

The Skeletal System



Skeletal System: Made of Connective Tissue

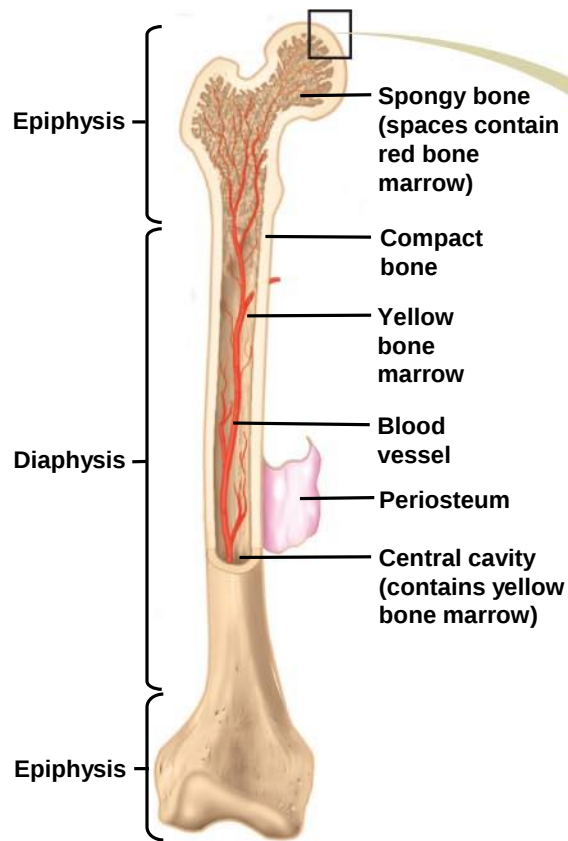
- Three types of connective tissue
 - Bone (Osseous tissue)
 - Ligaments
 - Cartilage

Bones – Functions

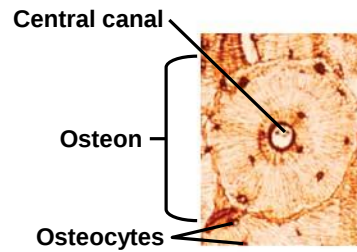
- Bones
 - hard elements of the skeleton
- Five important functions
 - 1.Support
 - 2.Protection
 - 3.Movement
 - 4.Blood cell formation
 - 5.Mineral storage
 - Calcium
 - Phosphate

Bone – Structure

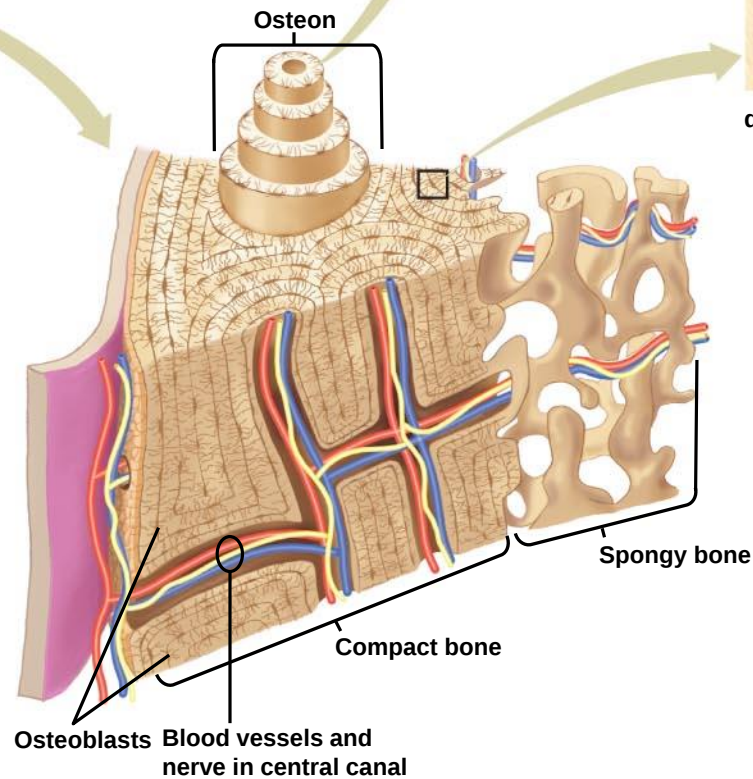
- **Bone:** hard inorganic matrix of calcium salts
 - **Compact:** forms shaft and ends, contains marrow space
 - **Spongy:** trabeculae
 - **Cells:** osteoblast, osteocytes, osteoclasts
 - **Types:** long, flat, irregular
- **Osteons/haversian system**
 - cellular arrangement
- **Periosteum**
 - connective tissue covering



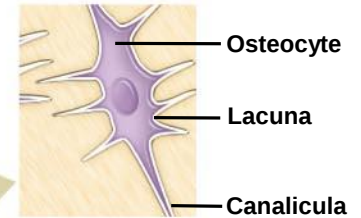
a) A partial cut through a long bone.



c) A photograph of an osteon of compact bone showing osteocytes embedded within the solid structure.



b) A closer view of a section of bone. Compact bone is a nearly solid structure with central canals for the blood vessels and nerves.



d) A single osteocyte in a lacuna. Osteocytes remain in contact with each other by cytoplasmic extensions into the canaliculi between cells.

Cartilage and Ligaments

- **Cartilage**

- Function

- support

- Types

- Fibrocartilage
 - Hyaline
 - Elastic cartilage

- **Ligaments**

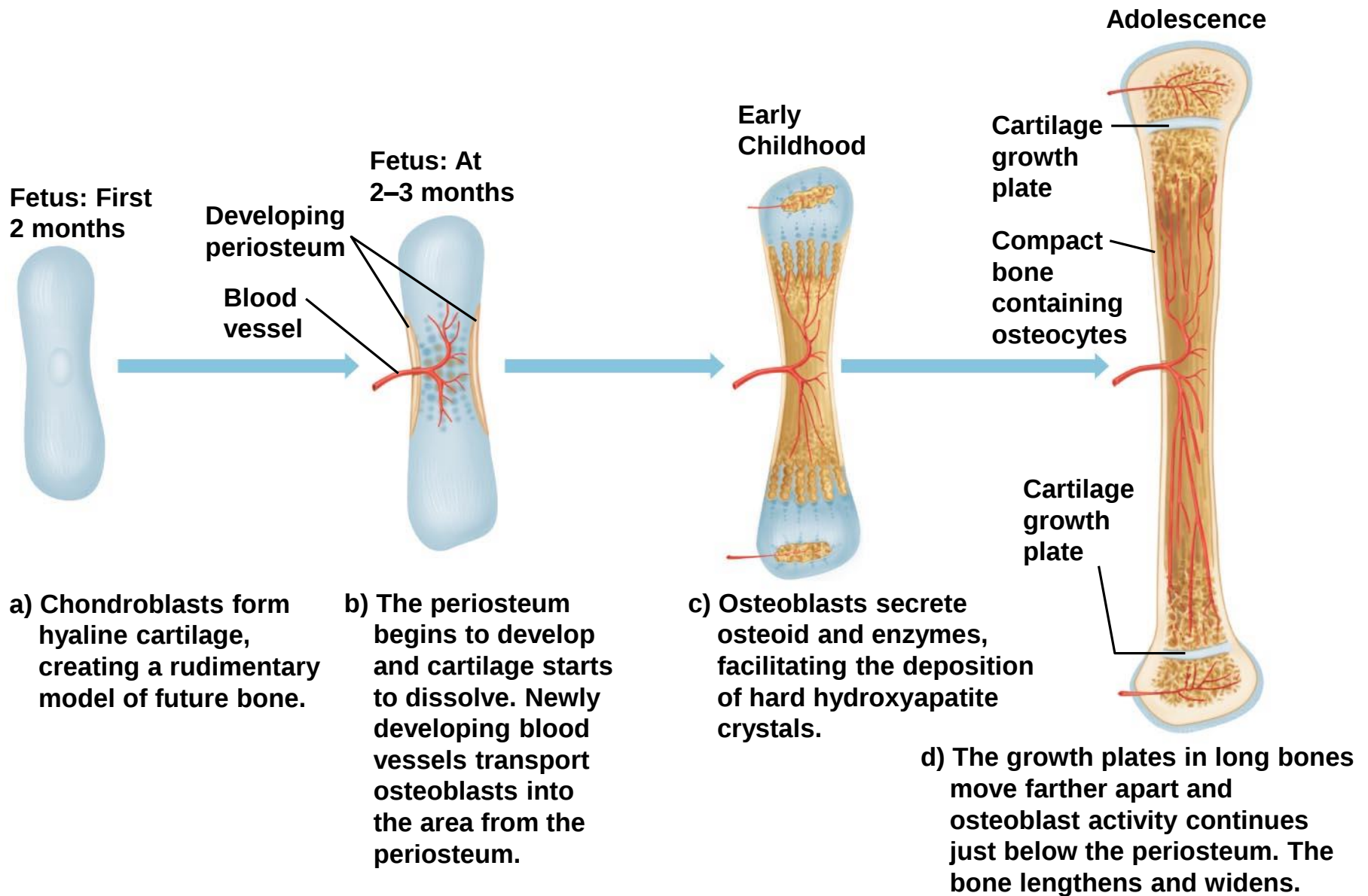
- Function

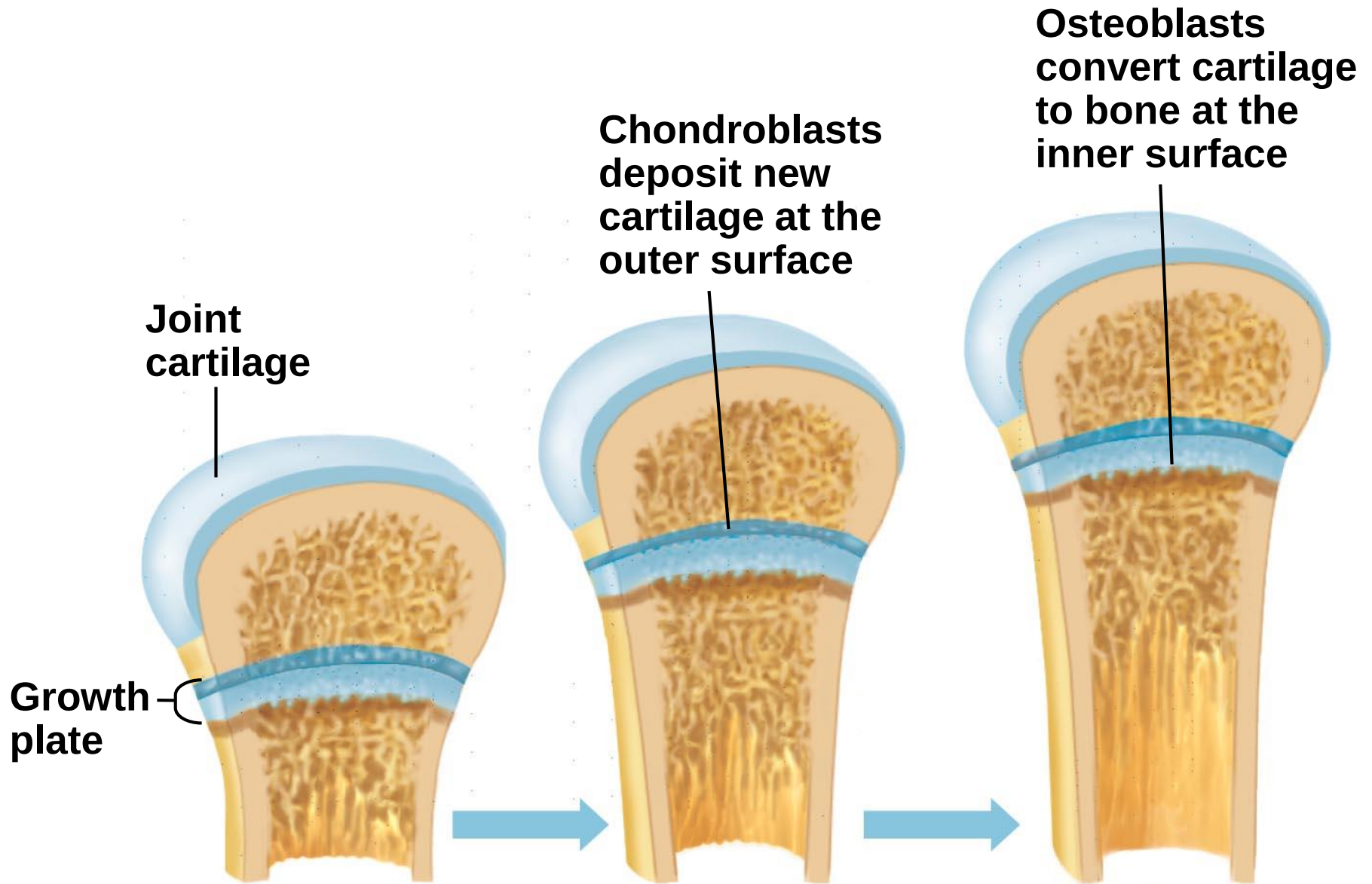
- attach bone to bone

- Dense fibrous connective tissue

Bone Development

- Early fetal development
 - Formed by chondroblasts (cartilage-forming cells)
- Later fetal development
 - osteoblasts replace cartilage with bone
- Childhood
 - primary and secondary ossification sites formed
- Adolescence
 - elongation at growth plates





Hormonal Control of Bone Growth

- Preadolescence
 - Growth hormone stimulates bone lengthening
- Early Adolescence
 - Estrogen and testosterone stimulate bone lengthening
- Late Adolescence
 - Estrogen and testosterone cause replacement of cartilage growth plates with bone

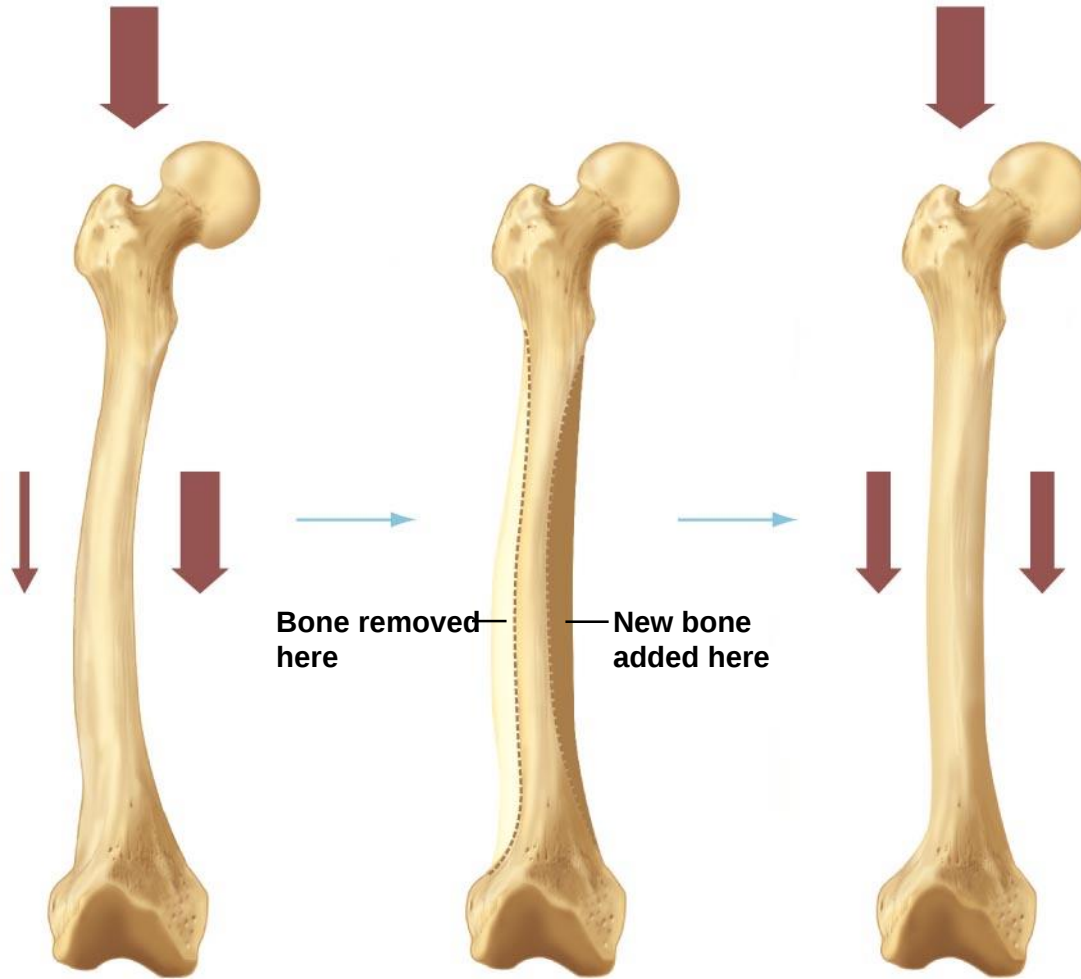
Cells Involved in the Development and Maintenance of Bone

- Chondroblasts
 - cartilage-forming cells
- Osteoblasts
 - young bone-forming cells
- Osteocytes
 - mature bone cells
- Osteoclasts
 - bone-dissolving cells

Mature Bone Remodeling and Repair

- Changes in shape, size, strength
 - Dependent on diet, exercise, age
- Bone cells regulated by hormones
 - Parathyroid hormone (PTH)
 - removes calcium from bone
 - Calcitonin
 - adds calcium to bone
- Repair
 - hematoma and callus formation

Compressive force



**Bone removed
here**

**New bone
added here**

a) The application of force to a slightly bent bone produces a greater compressive force on the inside curvature. Compressive force produces weak electrical currents which stimulate osteoblasts.

b) Over time, bone is deposited on the inside curvature and removed from the outside curvature.

c) The final result is a bone matched to the compressive force to which it is exposed.

Human Skeleton

- 206 bones
- **Axial skeleton**
 - Skull, vertebral column, sternum
- **Appendicular skeleton**
 - Pectoral girdle, pelvic girdle, limbs

Axial skeleton

Appendicular skeleton

Cranium
(skull)

Maxilla

Mandible

Sternum

Ribs

Vertebrae

Sacrum

Clavicle

Scapula

Humerus

Ulna

Radius

Carpals

Metacarpals

Phalanges

Coxal bone

Femur

Patella

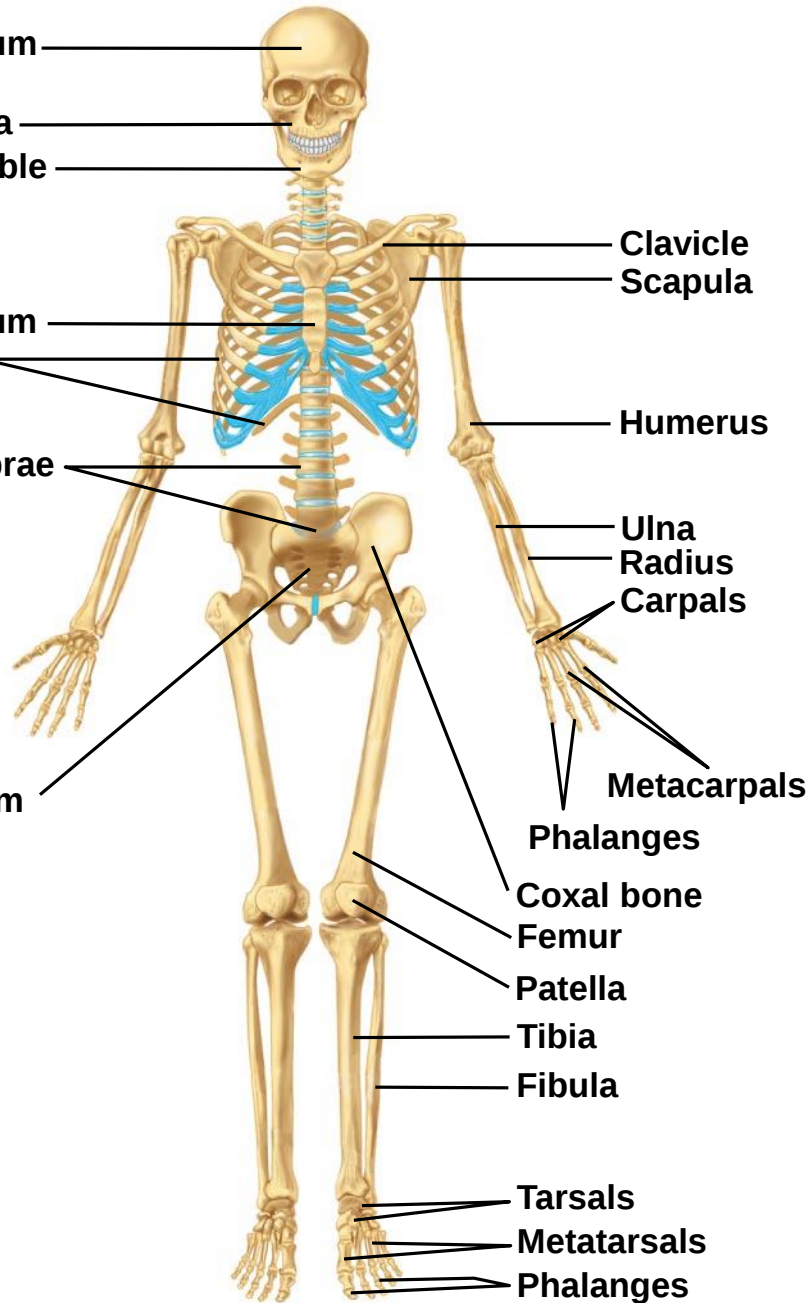
Tibia

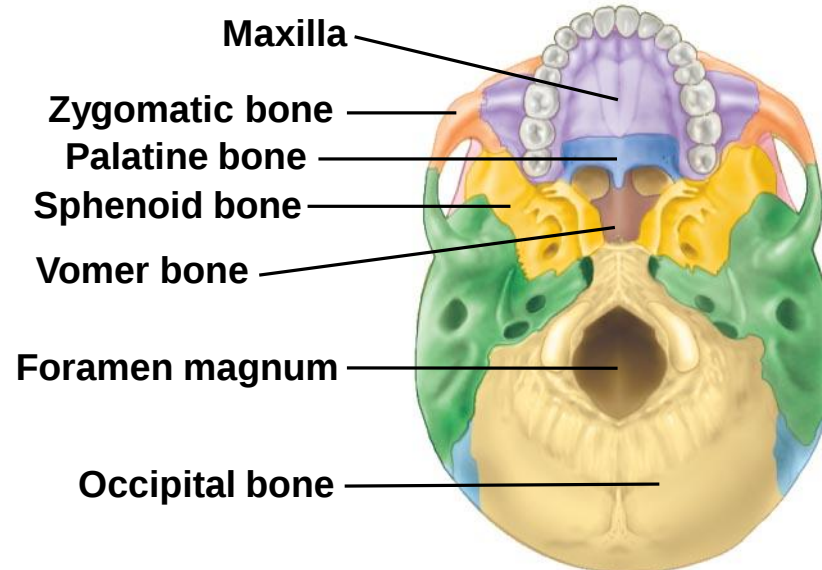
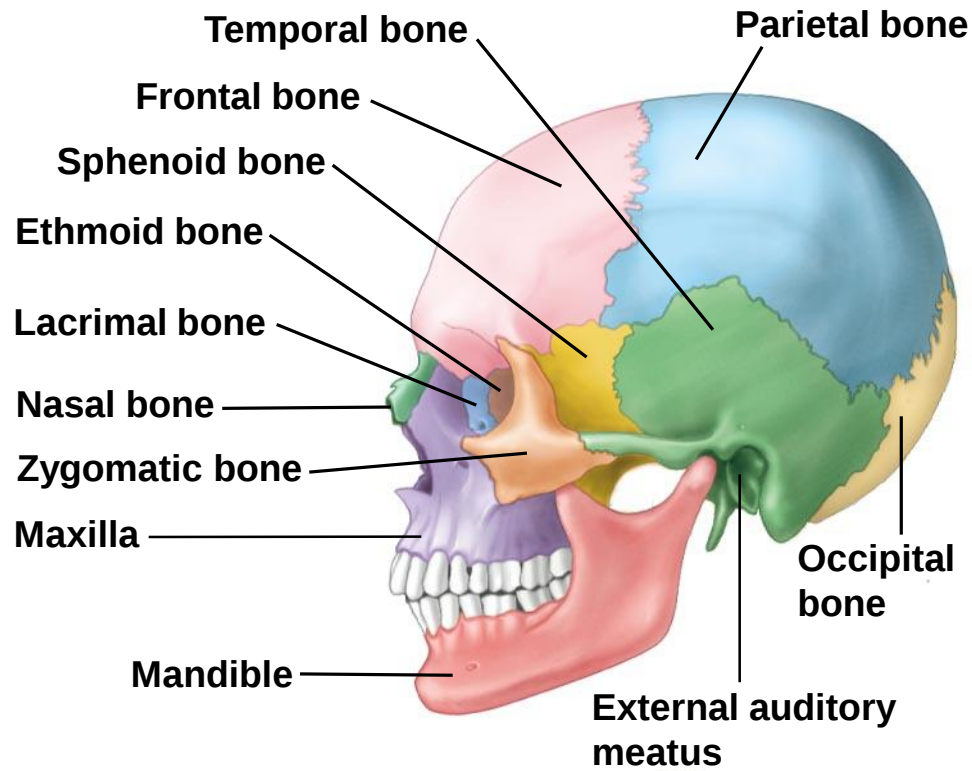
Fibula

Tarsals

Metatarsals

Phalanges





**Cervical
vertebrae
(7)**

1
2
3
4
5
6
7

**Thoracic
vertebrae
(12)**

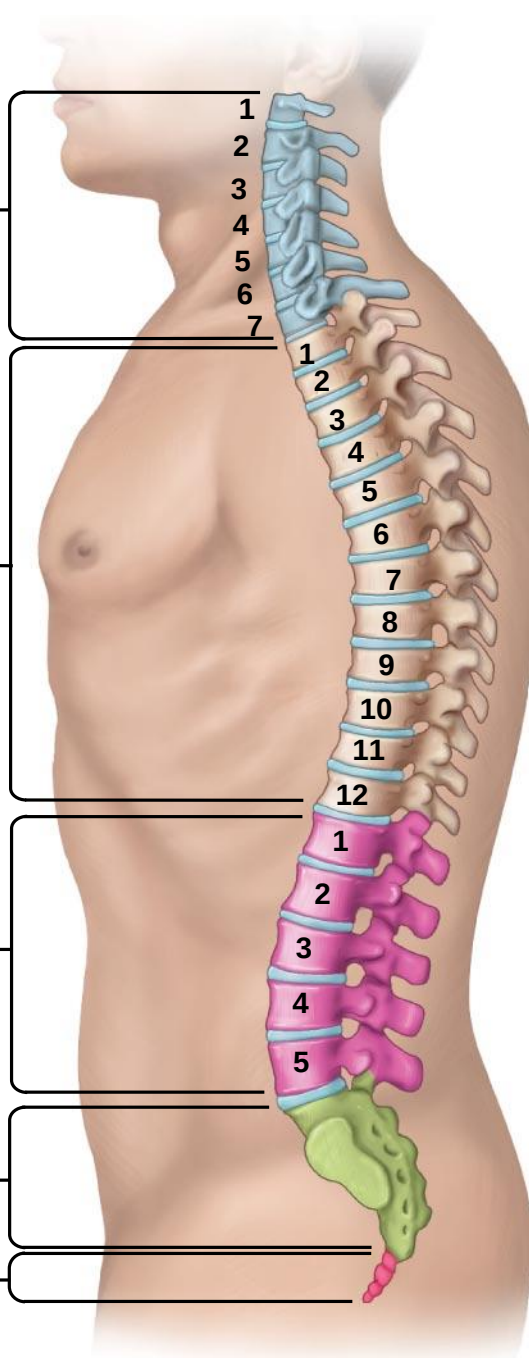
1
2
3
4
5
6
7
8
9
10
11
12

**Lumbar
vertebrae
(5)**

1
2
3
4
5

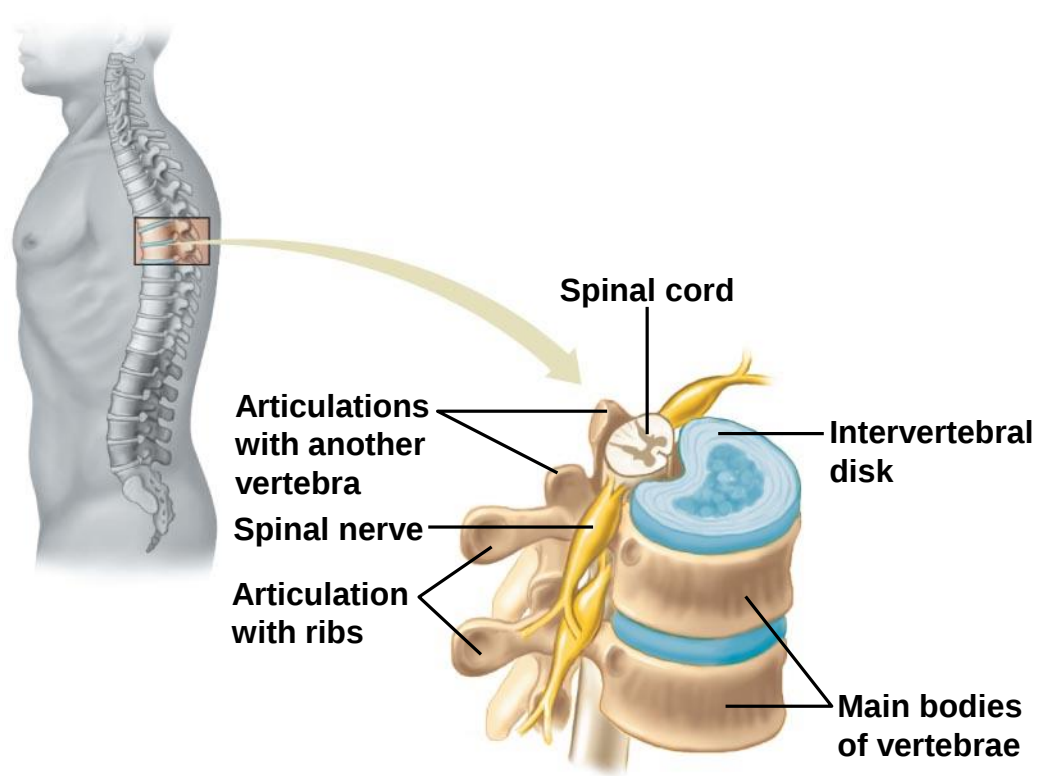
**Sacrum
(5 fused)**

**Coccyx
(4 fused)**

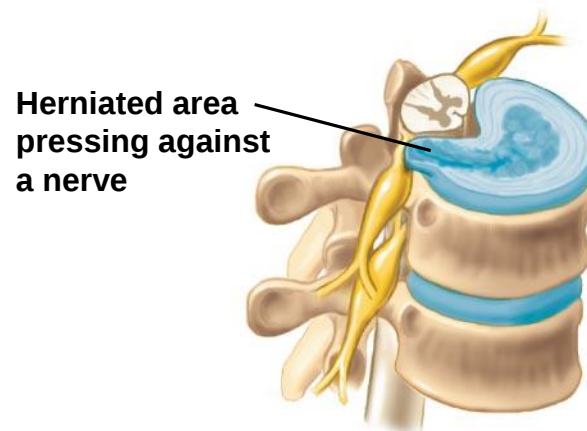


Axial Skeleton: Vertebral Column (cont.)

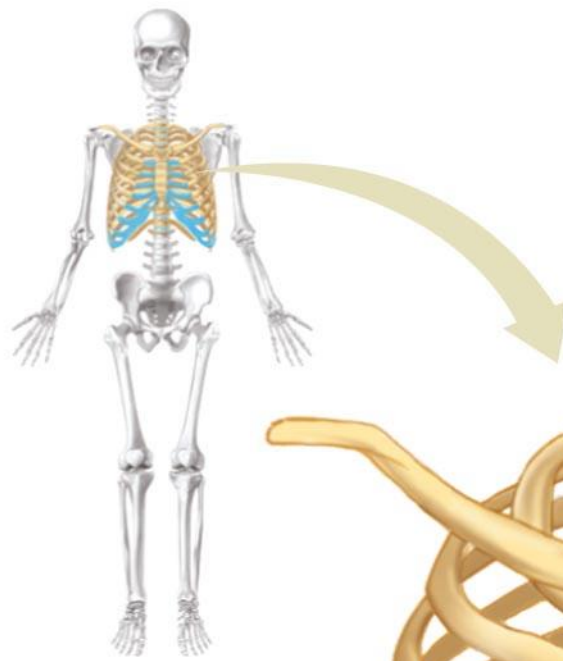
- Vertebral column
 - Regions: cervical, thoracic, lumbar, sacral, coccygeal
 - Intervertebral disks: cushion vertebrae; assist in movement and flexibility
- Ribs
 - Twelve pairs
 - Bottom two pair floating
- Sternum
 - Three bones fused together



a) Healthy disks.



b) A herniated disk.



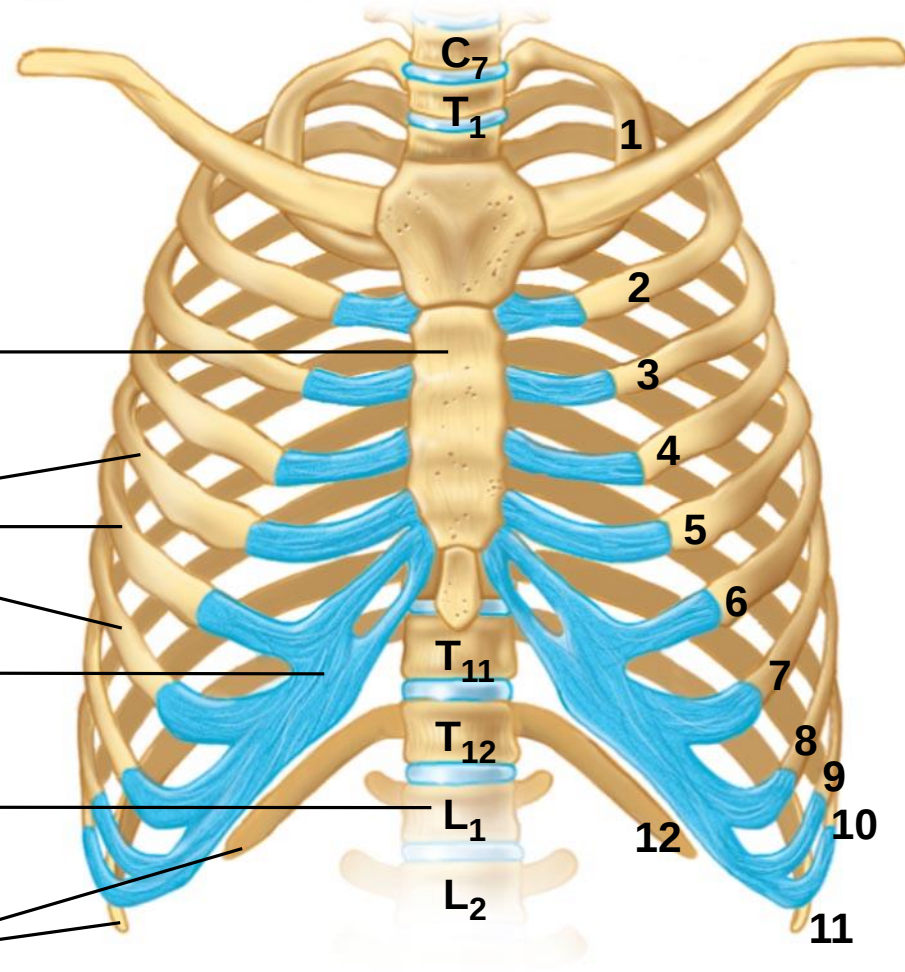
Sternum
(breastbone)

Ribs

Cartilage

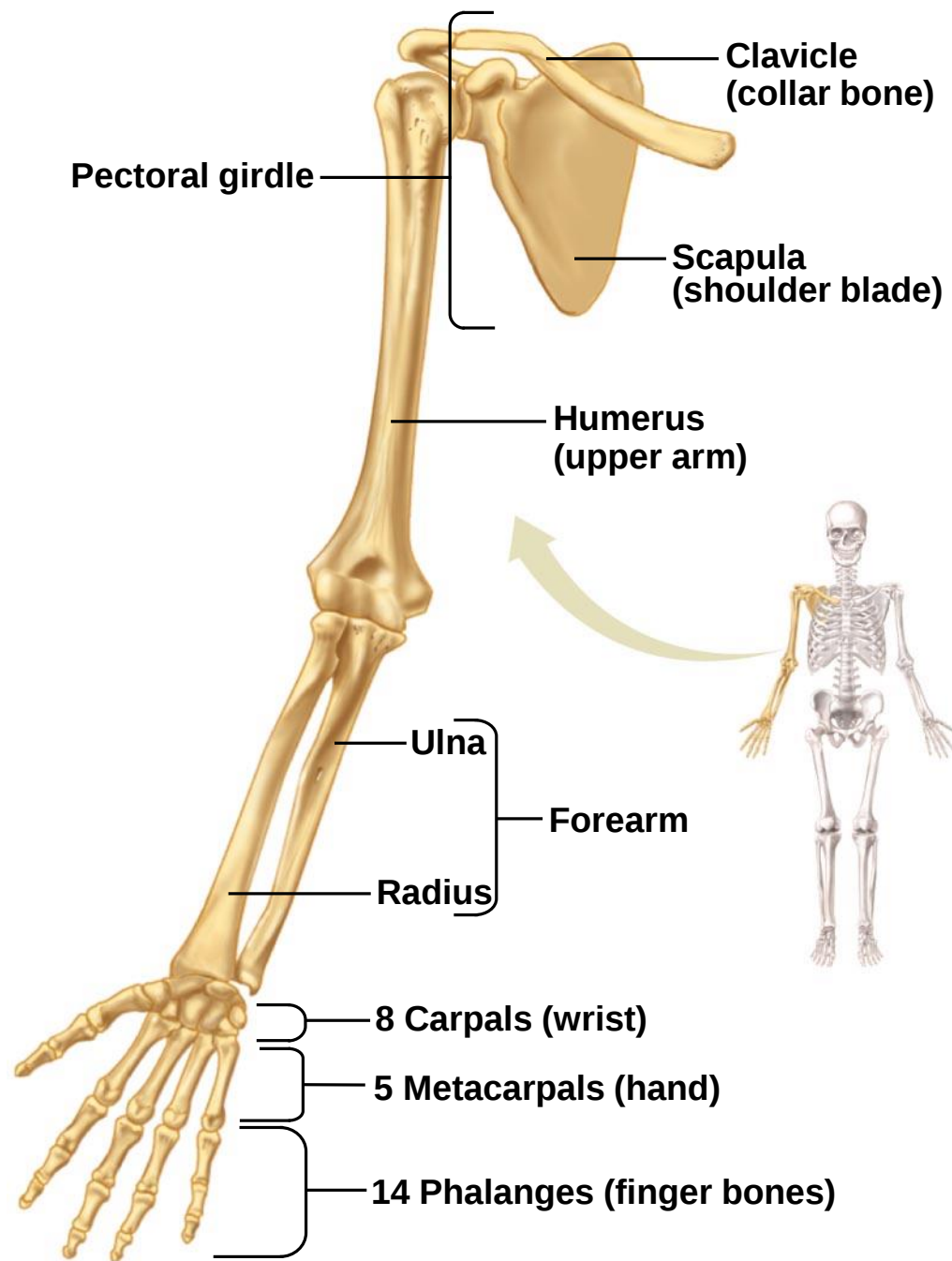
Vertebral column

Floating ribs



Appendicular Skeleton

- Pectoral girdle: shoulder
 - Clavicle and scapulas
- Pelvic girdles: hip
 - Coxal bones, sacrum
- Arms
 - humerus, radius, ulna, carpals, metacarpals and phalanges
- Legs
 - femur, tibia, fibula, tarsals, metatarsals and phalanges



**Coxal bones and
sacrum (pelvis)**



**Pubic
symphysis**

Femur (upper leg)

Patella (knee cap)

Lower leg

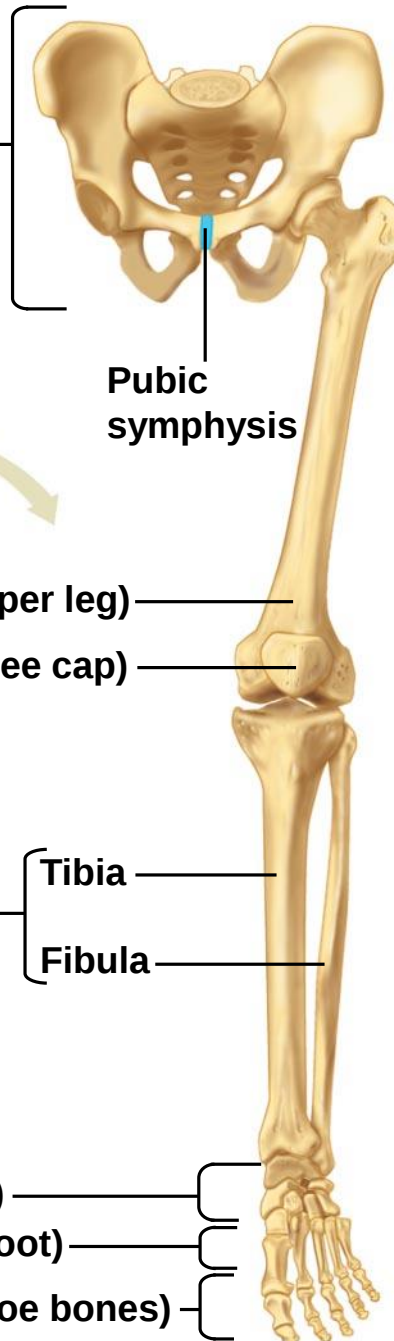
Tibia

Fibula

7 Tarsals (ankle)

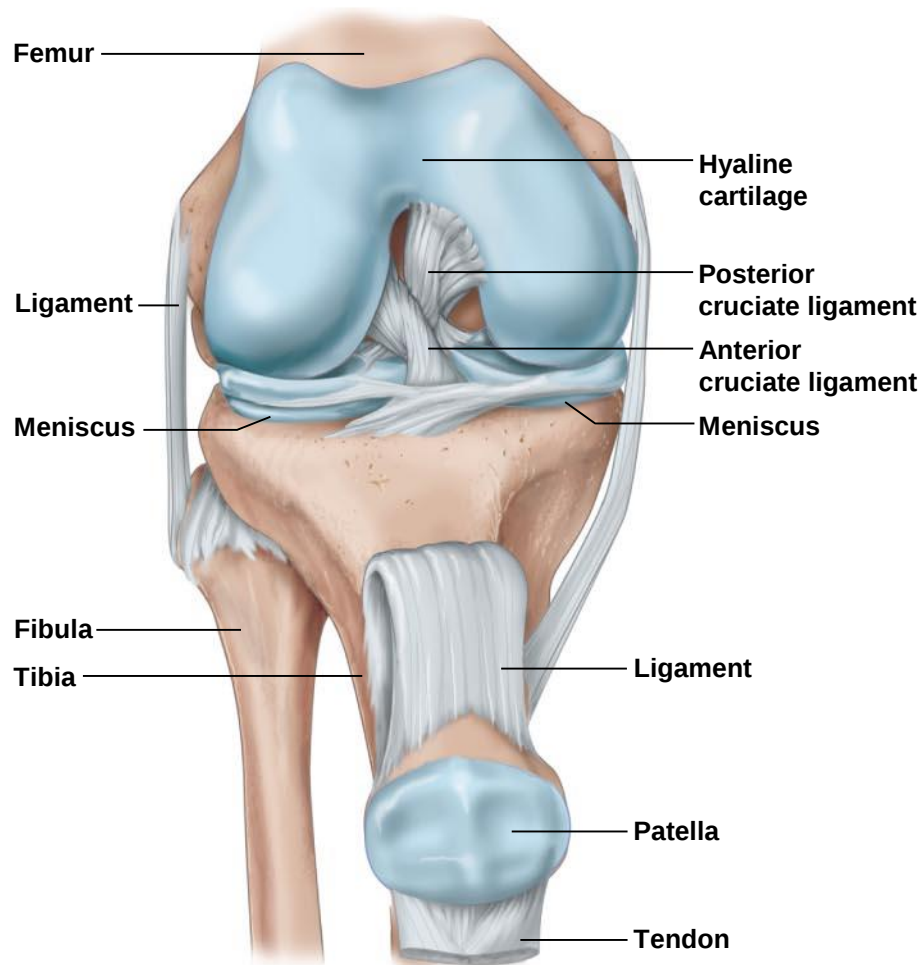
5 Metatarsals (foot)

14 Phalanges (toe bones)

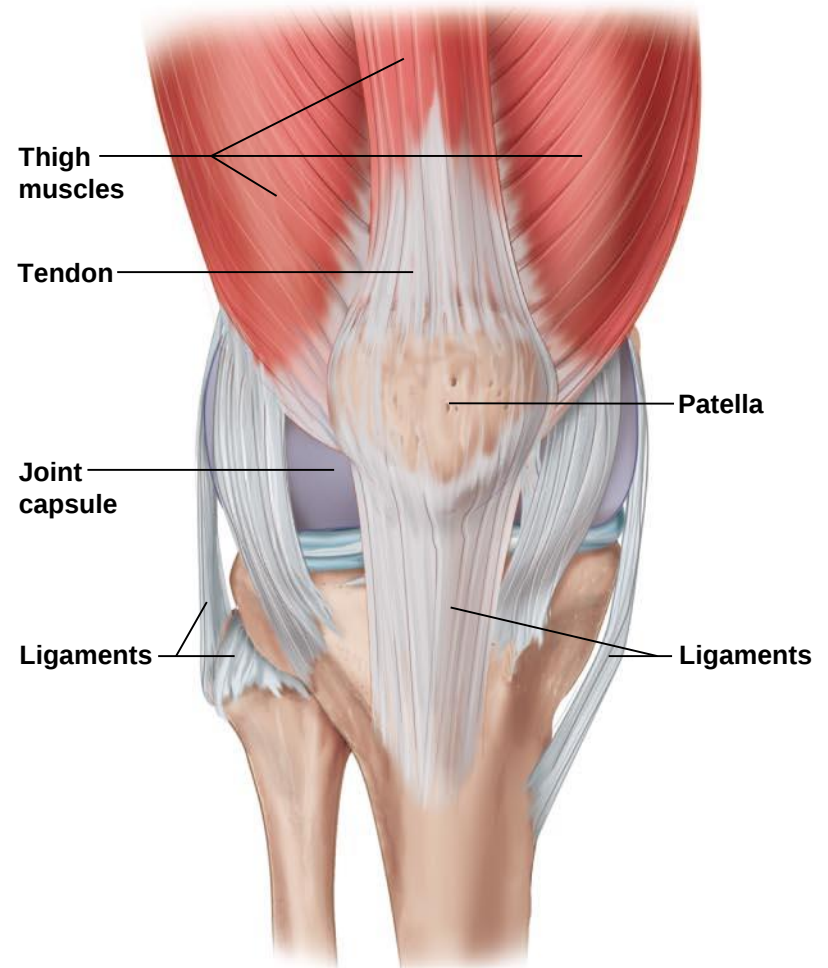


Joints (Articulations)

- Classified by degree of movement
 - **Fibrous joint**
 - immovable (e.g., fontanelles)
 - **Cartilaginous joint**
 - slightly movable, cartilage connection (e.g., backbone)
 - **Synovial joint**
 - freely movable (e.g., shoulder, hip)



a) A cutaway anterior view of the right knee with muscles, tendons, and the joint capsule removed and the bones pulled slightly apart so that the two menisci are visible.



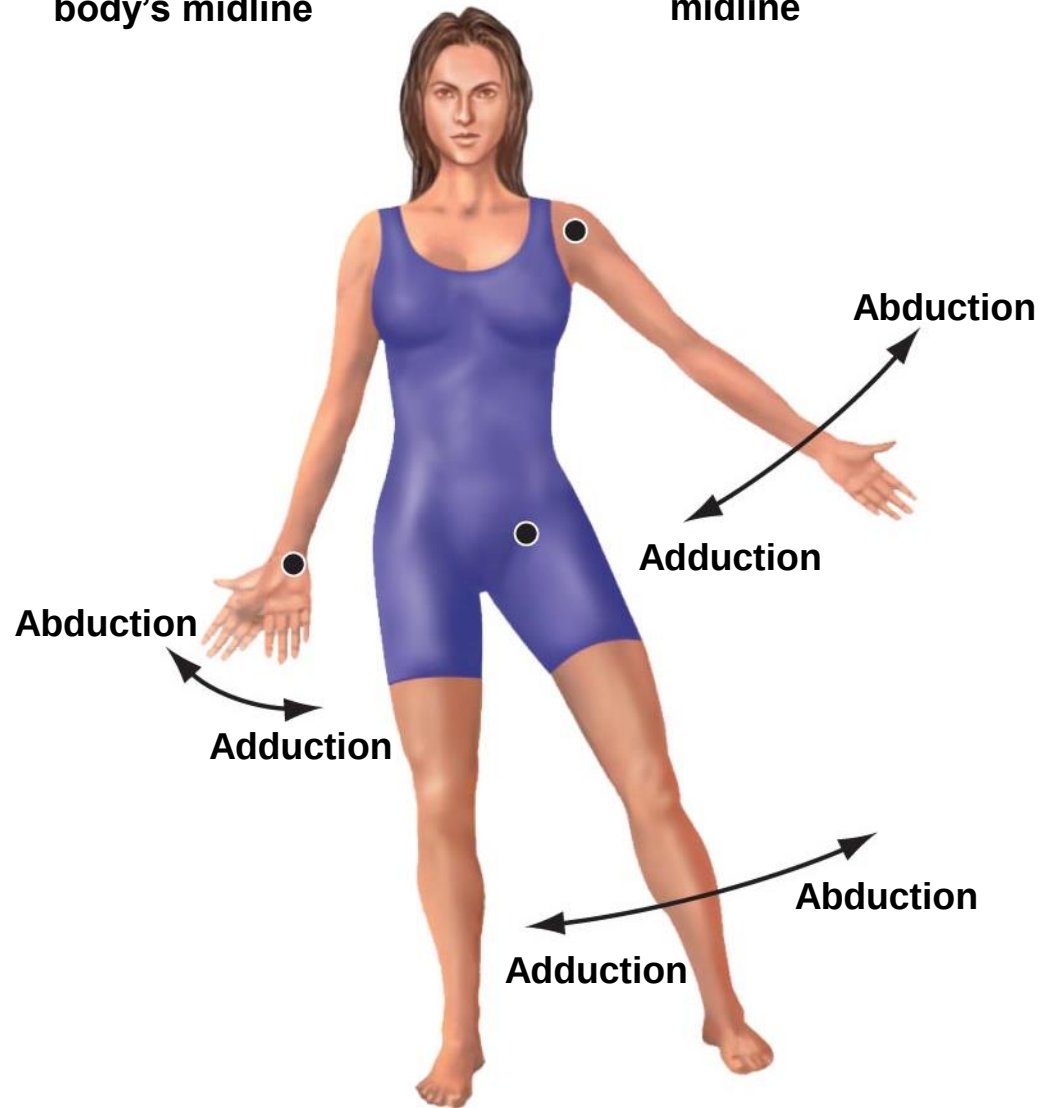
b) A view of the knee with muscles, tendons, and ligaments in their normal position surrounding the intact joint capsule. The combination of ligaments, tendons, and muscles holds the knee tightly together.

Synovial Joints

- Joint capsule
 - synovial membrane + hyaline cartilage
- Synovial membrane secretes synovial fluid as a lubricant
- Hyaline cartilage acts as a cushion
- Types of synovial joints
 - Hinge joint
 - Ball and socket joint
- Tendons – join bone to muscle

Abduction:
Movement of a
limb away from a
body's midline

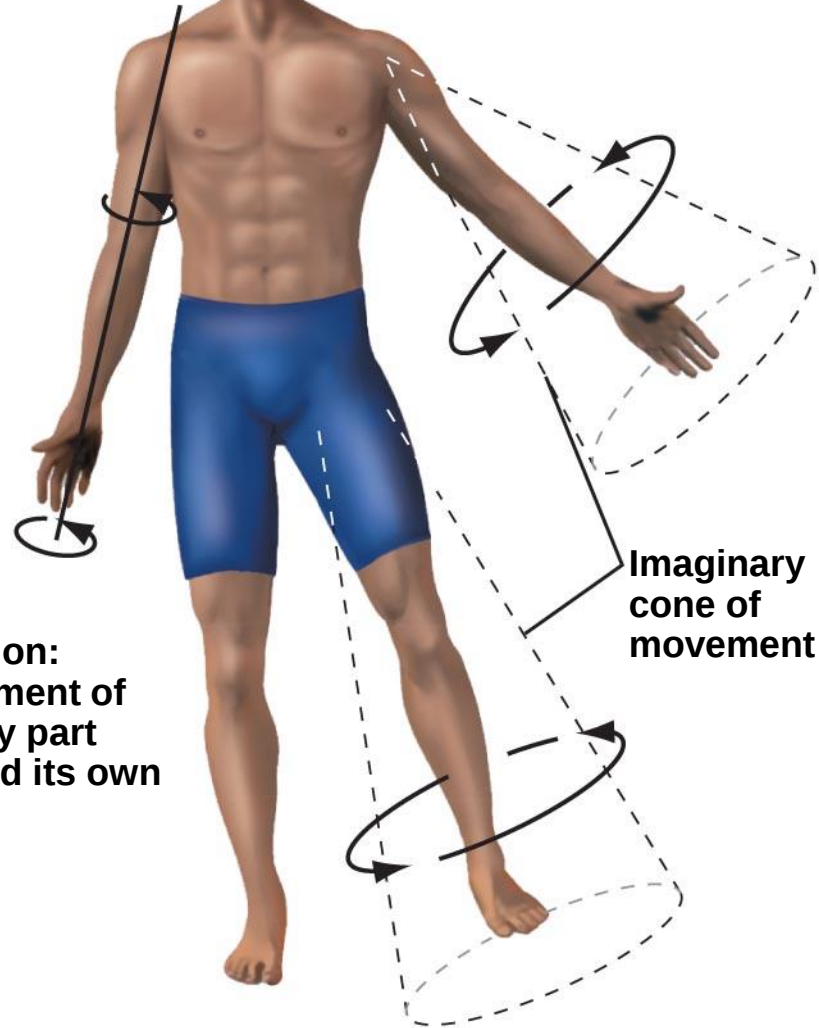
Adduction:
Movement of a limb
toward the body's
midline



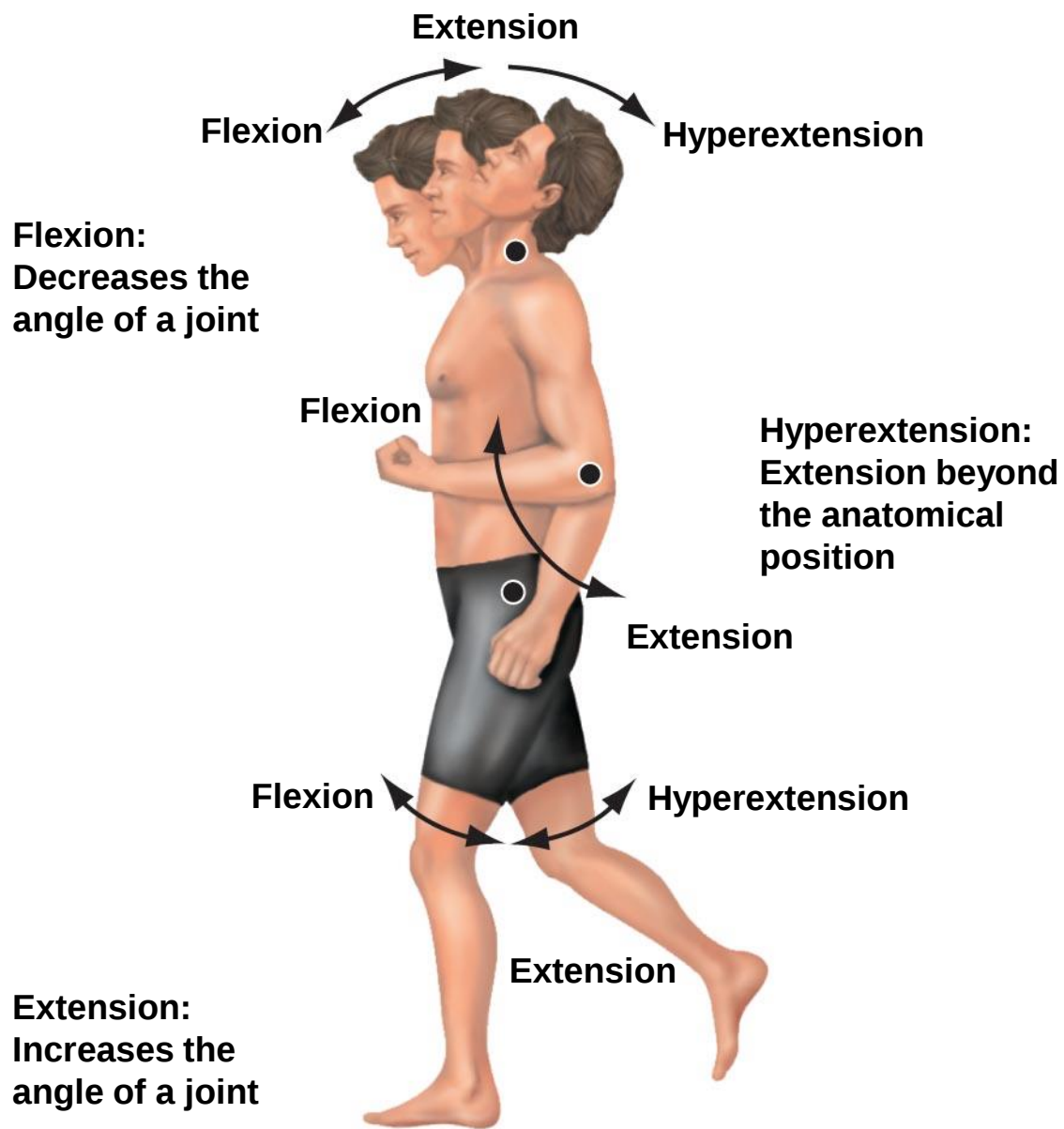
a) Abduction and adduction.

**Circumduction:
Movement of a limb
so that it describes
a cone**

**Rotation:
Movement of
a body part
around its own
axis**



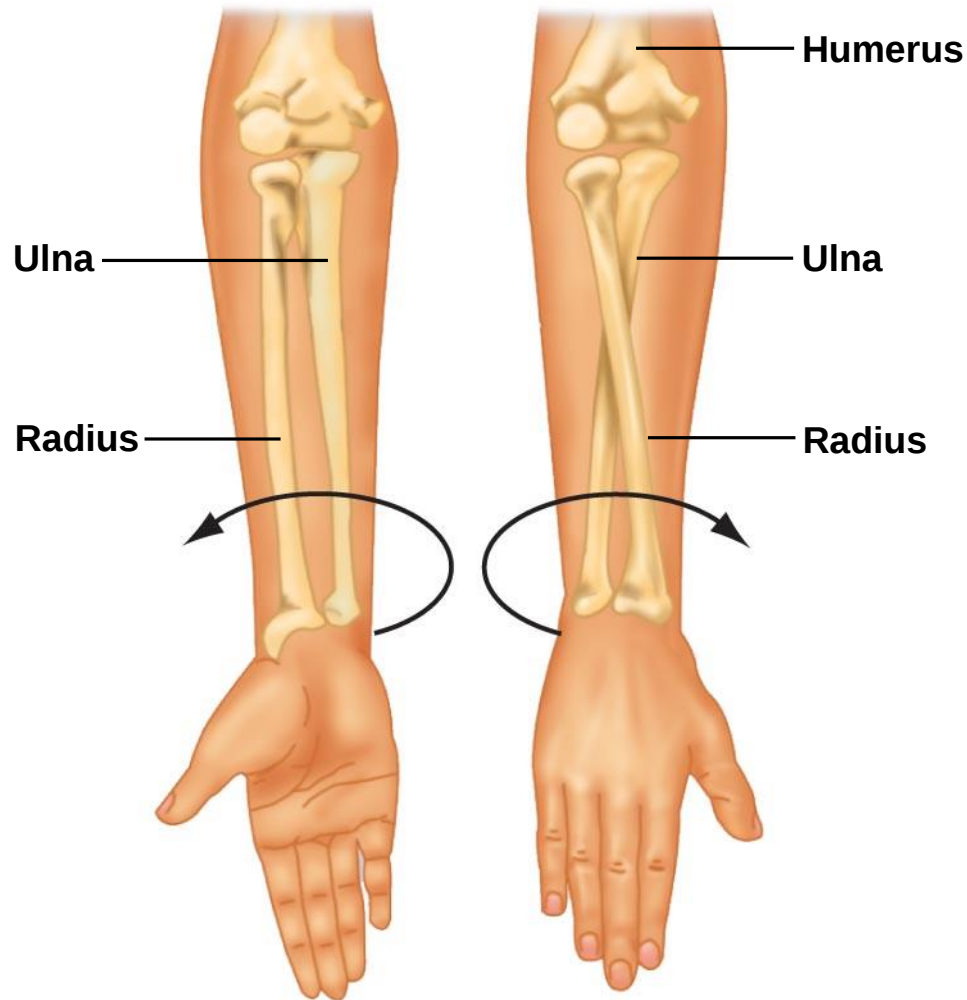
b) Rotation and circumduction.



c) Flexion, extension, and hyperextension.

Supination:
Rotation of the
forearm so palm
faces anteriorly

Pronation:
Rotation of the
forearm so palm
faces posteriorly



d) Supination and pronation.

Diseases and Disorders of the Skeletal System

- **Sprains**
 - stretched or torn ligaments
- **Bursitis and tendinitis**
 - inflammations
- **Arthritis**
 - inflammation of joints
 - Osteoarthritis
 - Rheumatoid arthritis

Diseases and Disorders of the Skeletal System

- **Osteoporosis**
 - excessive bone loss



(b)



(a)