Cartilage and Bone

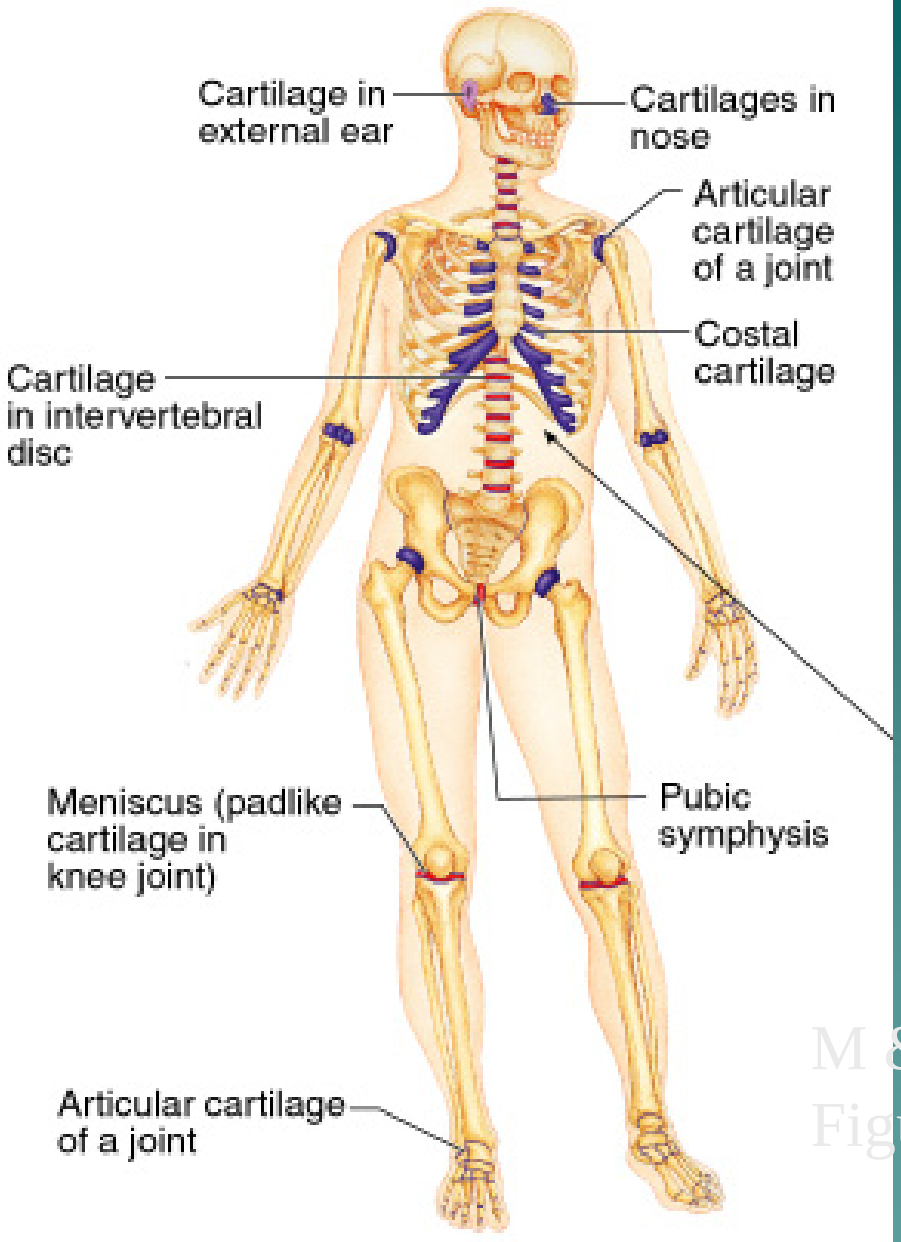
- Cartilage--function, types, location
- Bone Tissue--structure, types
- Long Bone Structure and Development
- Most common bone problems
  - Fractures
  - Osteoporosis

What is cartilage?

- Skeletal tissue--maintains certain shape and form
- Very resilient (bouncy or rubbery), mostly water
- Grows fast--forms embryonic skeleton

Kinds of cartilage

- Hyaline cartilage--most common, found in joints
- Elastic cartilage--epiglottis, ear
- Fibrocartilage--annular fibrosis of intervertebral disk, menisci of knee



M & M
Figure 6.1

Bones provide:

- Support and movement (limbs, axial skeleton)
- Protection (skull bones)
- Mineral storage
- Blood cell development (long bone marrow)

Bone is made up of:

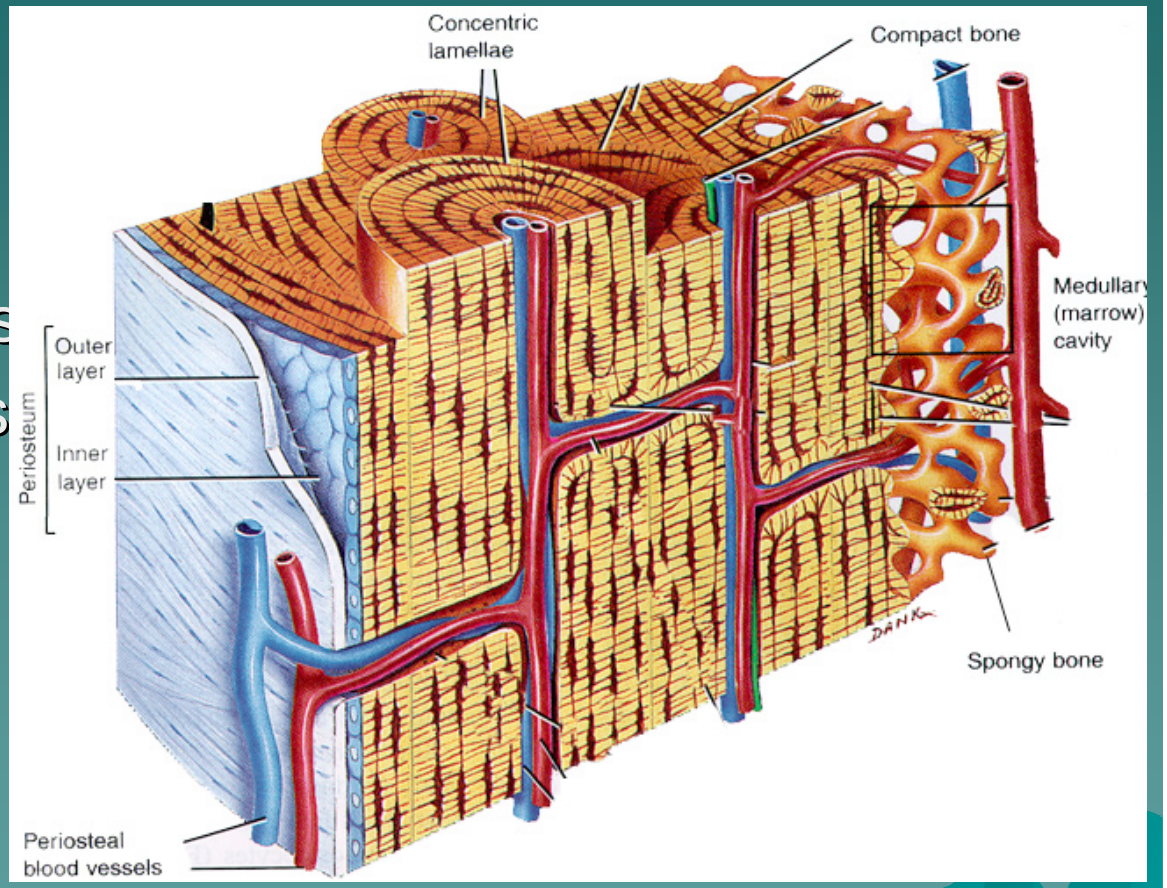
- 35% collagen, ground substance and cells
- 65% inorganic calcium (hydroxyapetite)

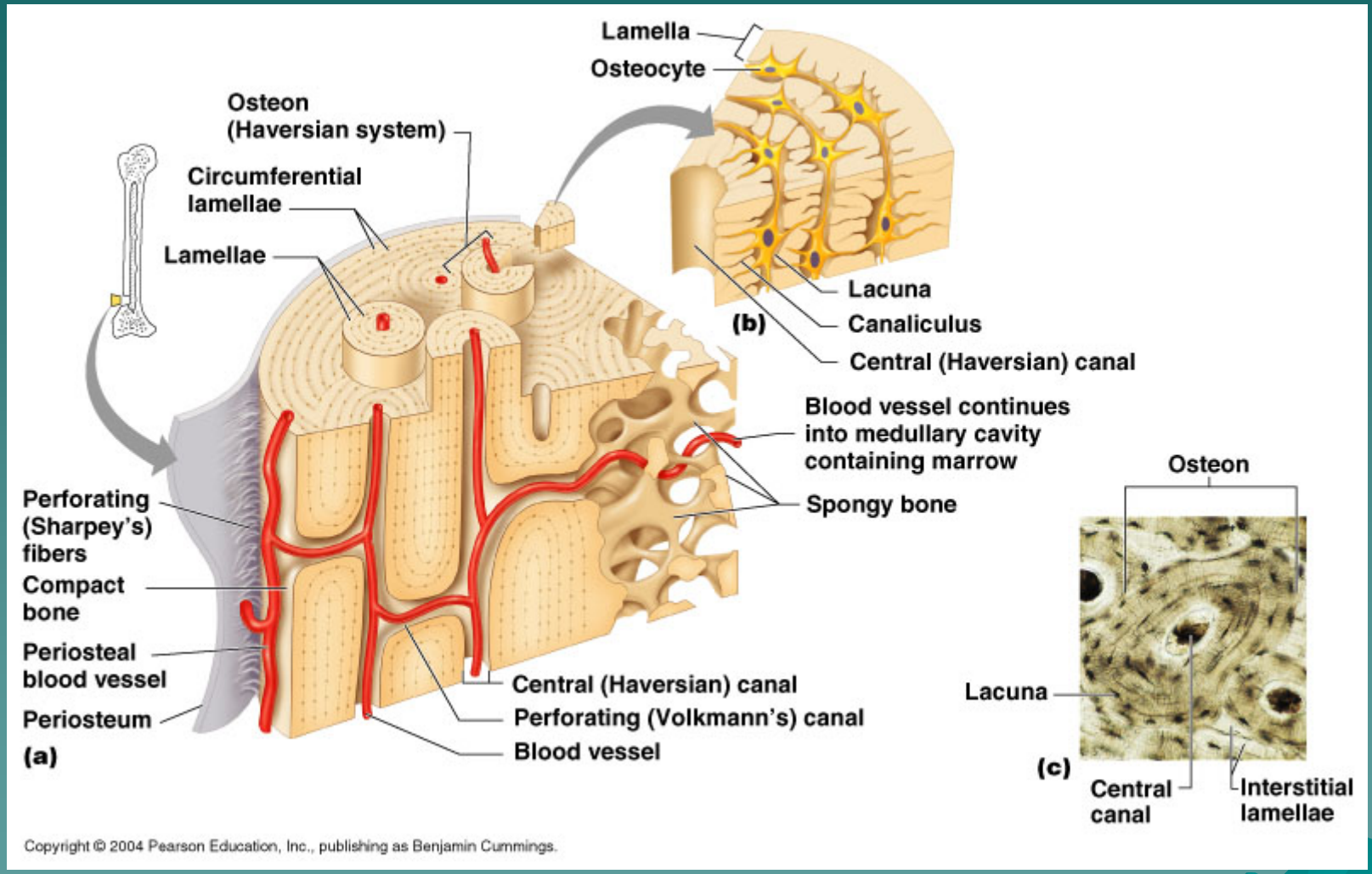
Bone is alive!! Bone cell types:

- Osteoblasts: Make and deposit components of bone extracellular matrix
- Osteoclasts: Degrade and resorb bone for remodeling
- Osteocytes: “watcher cells” Sit in bone and monitor its current status

Types of bony tissue

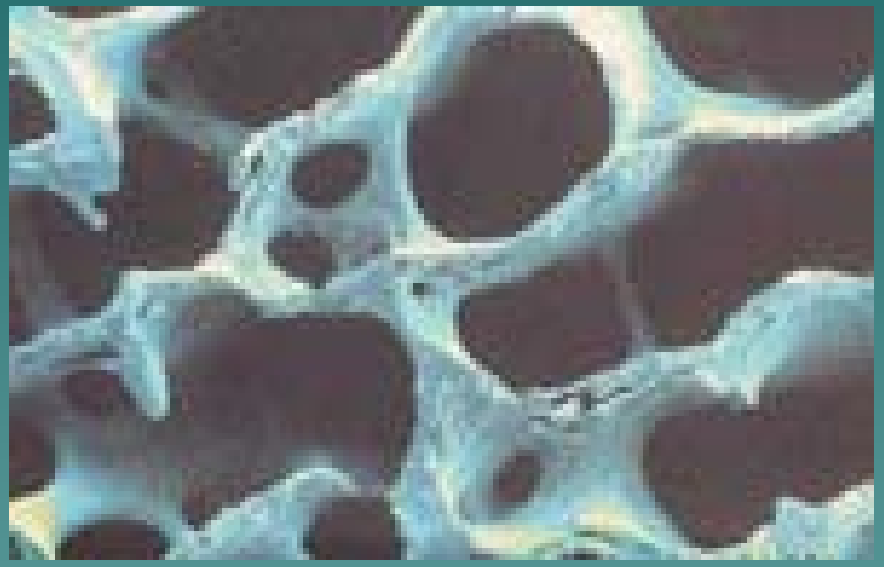
- Compact Bone
  - Dense tissue at surface of bones
  - Haversian canals
  - Osteocytes in lacunae
  - Highly vascularized
  - Fig. 6.6, p. 138





Types of bony tissue

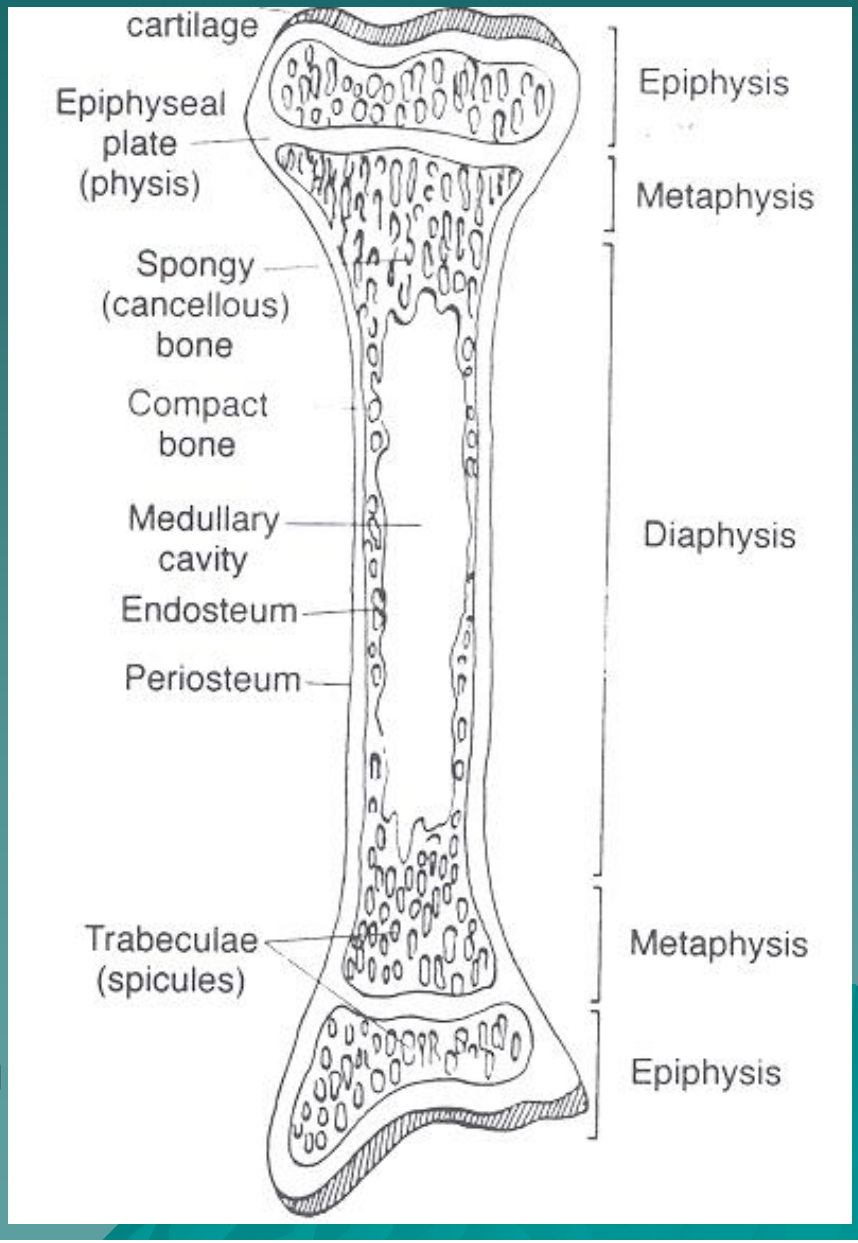
- Spongy bone
  - Trabeculae (oriented to give mechanical strength)
  - Interior of long bones, skull bones
  - Epiphyses of long bones
  - Intramembranous ossification (osteoblasts lay down bone around blood vessels in connective tissues of dermis (after 8 weeks of development)

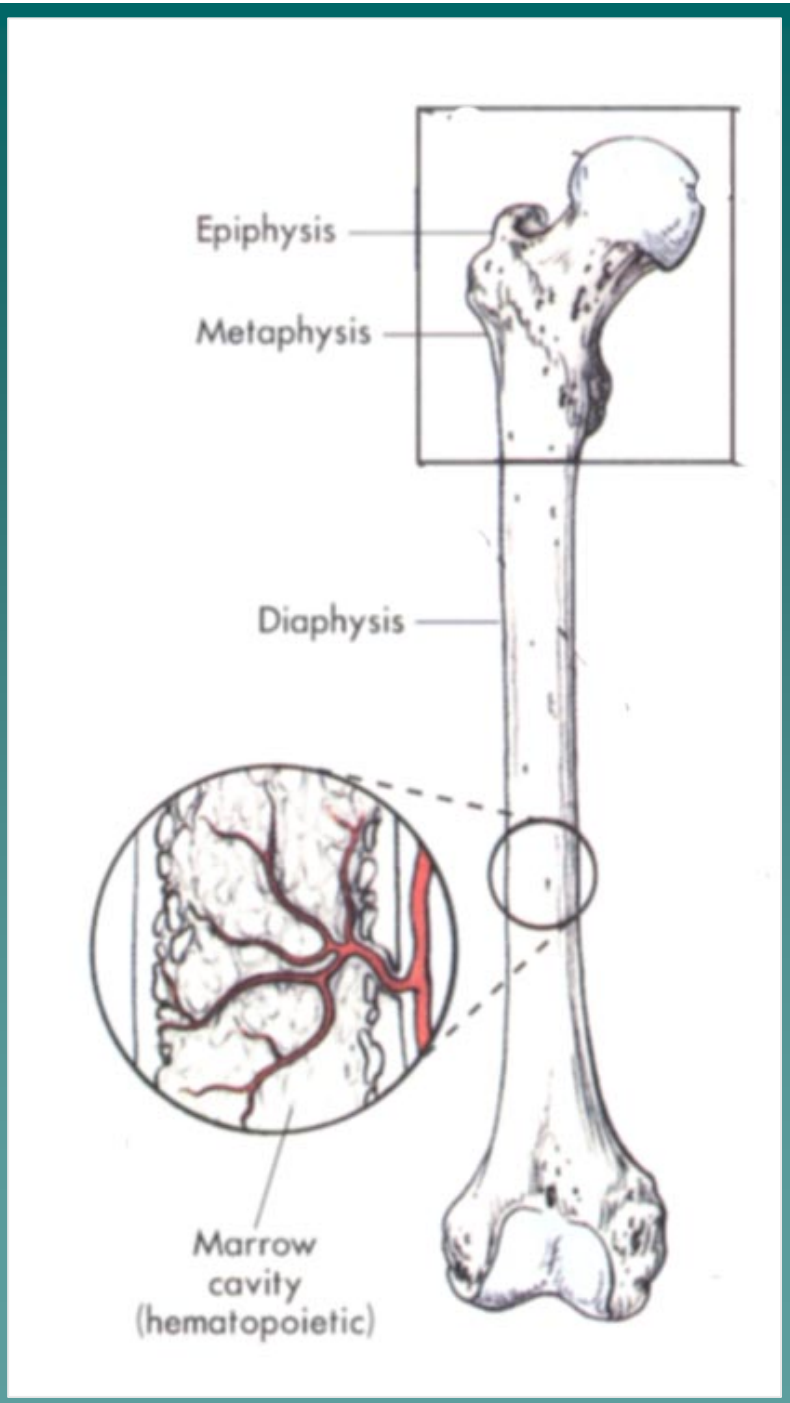


Structure of a long bone

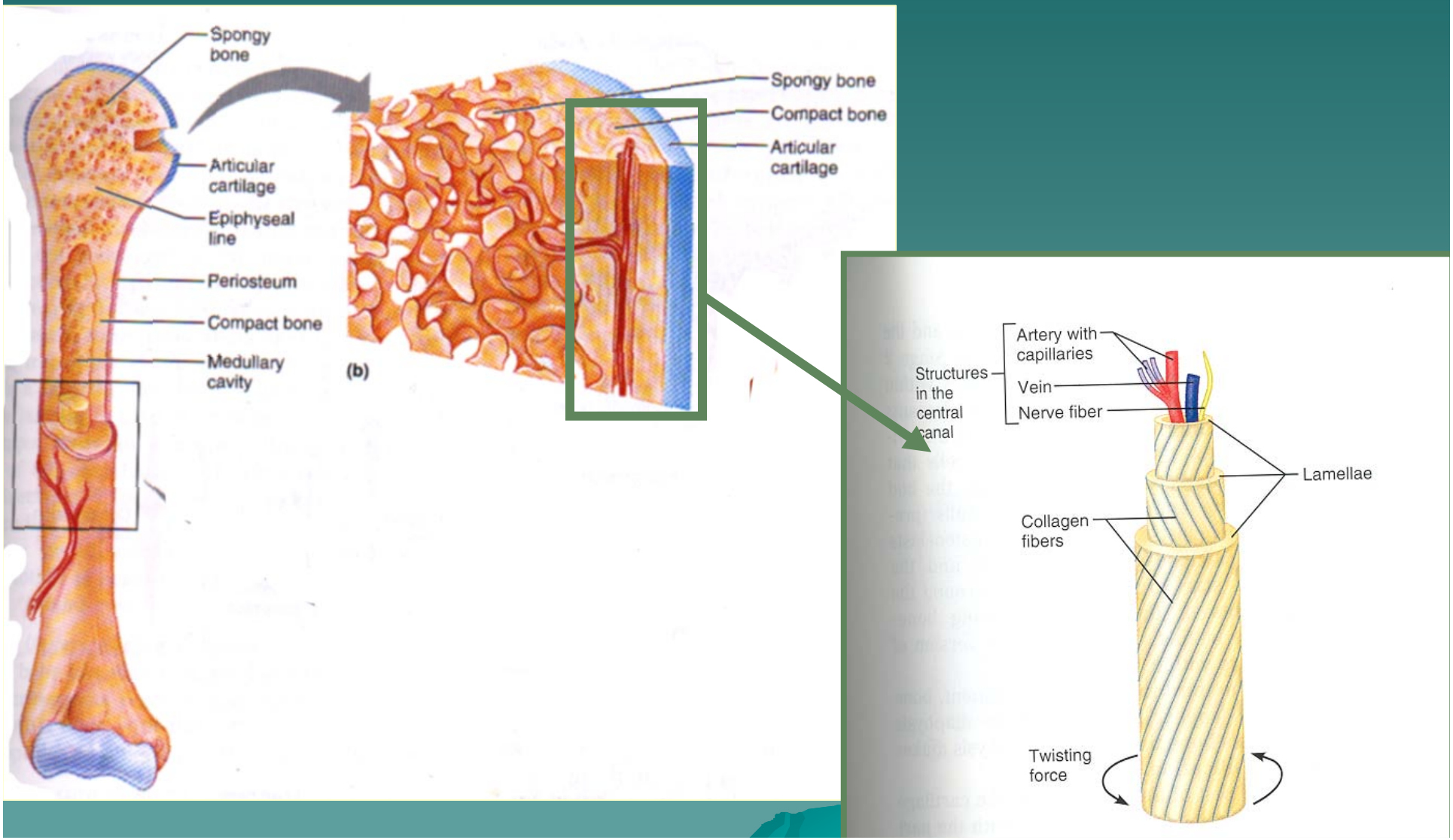
Fig. 6.3, p. 135

- Diaphysis (shaft)
- Epiphysis
  - Proximal
  - Distal
- Compact bone
- Spongy bone
- Periosteum
- Medullary cavity
- Articular/hyaline cartilage
- Nutrient V/A/N
- Epyphyseal (growth plates

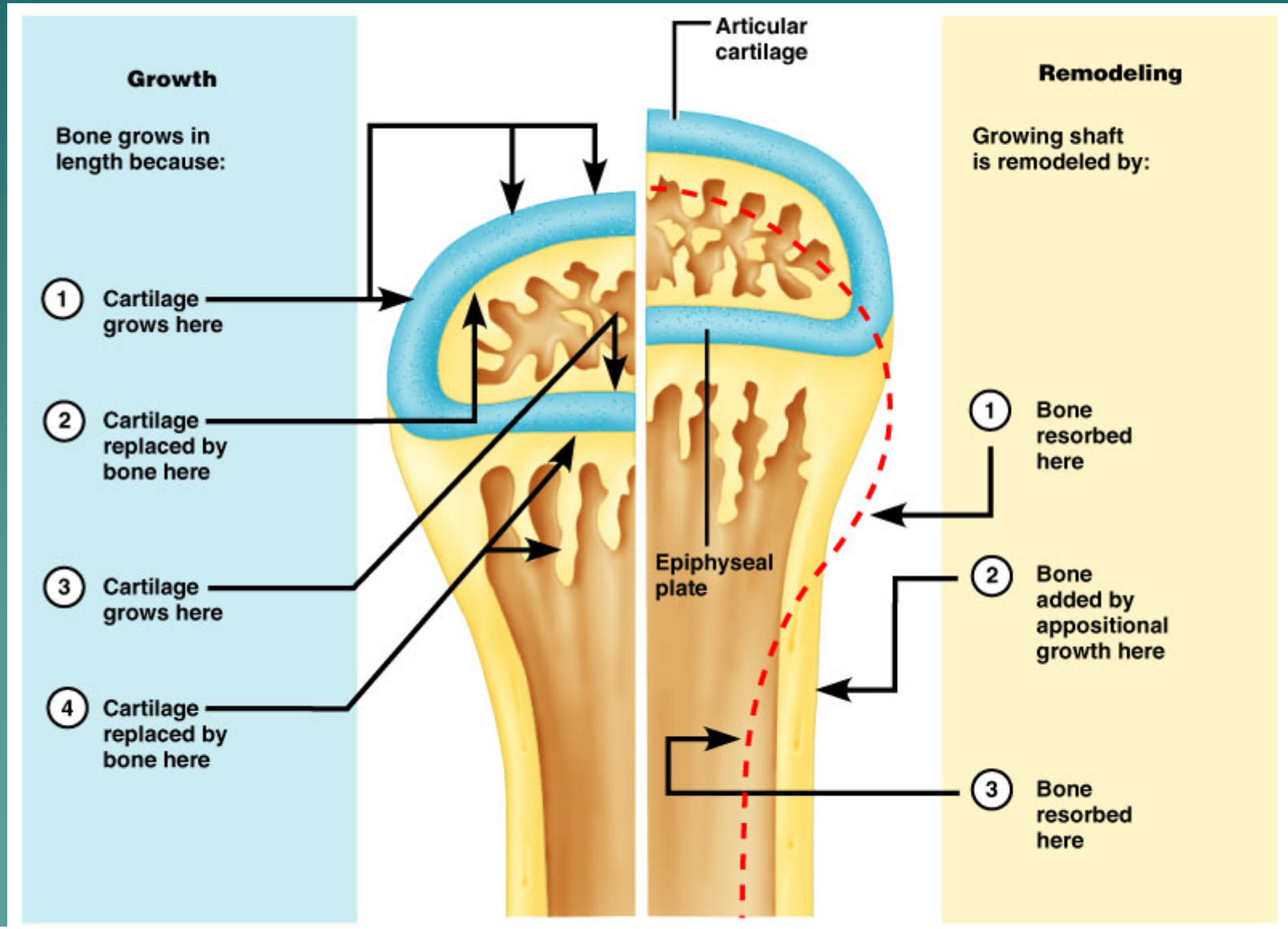



Epiphysis
Metaphysis
Diaphysis
Marrow
cavity
(hematopoietic)

Bone Tissue within a Bone



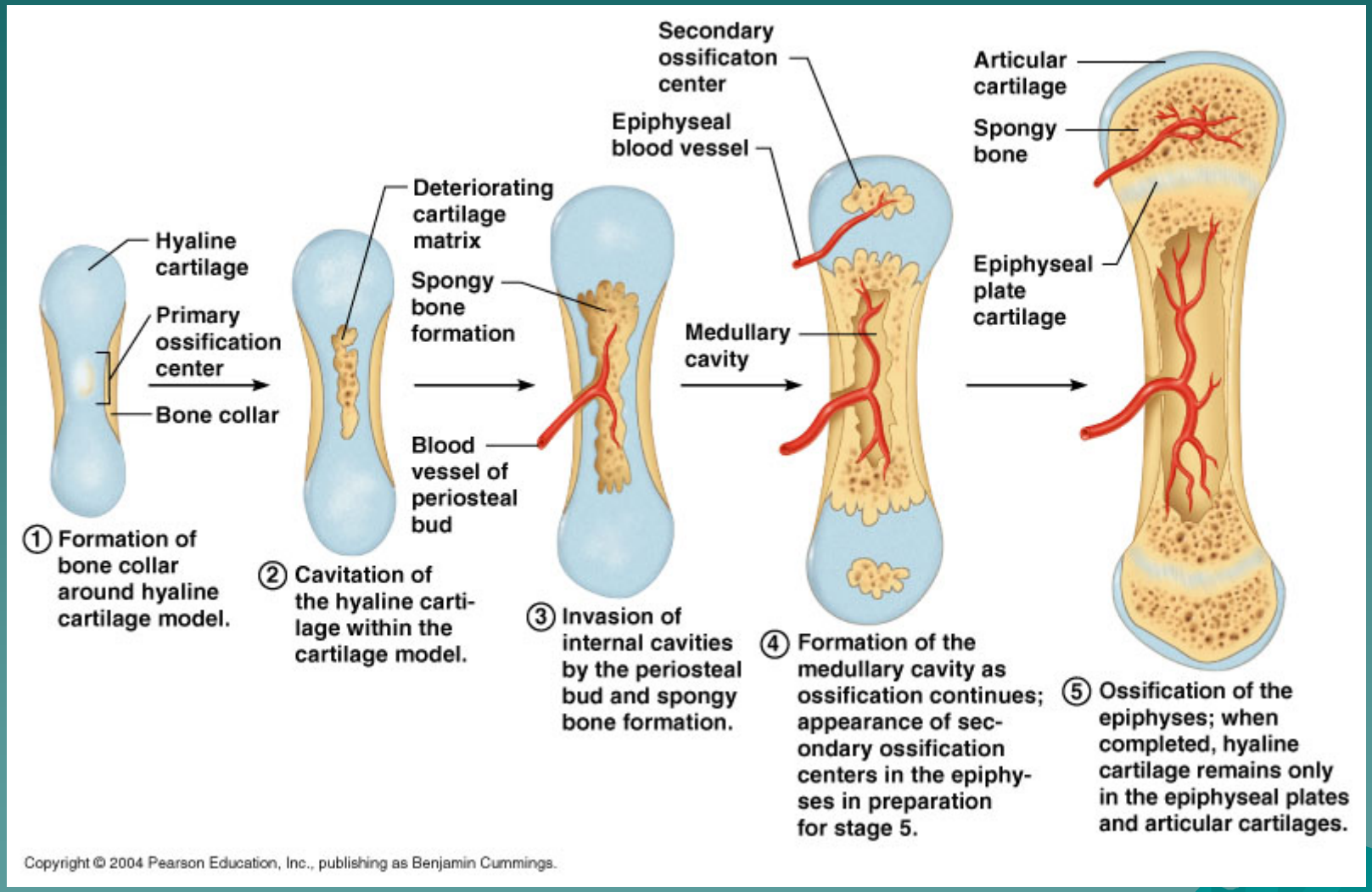
Why do bones need to “remodel?”

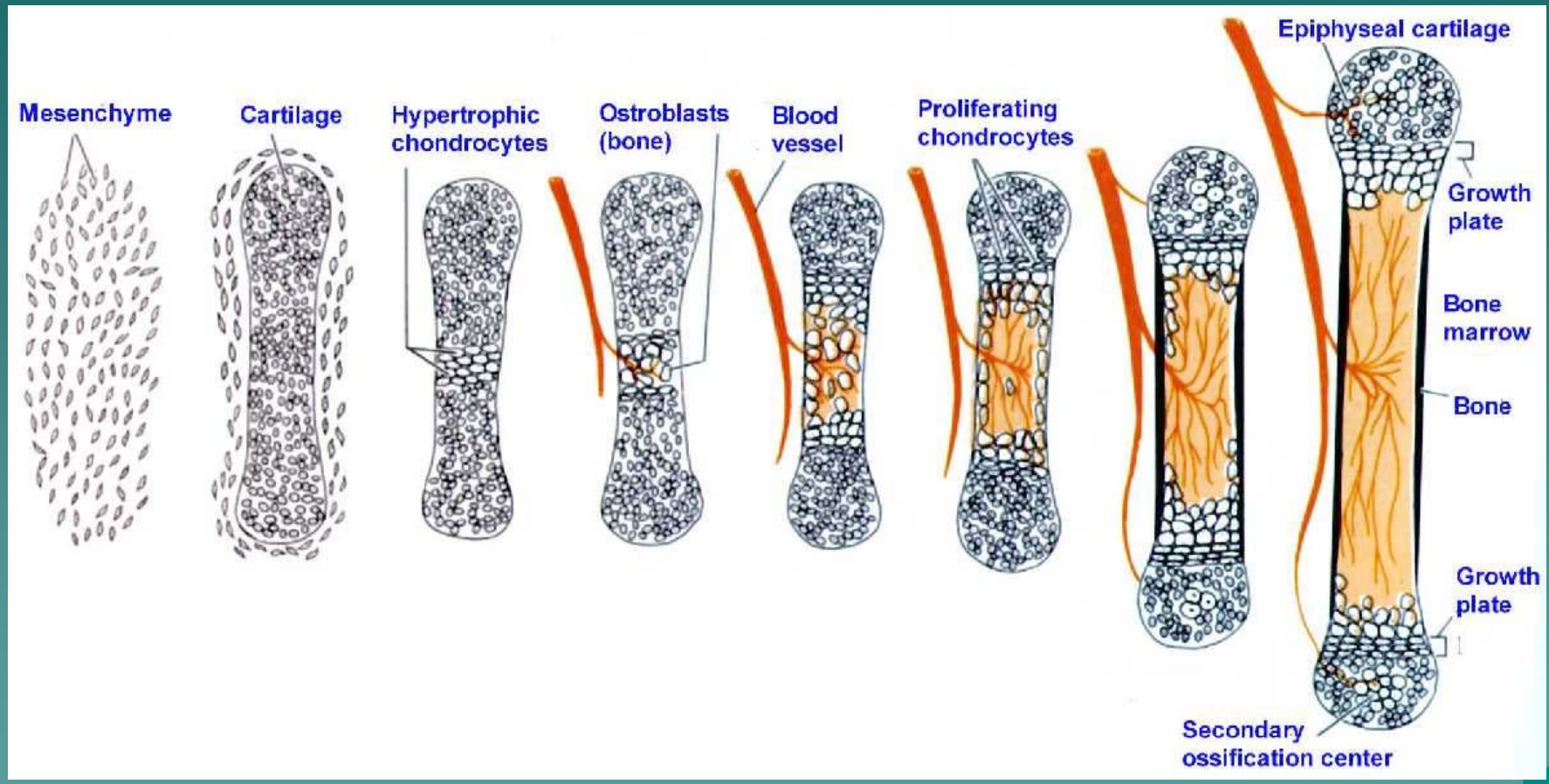


Endochondral Ossification

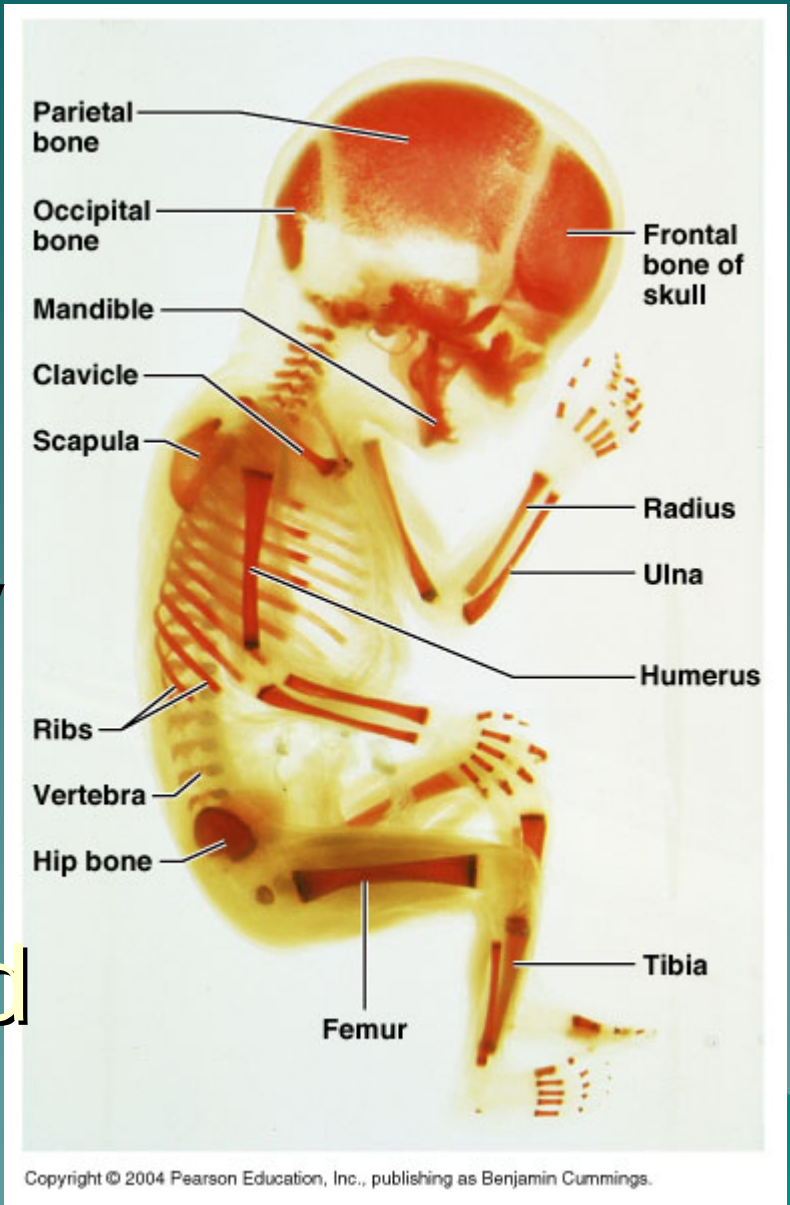
Fig. 6.9, p. 141

1. Cartilage model
2. Bone collar forms in diaphysis (dense bone)
   - Cartilage chondrocytes in center of diaphysis die and cartilage disintegrates
3. Periosteal bud enters diaphysis
   - Makes spongy bone at ends of diaphysis (primary ossification center)
4. Epiphysis begins to ossify (secondary ossification center)
5. Hyaline cartilage remains only at
   - Epiphyseal surfaces (articular surfaces of joints)
   - Epiphyseal growth plates between




Mesenchyme
Cartilage
Hypertrophic chondrocytes
Ostroblasts (bone)
Blood vessel
Proliferating chondrocytes
Epiphyseal cartilage
Growth plate
Bone marrow
Bone
Growth plate
Secondary ossification center

Endochondral ossification centers—newly formed bone within cartilage shown is stained red



Osteoclasts

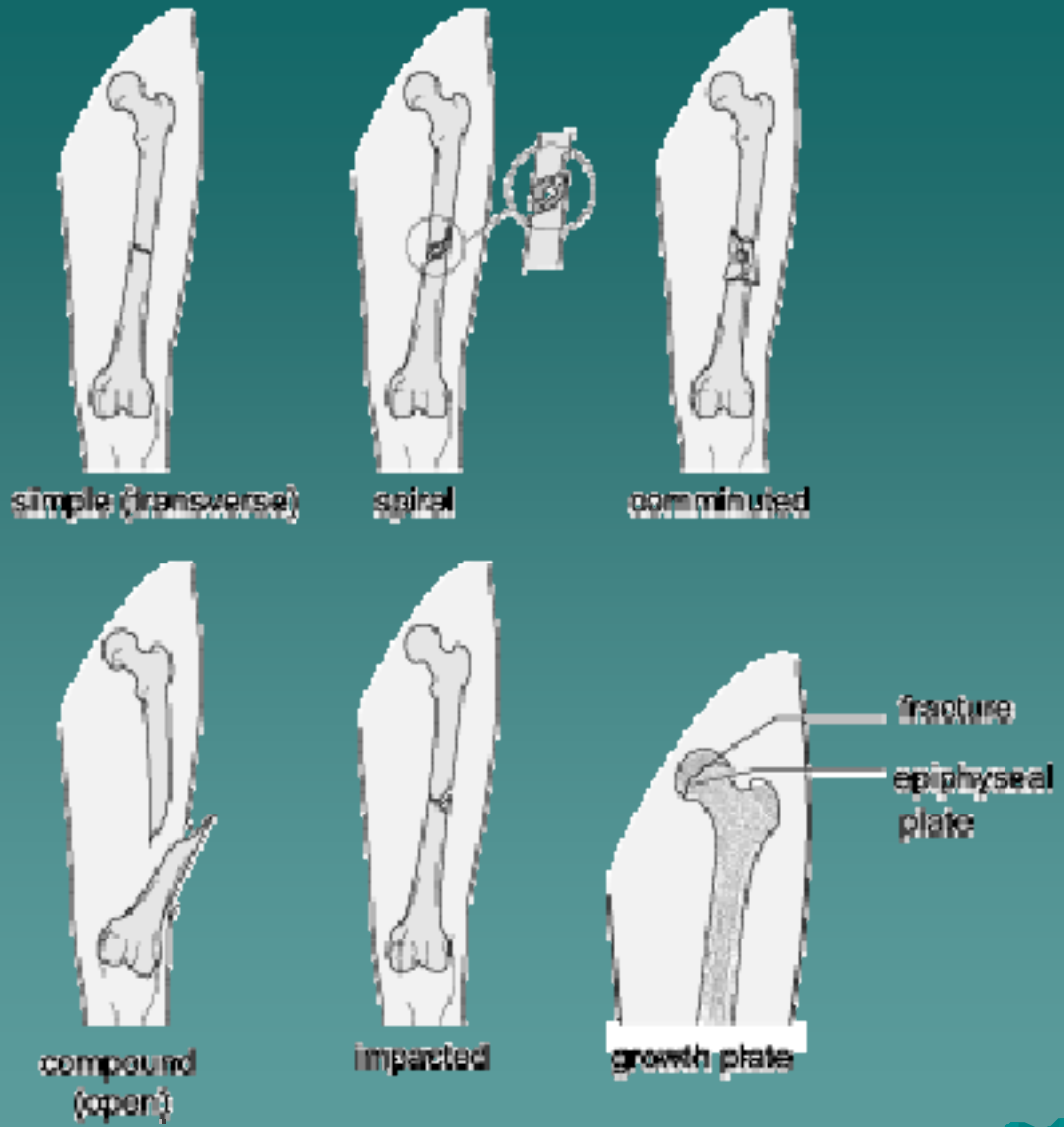
- “Dig holes” with hydrochloric acid
- Degrades calcium
- Phagocytize collagen fibers and dead osteocytes

Osteoblasts

- Line tubes (Haversian canals) left by osteoclasts
- Lay down new bone in circular concentric lamellae
- Unique to warm-blooded animals--dinosaurs???

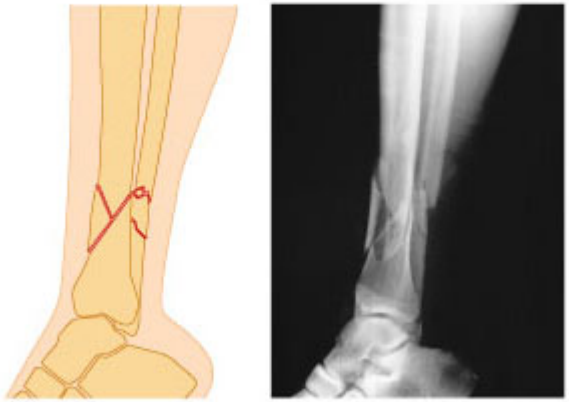
Bone Fractures

- Treatment is reduction
  - Closed--set in place by physical manipulation from outside body
  - Open--surgical placement of pins or screws
- Healing
  - Hematoma
  - Fibrocartilaginous callus
  - Bony calllus
  - Remodeling by osteoclasts/osteoblasts
- Types of Fractures


simple (transverse)
spiral
comminuted
compound (open)
impacted
fracture
epiphyseal plate
growth plate

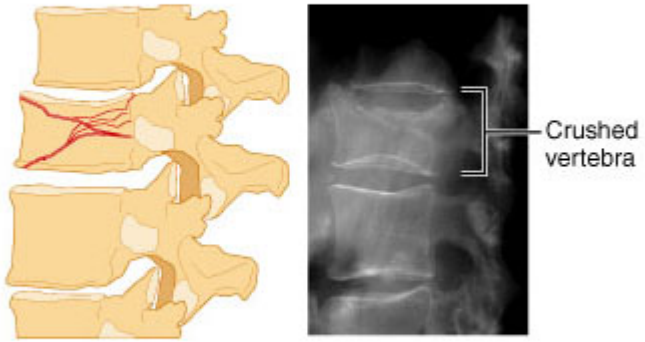
Comminuted — Bone fragments into three or more pieces

Particularly common in the aged, whose bones are more brittle



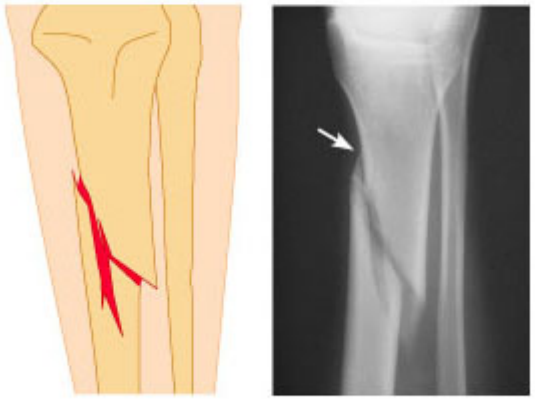
Compression — Bone is crushed

Common in porous bones (i.e., osteoporotic bones) subjected to extreme trauma, as in a fall



Spiral — Ragged break occurs when excessive twisting forces are applied to a bone

Common sports fracture



Epiphyseal — Epiphysis separates from the diaphysis along the epiphyseal plate

Tends to occur where cartilage cells are dying and calcification of the matrix is occurring

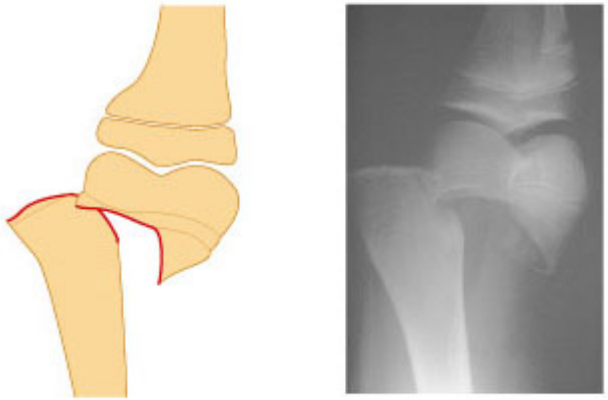
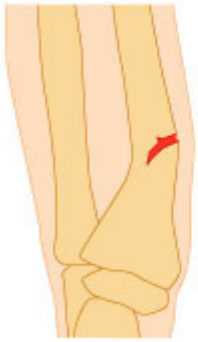
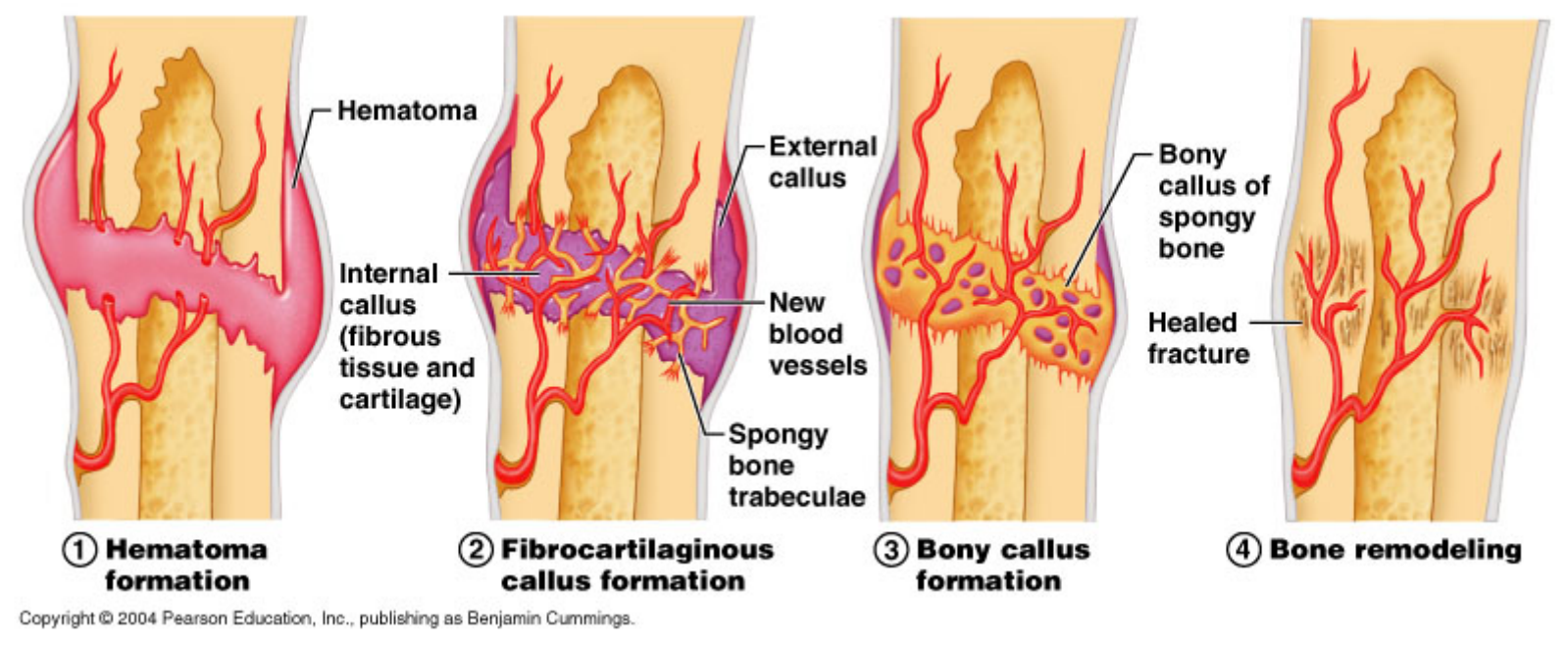


TABLE 6.2 Common Types of Fractures *(continued)*

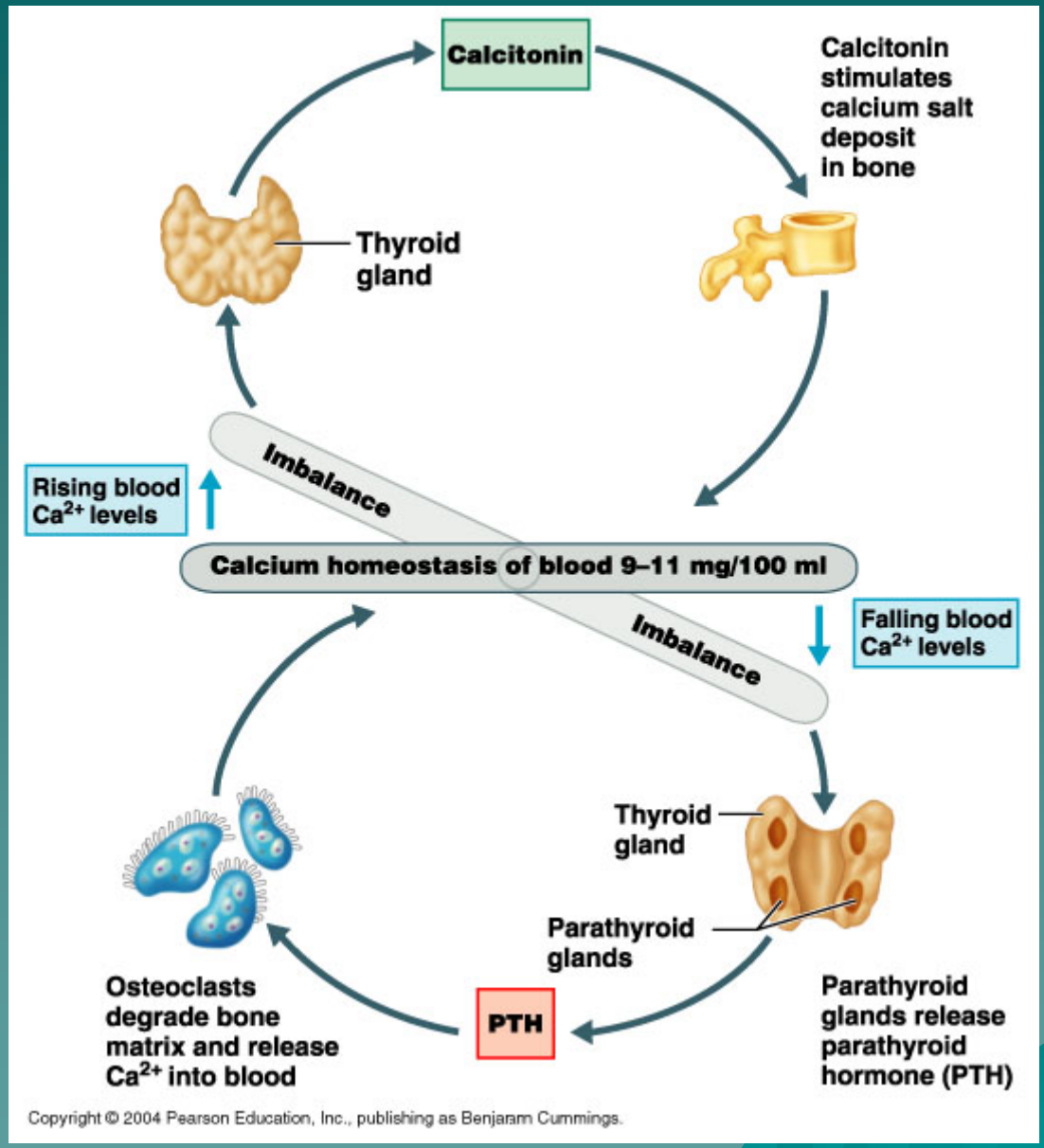
Fracture Type	*Description and Comments*	*Fracture Type*	*Description and Comments*
Depressed	Broken bone portion is pressed inward Typical of skull fracture	Greenstick	Bone breaks incompletely, much in the way a green twig breaks. Only one side of the shaft breaks; the other side bends Common in children, whose bones have relatively more organic matrix and are more flexible than those of adults

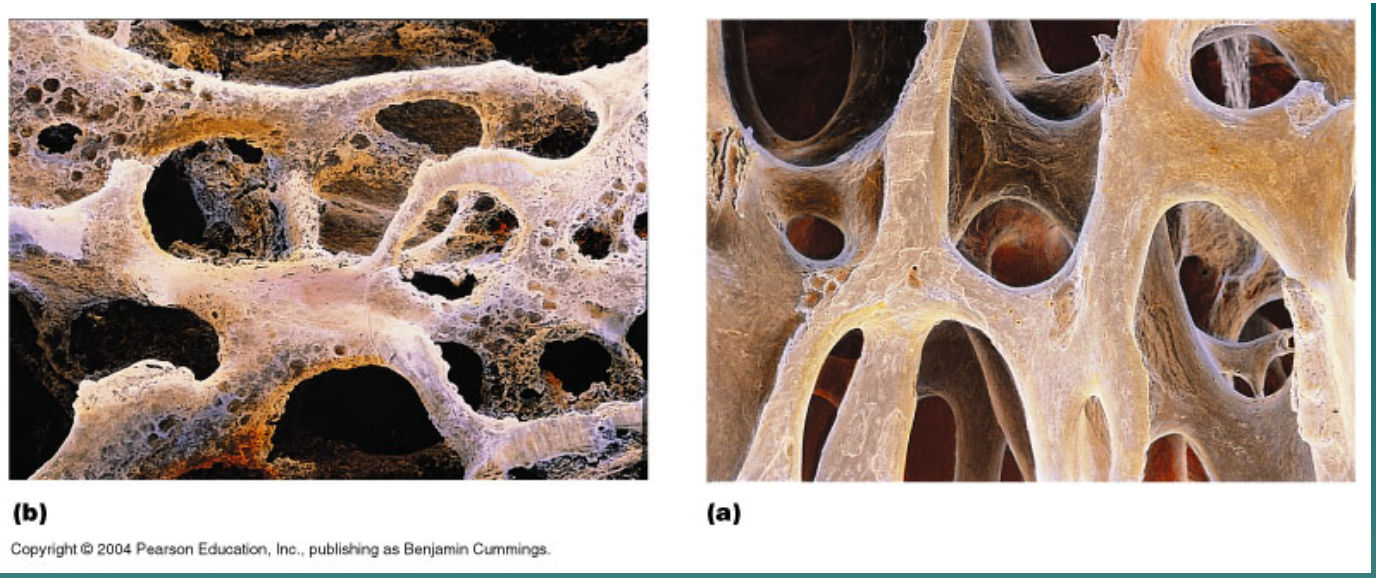


Fracture repair



Calcium regulation is negative feedback mechanism





- Affects elderly, especially women
- Bone resorption proceeds faster than deposition
- Low estrogen levels implicated but estrogen replacement now considered risky
- Importance of calcium in diet???
- Leads to fractures
  - Compression fractures of vertebrae
  - Neck of femur

Bone grafts and artificial bone

- Widely used cutting-edge technologies
- Bone cells highly regenerative and move into any suitable matrix
  - Use bone pieces from same body—fibula
  - Use crushed bone from cadavers
  - Use bone substitutes—coral, synthetics—”nanotechnology”
- Applications are numerous
  - Jaw bone filler for dental work
  - Birth defects
  - Osteoporosis
  - Bone repair