BSC2085L
Anatomy & Physiology 1 LAB

E-Book (Part 2)

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(Bone Tissue, Bones and bone markings (parts), Joints, Cell, Integument)
LONG BONE: Structures

Long bones: Humerus, Radius, Ulna, Femur, Tibia, Fibula, Phalanges

A long bone has diaphysis (shaft), a long slender middle section, and epiphysis (head, base), two ends (proximal and distal). The epiphysis and diaphysis are separated by metaphysis, the region or area where an epiphyseal line, a scar (line) where active bone growth had occurred earlier can be seen. Compact bone layer surrounds a central medullary (marrow) cavity. The outermost layer of compact bone is the periosteum and endosteum, the innermost layer is found facing the marrow cavity. Spongy (cancellous) bone is found mainly toward the epiphysis. Articular (hyaline) cartilage can be seen externally at both ends.
TEST YOURSELF
(Identify the labelled parts)
BONE TISSUE MODEL

Video  http://www.youtube.com/watch?v=BGzdpgc0or4&feature=youtu.be

**Osteon** (large circle(s) with rings and a central hole), **Concentric Lamellae** (the rings inside the circle), **Osteocyte(s)** (cell(s) of bone tissue that appear as dots in the rings), **Lacuna(e)** (space(s) in which the osteocyte is found or resides, hard to see with the eye), **Canaliculi** (canals that link the adjacent osteocytes); **Central (Haversian or Osteonic) Canal** (passage in the middle of each osteon), **Periosteum** (outermost layer of compact bone)
BONE TISSUE SLIDE

Video Link:  http://www.youtube.com/watch?v=jldYo_AfkCU&feature=channel

Osteon (large circle(s) with rings and a central hole), Concentric Lamella(e) (the rings inside the circle), Osteocyte(s) (cell(s) of bone tissue that appear as dots in the rings), Lacuna(e) (space(s) in which the osteocyte is found or resides, hard to see with the eye), Canaliculi (canals that link the adjacent osteocytes); Central (Haversian or Osteonic) Canal (passage in the middle of each osteon)
CARTILAGE TISSUE

HYALINE CARTILAGE

Note:
Appearance:
few chondrocytes (cells), lot of matrix (space) – cells appear like dew drops on a windshield

Function:
Found in areas where it allows some degree of flexibility as in the costal cartilage of ribcage. Much less flexible than elastic cartilage, more than fibrocartilage.

FIBRO CARTILAGE

Note: mostly fibers with very few cells – fibers appear like hills and valleys. Nuclei of chondrocytes (cells) appear as tiny spots.
SKELETON (209 bones)

AXIAL SKELETON (↔)

- Skull (22 bones: 8 cranial, 14 facial)
- Ribcage (24 bones)
- Vertebral Column (26 (33) bones)

APPENDICULAR SKELETON (↔)

- Pectoral Girdle
  (attaches bones of arm to the axial skeleton)
  - Clavicle (collar bone) (2)
  - Scapula (shoulder bone) (2)

Bones of Arm (30/arm)
- Humerus (arm)
- Radius (lateral bone of forearm)
- Ulna (medial bone of forearm)

Hand (27 bones)
- Carpal (wrist) Bones (8)
- Metacarpal (palm) Bones (5)
- Phalanges (bones of fingers) (14)
  (phalanx = singular)

- Pelvic Girdle
  (attaches bones of leg to the axial skeleton)
  - Os Coxa (e) (hip bone(s)) (2)
    1. Ilium
    2. Ischium
    3. Pubis

Bones of Leg (29/leg)
- Femur (thigh)
- Tibia (medial leg)
- Fibula (lateral leg)
- Patella (knee bone)

Foot (26 bones)
- Tarsal (ankle) (7)
- Metatarsal (sole) bones (5)
- Phalanges (bones of toes) (14)
  (phalanx = singular)
SKULL (anterior view)

Video Links:
http://www.youtube.com/watch?v=1v1SDv3ZUrE&feature=youtu.be Dr. Chandra
http://www.youtube.com/watch?v=Nc5lRj3OIjE&feature=PlayList&p=C50FD8ACF0A598EF&index=10
http://www.youtube.com/watch?v=Nc5lRj3OIjE&list=PLMaKvMvUYmGx5lJko1BNOMD7nLrwPKOc7

Bones (seen here) : Frontal (1) (front), Nasal (2) (bridge of nose), Zygomatic (3) (cheek), Maxilla (4) (upper jaw), Mandible (5) (lower jaw), Vomer (6) inferior part of nasal septum), parts of Ethmoid bone (posterior to nasal bones), Lacrimal bones (posterior and lateral to nasal bones)

Bone Markings (parts/structures): Perpendicular plate of Ethmoid bone (7) (superior part of nasal septum), Nasal concha(e) (8) (projections lateral to nasal septum), Mental foramen (9) (hole) of mandible, Mental Protuberance (10).
**SKULL** (lateral view)

**Bones:** Frontal (1), Parietal (2), Temporal (3), Occipital (4)

**Sutures:** **Sagittal** (5) (separates Parietal bones), **Frontal or Coronal** (6) (separates Frontal and Parietal bones), **Squamous** (7) (separates Parietal and Temporal bones), **Lambdoid** (8) (encloses Occipital bone)
**SKULL** (lateral view)

**Zygomatic Arch** is formed by Zygomatic process (1) of Temporal bone and Temporal Process (2) of Zygomatic bone (see thin suture separating the two processes of the respective bones)

Note: The names of the processes are derived based on which bone each process articulates with)

(Markings/Parts): Temporal bone (3), Zygomatic process (1), Temporal process (2), Zygomatic bone (4)
SKULL (inferior view)

Palatine process of Maxilla (1), Palatine bone(s) (2)

Occipital Bone: Foramen Magnum (3) (large hole); Occipital condyle (4) (raised and smooth, on either side of the large hole)
SKULL (inferior view)

**Temporal Bone:** Zygomatic Process (1) of Temporal bone (articulates with Zygomatic bone)

External Acoustic Meatus (2) (passage)  Mastoid process (3) (thick projection)

Styloid process (4) (stylus-like)  Mandibular Fossa (not seen, cavity where mandible articulates with the skull) (5)
SKULL (anterior view)

Foramen (hole)/Fissures

Note: foramen (singular), foramina (plural)

(Markings/Parts): Supra Orbital Ridge (1), Supra Orbital Foramen (2), Infra Orbital Foramen (3), Optic Foramen (4), Supra Orbital Fissure (5), Infra Orbital Fissure (6),
SKULL (inferior view)

Foramina (holes): (foramen (singular), foramina (plural)) Foramen Magnum (1) (on occipital bone), Jugular Foramen (2), Carotid Canal (3), Foramen Lacerum (4), Foramen Ovale (5) (oval-shaped), Foramen Spinosum (6) (small)
**SKULL** (floor of the cranium (inside skull))

Bone Markings (parts):

**Ethmoid bone:** Crista Galli (1) (sharp, pointed projection), Cribriform Plate (2) with Cribriform Foramen (3)

**Sphenoid bone:** Sella Turcica (depression) (4), Lesser wing (5) (shorter wing), Greater wing (6) (longer wing)
RIBCAGE

Video Link: [http://www.youtube.com/watch?v=Qg9-SzrwAzw&feature=youtu.be](http://www.youtube.com/watch?v=Qg9-SzrwAzw&feature=youtu.be)

Ribs: True ribs (1) (pairs 1 to 7), False ribs (2) (pairs 8, 9, 10), Floating ribs (3) (pairs 11, 12), Costal cartilage (4) (hyaline cartilage connecting ribs to sternum)

Sternum (bone in the middle of rib cage): Manubrium (5) (superior broad end), Body (6) (middle portion), Xiphoid Process (7) (inferior pointed/narrow end)
**RIB**

**Video Link:** [http://www.youtube.com/watch?v=4L-otE0P6KY](http://www.youtube.com/watch?v=4L-otE0P6KY)

Note: Rib articulates anteriorly with the sternum and posteriorly with the vertebral column

**Rib:** Head (1), Neck (2), Angle (3) (curve), Tubercle (4) (tiny bump), Costal Groove (5) (groove)
VERTEBRAL COLUMN

Video Link: http://www.youtube.com/watch?v=6Lo6U-EHB0o&feature=youtu.be

Curvatures (four): Cervical (1), Thoracic (2), Lumbar (3), Sacral (4) (sacrum and coccyx are in the same curvature)

Regions/Divisions (five): Cervical, Thoracic, Lumbar, Sacral, and Coccygeal (5)
**VERTEBRA**

**Parts of a vertebral bone:**
- Body (main part) (1)
- Vertebral foramen (hole) (2)
- Spinous process (sharp projection located posteriorly) (3)
- Transverse process (4)
- Lamina (area between transverse and spinous processes) (5)
- Pedicle (area between body and transverse process) (6)
- Facet (smooth, flat articulating surface, superior/inferior depends on the location of facet) (7)
VERTEBRAE

Cervical Vertebrae (1) (C1 to C7): (note: Transverse Foramen (4) – only in cervical vertebrae)

C1 (Atlas) and C2 (Axis) together (1)

C1 (Atlas), C2 (Axis) and typical C3 to C7 (bottom, left):

- **Atlas (C1)** (2) has no body and no spinous process.
- **Axis (C2)** (3) has a superior process – “Dens” or “Odontoid Process” and a Bi-fid Spinous Process. Body is inferior to the “Dens”. C3 to C7 look alike.

Thoracic Vertebrae (5) (T1 to T12): (top, right) (note: body is thicker than cervical vertebrae, spinous process pointing more down and sharp ended (5))

Lumbar Vertebra (6) (L1 to L5): (bottom, right) (note: body is even thicker than thoracic vertebrae, spinous process pointing horizontally and thick & blunt ended (6))

Video Link(s) to compare vertebrae:
http://www.youtube.com/watch?v=s7J4Gb4T9_s&list=PLMaKVmvUYmGzwMK_oc0qnX9hJNdjzE_r
CERVICAL VERTEBRA - Superior View (C3 to C7)

Video Link for Cervical vertebra:
http://www.youtube.com/watch?v=vi7NuCGKzoY&feature=PlayList&p=6098E914B07DED08&index=11

CERVICAL VERTEBRA - Inferior View (C3 to C7)
THORACIC VERTEBRA - Superior View (T1 to T12)

THORACIC VERTEBRA - Inferior View (T1 to T12)

Video Link for Thoracic Vertebra:
http://www.youtube.com/watch?v=FC4Fv_bBlyo&feature=PlayList&p=6098E914B07DED08&index=12
Video Link for Lumbar Vertebra:
http://www.youtube.com/watch?v=KXTebj8n-J0&feature=PlayList&p=6098E914B07DED08&index=14

LUMBAR VERTEBRA - Superior View (L1 to L5)

LUMBAR VERTEBRA - Inferior View (L1 to L5)
IDENTIFY THE VERTEBRA(E)

“Alligator head”

“Giraffe’ head”

“Moose’ head”
IDENTIFY THE VERTEBRA(E) & Parts?
- S1 (1)
- Anterior Sacral Foramen (hole)
- Transverse Line (horizontal line)
- S2 (2)
- S3 (3)
- S4 (4)
- S5 (5)
- Facet, articular (1)
- Lateral Sacral Crest (2)
- Median Sacral Crest (3)
- Posterior Sacral Foramen (4)
- Ala (5)
- Sacral Promontory (6)
COCCYX

- Transverse Process
- Co1 (1)
- Co2 (2)
- Co3 (3)
- Co4 (4)
PECTORAL GIRDLE (Clavicle and Scapula)

Video Link: http://www.youtube.com/watch?v=iLuJapEdzwc&feature=youtu.be

CLAVICLE (collar bone) http://www.youtube.com/watch?v=nzy4tOStTQE

Acromial end (1) (more curved end)  Sternal end (2)
Conoid Tubercle (3) (on inferior side of acromial end)
SCAPULA (shoulder bone) (anterior view)

Markings: Acromion Process (1), Coracoid Process (2), Scapular notch (3), Subscapular Fossa (4); Angles (Superior (5), Inferior (6), Lateral (7)), Borders (Superior (8), Medial (9), Lateral (10))
**SCAPULA** (shoulder bone) (posterior view)

**Markings:** Acromion Process (1) (extends from spine), Coracoid Process (2), Scapular Spine (3), Supraspinous Fossa (4) (above spine), Infraspinous Fossa (5) (below spine), Glenoid Fossa/cavity (6) (cavity or depression at lateral angle, where humerus will articulate or attach)
HUMERUS (1), RADIUS, lateral (2) & ULNA, medial (3) (right arm, anterior view)
HUMERUS
(anterior view)

- Greater Tubercle (1) (larger, lateral)
- Lesser Tubercle (2) (smaller, medial)
- Intertubercular Groove (3) (between the tubercles)

- Deltoid Tuberosity (4) (rough area)

Video Link for Humerus:  http://www.youtube.com/watch?v=cFZxXrQVyAA

- Medial Epicondyle (5)
- Lateral Epicondyle (6)
- Radial Fossa (lateral, shallow) (7)
- Coronoid Fossa (medial, deep) (8)
- Trochlea (medial, spool-like) (9)
- Capitulum (lateral) (10)
HUMERUS
(posterior view)

- Anatomical Neck (1)
  (ridge going around head)

- Surgical Neck (2)
  (below head)

- Olecranon Fossa ("O" shaped)
  (ulna’s larger process articulates with this cavity)
**RADIUS & ULNA** (right arm) (anterior view)


**Note:** Radius is lateral, has a flat & rounded **head** (1) with a **radial tuberosity** (2)  
Ulna is medial, has “U”-shaped **ulnar or trochlear notch** (3) (looks like a wrench)  
Both Radius and Ulna have stylus-like projections (**styloid process** (4)) at the base
**RADIUS (parts - closer view)**


Head of radius (1), Radial Tuberosity (2) (raised, rough), Styloid Process (4) (stylus-like)

**ULNA (parts - closer view)**

Video Link: [http://www.youtube.com/watch?v=Jh4a_dXIXnF](http://www.youtube.com/watch?v=Jh4a_dXIXnF)

Olecranon Process (5), articulates with Olecranon Fossa of Humerus
Coronoid Process (6), articulates with Coronoid Fossa of Humerus
Trochlear Notch (3), notch articulates with Trochlea
Styloid Process (4, stylus-li)
HAND (right, anterior view) (8 carpal, 5 metacarpal bones & 14 phalanges)

In each hand, the bones are numbered starting with the Thumb as I, II, III, IV & V.

Each Carpal Bone has an individual name (Lateral to Medial):

Proximal row: Scaphoid (largest), Lunate, Triquetrum (triangular), Pisiform (like pea seed)
Distal row: Trapezium, Trapezoid, Capitate, Hamate with a hook (Hamulus)

Mnemonic to remember carpal bones (Lateral to Medial) in either hand, right or left:

She (scaphoid) Left (Lunate) The (Triquetrum) Party (Pisiform)
To (Trapezium) Take (Trapezoid) Cindy (Capitate) Home (Hamate)

Video Link: [http://www.youtube.com/watch?v=Z6jUzWUGcOs](http://www.youtube.com/watch?v=Z6jUzWUGcOs)
HOW TO REMEMBER YOUR CARPAL BONES

Color the different carpals different colors.

The carpals should be viewed as two rows of 4 bones each.

You can use the mnemonic,

"Sandy Left The Party To Take Cathy Home"

Move across the top row beginning at the thumb side. Then, proceed in the same direction for the bottom row.
Can you identify the individual Carpal Bones? Can you number & name the Metacarpal bones and the Phalanges? Note: Phalanx (singular), Phalanges (plural)
Can you identify the individual Carpal Bones? Can you number & name the Metacarpal bones and the Phalanges? Note: Phalanx (singular), Phalanges (plural)
The Pelvic Girdle is made of two Os Coxae.

Each Os Coxa is made of 3 bones: Ilium (1) (broad and large), Ischium (2) (inferior and posterior), Pubis (3) (superior and anterior)

- The articulation (joint) between Ilium of Os Coxa and Sacrum is the Sacroiliac (4) or Iliosacral joint.
- Ilium has an “Iliac fossa” (5) anteriorly, and a superior raised, rough edge “Iliac Crest” (6)
- Femur articulates with a lateral cavity (fossa), the “Acetabulum” (7)
- Pubic bones are separated by an interpubic disc (fibrocartilage), the “Pubic Symphysis” (8)
- Sciatic nerve passes through the large “O”-shaped large hole, “Obturator Foramen” (9)
- Ischium has a rough tuberosity “Ischial Tuberosity” (10) on the posterior side
TEST YOURSELF ON PELVIC GIRDLE
FEMUR (right, anterior view)

Video Link: http://www.youtube.com/watch?v=9aMr4Gi_KUI
**FEMUR (thigh bone)**

**Anterior View:** Head of Femur (1) (rounded projection); condyles (medial (2), lateral (3)), epicondyles Imedial (4), lateral (5))

**Posterior View:** (Superior end) Greater Trochanter (7) (larger process), Lesser Trochanter (8) (smaller process), Inter Trochanteric Crest (9) (ridge connecting both processes); (Inferior end) Condyles (medial & lateral), Epicondyles (medial & lateral), Intercondylar fossa (6) (cavity between the condyles), Linea Aspera (10) (not seen fully in this view, a sharp line that runs along the length of the
TIBIA & FIBULA (LEFT LEG) (anterior view)

Note: Tibia is medial and thicker bone. Fibula is lateral and finer
TIBIA & FIBULA (LEFT LEG) (anterior view)

Video Link: [http://www.youtube.com/watch?v=bPUwxiyEqJ0](http://www.youtube.com/watch?v=bPUwxiyEqJ0)

Head of Tibia (1) (superior end)

Intercondylar Eminence (projection between condyles) (3)

Tibial Tuberosity (2) (raised, rough area for anterior thigh muscle attachment)

Medial malleolus (4) (large process)
FIBULA

- Head of Fibula
  (note the line on the head)

- Lateral Malleolus
FOOT (right, superior view) (7 tarsal, 5 metatarsal bones & 14 phalanges)

Video Links:
http://www.youtube.com/watch?v=SJqV8Zkvmsg&feature=PlayList&p=C50FD8ACF0A598EF&playnext=1&playnext_from=PL&index=8
http://www.youtube.com/watch?v=bNwQisF8ND0

Bones are numbered starting with the Big Toe in each foot. Roman Numerals are used (I, II, III, IV, V)

Tarsal Bones:
Proximal row: Talus (inferior to tibia), Calcaneus (heel bone, inferior to Talus), Navicular, Cuboid (cube-like)
Distal row: Cuneiform bones (Medial (I, first), Intermediate (II, second), Lateral (III, third))

Note: Phalanx (singular)  Phalanges (plural)

Mnemonic to remember Tarsal bones:

Chris (Calcaneus, largest)  Told (Talus)  Natasha (Navicular)  Milk (Medial Cuneiform)  Is (Intermediate Cuneiform)  Like (Lateral Cuneiform)  Cream (Cuboid, cube-like)
HOW TO REMEMBER YOUR TARSAL BONES

Color the different tarsals different colors.

Schematic of the foot

Tarsals (color)
Metatarsals (grey)
Phalanges (white)

The tarsals should be viewed as the schematic diagram above.

You can use the mnemonic, "Cat Told Nora, Milk Is Like Cream!"

Right foot superior view

TARSALS

Phalanges

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
SHOULDER ARTICULATION

Video Link: http://www.youtube.com/watch?v=5jPvwIYiHsg&feature=youtu.be

Note: Ligament attaches bone/part to another bone/part; Tendon attaches muscle to bone

(Both are made of fibrous connective tissue) Link: http://www.nlm.nih.gov/medlineplus/ency/imagepages/19089.htm

Ligaments:
1 Acromioclavicular Ligament (connects acromion to clavicle)
2 Coracoclavicular Ligament (connects coracoid process to clavicle (two short, under clavicle))
1 Coracoacromial Ligament (connects coracoid process to acromion process)
3 Glenohumeral Ligament (connects glenoid fossa to humerus, one not seen in this view)
1 Coracohumeral Ligament (connects coracoid process to humerus)

Note: Names of ligaments start with a marking or part on the scapula and end with a marking or bone to which each ligament attaches (example: acromioclavicular attaches acromion process of scapula to clavicle, coracoacromial ligament attaches both processes of scapula)
KNEE ARTICULATION

Video Link:
http://www.youtube.com/watch?v=dOfVaLiVel8&feature=youtu.be

- **Anterior View (Right Knee)**
  - Quadriceps Tendon
    (above the Patella, attaches Quadriceps (anterior thigh) muscles)
  - Patellar Ligament
    (attaches to Patella)

- **Posterior View (Right Knee)**
  - Tibial (Medial) Collateral Ligament
    (seen on the medial side of joint)
  - Fibular (Lateral) Collateral Ligament
    (seen on the lateral side of joint)
  - Medial Meniscus
    (between medial condyle of Femur and medial Tibial head)
  - Lateral Meniscus
    (between lateral condyle of Femur and lateral Tibial head)
  - Anterior Cruciate Ligament (ACL)
    (tail end of ACL is visible between condyles of Femur in the intercondylar fossa)
  - Posterior Cruciate Ligament (PCL)
    (inferior, small piece touching the head of Tibia)
KNEE ARTICULATION

Can you identify the various ligaments on this Knee articulation?
Can you identify the various STRUCTURES? **Cell Membrane/Plasma Membrane** (wraps around cell), **Nucleus** (whitish, in middle), **Nucleolus** (orange, inside nucleus), **Ribosomes** (white dots), **Endoplasmic Reticulum** (ER, bluish channels with **Rough ER** and without white dots attached **Smooth ER**), **Golgi Complex or Apparatus** (pink channels), **Mitochondrion** (a) (orange colored), **Lysosome** (yellow), **Peroxisome** (grey, looks like lysosome), **Centrioles/Centrosome** (brown area above and close to nucleus)
**Epidermis:** Stratum Corneum, Lucidum (thick skin), Granulosum, Spinosum, Basale (Mnemonic to remember the five strata: Come Let’s Get Sun Burn)
- Stratified squamous epithelial tissue found in all strata, except S. Lucidum and S. Basale (they have simple squamous).
- Melanocytes (melanin: color pigment, UV protection, mainly in S. Basale) and Keratinocytes (Keratin: water-resistant protein, found in large numbers in other strata as cells move up the different strata. Accumulation of Keratin damages cell, cell loses shape, becomes like flakes (dander) and exfoliate (fall off)).

**Dermis**
- Papillary Layer (superior half): Dermal Papillae (finger-like projections, seen on superior surface of dermis), areolar tissue present
- Reticular Layer (inferior half): Dense irregular connective tissue (mainly) present

**Hypodermis** (subcutaneous layer) Fat containing Adipose (primary) and some areolar tissue below dermis/skin

**Accessory Organs:**
- Meissner’s Corpuscle (mild or gentle touch sensation, when someone touches or something crawling on your skin),
- Pacinian Corpuscle (pain, pressure detection, when you have deep injury or wound or when someone applies lot of pressure)
- Pilo erector or Arrector Pili (muscle that makes hair stand erect, when one gets goosebumps)

**Glands:**
- Sudoriferous Gland (sweat) – two types: Apocrine (hairy regions: Anus, Armpit (Axilla), Groin) Microcrine (Eccrine)-more common (scalp)
- Sebaceous Gland (oil) – attached to hair (appears like a pair of wings on the hair)
REVIEW links
(go through all these links to review before exam)

Complete REVIEW for AP1 Lab (BSC2085L) Midterm by Dr. Chandra: [http://www.youtube.com/playlist?list=PLMaKVmUYmGyruAneAQ1koV_idKod6Ssk](http://www.youtube.com/playlist?list=PLMaKVmUYmGyruAneAQ1koV_idKod6Ssk)

INTERACTIVE
2. Tutorial site: [http://www.gwc.maricopa.edu/class/bio201/skeleton.htm](http://www.gwc.maricopa.edu/class/bio201/skeleton.htm)

Printable bone pictures to label and self-study: (to print, write out and check your spelling) [http://anatomycorner.com/skeletal/printables.html](http://anatomycorner.com/skeletal/printables.html)

PBSC Biology Website Images (just in case you need):
[https://picasaweb.google.com/103735086878095926179](https://picasaweb.google.com/103735086878095926179)

More links (if you need even more help)!!

“Go Palmbeach State” “Student Success Our Goal”

Best Wishes,

Dr. Chandra