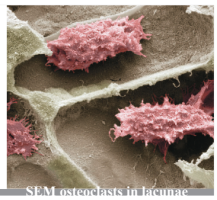
6

Bones and Bone Tissue



Skeletal system
= _____, _____, _____

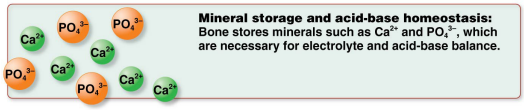
Bones are main organs:
- osseous tissue
- *dense regular* and *irregular CT, plus* **bone marrow**

Functions of the Skeletal System

- **Functions:**

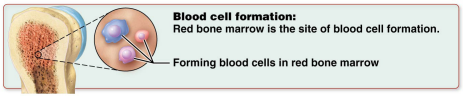
1. **Protection**

2. **Mineral storage and** _____

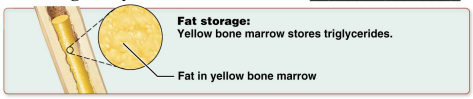


Functions of the Skeletal System

3. **Blood cell formation**: _____ involved in *formation of blood cells* (**hematopoiesis** or hemopoiesis)

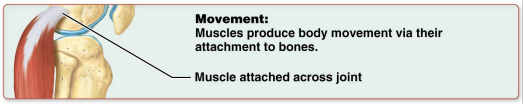


4. **Fat storage**: in **yellow bone marrow** of _____



Functions of the Skeletal System

5. **Movement**: bones are sites for *skeletal muscle attachment*



6. **Support**: *supports weight* and provides _____

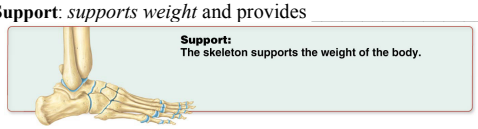
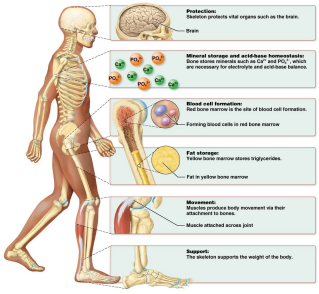


Figure 6.1 Functions of the skeletal system.

Functions of the Skeletal System

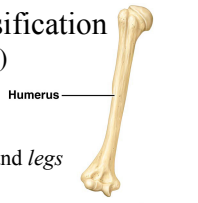


1. **Protection**
2. **Mineral Storage**
3. **Blood cell formation**
4. **Fat Storage**
5. **Movement**
6. **Support**

Figure 6.1 Functions of the skeletal system.

Bone Structure Classification
(based on shape)

1. **Long bones**
   - longer than they are wide;
   - include most bones in *arms* and *legs*



a) Long bone—bone is longer than it is wide.

2. **Short bones**
   – roughly *cube-shaped*
   - include **carpals** and _____

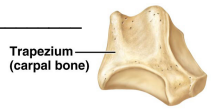


Figure 6.2a Classification of bones by shape.

(b) Short bone—bone is about as long as it is wide.

Bone Structure

3. **Flat bones**
   – *thin and broad bones*
   - *ribs*, *pelvis*, *sternum* and _____

4. **Irregular bones**
   – include _____ and certain *skull* bones

5. **Sesamoid bones**
   – located within _____
   - **patella** (kneecap)

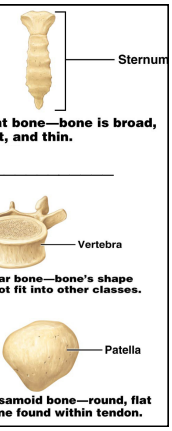


Figure 6.2c Classification of bones by shape.

Bone Structure

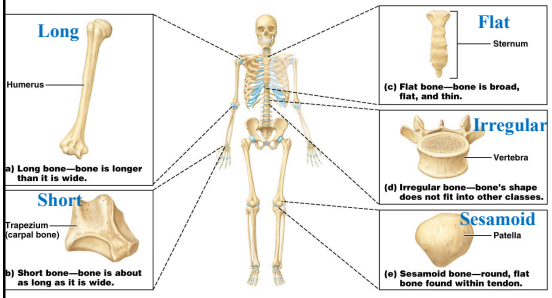
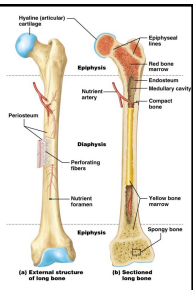


Figure 6.2 Classification of bones by shape.

Bone Structure

Structure of long bone:

- **Periosteum**
  – membrane surrounds outer surface
- **Perforating fibers (Sharpey's fibers)**
  - *anchors periosteum* firmly to bone surface
- **Diaphysis** – _____
- **Epiphysis** - _____ of long bone (proximal & distal)
- **Articular cartilage** – hyaline cartilage
- **Marrow cavity** – contains bone marrow **(red** or **yellow)**
- **Endosteum** – thin membrane lining marrow cavity



Bone Structure

- **Compact bone**
  - hard, dense outer region
  - allows bone to resist stresses (compression & twisting)
- **Spongy bone** (_____ bone)
  - found inside cortical bone
  - *honeycomb-like framework* of bony struts;
  - resist forces from many directions

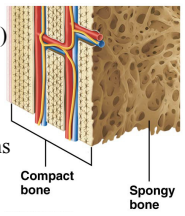
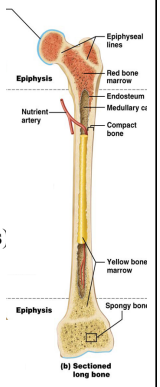


Figure 6.9 Structure of compact bone.

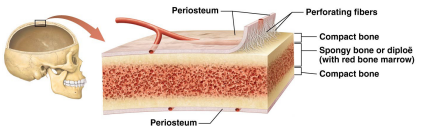
Bone Structure

- **Epiphyseal lines**
  – *separates* epiphyses from diaphysis
  - remnants of epiphyseal plates
- **Epiphyseal plates** (_____ **plates**)
  - hyaline cartilage found in developing bones of children



Bone Structure

- **Structure of short**, **flat**, **irregular**, and **sesamoid bones**
  - covered by *periosteum*
  - **diploë** = two *outer layers of thin compact bone* with middle layer of *spongy bone*
  - **sinuses** = air-filled spaces _____



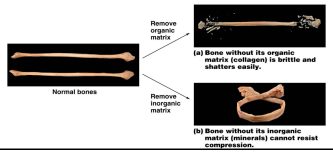
Bone Marrow Transplantation *(p. 187)*

- Diseases of blood
- Needle is inserted into pelvic bone
- Recipient's marrow is *destroyed*
- **Complications** –
- Many recipients can return to a healthy life if transplant "takes"

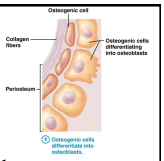
Microscopic Structure

Extracellular matrix of bone:

- **Inorganic matrix** (65%)
  - consisting of _____ (hydroxyapatite salts of Ca & P)
- **Organic matrix** (35%)
  - osteoid
  - consists of collagen fibers and *usual ECM*



Bone Cells



Bone cells :

- **Osteogenic** – differentiate into osteoblasts
- **Osteoblasts** – _____
- **Osteocytes** – mature bone cells in lacunae
- **Osteoclasts**
  - bone _____
  - secrete acid and enzymes

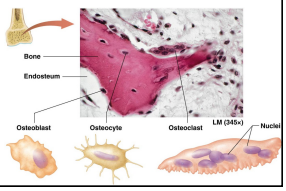


Figure 6.6 Types of bone cells.

Bone Cells

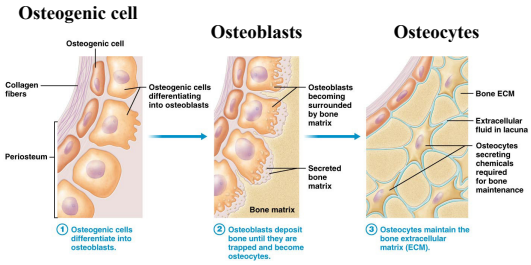


Figure 6.7 Functions of osteoblasts and osteocytes.

Histology of Bone

Structure of **compact bone:**

Osteon (Haversian system)

- **Lamellae = concentric r**ings of *thin layers of bone*
- **Central canal** = contains blood vessels & nerves
- **Lacunae** = _____ for osteocyte
- **Canaliculi** = _____
- **Perforating canals** (Volkmann's canals) *perpendicular to central canals*

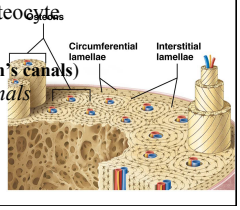


Figure 6.9 Structure of compact bone.

Histology of Bone

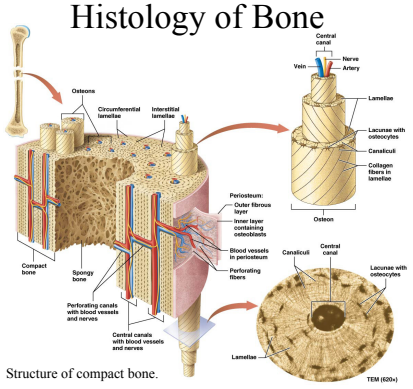


Figure 6.9 Structure of compact bone.

Histology of Bone

- **Structure of spongy bone**
  - usually not wt. bearing
  - not organized into osteons
  - **trabeculae** = _____

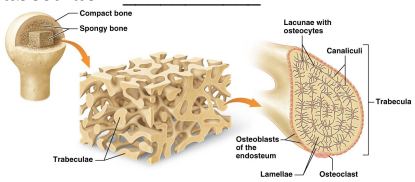


Figure 6.10 Structure of spongy bone.

Ossification

- **Ossification** (**osteogenesis**)
  - Process of bone formation
  - Begins in embryonic period and continues throughout adulthood

[fetal "skeleton"] [14 weeks]

cartilage template **endochondral** | fibrous CT **intramembranous**

BONE

Intramembranous Ossification

- **Intramembranous ossification**
  - forms many _____(bones of skull and clavicles)
  - formed within a *mesenchymal* _____
  - spongy bone ossifies before outer compact bone layers
  - forms **primary ossification center**
  - _____ = areas of incomplete intramembranous ossification

Intramembranous Ossification

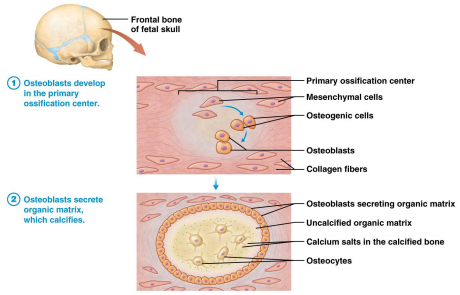


Figure 6.11 The process of intramembranous ossification.

Intramembranous Ossification

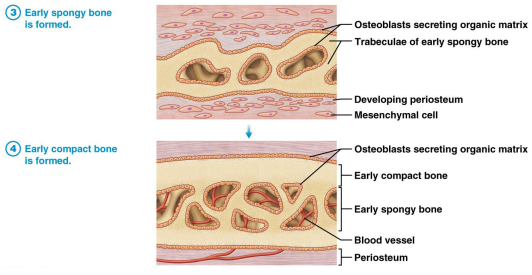


Figure 6.11 The process of intramembranous ossification.

Endochondral Ossification

- **Endochondral ossification** (**Figure 6.12**):
  - Bone development for all bones below head except _____
  - Many bones *complete ossification* by age 7

Endochondral Ossification

- Endochondral ossification
  - bones begin within *hyaline* _____
  - – Hyaline cartilage model made of *chondrocytes*, *collagen*, *and ECM* surrounded by CT **perichondrium**
  - – Cartilage breaks down
  - – Collar formation (periosteum)
  - – _____ ***ossification center*** mid-diaphysis
  - - ***secondary ossification centers*** at _____

Most bones of skeleton formed this way.

Endochondral Ossification

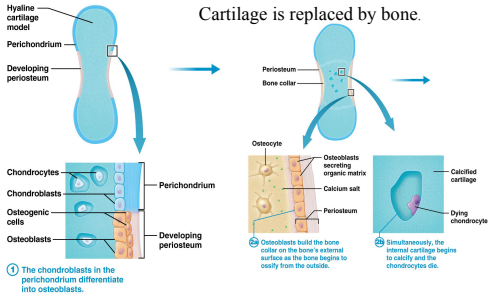


Figure 6.12 The process of endochondral ossification.

Endochondral Ossification

Cartilage remains at epiphyseal plate and articular ends.

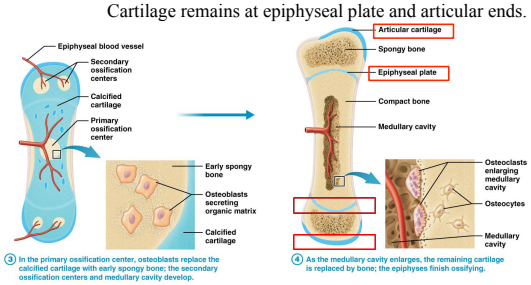
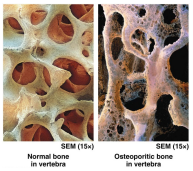


Figure 6.12 The process of endochondral ossification.

Osteoporosis and Healthy Bones *(p. 192)*

- Most common bone disease in U.S
- Diagnosed by *bone density measurement*
- **Causes** – *dietary* (calcium and/or vitamin D deficiency)
- **Prevention**
- **Treatment**



Growth in Length

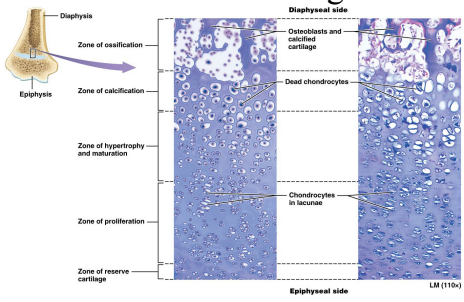


Figure 6.13 Structure of the epiphyseal plate.

Growth in Length

- Long bones lengthen via **longitudinal growth**; involves division of _____ (not osteocytes or osteoblasts) in epiphyseal plate
- Bone growth takes place at epiphysis on side *closest to diaphysis*

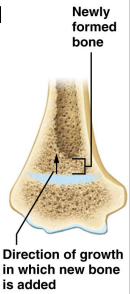


Figure 6.14 Growth at the epiphyseal plate.

Growth in Length

- **Epiphyseal plate**

1. **Zone of reserve cartilage** – (found closest to epiphysis) contains cells that are not directly involved in bone growth but *can be recruited* for cell division if need arises
2. **Zone of proliferation** - consists of *actively dividing chondrocytes* by endochondral ossification
3. **Zone of hypertrophy and maturation** (next region closer to diaphysis) contains *mature chondrocytes*
4. **Zone of calcification** (second to last region) contains dead chondrocytes, some of which have been calcified
   Calcified cartilage is replaced with bone.
5. **Zone of ossification** (last region) consists of *calcified chondrocyte and osteoblasts*

Growth in Length

- Longitudinal growth continues at epiphyseal plate as long as *mitosis continues* in zone of proliferation:
  - Mitotic rate slows around ages of 12-15 years old
    Between ages of 18-21 epiphyseal plate is **closed**
  - _____ is a *calcified remnant* of epiphyseal plate

Growth in Length

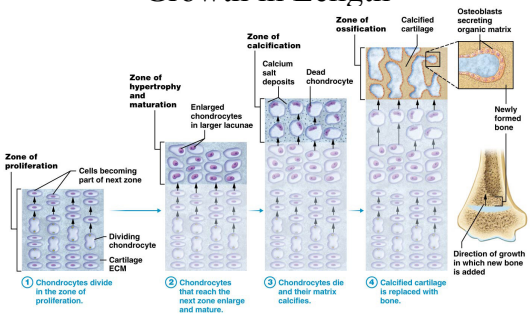


Figure 6.14 Growth at the epiphyseal plate.

Growth in Width

Appositional growth = _____

- Osteoblasts, *lay down new bone*
  - Appositional growth does not result in immediate formation of osteons; instead, *new circumferential lamellae* are formed
  - Bones may *continue to increase in width* even after epiphyseal plates have *closed* and bone is no longer *lengthening*

Achondroplasia *(p. 199)*

- Most common cause of **dwarfism**; gene defect
- Defective gene produces an *abnormal growth factor receptor*
- Bones form and grow abnormally;
- Long-term problems

Role of Hormones in Bone Growth

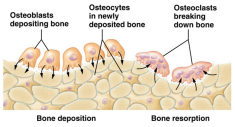
- _____ (GH) – secreted by *anterior pituitary gland*; enhances protein synthesis and cell division in most all tissues, including bone
- _____ - pronounced effect on bone growth:
  - Increases appositional growth in males
  - Increases *rate of mitosis in epiphyseal plate*; leads to "growth spurts" in teenage years
- **Estrogen** also plays a role in bone growth:
  - Increases *rate of longitudinal growth* and inhibits *osteoclasts*
  - Accelerates closure of epiphyseal plate at much *faster rate than testosterone* →*average height differences* between gender

Gigantism and Acromegaly *(p. 200)*

- *Excess GH* can produce two conditions, depending on when in life it develops; both generally caused by a _____ that secretes hormone
- **Childhood** – condition is _____
- **Adulthood** – condition is _____

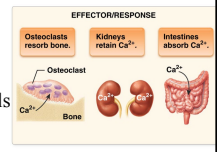
Bone Remodeling

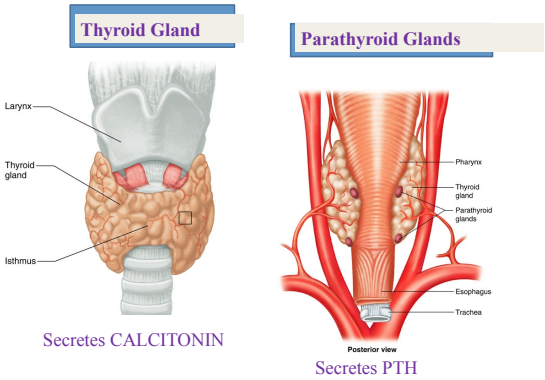
- **Bone remodeling** = new bone is formed by **bone** _____ and old bone is removed by **bone** _____
  - Maintenance of *calcium ion homeostasis*
  - *Replacement* of old brittle bone with newer bone
  - *Adaptation* to tension and stress



Bone Remodeling

- **PTH** (parathyroid hormone from parathyroid gland) stimulates effects that _____ *blood Ca^{+2} levels*
  - Increases osteoclast activity
  - Increases *absorption* of calcium from gut
  - Inhibits calcium *loss* in urine
- **Calcitonin** (from thyroid gland) causes _____ blood Ca^{+2} levels
  - Inhibits osteoclasts
  - Increases calcium loss in urine





Secretes CALCITONIN

Secretes PTH

Bone Remodeling

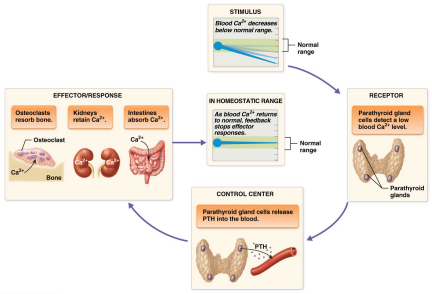


Figure 6.15 Structure of the epiphyseal plate.

Bone Remodeling

- **Factors influencing bone remodeling are summarized**:

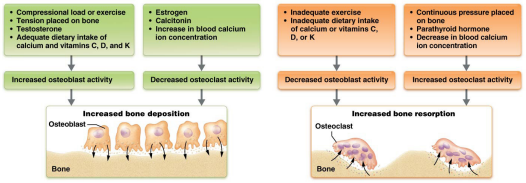
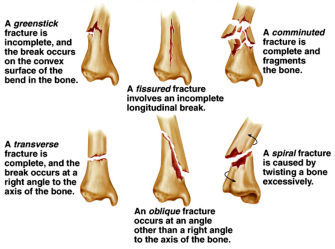


Figure 6.16 Factors that influence bone remodeling.

Bone Repair

Fractures:

- **Simple fractures** vs _____ **fractures**
- *Spiral*
- *Compression*
- *Comminuted*
- *Avulsion*
- *Greenstick*
- *Epiphyseal plate*



7

The Skeletal System

Skeletal System = _____ bones plus cartilages
- **Axial** (80 bones)
- **Appendicular** (126 bones)

Structure of the Skeletal System and Skeletal Cartilages

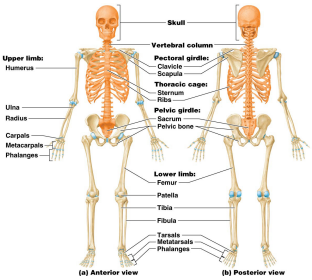


Figure 7.1 Divisions of the skeletal system.

Structure of the Skeletal System and Skeletal Cartilages

- **Axial skeleton**
  - **Skull, vertebral column, thoracic cage (ribs, sternum), _____**
- **Appendicular skeleton**
  - **Bones of pectoral girdle, upper limb, pelvic girdle, and lower limb**

  Pectoral girdle – _____; *anchors* upper limb to trunk

  Pelvic girdle – _____ bones; *anchors* lower limb to trunk

Bone Markings

Table 7.1 Bone Markings

Bone Marking	Description	Example
Depressions: clefts of varying depth in a bone; located where a bone meets another structure, such as another bone or a blood vessel.		
Facet	Shallow convex or concave surface where two bones articulate	**Rib:** Articular facet for articulation with a transverse process
Fossa (plural, *fossae*)	Indentation in a bone into which another structure fits	**Humerus:** Distal portion with olecranon fossa
Fovea	Shallow pit	**Femur:** Fovea capitis

Table 7.1 Bone Markings.

Bone Markings

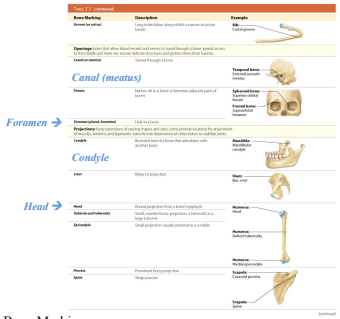


Table 7.1 Bone Markings.

Bone Markings

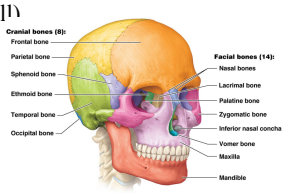
Table 7.1 Bone Markings *(continued)*

Bone Marking	Description	Example
Protuberance	Outgrowth from a bone	**Occipital bone:** External occipital protuberance
Trochanter	Large projection found only on the femur	**Femur:** Greater trochanter
Line	Long, narrow ridge	**Femur:** Linea aspera

Table 7.1 Bone Markings.

Overview of Skull Structure

- Skull = 22 bones organized in *two groups*:
  - **Cranial bones** – collectively known as **cranium**, composed of _____ bones (STEP OFf my skull)
    - Frontal -1
    - Occipital -1
    - Ethmoid -1
    - Sphenoid – 1
    - Parietal – 2
    - Temporal - 2



Overview of Skull Structure

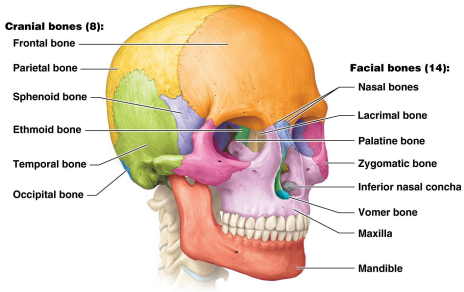
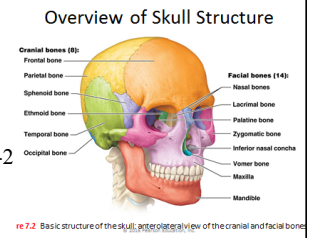


Figure 7.2 Basic structure of the skull: anterolateral view of the cranial and facial bones.

Overview of Skull Structure

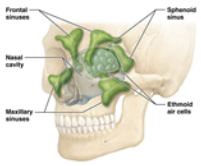
- **Facial bones** = _____ bones
  - Maxillary – 2
  - Zygomatic -2
  - Nasal -2
  - Lacrimal -2
  - Palatine -2
  - Inferior nasal concha -2
  - Mandible -1
  - Vomer -1

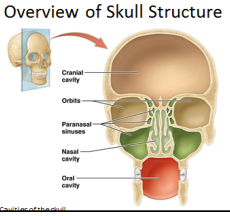


re 7.2 Basic structure of the skull: anterolateral view of the cranial and facial bones

Overview of Skull Structure

- Sinuses = _____, membrane-lined *spaces*; **paranasal sinuses** = frontal, ethmoid, sphenoid, maxillary





7.13 Paranasal sinuses. © 2016 Pearson E

Understanding How Skull Bones Relate to Each Other

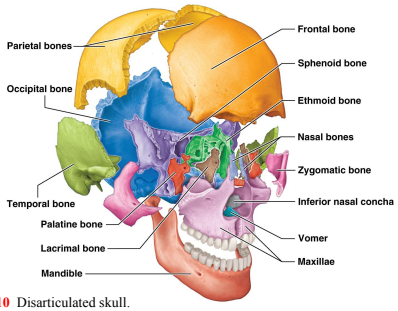
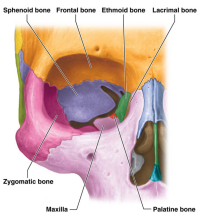


Figure 7.10 Disarticulated skull.

Cavities of the Skull

- **Orbit** – FLEZMS *7 fused bones*; form walls that encase eyeball, lacrimal gland, and their associated blood vessels, muscles, and nerves (**Figure 7.11**)
  - **Frontal bone**
  - **Lacrimal**
  - **Ethmoid**
  - **Zygomatic**
  - **Maxilla**
  - **Sphenoid bone**
  - and _____ **bones**



The Fetal Skull

Fontanel (soft spot) = area of incomplete _____

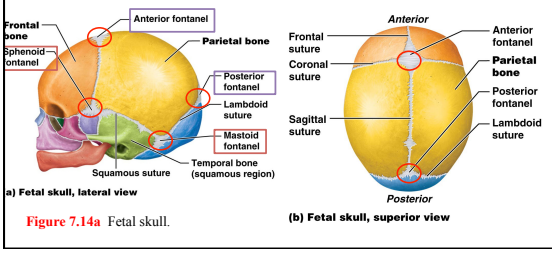
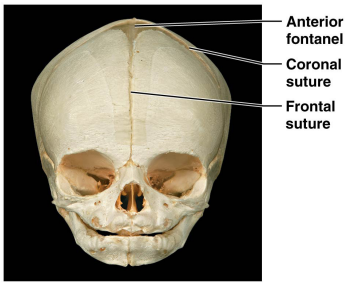


Figure 7.14a Fetal skull.

The Fetal Skull

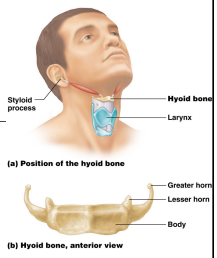


(c) Photo of fetal skull, anterior view

Figure 7.14c Fetal skull.

Hyoid Bone

- **Hyoid**
  - – doesn't *articulate* with any other bones
  - – C-shaped bone
  - – Provides numerous muscle attachment points involved in _____



Forensic Skull Anatomy *(p. 229)*

- Forensic investigators often must identify human remains with little to go on except bones; can provide many clues (particularly skull); one of most basic traits that can be identified from a skull is *gender*
- Four obvious differences:

Forensic Skull Anatomy

Male skull Female skull

Overview of the Vertebral Column

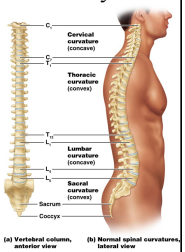
Vertebral column (**spine**) – composed of *about* _____ bones (**vertebrae**)

- 7 **cervical** – located in _____
- 12 **thoracic** – articulate with _____
- 5 **lumbar** – in _____

- 5 fused **sacral** (collectively called **sacrum**)
- 3–5 fused **coccygeal** (collectively called **coccyx**)

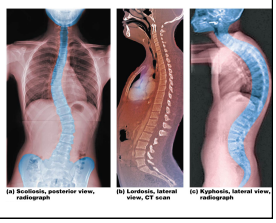
Overview of the Vertebral Column

- **Spinal curvatures** – C-shaped vertebral column of newborn → S-shaped secondary curvatures as infant grows
  - **Primary curvatures** (_____ and *sacral*) present <u>during</u> fetal dev.
  - **Secondary curvatures** (_____ and *lumbar*) dev. <u>after</u> fetal period



Overview of the Vertebral Column

- **Abnormal spinal curvatures**:
  - **Scoliosis** – abnormal _____ *curvatures*
  - **Lordosis (swayback)** – exaggerated *cervical* and _____ curvatures
  - **Kyphosis (hunchback)** – exaggeration of _____ *curvature*



Structure of the Vertebrae

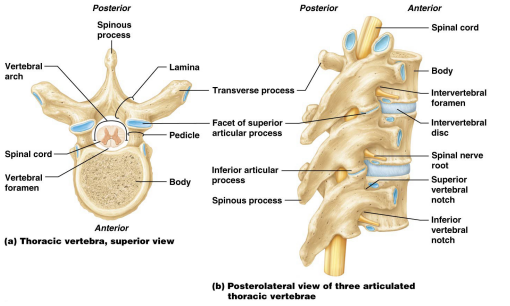
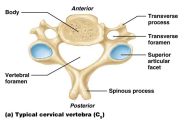
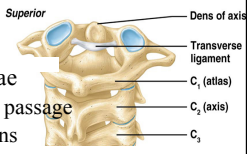


Figure 7.18 Basic structure of vertebrae.

Structure of the Vertebrae



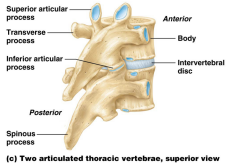


- **Cervical** (**7**) – smallest vertebrae
  - _____ **foramina** allows passage of vertebral arteries and veins
  - **C_1** (_____)
    - <u>Lacks</u> **vertebral body**
    - Articulates with *occipital condyles* and C_2
  - **C_2** (_____)
    - **Dens** (**odontoid process**) protrudes from body
    - Allows for *rotational movement* of head at neck; (shaking your head "no")

Structure of the Vertebrae

- **Thoracic vertebrae** (**12**)
  - long spinous processes
  - **Superior** and **inferior costal facets** (articulate with **head of rib**)
  - **Transverse costal facets** on transverse processes (articulate with _____ **on rib**)

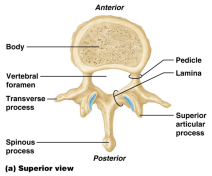
Posterior view: Shaped like **giraffe head**

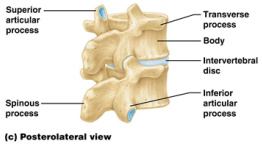


Structure of the Vertebrae

- **Lumbar vertebrae** (**5**) – *largest* and *heaviest* of all vertebrae (_____)

Posterior view- shaped like **moose head**





Structure of the Vertebrae

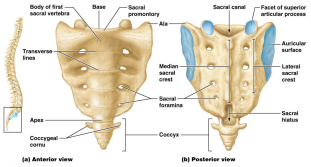
TABLE 7.3 COMPARISON OF CERVICAL, THORACIC, AND LUMBAR VERTEBRAE

Characteristic	Cervical Vertebrae	Thoracic Vertebrae	Lumbar Vertebrae
Body shape and size	Small and oval; C_2 lacks a body; C_2 has the dens on the superior surface of its body	Larger and heart-shaped; contain costal facets	Largest and kidney-shaped
Vertebral foramen shape	Triangular	Circular	Flattened triangular
Transverse processes	Contain transverse foramina	Long; contain articular facets for ribs	Short with no facets or foramina
Spinous processes	Most are fork-shaped; C_7 lacks a spinous process	Long; point inferiorly	Thick; point posteriorly
Appearance (superior view)			

Table 7.3 Comparison of Cervical, Thoracic, and Lumbar Vertebrae.

Structure of the Vertebrae

- **Sacrum** – 5 *fused* sacral vertebrae
  - **Sacral promontory** – bony *projection* at anterior margin of base (superior aspect)
  - **Sacral foramina** – *4 pairs of holes* allows for _____ _____
- **Coccyx** = 4 fused (3-5) vertebrae

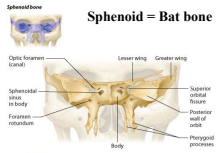


Study Boost: Remembering Skull Bones and Vertebrae

- **PEST OF** 6 (*six cranial bones*): Parietal, Ethmoid, Sphenoid, Temporal, Occipital, Frontal
- **Virgil Is Now Making My Pet Zebra Laugh** (*facial bones*): Vomer, Inferior nasal conchae, Nasal, Mandible, Maxillae, Palatine, Zygomatic, Lacrimal
- **For Easier Sinus Memorization** (*paranasal sinuses*): Frontal, Ethmoidal, Sphenoidal, Maxillary
- **Breakfast at 7**, **lunch at 12**, **dinner at 5** (*number of vertebrae*): 7 cervical, 12 thoracic, and 5 lumbar

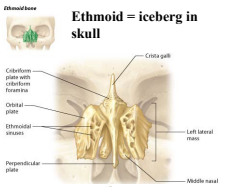
Study Boost: Remembering Skull Bones and Vertebrae

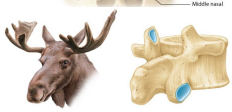
Sphenoid = Bat bone



Thoracic giraffe

Ethmoid = iceberg in skull



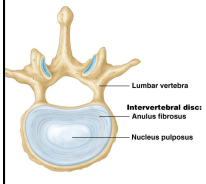


Lumbering moose

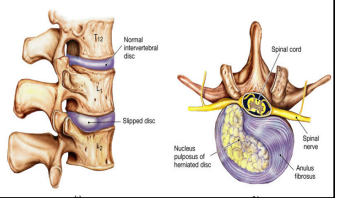
Intervertebral Discs

- **Intervertebral disc**

  = *fibrocartilage pad* found between bodies vertebrae
  - **Nucleus pulposus** – *jelly-like* substance; shock absorber
  - **Anulus fibrosus** – outer ring of _____



Herniated disc or "slipped disc"



Herniated Disc *(p. 238)*

- A tear in anulus fibrosus can allow nucleus pulposus to *protrude*, a condition known as a **herniated disc** (commonly called a **slipped disc**)
- Bulging nucleus pulposus *compresses* nerve
- Treatments

The Thoracic Cage

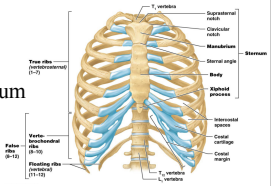
- **Thoracic cage**
  =

  – **sternum**
    - **Manubrium** – *superiormost*
    - **Body** - middle
    - **Xiphoid process** - inferior

The Thoracic Cage

Rib cage= 12 pairs of ribs and their costal cartilages

- Ribs 1–7 (_____**ribs** or **vertebrosternal** ribs) attach to sternum via their *costal cartilages*
- Ribs 8–12 (_____ **ribs**) not directly attached to sternum
  – **Vertebrochondral** ribs 8–10 – attached to *cartilage of 7th rib*
  – _____ or **vertebral** ribs 11 & 12
  - are not attached to sternum



The Thoracic Cage

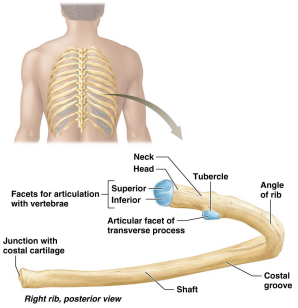


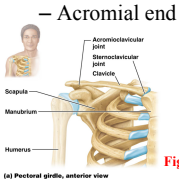
Figure 7.25 Structure of a typical rib.

The Sternum and CPR *(p. 239)*

- **Cardiopulmonary resuscitation (CPR)**
- *Correct placement of hands on sternum is critical*

The Pectoral Girdle

- **Pectoral girdle** – **clavicle** and **scapula**
- **Clavicle**
  – Sternal end
  – Acromial end



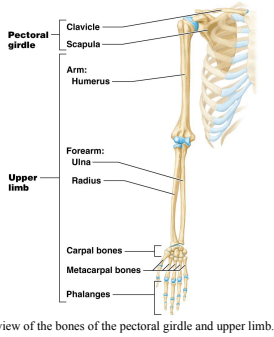
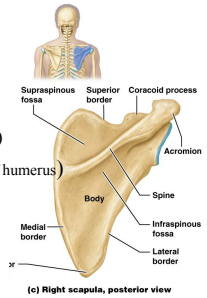


Figure 7.26 Overview of the bones of the pectoral girdle and upper limb.

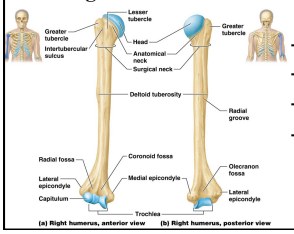
The Pectoral Girdle

- **Scapula**
  - **Acromion**
  – **Coracoid process**
  – **Subscapular fossa** (anterior aspect)
  – **Glenoid cavity** (articulates with head of humerus)
  – **Spine** (_____ *ridge)*
  – **Supraspinous fossa**
  – **Infraspinous fossa**



The Humerus

- **Humerus**
  - **head** articulates with *glenoid cavity* at shoulder joint
  - _____ **neck** is a groove surrounding head
  - _____ **neck** proximal diaphysis
  - **greater & lesser tubercle** lateral and anterior to head



- olecranon fossa
- coronoid fossa
- capitulum
- trochlea

Bones of the Forearm

Bones of forearm (antebrachium)

- **Radius** (_____ bone)
  - head, neck, radial tuberosity, styloid process
- **Ulna** (_____)
  - trochlear notch, olecranon, coronoid process, radial notch, styloid process

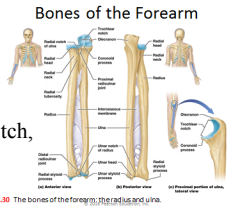


Figure 7.30 The bones of the forearm: the radius and ulna.

Bones of the Wrist: Carpals

Wrist (carpus) – _____ **(carpals)**
(lateral to medial)

- **Scaphoid , Lunate , Triquetrum, Pisiform** (proximal)
- **Trapezium, Trapez**

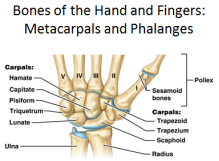


Figure 7.32a The hand and wrist.

Bones of the Hand and Fingers: Metacarpals and Phalanges

Metacarpals – 5 each hand

Phalanges – 14 each hand

- **proximal**, **middle**, and **distal** _____
- **Thumb**
  proximal &
  distal phalanx

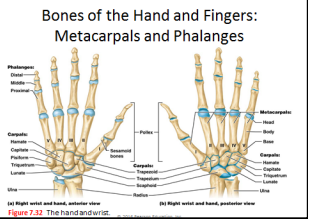


Figure 7.32 The hand and wrist.

Wrist Fractures *(p. 247)*

- Wrist is the most *frequently injured* region of upper limb;
- Fractures

Colles fracture

Bones of the Pelvic Girdle and Lower Limb

Pelvic girdle =

- **coxal bones** (also known as **os coxae**)
- Articulates with **sacrum** (axial skeleton)

Pelvis – bowl-shaped sacrum and two coxal bones; creates *boundary* for pelvic cavity

Pelvic inlet – oval *opening* formed by sacrum and pelvic girdle

Pelvic brim – bony *ridge* surrounding inlet that defines boundaries between **greater** and **lesser pelvis**

Bones of the Pelvic Girdle and Lower Limb

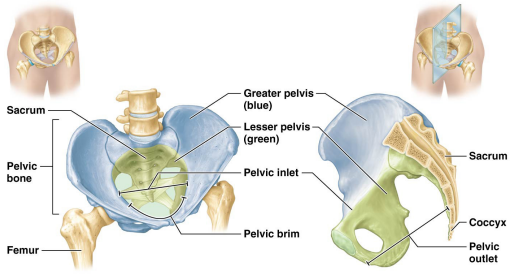


Figure 7.33 The pelvis.

Bones of the Pelvic Girdle and Lower Limb

- Each _____ is composed of 3 *fused bones*: **ilium**, **ischium**, and **pubis**

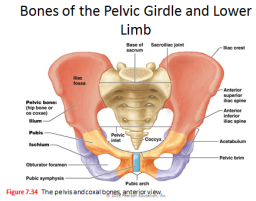


Figure 7.34 The pelvis and coxal bones, anterior view.

Bones of the Pelvic Girdle and Lower Limb

Female and male pelvis differ between genders: female pelvis (adapted for *childbirth*) is *wider* and *shallower* than male

- **Shape of greater pelvis**:
  - pelvis is *wider* in females with *flared* iliac crests
  - increases distance between ASIS
- **Coccyx and sacrum**:
  - female sacrum is *wider* and *shorter* than male sacrum
  - while female coccyx is more *moveable* and more *posterior* than male

Bones of the Pelvic Girdle and Lower Limb

- **Pelvic inlet and outlet**: female inlet is usually *wider* and *oval-shaped* whereas male inlet is *narrow* and *heart-shaped*; female outlet is generally *wider* than male
- **Acetabula**: generally *farther apart* in females and pointed more *anteriorly* than in males
- **Pubic arch**:
  - angle measured in females = _____
  - male arch measures between _____

Bones of the Pelvic Girdle

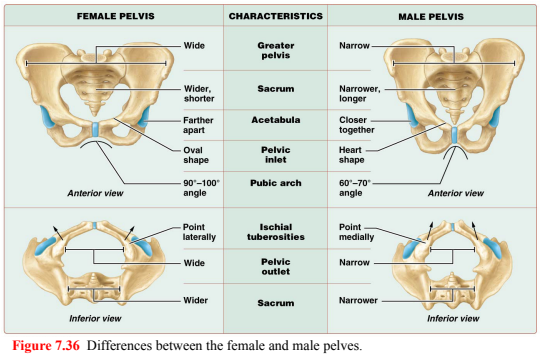
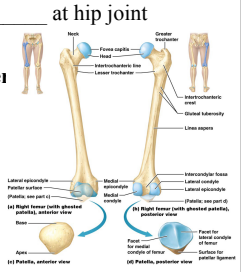


Figure 7.36 Differences between the female and male pelves.

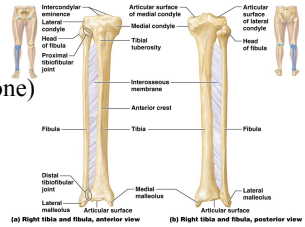
The Femur and Patella

- **Femur** – *largest* and *strongest* bone
  - **head** articulates with _____ at hip joint
  - **Neck**
  - **Greater and Lesser trochanter**
  - **Linea aspera**
  - **Medial** and a **lateral condyles**
  - **Patellar surface**
- **Patella**



Bones of the Leg: Tibia and Fibula

- **Tibia** (_____ bone) larger bone, wt. bearing
  - Tibial tuberosity
  - Medial malleolus
- **Fibula** (_____ bone)
  - Lateral malleolus



Bones of Ankle and Foot: Tarsals, Metatarsals, and Phalanges

- **Tarsals** – *7 short bones*
  - *Proximal* tarsals: _____, **calcaneus**, and **navicular**
  - *Distal* tarsals medial to lateral: 3 **cuneiforms (medial**, **intermediate**, **lateral**) and **cuboid**
- **Metatarsals** – 5 in each foot
- **Phalanges**
  - 14 in each foot

Bones of Ankle and Foot: Tarsals, Metatarsals, and Phalanges

Bones of Ankle and Foot: Tarsals, Metatarsals, and Phalanges

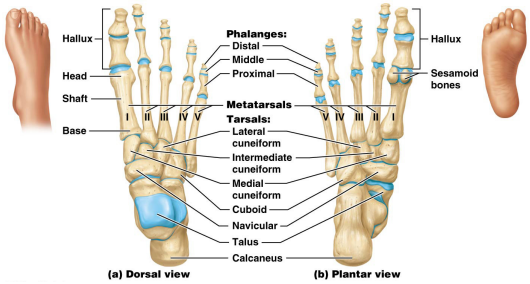


Figure 7.39a, b The ankle and foot.

The Study Boost: Remembering Bones of the Arm and Leg

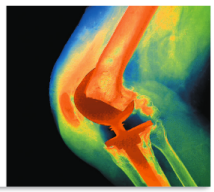
Carpals: Stop Letting The People Touch The Cadaver's Hand = Scaphoid, Lunate, Triquetrum, Pisiform, Trapezium, Trapezoid, Capitate, Hamate

(Mentions "hand", so remember that it describes carpals, not tarsals; trapeziUM is by thUMb)

Tarsals: College Needs Me In Lab Classes

= Talus, Calcaneus, Navicular; Medial, Intermediate, & Lateral cuneiform, Cuboid

8
Articulations



Articulations (joints) = where bones meet

- allow _____
- provide _____
- allow long bones to _____ (epiphyseal plate)

Functional Classification

Based on _____:

- **Synarthrosis** – no *movement* between articulating bones
- **Amphiarthrosis** – small amount of *movement* between articulating bones
- **Diarthrosis** – freely *moveable*, allowing a wide variety of specific movements

Structural Classification

Based on their _____ *features*:

- **Fibrous joints** – *dense regular collagenous CT ;* (synarthroses or amphiarthroses)
- **Cartilaginous joints** – *cartilage*; (synarthroses or amphiarthroses)
- **Synovial joints** – fluid-filled joint capsule with hyaline cartilage at articular ends; (diarthrosis)

Fibrous Joints

3 types:

- **Suture**
- **Gomphosis**
- **Syndesmosis**

Suture - fibrous CT _____ of cranium; *immoveable* joint

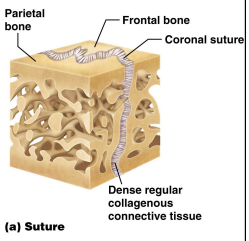
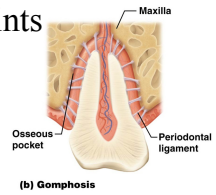


Figure 8.1a The three types of fibrous joints.

Fibrous Joints

- **Gomphosis** – tooth in bony socket (**periodontal ligament**); _____ joint



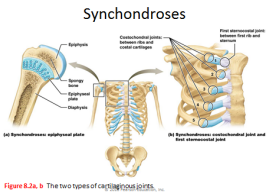
- **Syndesmosis** – joint between tibia & fibula, ulna & radius (interosseous membrane); _____

Figure 8.1b The three types of fibrous joints.

Cartilaginous Joints

2 types:

- **Synchondrosis**
- **Symphysis**



Synchondrosis - *hyaline cartilage*;
Synarthroses (epiphyseal plate, 1st sternocostal and costochondral joints); _____

Epiphyseal Plate Fractures *(p. 260)*

- **Epiphyseal plate** in a child's long bone is one of the *weakest parts* of a developing skeleton;
- **Treatment**

Fibrous Joints

- **Symphysis** – *fibrocartilaginous pad*; *amphiarthrosis*
  - – _____
  - – **Pubic symphysis**

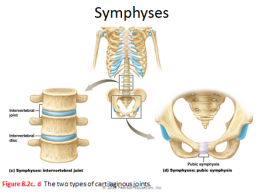


Figure 8.2c, d The two types of cartilaginous joints.

Synovial Joints

Synovial Joints:

- – **Joint cavity (synovial cavity)** – space found between articulating bones
- – **Articular capsule** – double-layered structure
  - Outer fibrous layer
  - Inner synovial membrane → synovial fluid (lubricates, metabolic fcn., shock absorber)
- - _____ **cartilage** – hyaline cartilage; *covers* all exposed articulating bones within a joint
- – **Diarthrosis**

Structural Elements

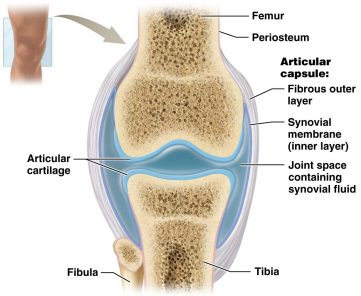
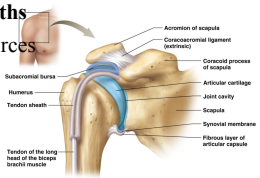


Figure 8.3 Structure of a typical synovial joint.

Stabilizing and Supporting Factors

- Synovial joints allow <u>more</u> *mobility*
  - – <u>less</u> *stable* than other joint types
  - - structures that provide additional stabilization:
    - **Ligament** – dense regular CT connects _____
    - **Tendon** - dense regular CT connects _____
    - **Bursae and tendon sheaths** provide stabilization forces



Bursitis *(p. 264)*

- **Bursitis**
- Most *common sites* of bursitis
- Clinical features

Arthritis

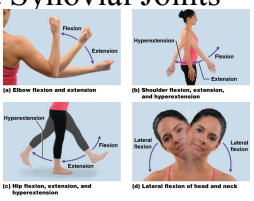
- **Arthritis** – defined as *inflammation* of one or more joints which results in pain and limitations of joint movement:
  - **Osteoarthritis (OA)** – most common; associated with _____, *injuries*, and advanced *age*; characterized by pain, joint stiffness, and lost mobility
  - **Rheumatoid arthritis (RA)** – associated with joint destruction; _____
  - **Gouty arthritis** – joint damage due to inflammatory reaction to _____deposits

Movements at Synovial Joints

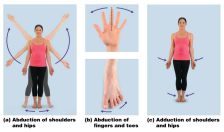
- **Gliding movements** – *sliding motion* between articulating surfaces
- **Flexion**, **Extension**, **Hyperextension**
- **Abduction, Adduction**
- **Circumduction, Rotation**
- **Inversion, Eversion**
- **Supination, Pronation**
- **Dorsiflexion, Plantar flexion**

Movements at Synovial Joints

Gliding movement



Flexion, Extension, Hyperextension

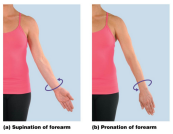


Abduction, Adduction

Movements at Synovial Joints

Rotation at C1-C2

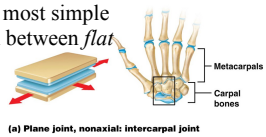
Inversion, Eversion



Dorsiflexion, Plantarflexion

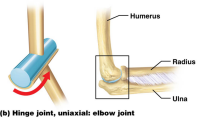
Types of Synovial Joints

- **Plane joint** (gliding joint) – most simple and least mobile articulation between *flat surfaces* of two bones



(a) Plane joint, nonaxial: intercarpal joint

- **Hinge joint** – *convex* articular surface of one bone interacts with *concave* depression of second bone

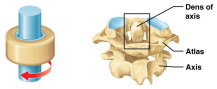


(b) Hinge joint, uniaxial: elbow joint

Figure 8.11a The six types of synovial joints and motion allowed at each.

Types of Synovial Joints

- **Pivot joint** – one bone pivots or rotates around other



(c) Pivot joint, uniaxial: atlantoaxial joint

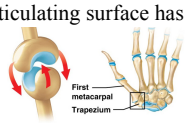
- **Condylar (ellipsoid) joint** – *convex* surface of one bone fits into concave articular surface of a second bone

(d) Condylar joint, biaxial: metacarpophalangeal joint

Figure 8.11c The six types of synovial joints

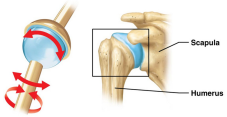
Types of Synovial Joints

- **Saddle joint** – each bone's articulating surface has both a *concave* and *convex* region



(e) Saddle joint, biaxial: carpometacarpal joint of thumb

- **Ball-and-socket joint** – spherical surface of one bone fits into *cup-shaped depression* in second bone



(f) Ball-and-socket joint, multiaxial: shoulder joint

Figure 8.11e The six types of synovial joints.

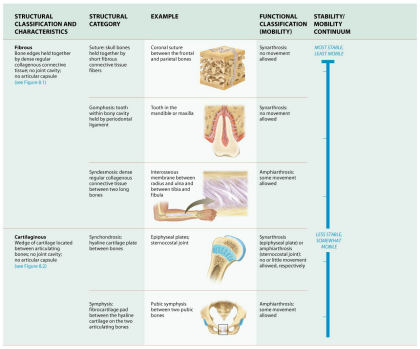


Figure 8.12 The Big Picture of Joint Classifications and Stability versus Mobility.

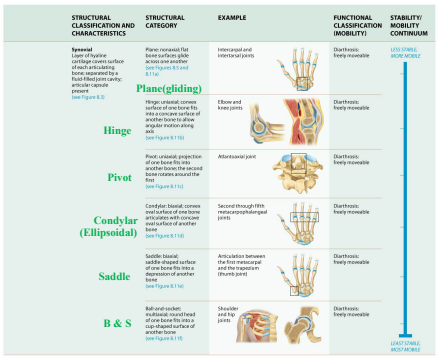


Figure 8.12 The Big Picture of Joint Classifications and Stability versus Mobility.

Specific Hinge Joints

Elbow – very stable hinge joint (**Figure 8.13**):

- **Humeroulnar joint** – articulation between *trochlea* of humerus and *trochlear notch* of ulna

(a) Anterior view

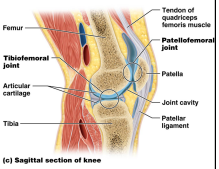
- **Humeroradial joint** – articulation between *capitulum* of humerus and *head* of radius

(b) Sagittal view

A&P Flix: Movement at the Elbow

Specific Hinge Joints

- **Knee**:
  - **_____ joint** – articulation between *femoral and tibial condyles*
  - **Patellofemoral joint** – articulation between posterior surface of *patella* and anterior patellar surface of *femur*



(c) Sagittal section of knee

  - **Medial** and **lateral meniscus** – fibrocartilage *pads* between femoral and tibial condyles
  - **Tibial collateral ligament** (medial collateral) – connects femur, medial meniscus, and tibia to one another to provide *medial joint stabilization*

Specific Hinge Joints

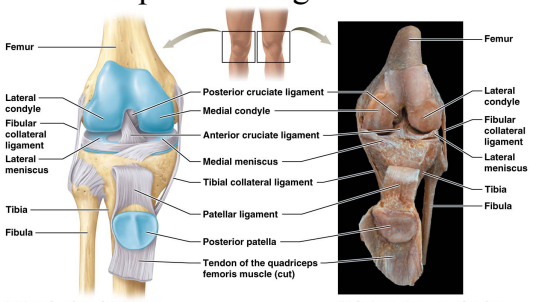
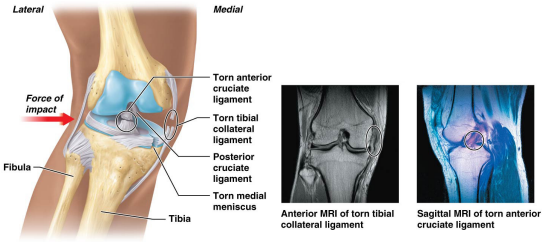


Figure 8.14a, b Anatomical structure of the knee joint.

A&P Flix: Movement at the Knee Joint

Knee Injuries and the Unhappy Triad *(p. 276)*



Specific Hinge Joints

- **Shoulder** (_____) – ball-shaped head of *humerus* and *glenoid cavity:*
  - **Glenoid labrum** – *fibrocartilaginous ring*; increases depth of glenoid cavity to provide more *stability*
  - **Biceps brachii tendon** - helps keep head of humerus within glenoid cavity
  - **Rotator cuff**, providing most of joint's structural stabilization: _____, **infraspinatus**, **subscapularis**, and _____

Specific Hinge Joints

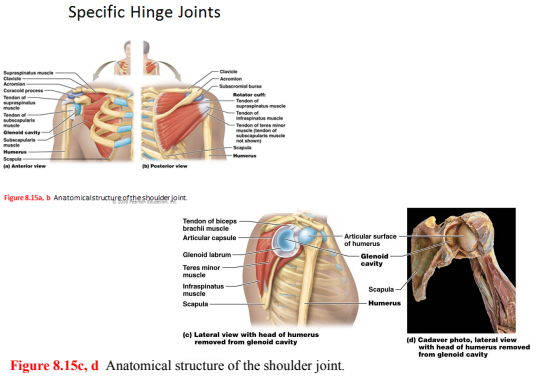
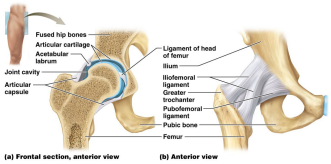


Figure 8.15c, d Anatomical structure of the shoulder joint.

A&P Flix: Movement at the Glenohumeral Joint

Specific Hinge Joints

- **Hip** (_____) – *acetabulum* and ball-shaped *head of femur*:
  - **Acetabular labrum** – *fibrocartilaginous ring* that helps to stabilize head of femur within acetabulum



Specific Hinge Joints

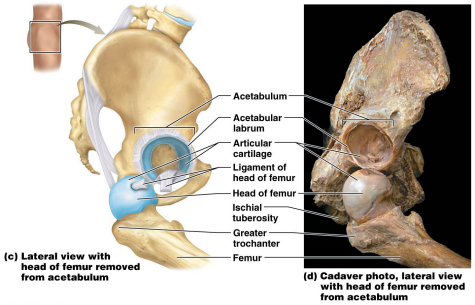


Figure 8.16c, d Anatomical structure of the hip joint.

A&P Flix: Movement at the Hip Joint

Hip Joint Replacement Surgery *(p. 279)*

- **Hip replacement** – surgical procedure that replaces a painful damaged joint with an *artificial prosthetic device*
- Severe *arthritis*, *trauma*, *fractures*, and *bone tumors* can all progress to point where hip joint replacement is an option

Hip Joint Replacement Surgery *(p. 279)*

- **Total replacement**
- **Partial replacement**