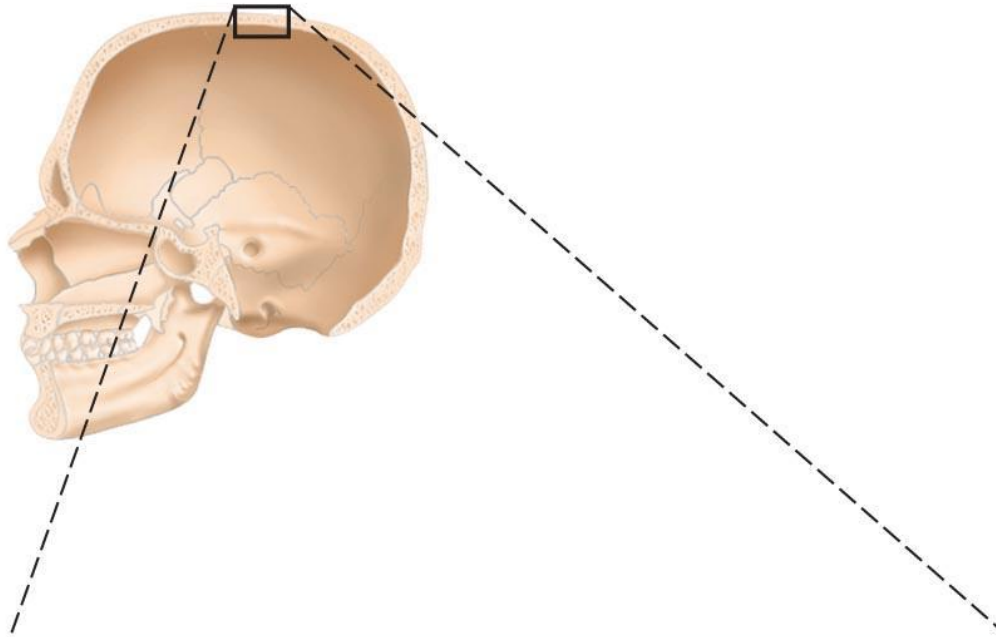


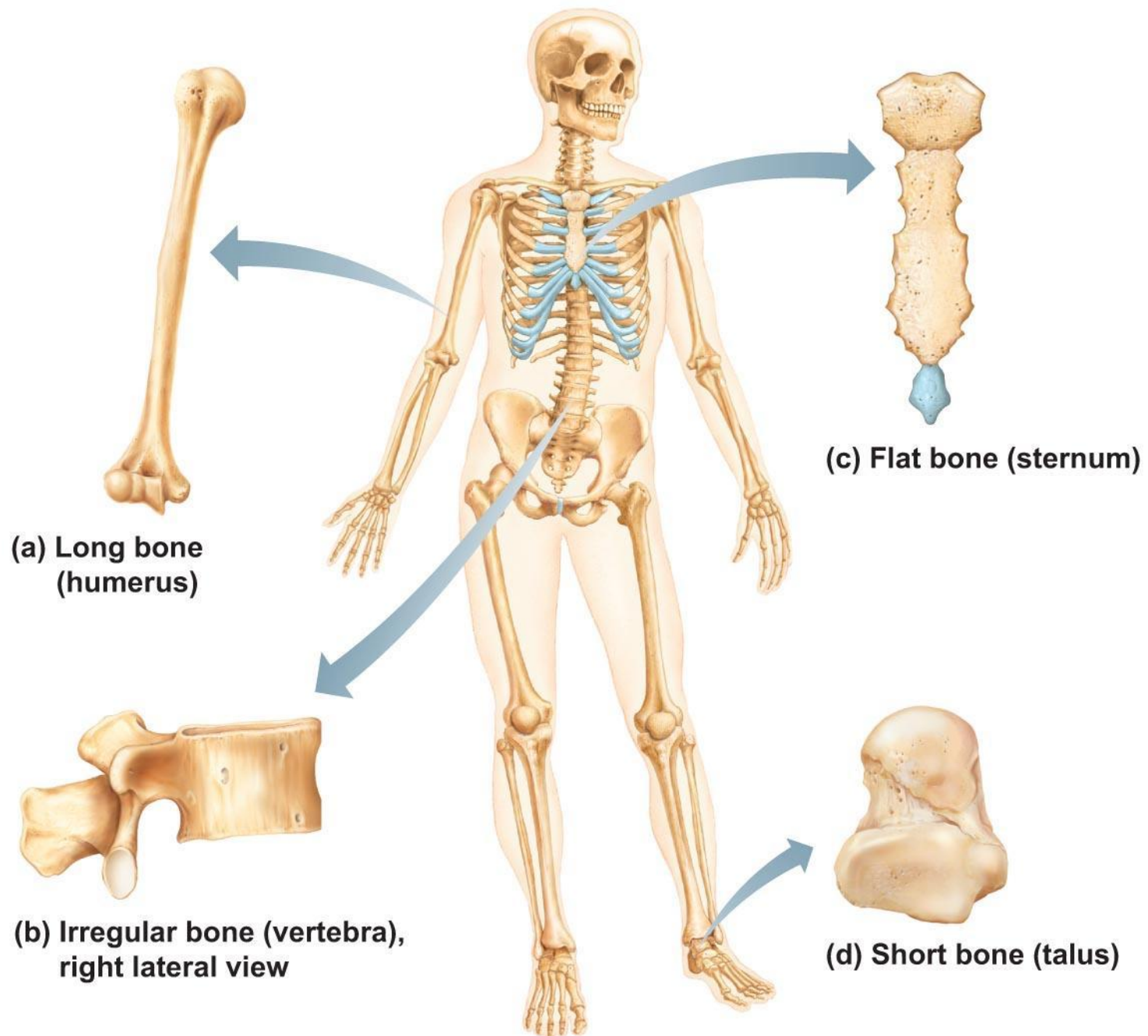
Figure 5.2b



Spongy
bone

Compact
bone

Figure 5.1



(a) Long bone (humerus)

(b) Irregular bone (vertebra), right lateral view

(c) Flat bone (sternum)

(d) Short bone (talus)

Figure 5.2

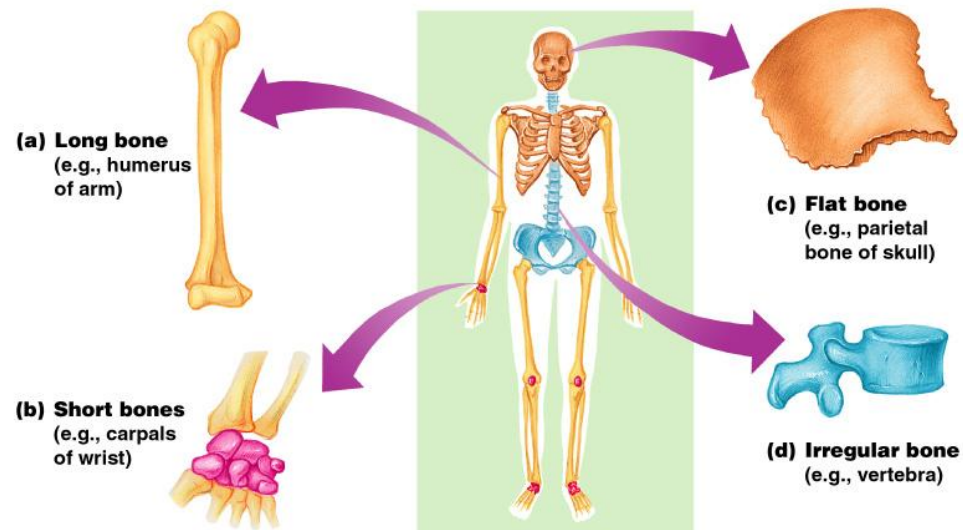
Classification of Bones

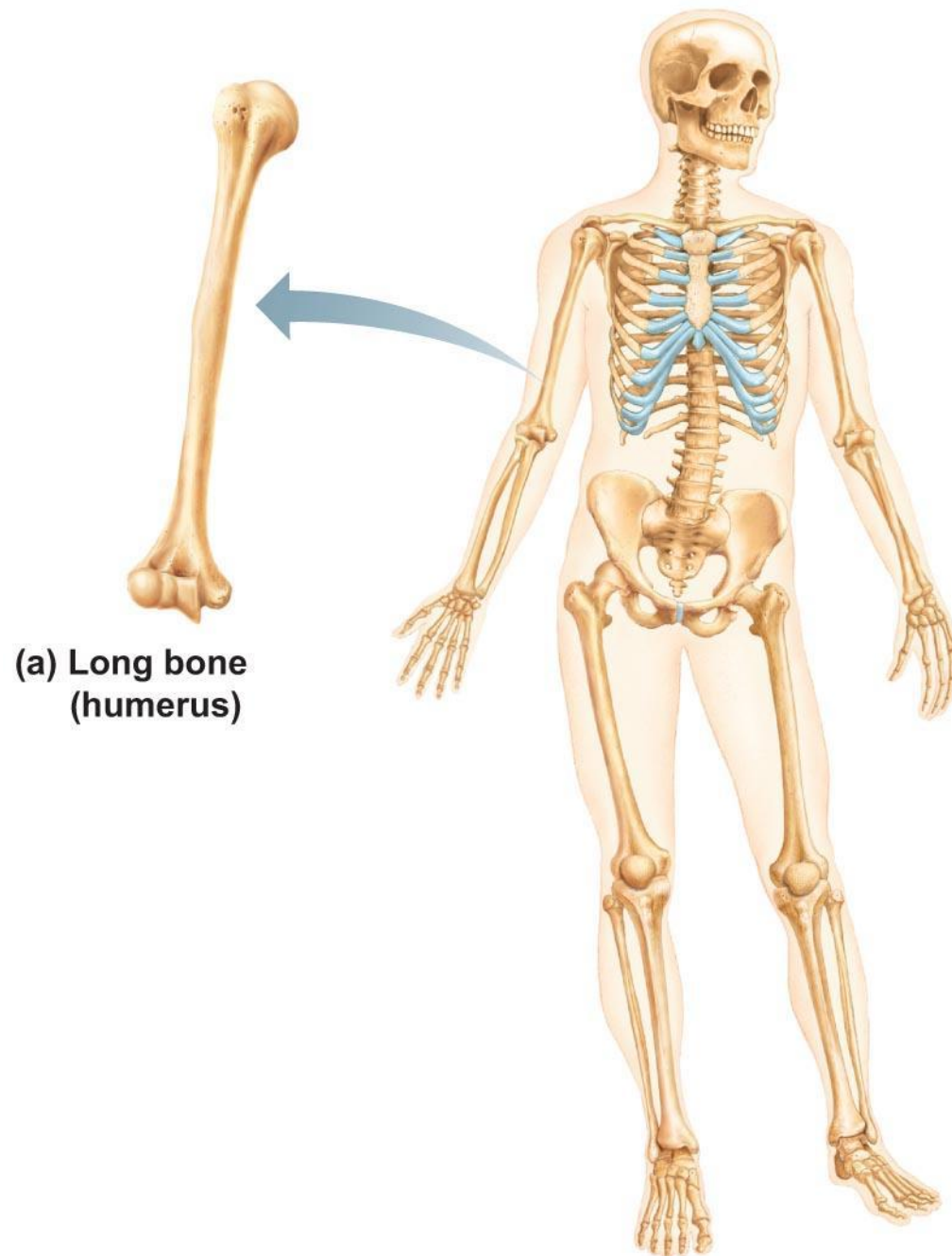
- **Long bones**

- Typically longer than they are wide
- Shaft with heads situated at both ends
- Contain mostly compact bone
- All of the bones of the limbs (except wrist, ankle, and kneecap bones)

- **Examples:**

- Humerus, ulna, radius
- Metacarpals, metatarsals
- Phalanges (on both hands and feet)
- Femur, tibia, fibula





**(a) Long bone
(humerus)**

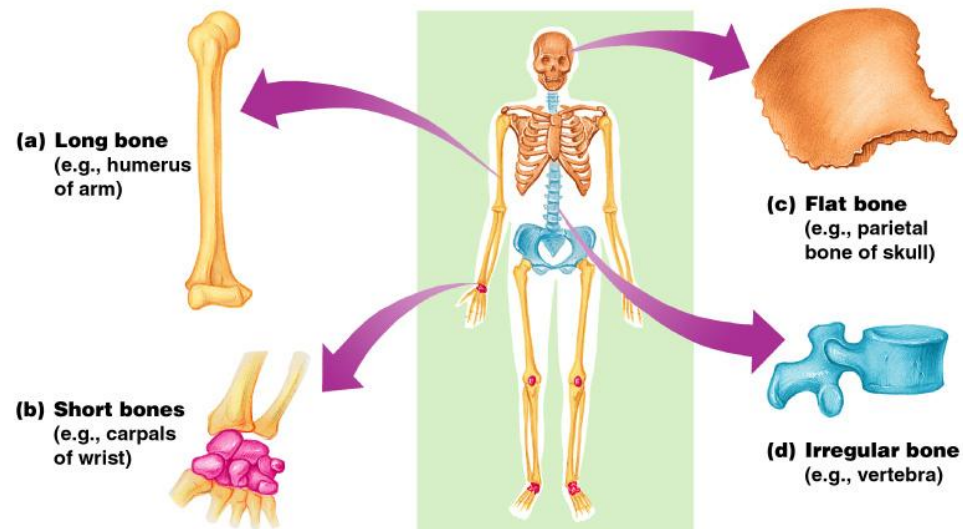
Classification of Bones

- **Short bone**

- Generally cube-shaped
- Contain mostly spongy bone
- Includes bones of the wrist and ankle
- Sesamoid bones are a type of short bone which form within tendons (patella)

- **Examples:**

- Carpals, tarsals
- Talus, calcaneus
- patella



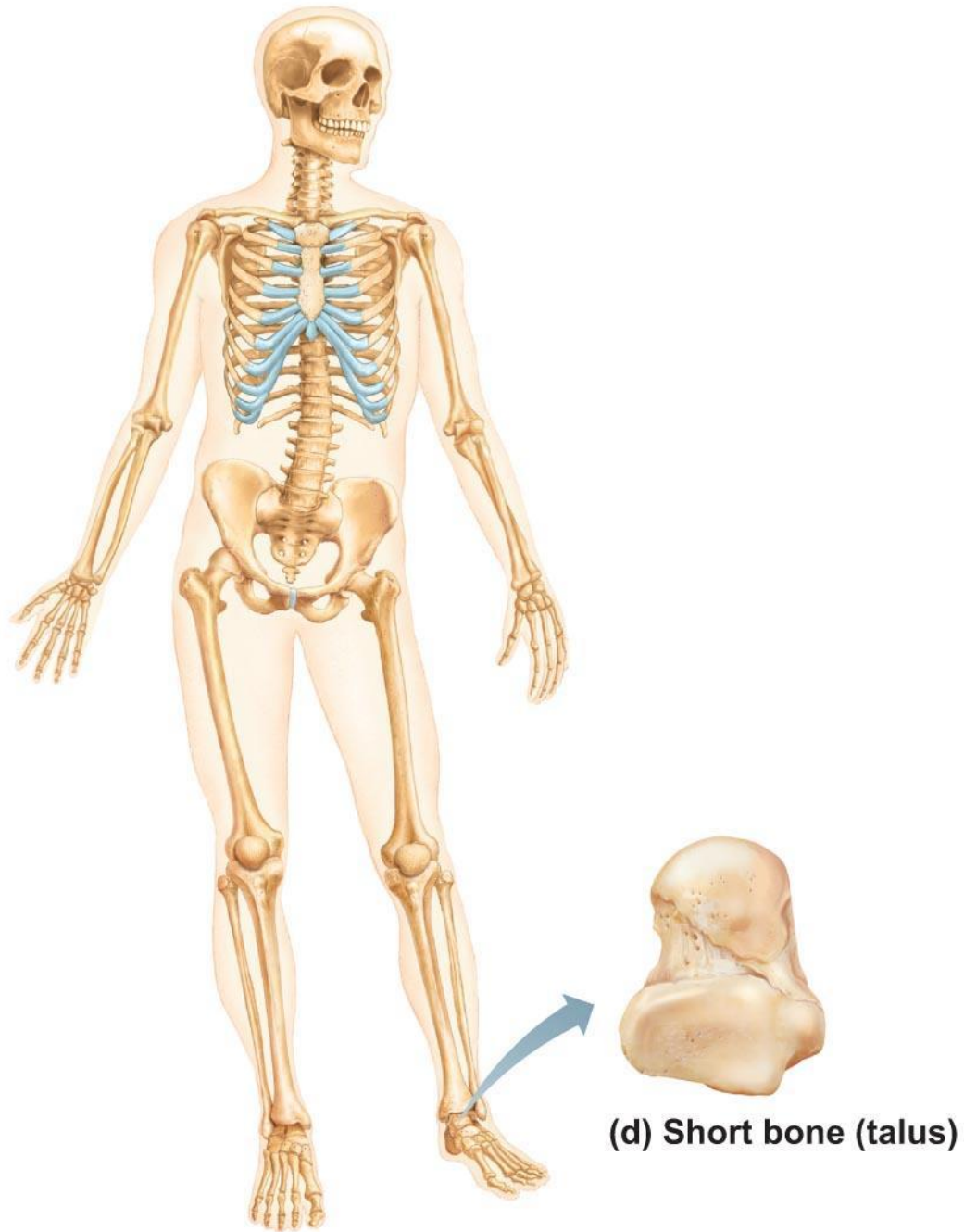


Figure 5.2d

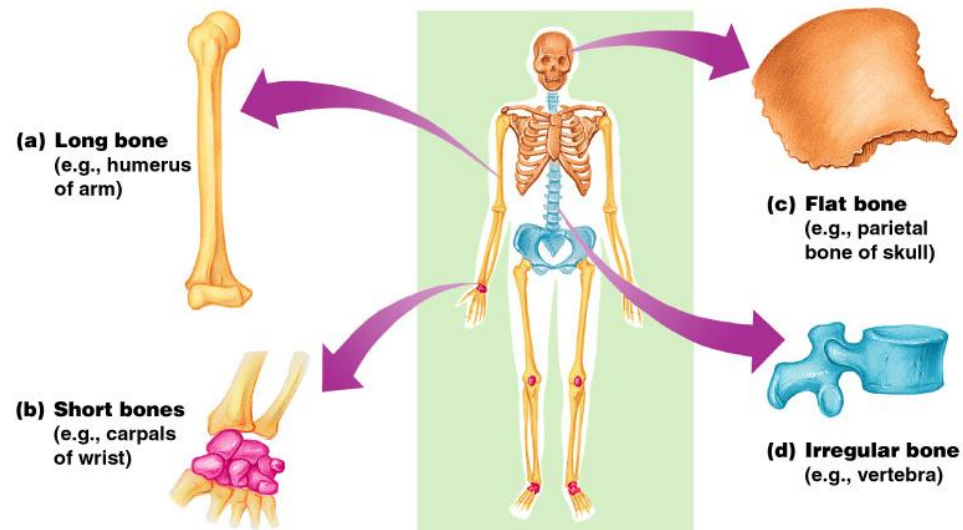
Classification of Bones

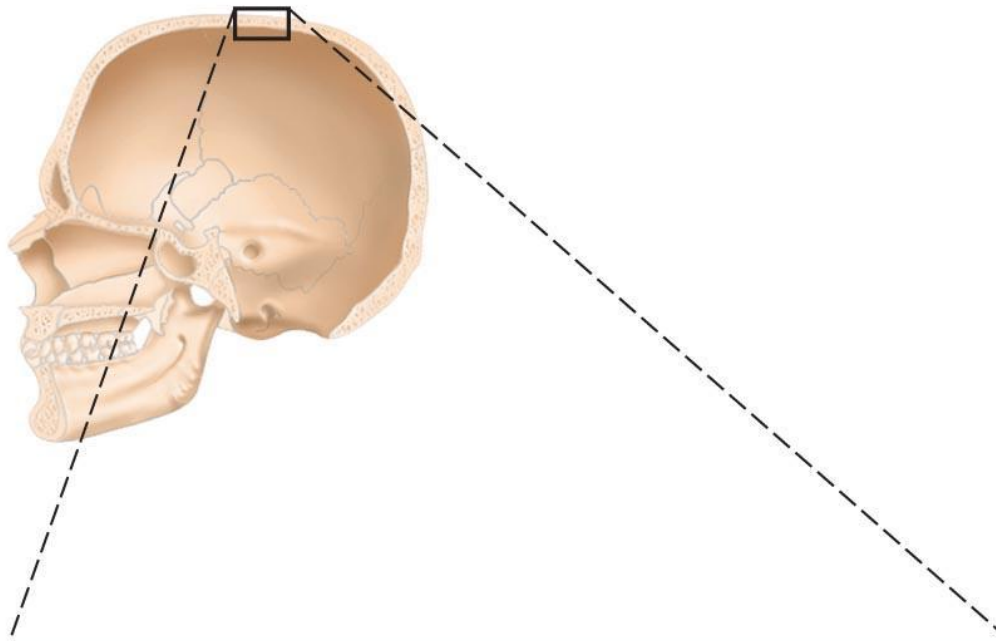
- **Flat bones**

- Thin and flattened
- curved
- Thin layers of compact bone around a layer of spongy bone

- **Examples:**

- All skull bones
- Sternum
- Clavicle
- Scapula
- All ribs





— **Spongy
bone**

— **Compact
bone**

Figure 5.1

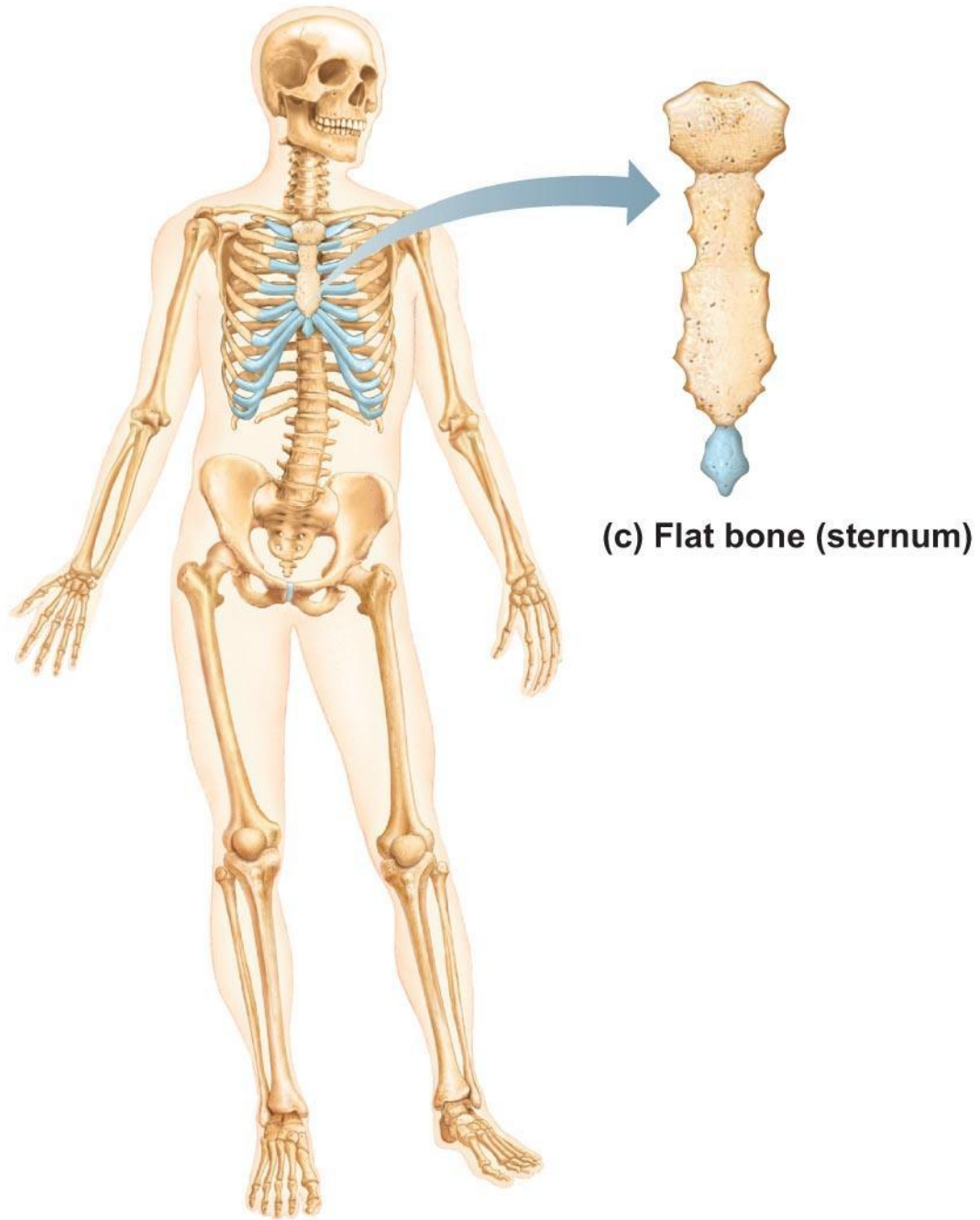


Figure 5.2c

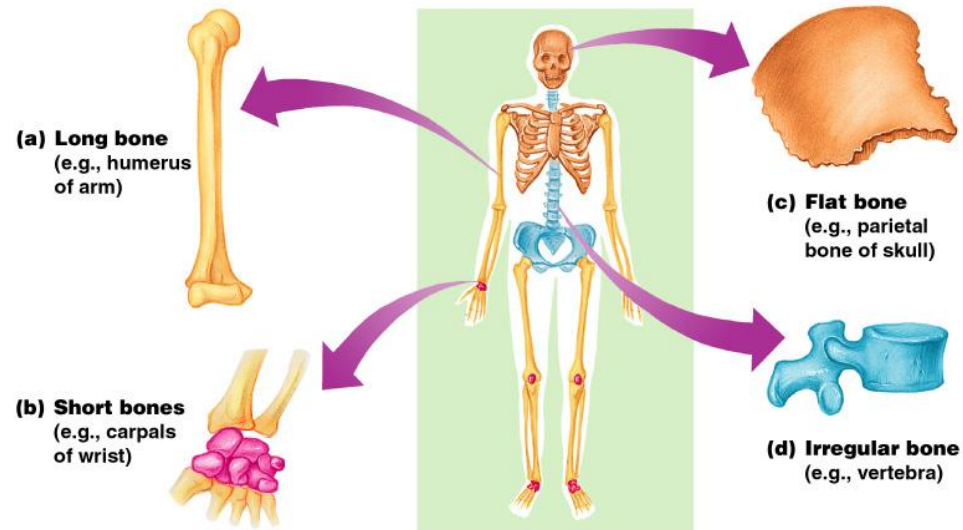
Classification of Bones

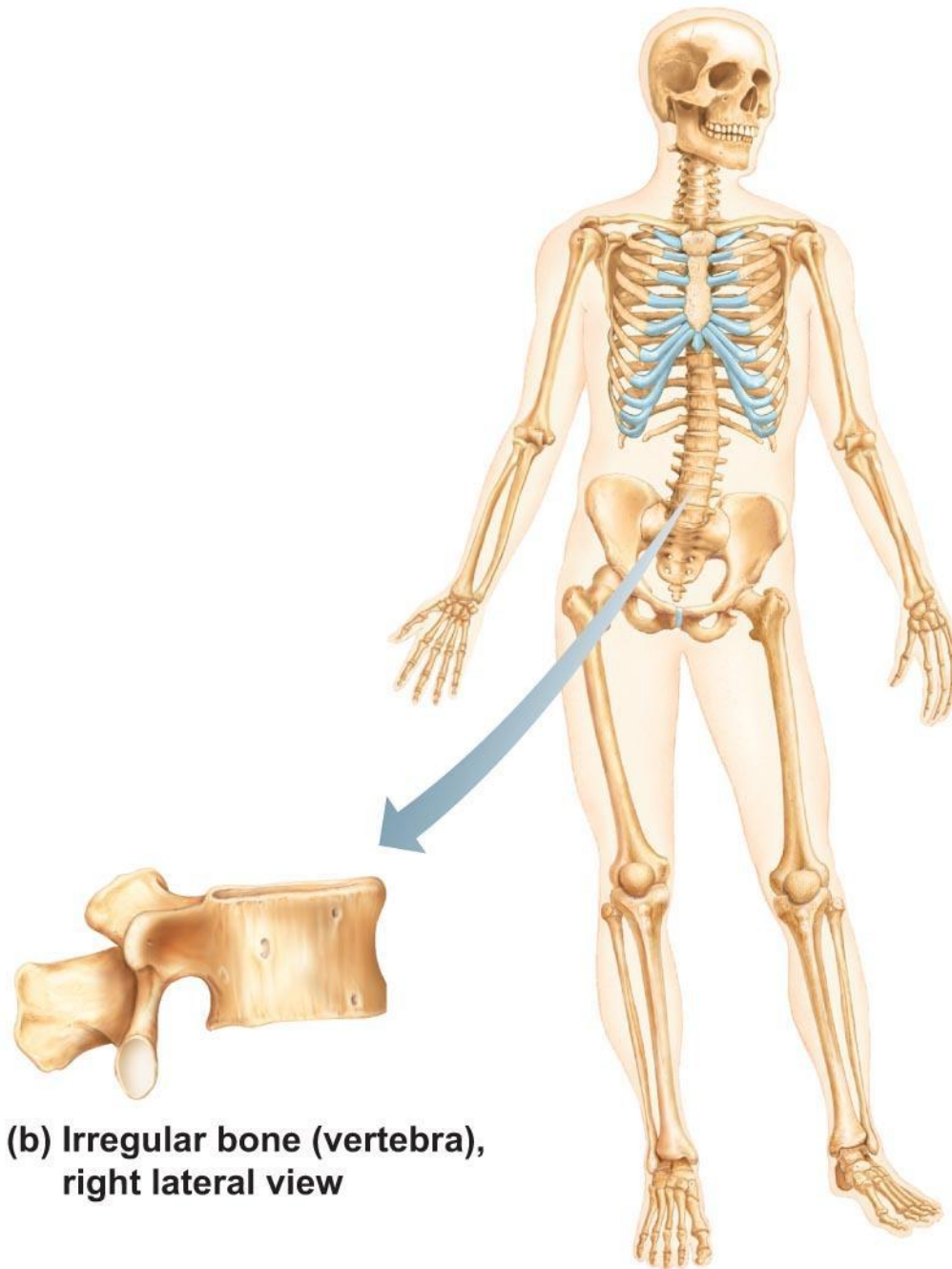
- **Irregular bones**

- Irregular shape
- Do not fit into other bone classification categories

- **Example:**

- All vertebrate
- All bones of the pelvic girdle





**(b) Irregular bone (vertebra),
right lateral view**

Structures of a Long Bone

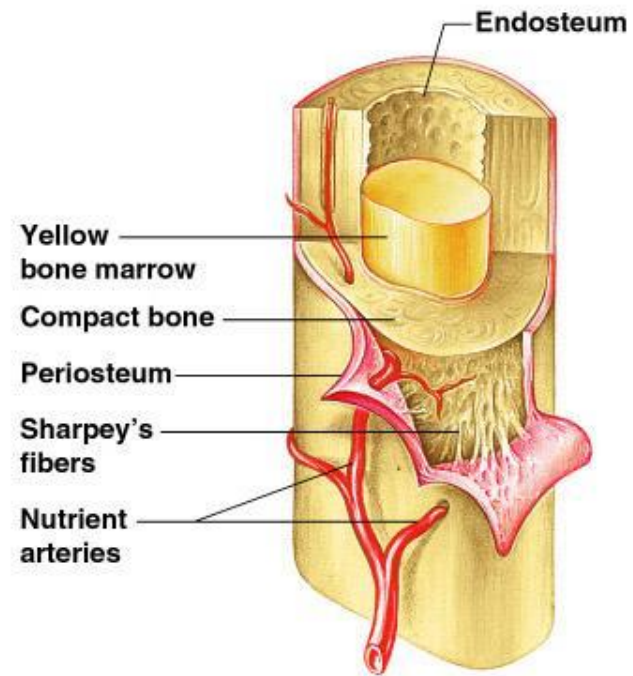
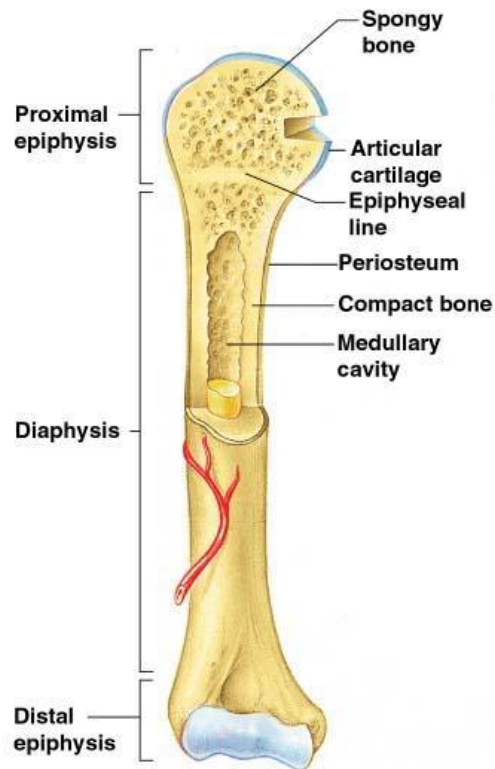


Figure 5.2a

Gross Anatomy of a Long Bone

- **Diaphysis**
 - Shaft
 - Composed of compact bone

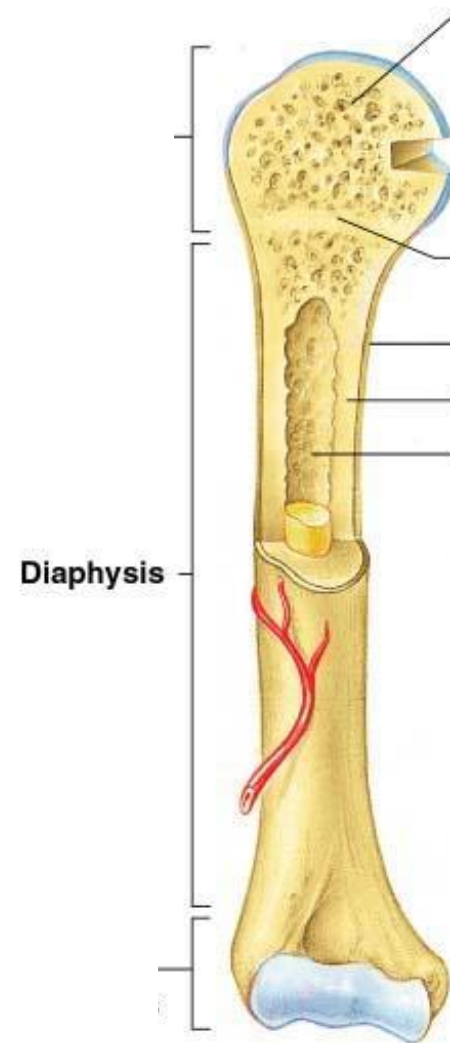


Figure 5.2a

Gross Anatomy of a Long Bone

- **Epiphysis**
 - Ends of the bone
 - Composed mostly of spongy bone

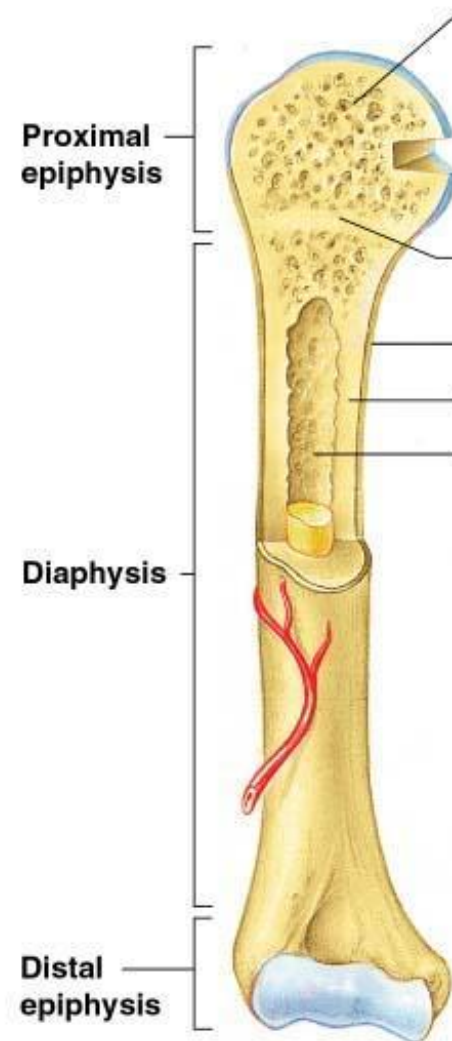


Figure 5.2a

Structures of a Long Bone

- **Periosteum**
 - Outside covering of the diaphysis
 - Fibrous connective tissue membrane

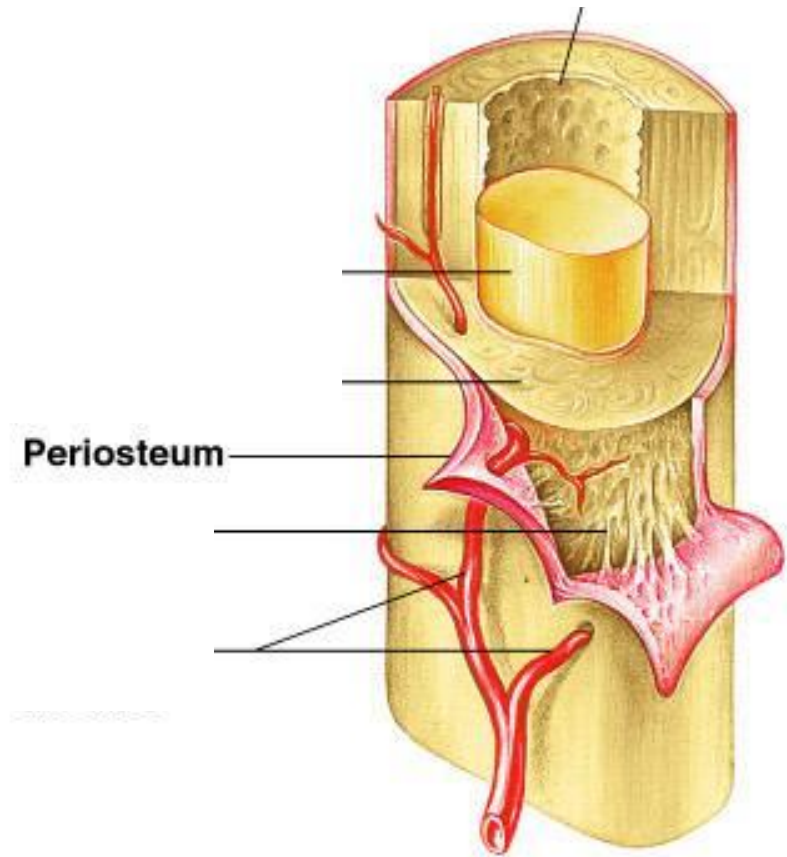


Figure 5.2c

Structures of a Long Bone

- **Sharpey's fibers**
 - Secure periosteum to underlying bone

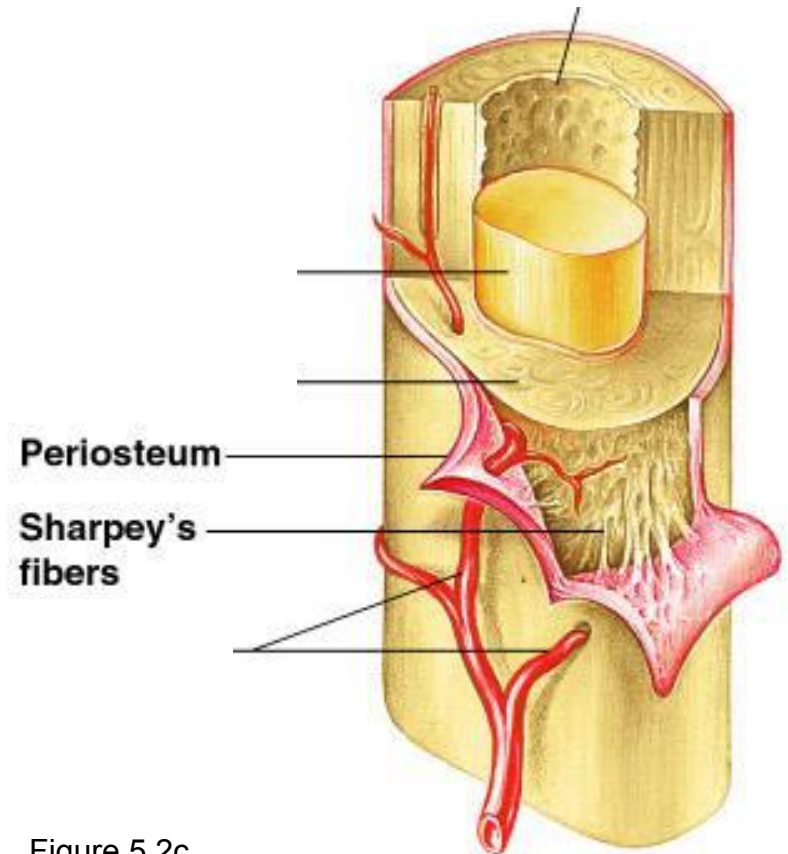


Figure 5.2c

Structures of a Long Bone

- **Arteries**
 - Supply bone cells with nutrients

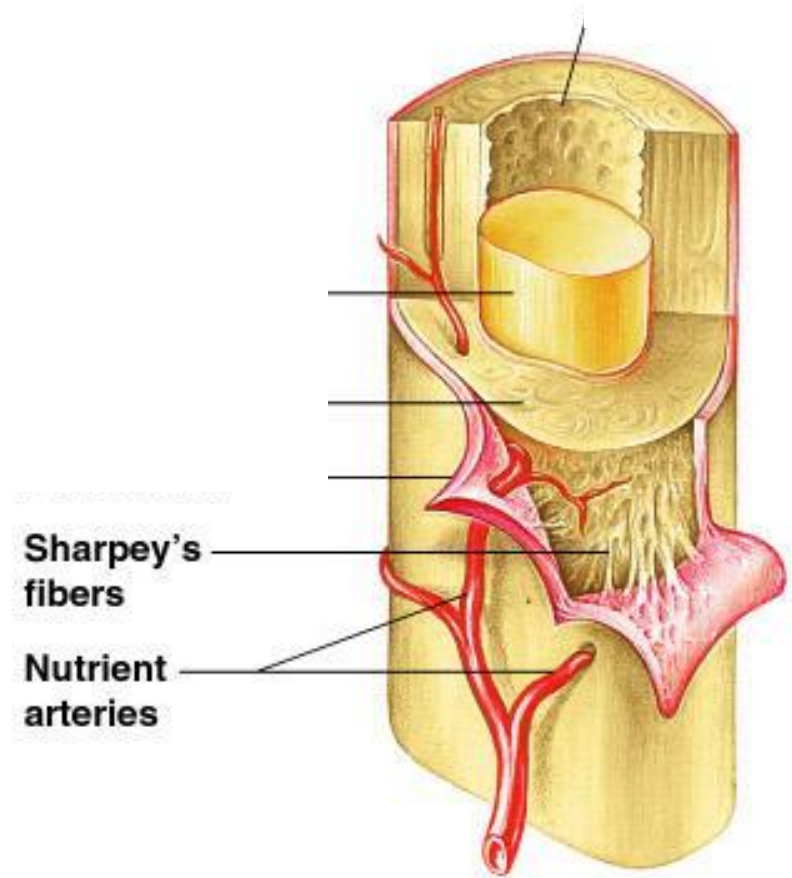


Figure 5.2c

Structures of a Long Bone

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

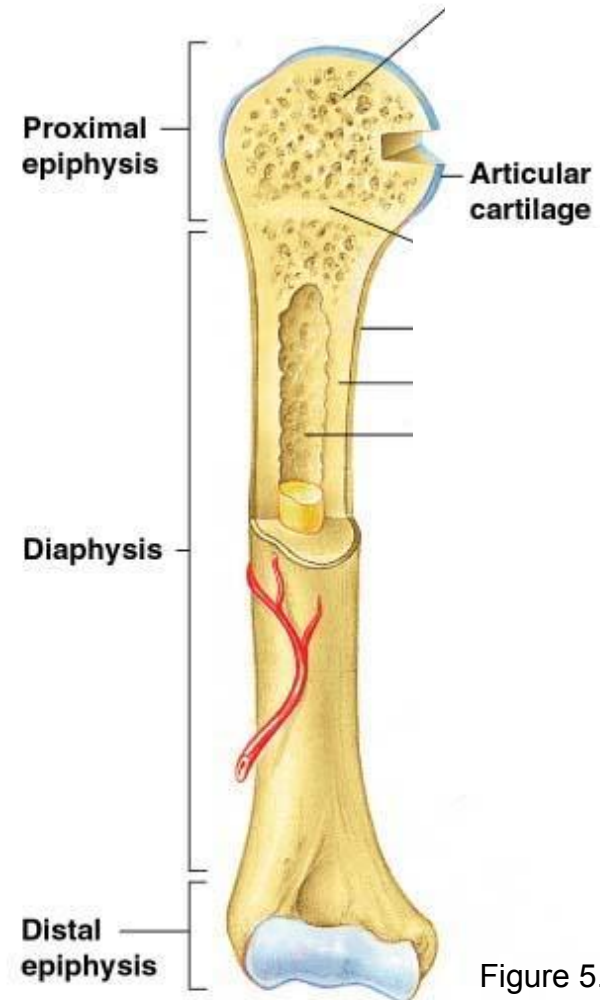


Figure 5.2a

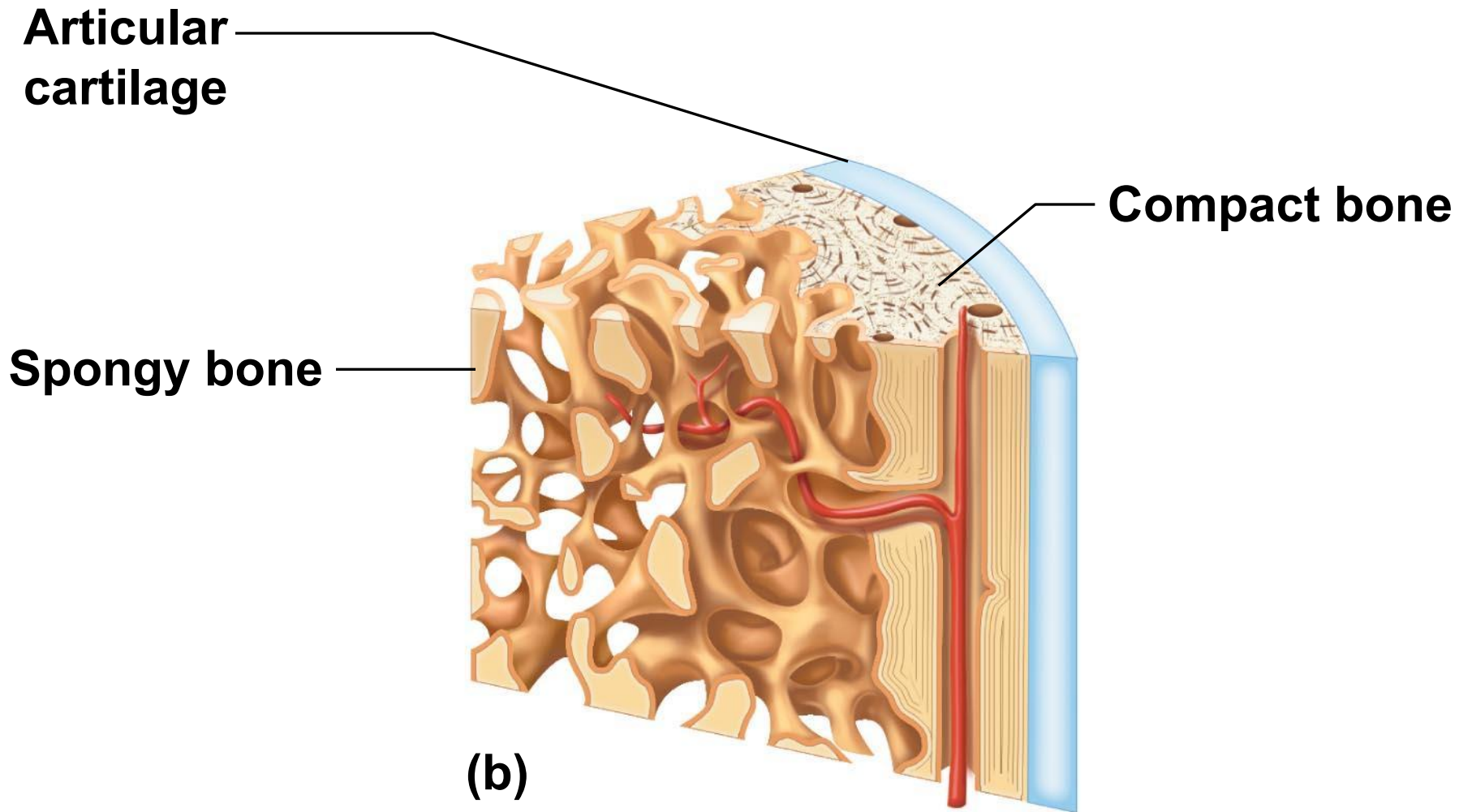


Figure 5.3b

Structures of a Long Bone

- **Medullary cavity**
 - Contains yellow marrow (mostly fat) in adults
 - Contains red marrow (for blood cell formation) in infants

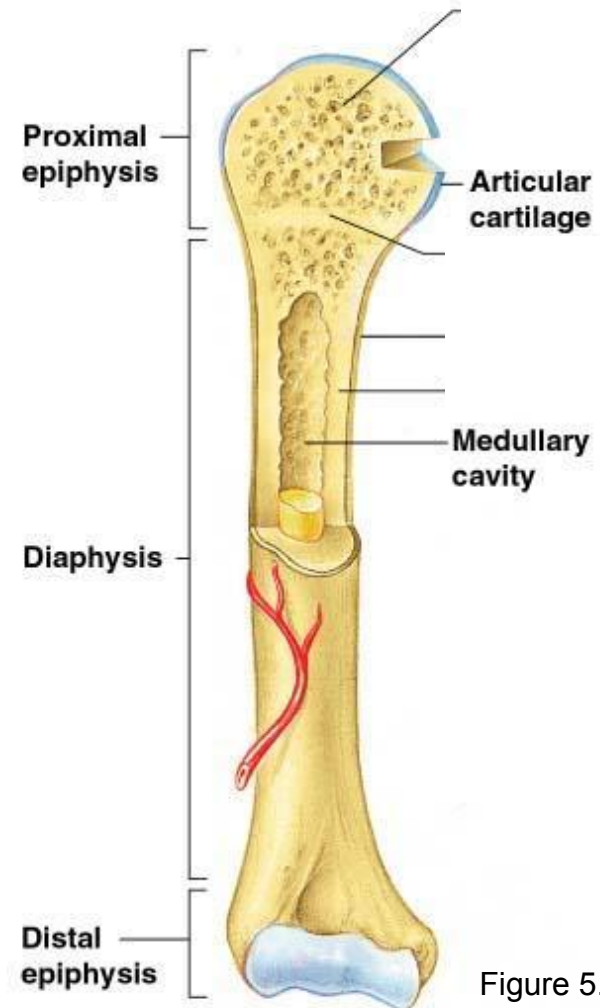


Figure 5.2a

Bone Markings

- Surface features of bones
 - Sites of attachments for muscles, tendons, and ligaments
 - Passages for nerves and blood vessels
- Categories of bone markings
 - Projections or processes—grow out from the bone surface
 - Terms often begin with “T”
 - Depressions or cavities—indentations
 - Terms often begin with “F”



- Title

- Microscopic Anatomy
and Bone Growth

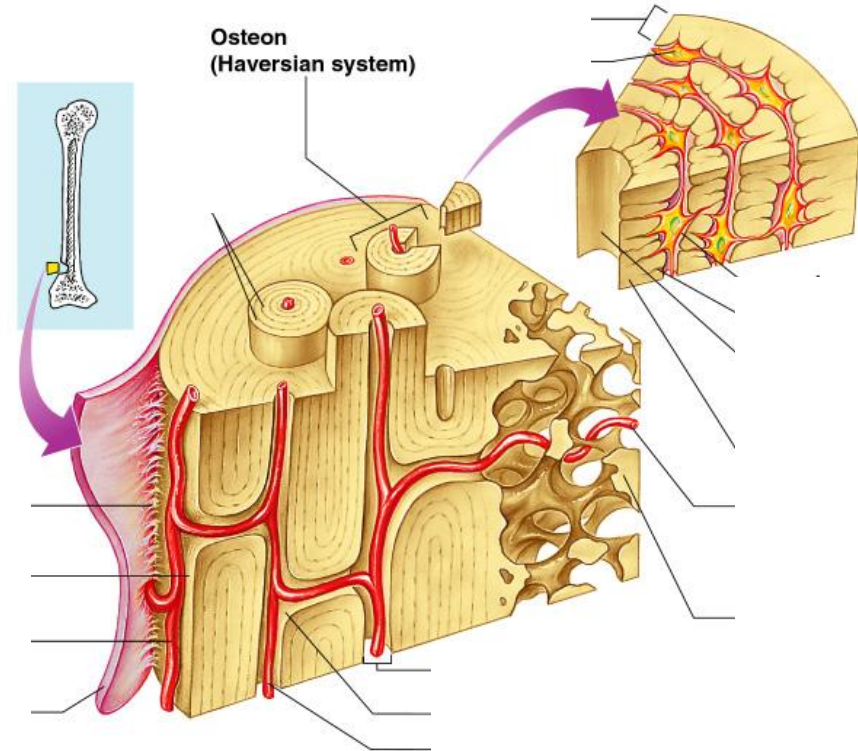
- Essential Question

- How do the microscopic structures of bone help in the process of bone growth and remodeling?

Microscopic Anatomy of Bone

- **Osteon**
(Haversian
System)

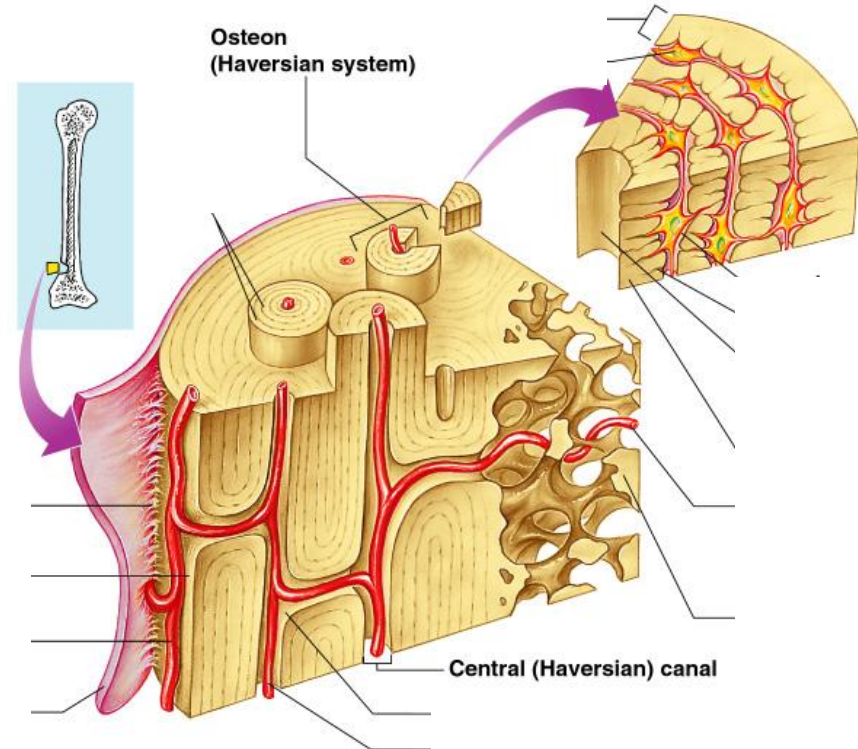
- A unit of bone containing central canal and matrix rings



Microscopic Anatomy of Bone

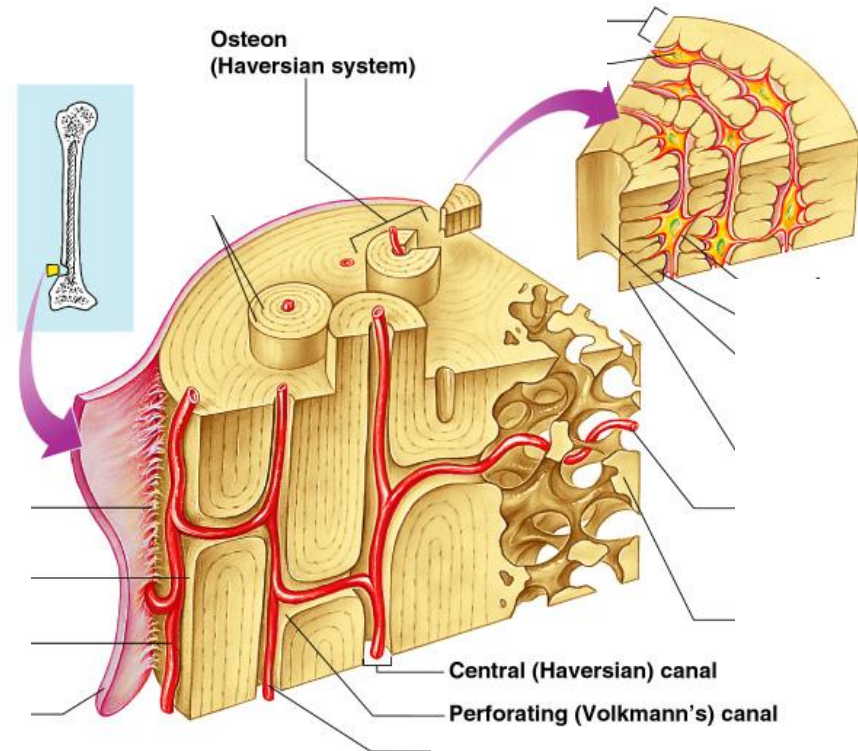
- **Central (Haversian) canal**

- Opening in the center of an osteon
- Carries blood vessels and nerves



Microscopic Anatomy of Bone

- **Perforating (Volkman's) canal**
 - Canal perpendicular to the central canal
 - Carries blood vessels and nerves



Microscopic Anatomy of Bone

- **Lacuna**
 - Cavities containing bone cells (osteocytes)
 - Arranged in concentric rings

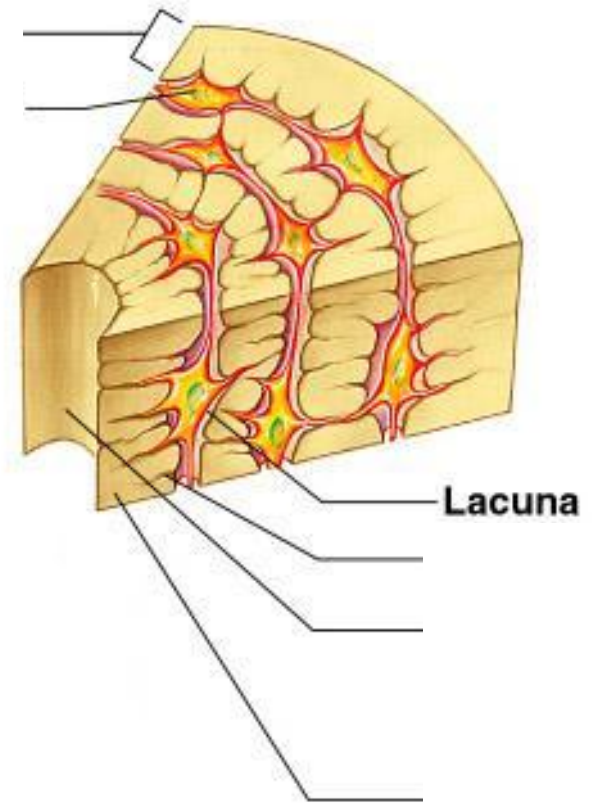
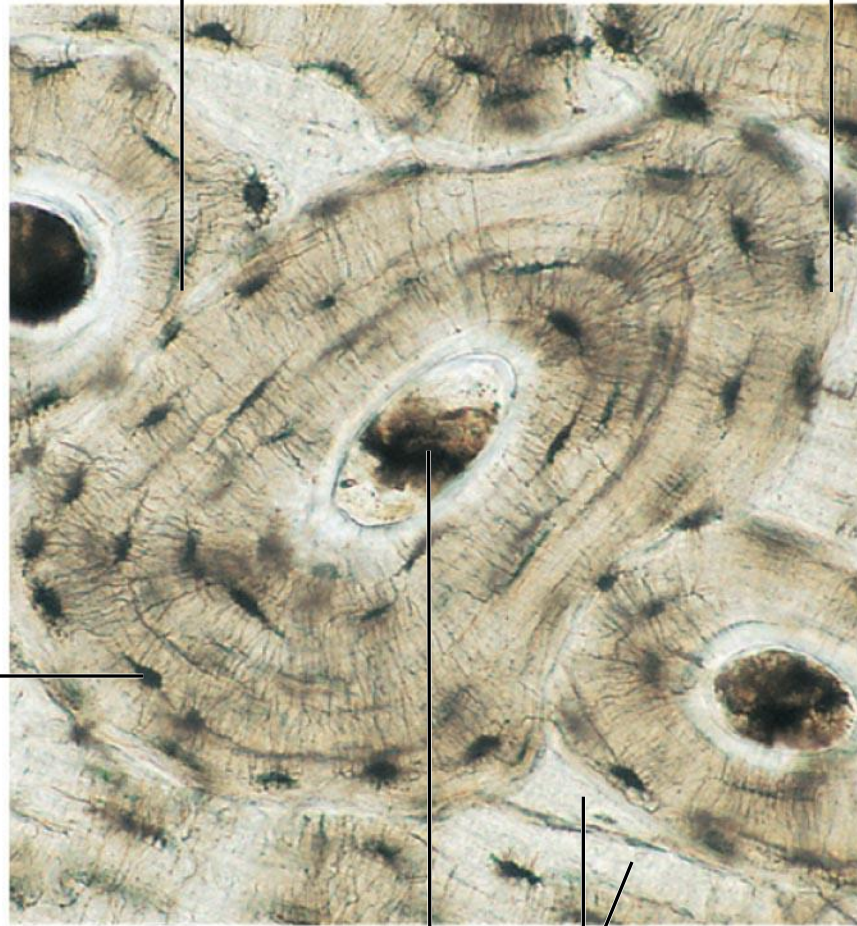


Figure 5.3

Osteon

Lacuna



(c) Central canal

Interstitial lamellae

Microscopic Anatomy of Bone

- **Lamella**
 - Rings around the central canal
 - Sites of lacunae

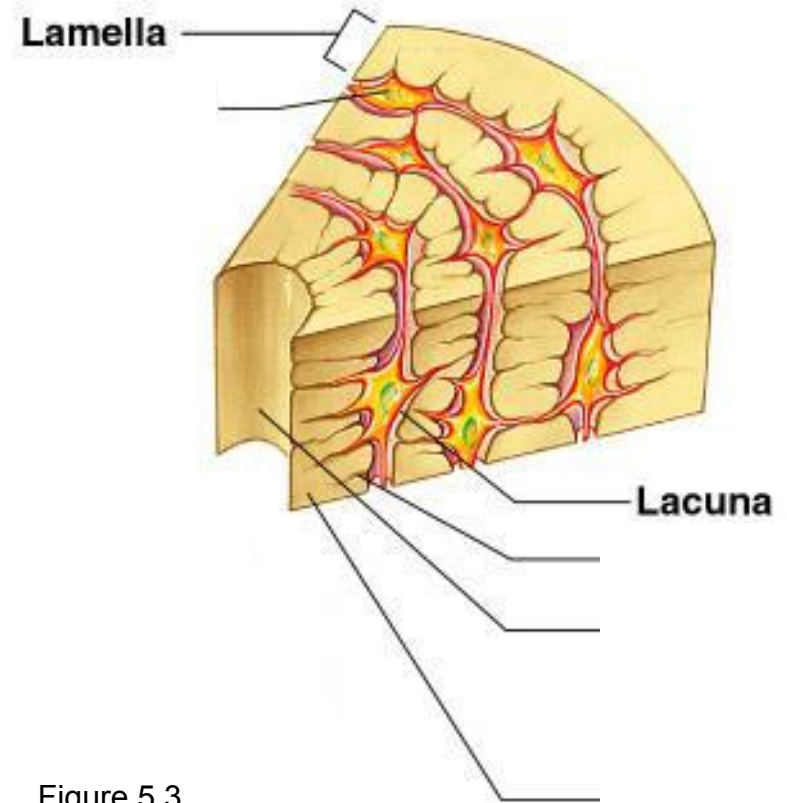


Figure 5.3

Microscopic Anatomy of Bone

- **Canaliculus**
 - Tiny canals
 - Radiate from the central canal to lacunae
 - Form a transport system

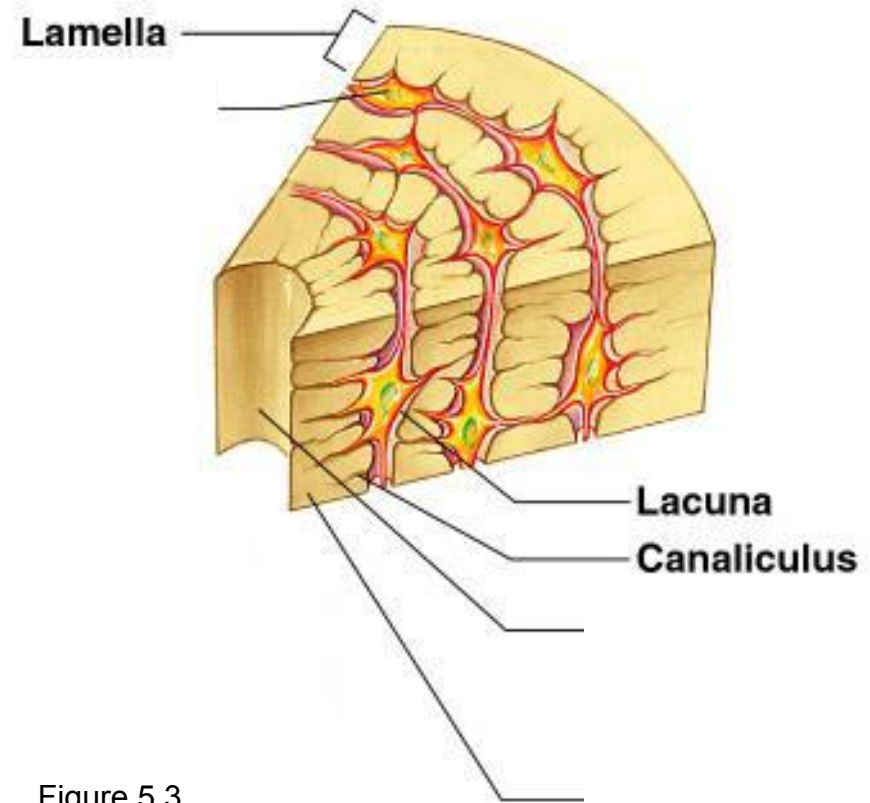


Figure 5.3

Types of Bone Cells

- **Osteocytes**
 - Mature bone cells
- **Osteoblasts**
 - Bone-forming cells

Types of Bone Cells

- **Osteoclasts**

- Bone-destroying cells
- Break down bone matrix for remodeling and release of calcium in response to parathyroid hormone

Formation of 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 (Ossification)

- **Epiphyseal plates** allow for lengthwise growth of long bones during childhood
 - New cartilage is continuously formed
 - Older cartilage becomes ossified
 - Cartilage is broken down
 - Enclosed cartilage is digested away, opening up a medullary cavity
 - Bone replaces cartilage through the action of osteoblasts

Bone Growth – Bone Remodeling

- Bones are remodeled and lengthened until growth stops using both osteoblasts and osteoclasts
 - Bones are remodeled in response to two factors
 - Blood calcium levels
 - When blood calcium levels decrease, PTH (parathyroid hormone), is released which causes bone to be broken down.
 - When blood calcium levels increase, calcitonin is released which causes bone to be built.
 - Pull of gravity and muscles on the skeleton – will determine where bone matrix is to be remodeled
 - Bones grow in width (appositional growth)

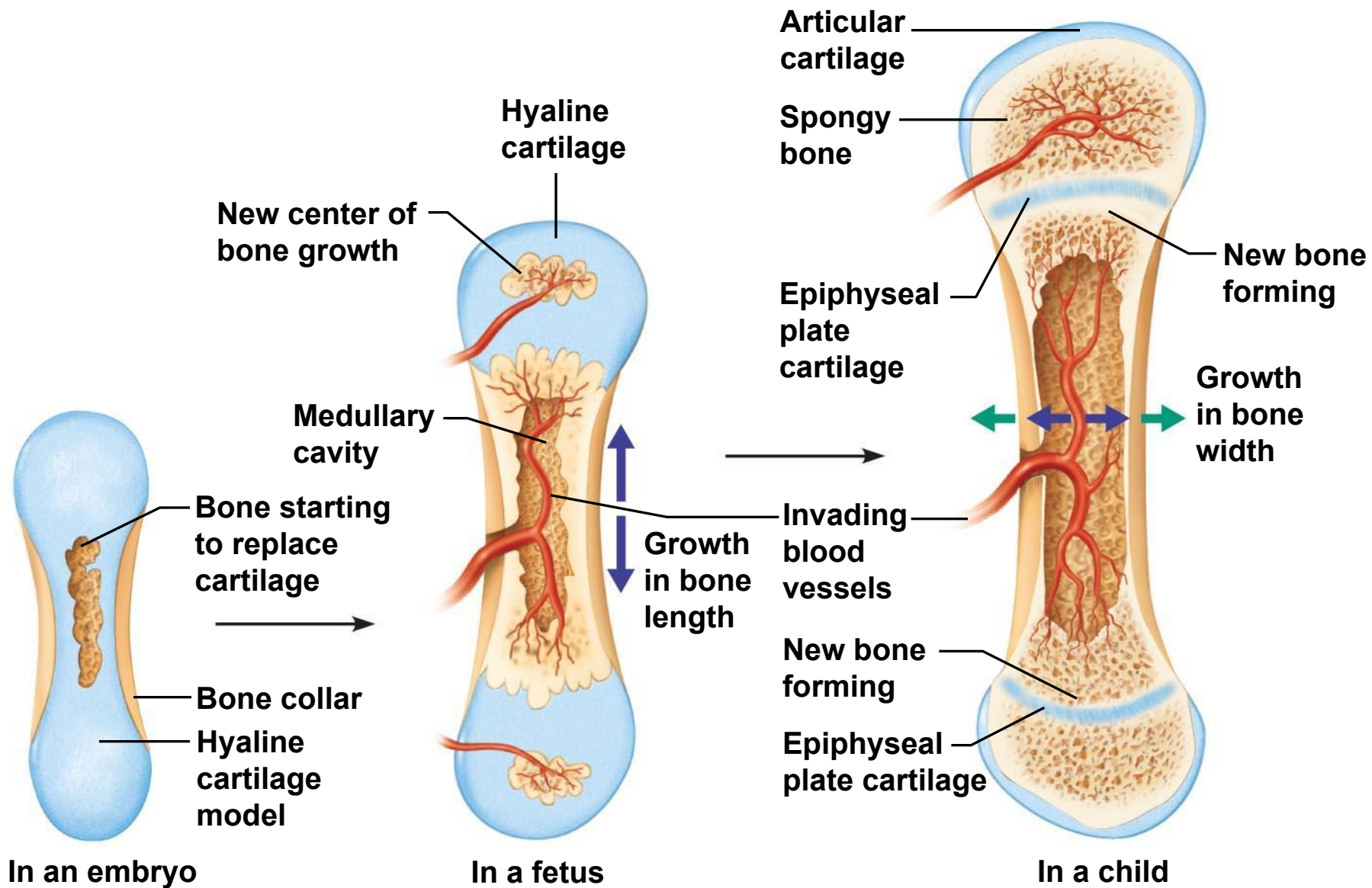
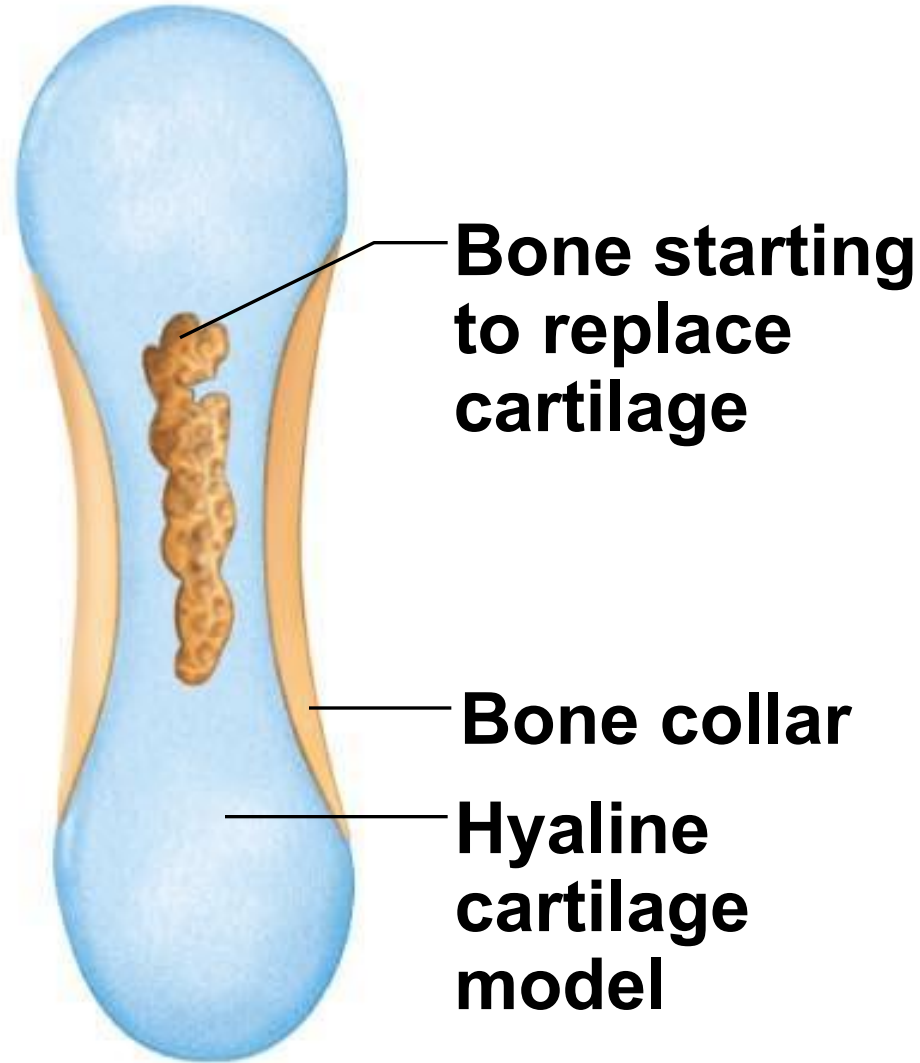


Figure 5.5



In an embryo

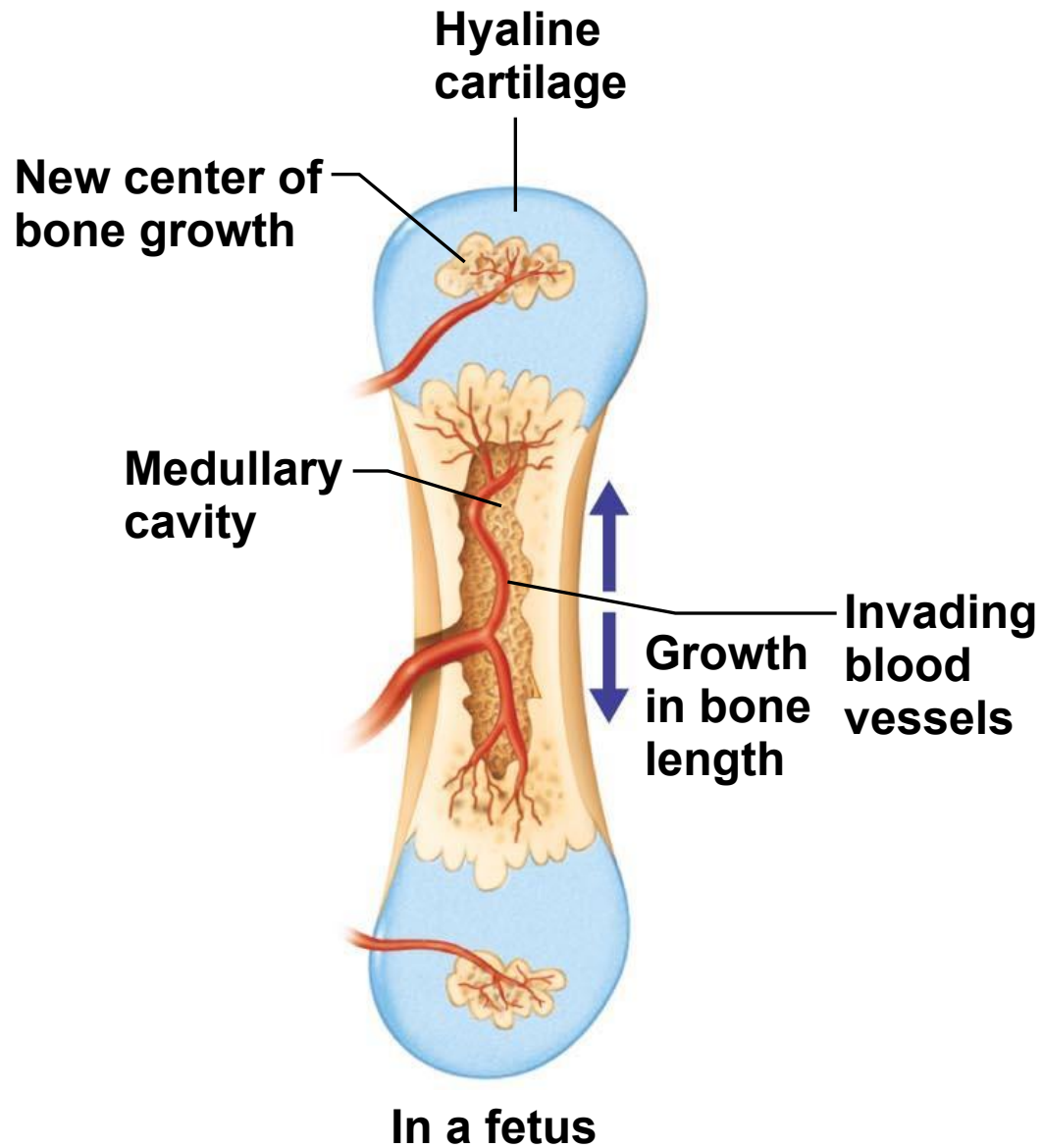


Figure 5.5, step 2

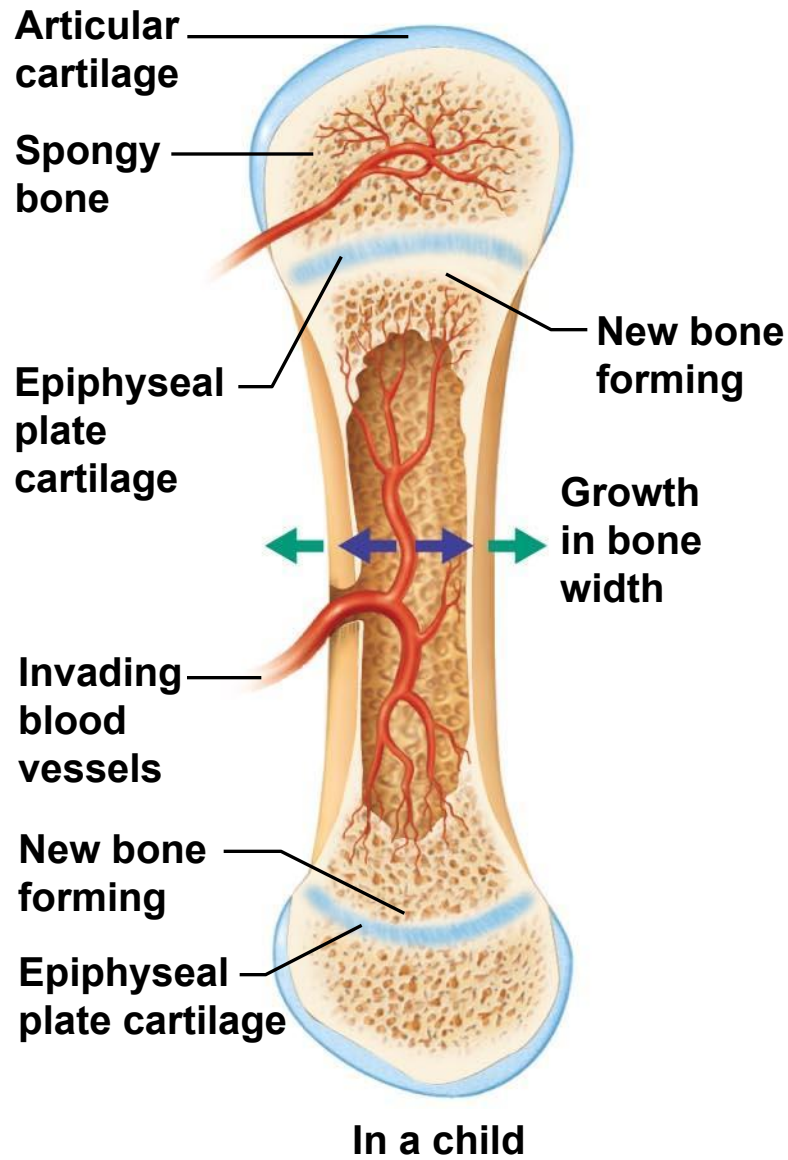


Figure 5.5, step 3

Bone growth

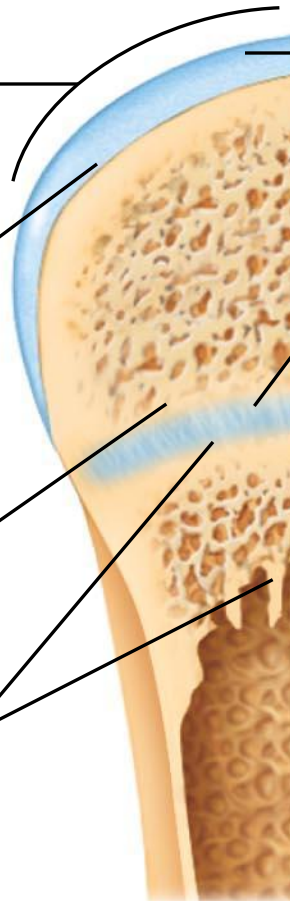
Bone grows in length because:

① Cartilage grows here.

② Cartilage is replaced by bone here.

③ Cartilage grows here.

④ Cartilage is replaced by bone here.



Bone remodeling

Growing shaft is remodeled as:

Articular cartilage

Epiphyseal plate

① Bone is resorbed here.

② Bone is added by appositional growth here.

③ Bone is resorbed here.

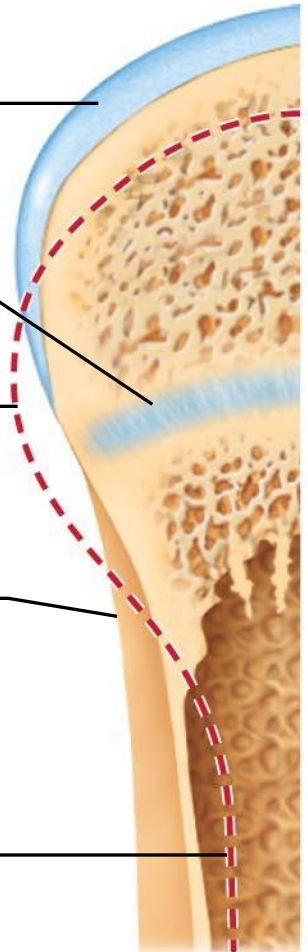


Figure 5.6



- Title

- Bone Fractures and Repair

- Essential Question

- What are the different types of bone fracture, and how does the body heal a fracture?

Bone Fractures

- Types of bone fractures
 - **Closed (simple) fracture** – break that does not penetrate the skin
 - **Open (compound) fracture** – broken bone penetrates through the skin

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. (i.e., osteoporotic bones).	Common in porous 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 adults.	Common in children, whose bones are more flexible than those of

Table 5.2

Bone Fractures

- Treatment
 - reduction and immobilization
 - Realignment of the bone
 - Surgery is needed in some occasions

Repair of Bone Fractures

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

Stages in the Healing of a Bone Fracture

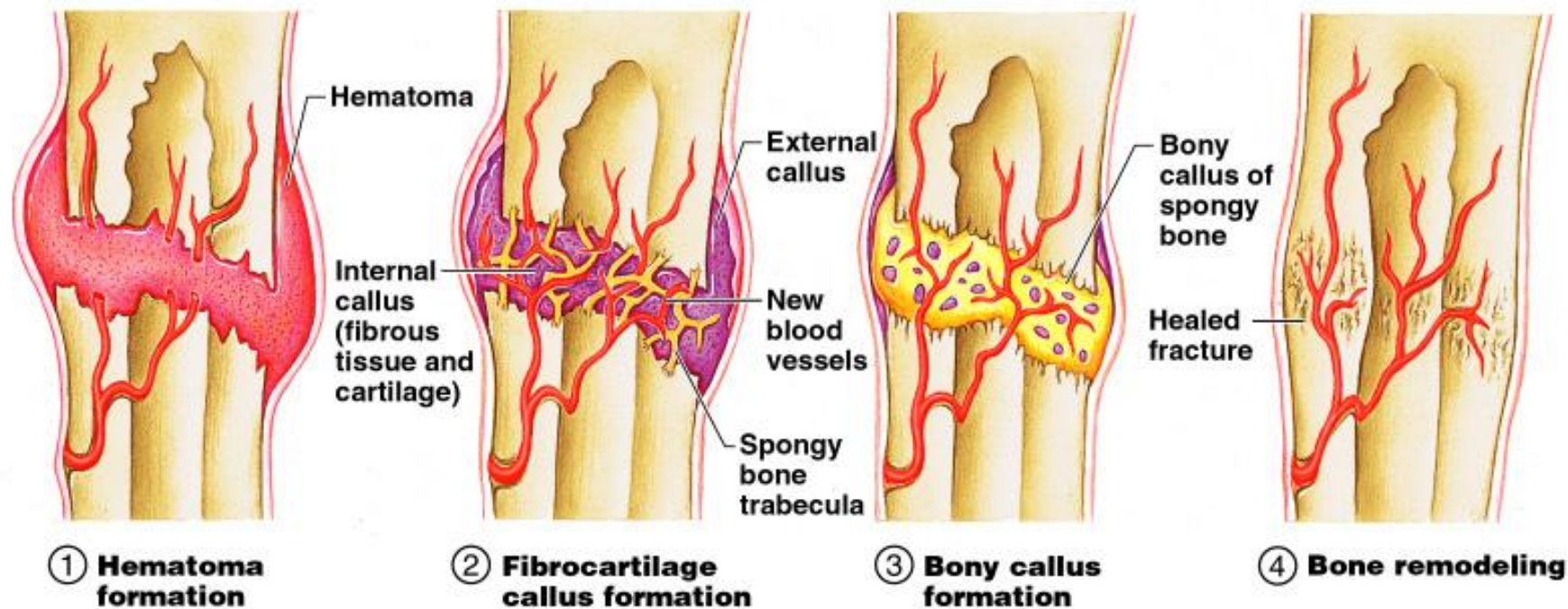


Figure 5.5

Analyzing X-Rays



Examining X-Rays

- Your team will be given an image of an x-ray and you will need to:
 - Name all the bones on the x-ray
 - Name the type of fracture (s)
 - Provide a treatment plan
 - Choose a team leader to speak for your group

INB pg 64

- Title: X Ray Example Date:
- Drawing of the x-ray
- Label ALL Bones
- Name the type of fracture(s)
- Write the treatment plan



My Expert Opinion

- **Bones on X-ray:** femur, tibia, fibula
- **Type of Fracture:** simple, impacted
- **Treatment Plan:** stabilize the bones and place cast on leg to immobilize the leg



My Expert Opinion

- **Bones on X-ray:** femur and pelvis
- **Type of Fracture:** compound and comminuted
- **Treatment Plan:** stabilize the open wound, surgery to clean the wound, and stabilize bones with pins and screws



My Expert Opinion

- **Bones on x-ray**: femur, tibia, fibula
- **Type of Fracture**: simple, spiral and greenstick
- **Treatment**: realign the bone and stabilize with a cast



My Expert Opinion

- **Bones on x-ray**: skull and cervical vertebrae
- **Type of Fracture**: compression of the C5
- **Treatment**: immobilize neck with brace



My Expert Opinion

- **Bones on x-ray**: humerus, radius, ulna, and phalange
- **Type of Fracture**: greenstick of the distal ulna
- **Treatment**: realign the bone and stabilize with a cast



My Expert Opinion

- **Bones on x-ray**: radius, ulna, carpel, metacarpal
- **Type of Fracture**: simple, impacted
- **Treatment**: realign the bone and stabilize with a cast



My Expert Opinion

- **Bones on x-ray**: humerus, ulna, and radius
- **Type of Fracture**: simple, spiral
- **Treatment**: realign the bone and stabilize with a cast



- Title

- Joints

- Essential Question

- Describe the structure and function of joints.

Joints

- **Functions**
 - Hold bones together
 - Allow for mobility

Functional Classification of Joints

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

Structural Classification of Joints

- Fibrous joints
- Cartilaginous joints
- Synovial joints

Fibrous Joints

- Bones united by collagenic fibers
- Types
 - Sutures
 - Immobile
 - Example:** Joints between skull bones
 - Syndesmoses
 - Allows more movement than sutures but still immobile
 - Example:** Distal end of tibia and fibula
 - Gomphosis
 - Immobile
 - Example:** Bind teeth to bony socket

Figure 5.27d, e

Slide 5.46

Fibrous joints



Figure 5.30a

Fibrous joints

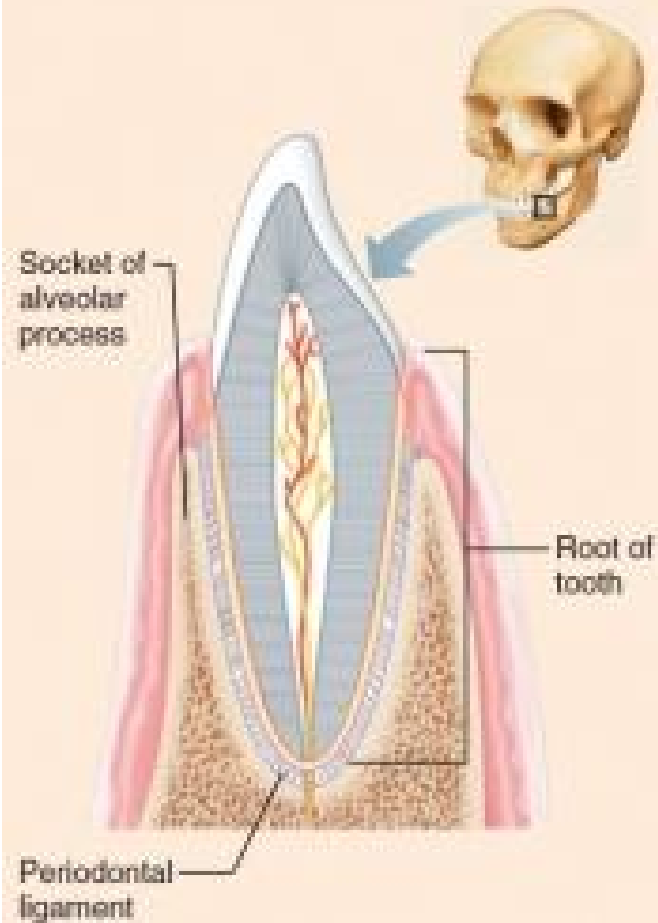


(b) Syndesmosis

Figure 5.30b

(c) Gomphosis

Peg-in-socket fibrous joint. Periodontal ligament holds tooth in socket.



Cartilaginous Joints

- Bones connected by cartilage
- Types
 - Synchrondrosis
 - Immobile
 - Example:** first sternocostal joint
 - Symphysis
 - Slightly movable
 - Example:** Pubic symphysis, intervertebral joints

Figure 5.27b, c

Slide 5.47

Cartilaginous joints

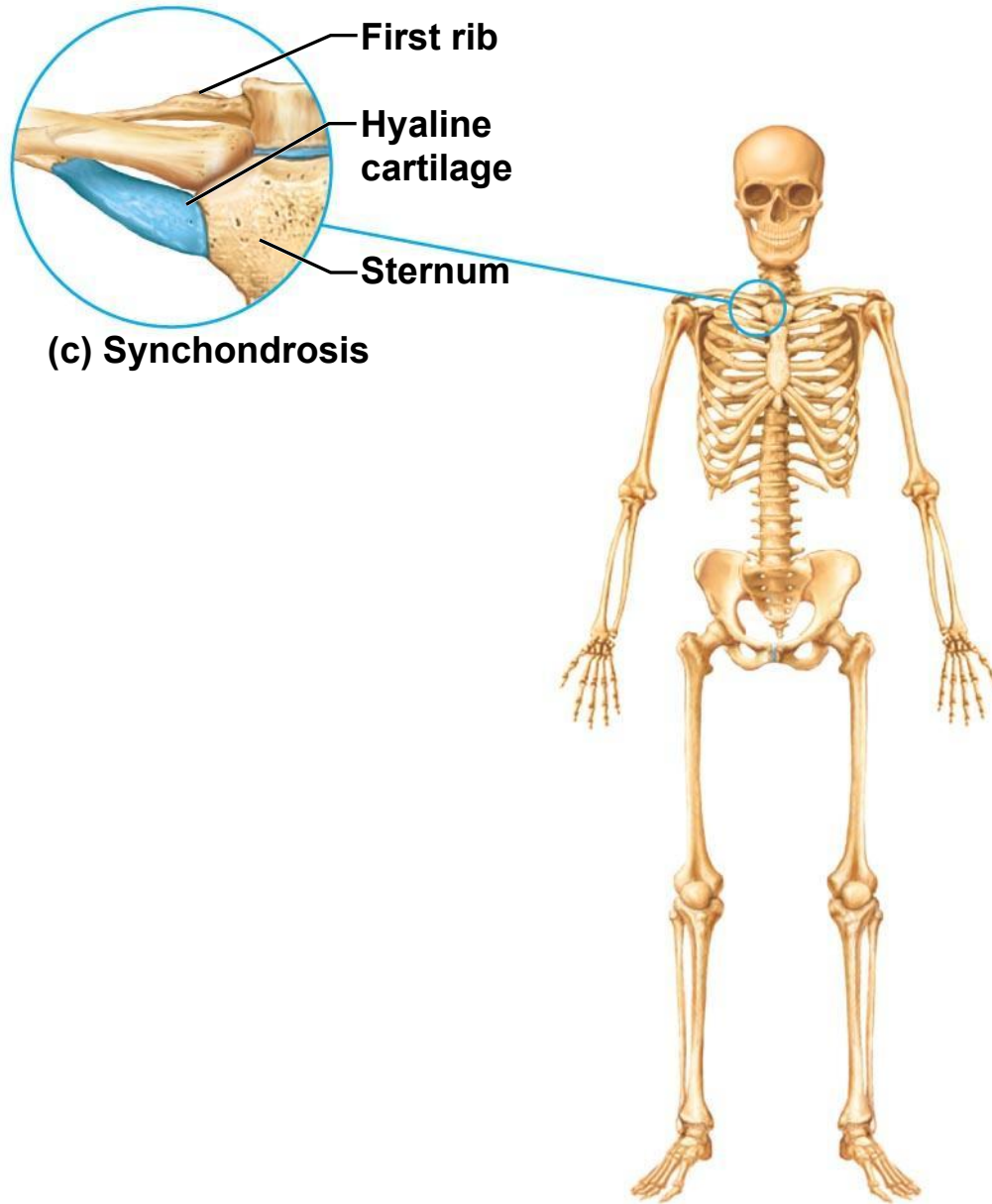


Figure 5.30c

Cartilaginous joints

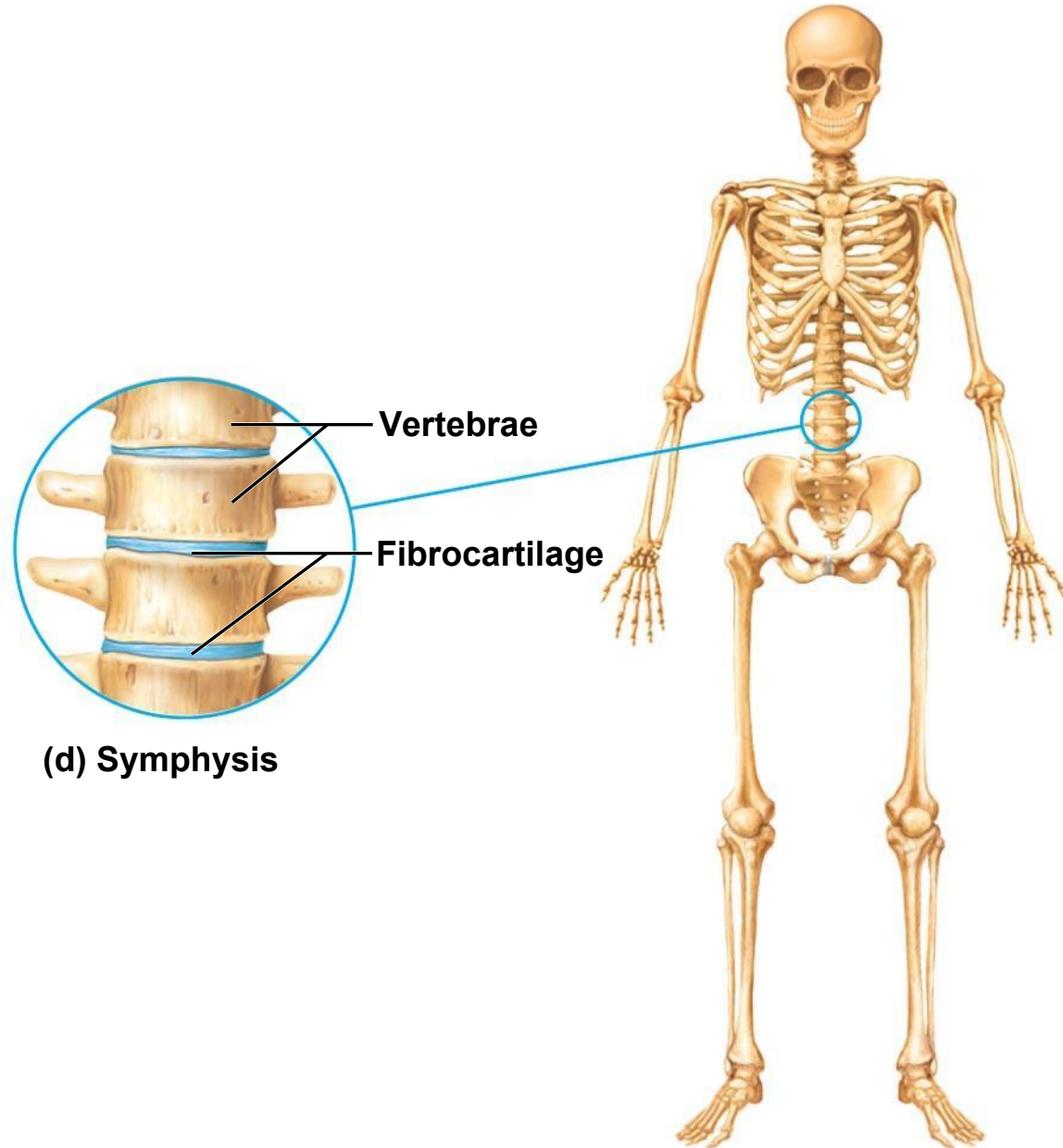
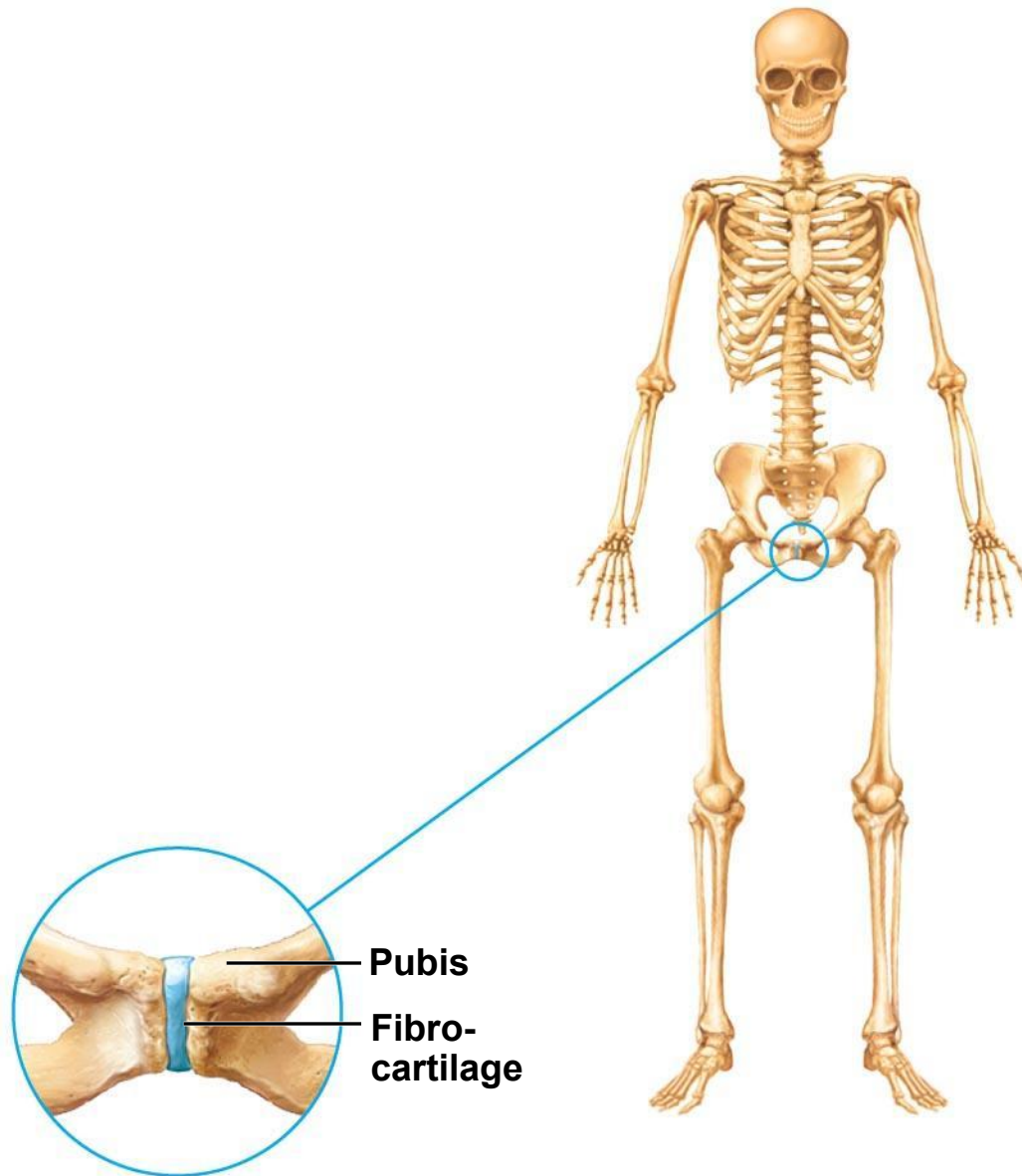


Figure 5.30d

Cartilaginous joints



(e) Symphysis

Synovial Joints

- Articulating bones are separated by a joint cavity
- Synovial fluid is found in the joint cavity
- Articular cartilage (hyaline cartilage) covers the ends of bones
- Articular capsule encloses joint surfaces and lined with synovial membrane
- Joint cavity is filled with synovial fluid
- Reinforcing ligaments
- **Example:** Humerus with the ulna and radius

Figure 5.27f–h

Synovial joints

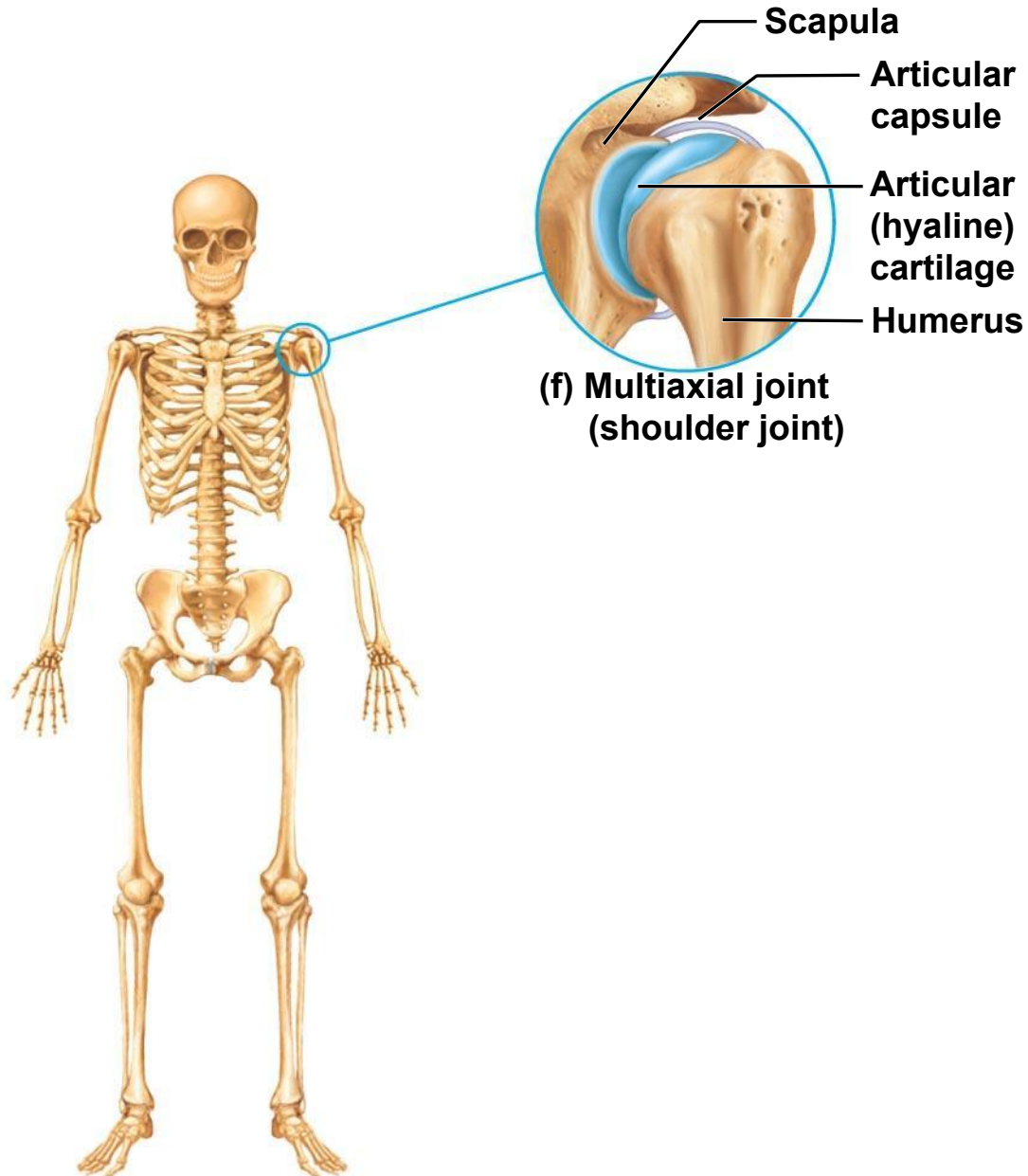


Figure 5.30f

Synovial joints

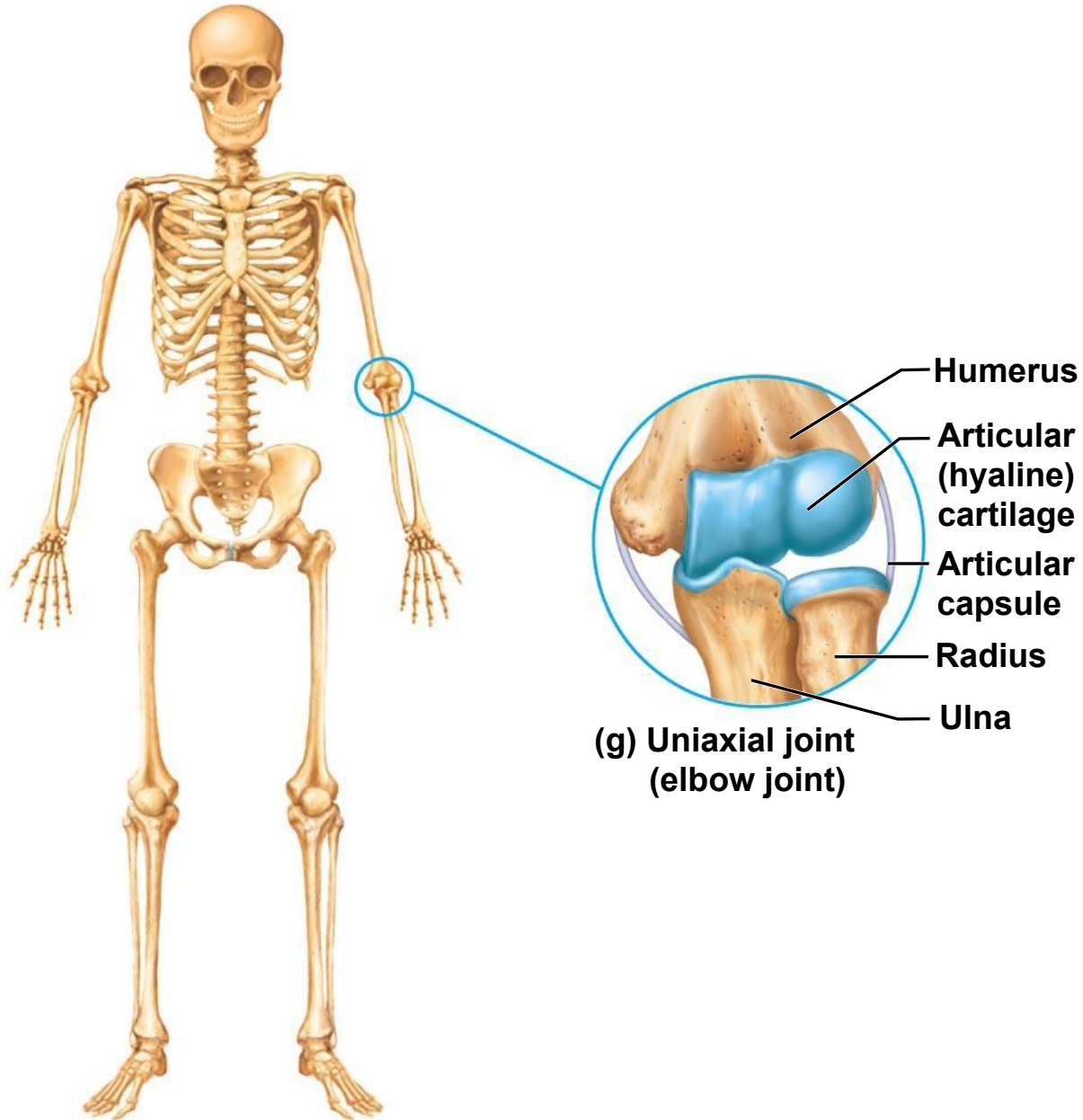
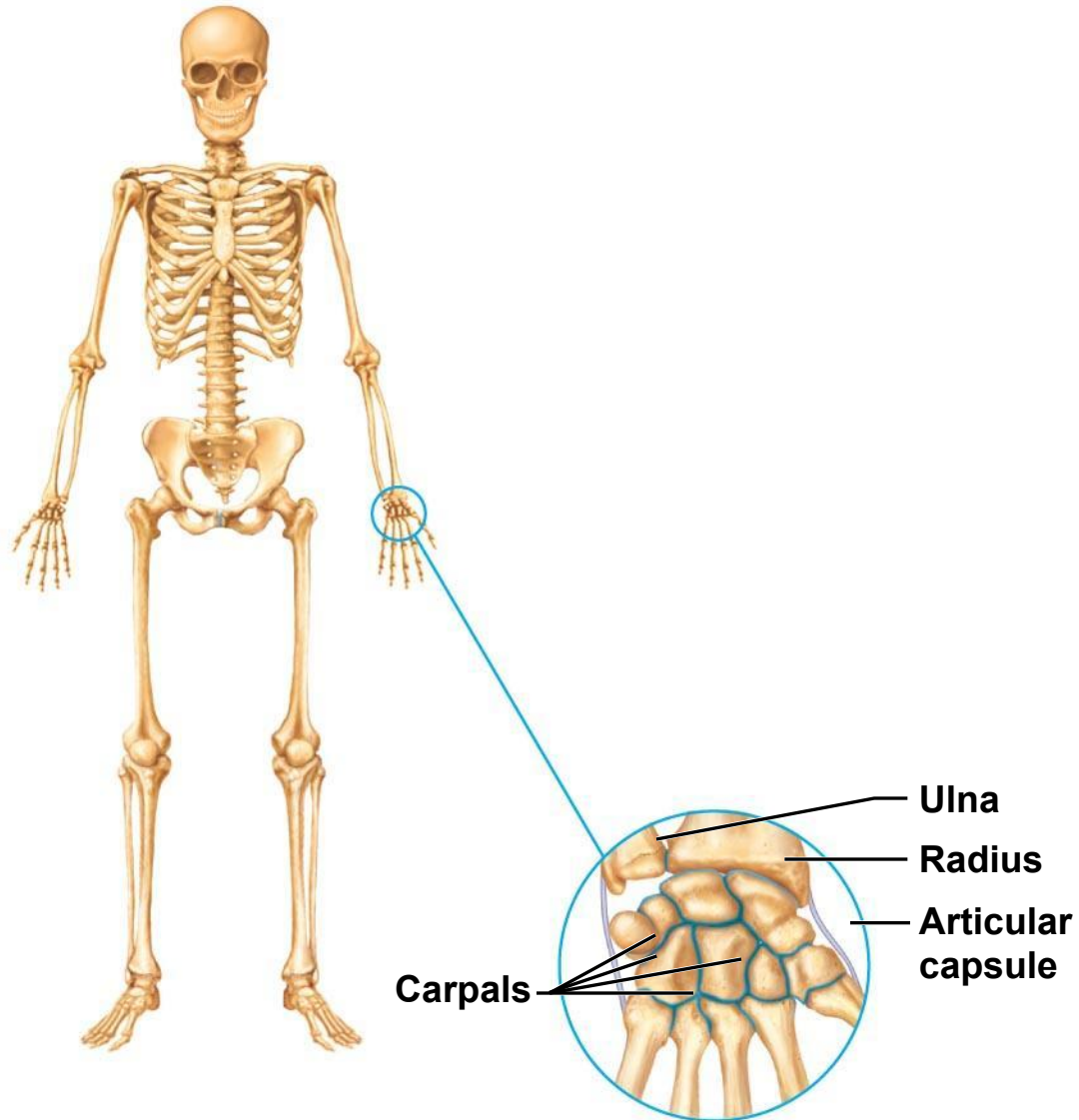


Figure 5.30g

Synovial joints



(h) Biaxial joint
(intercarpal joints of hand)

The Synovial Joint

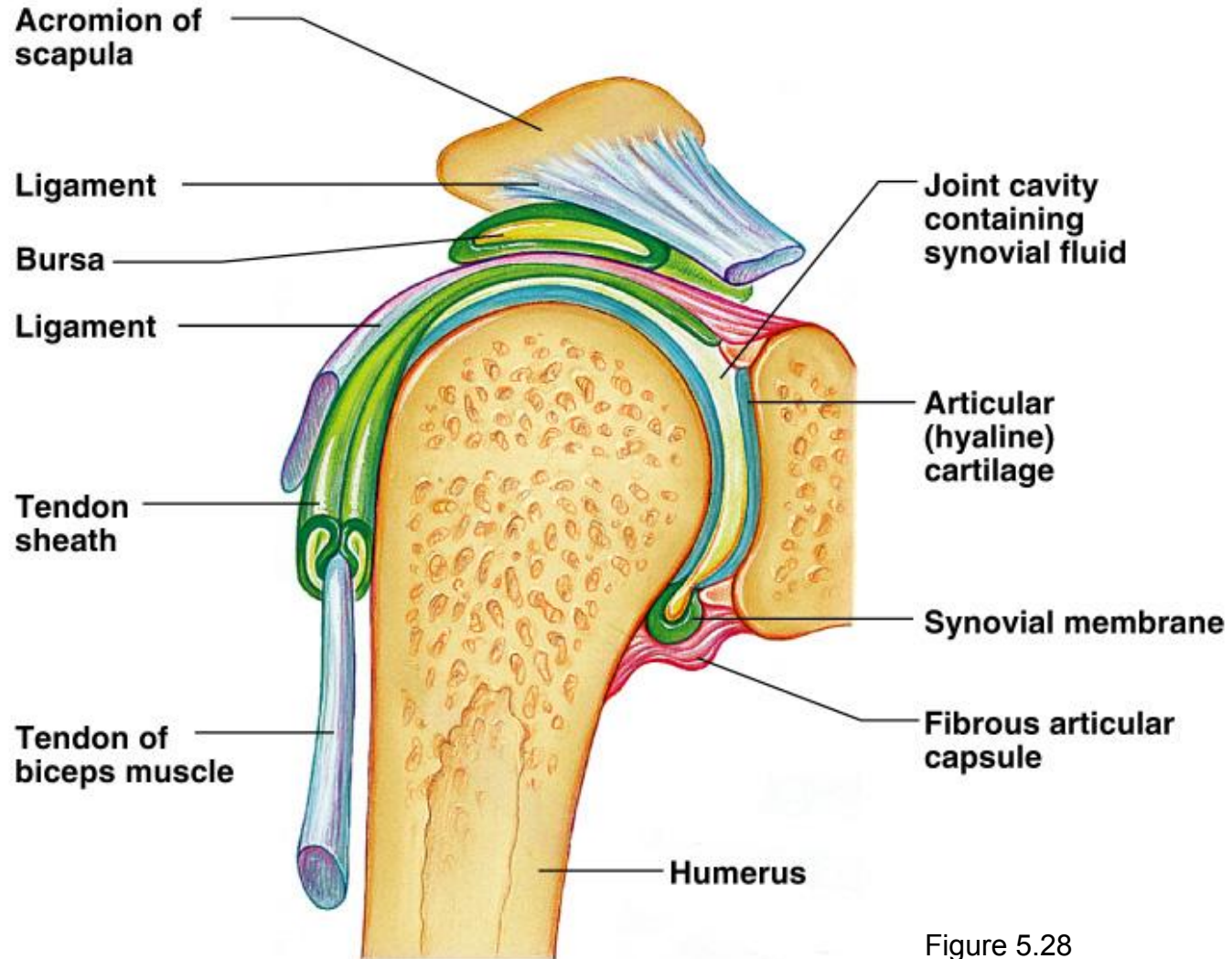


Figure 5.28

Types of Synovial Joints Based on Shape

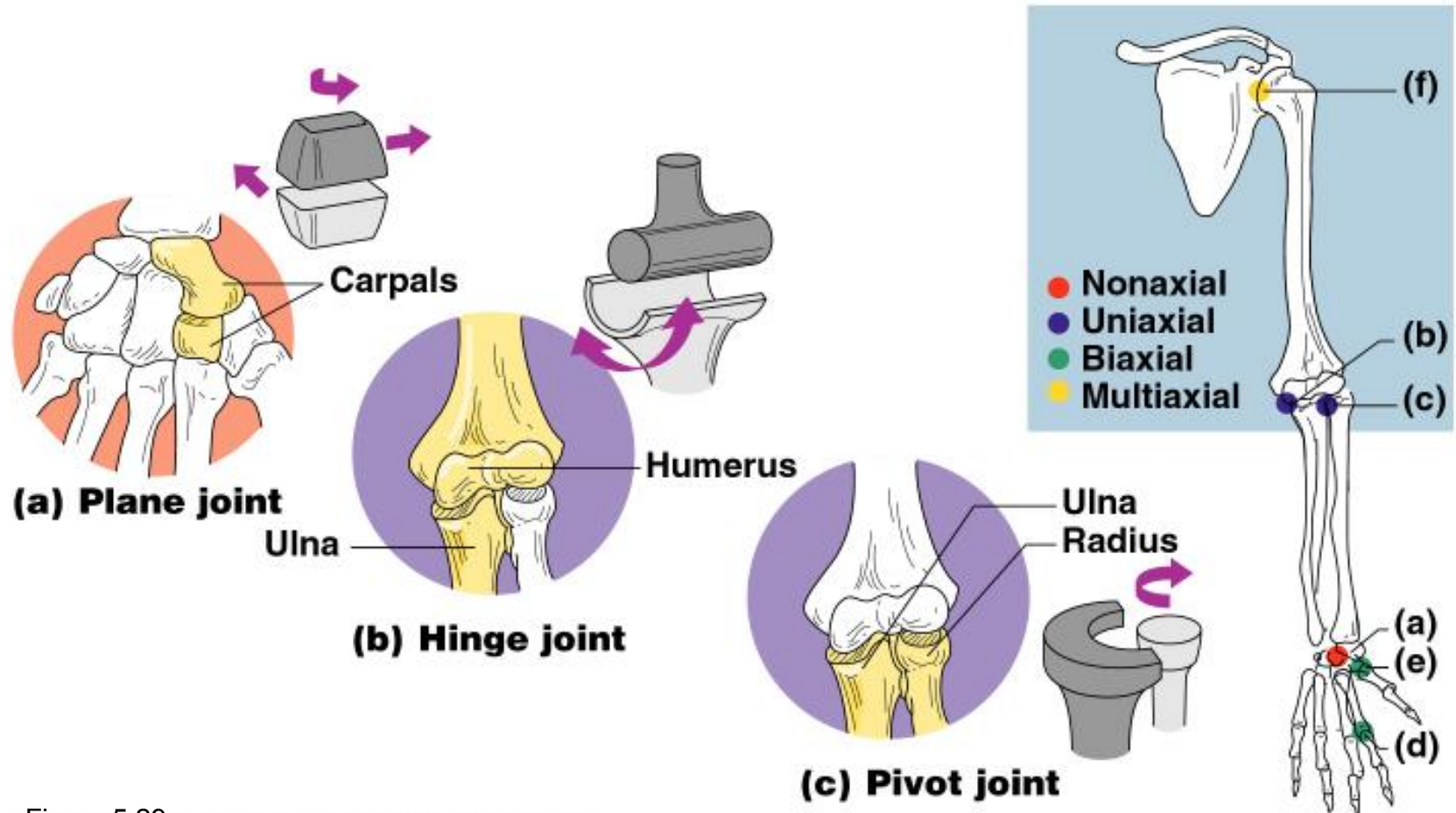


Figure 5.29a–c

Types of Synovial Joints Based on Shape

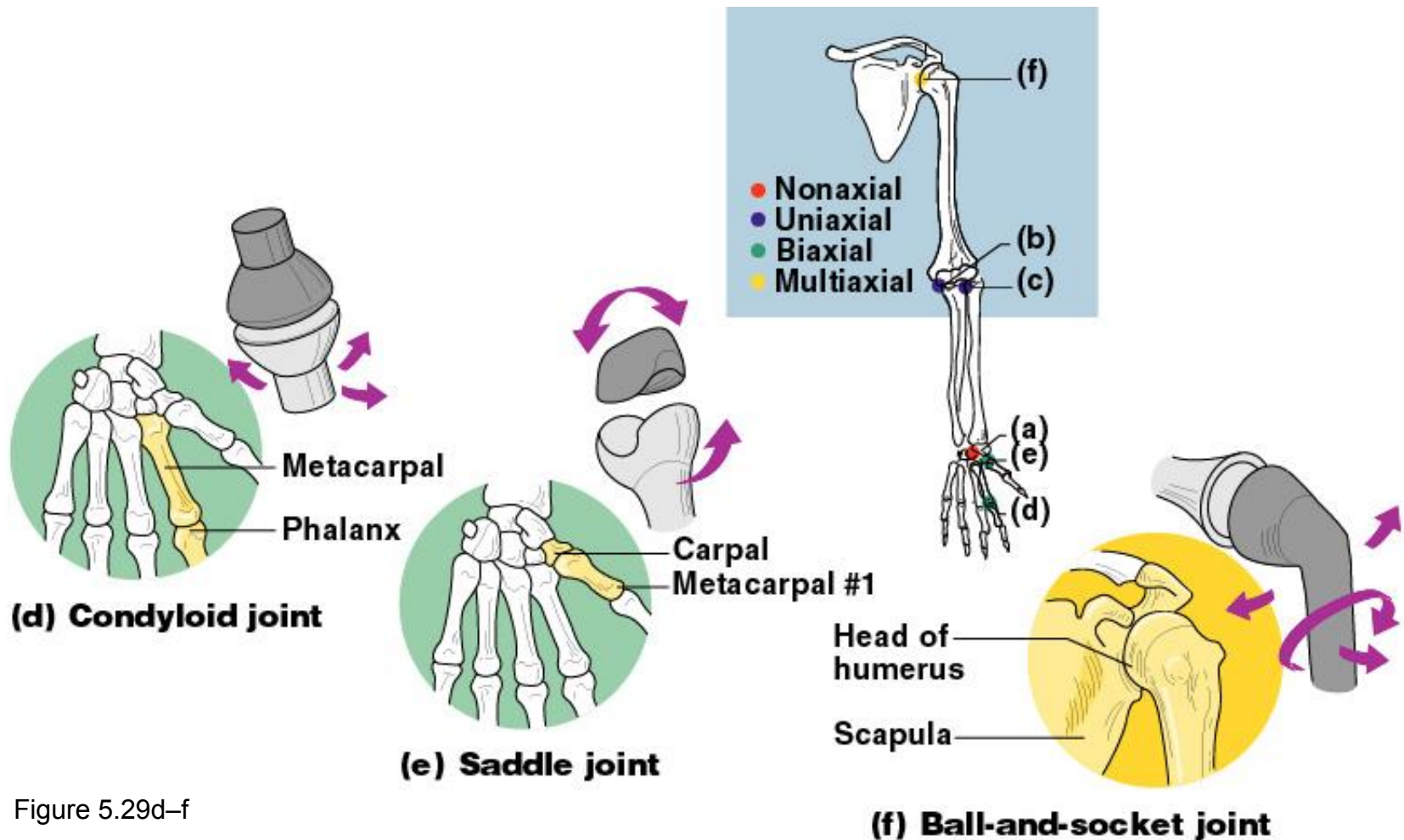


Figure 5.29d-f

