The Skeletal System: Appendicular Skeleton

The Big Idea
- The Appendicular Skeleton & Homeostasis
  - The bones of the appendicular skeleton contribute to homeostasis by providing attachment points and leverage for muscles, which aids body movements; by providing support and protection of internal organs, such as the reproductive organs; and by storing and releasing calcium
- The 126 bones of the appendicular skeleton are primarily concerned with movement
  - As “appendages” to the central skeleton, these bones include those of the upper and lower limbs (including the girdles that attach them to the axial skeleton)

8.1 Pectoral (Shoulder) Girdle
- Objectives
  - Identify the bones of the pectoral (shoulder) girdle, their functions, and their principal markings
- The bones of the shoulder (pectoral) girdle include the scapula and the clavicle
  - The shoulder joint also incorporates the upper part of the humerus

Ex. 8A Clavicle
- The clavicle is “S” shaped
  - The medial end articulates with the manubrium of the sternum forming the sternoclavicular joint
  - The lateral end articulates with the acromion forming the acromioclavicular joint

Ex. 8B Scapula
- The triangular shaped scapula is also called the shoulder blade
  - Spine - a large process on the posterior of the scapula
  - Acromion - the flattened lateral portion of the spine
  - Coracoid process - a protruding projection on the anterior surface just inferior to the lateral aspect of the clavicle
  - Glenoid cavity - shallow concavity that articulates with the head of the humerus
8.2 Upper Limb (Extremity)

- Objectives
  - Identify the bones of the upper limb and their principle markings

- Each of the two upper limbs contains 30 bones
- The bones of each upper limb include the humerus, ulna, radius, carpals, metacarpals, and phalanges

Ex. 8C Humerus
- The only bone in the arm is the humerus
- The head of the humerus has two projections
  - The greater tubercle lies more laterally
  - The lesser tubercle lies more anteriorly
- Between the tubercles lies the intertubercular groove or sulcus (bicipital groove) where the long head of the biceps brachii tendon is located

Ex. 8D Ulna & Radius
- The two bones of the forearm are the radius and ulna
- The radius is lateral (in anatomic position) and widens distally
- The more medial ulna widens proximally into the olecranon process, a large prominence we feel as the tip of the elbow
- The diaphysis (shaft) of the radius and ulna are connected by an interosseus membrane
- There is a proximal radioulnar joint and a distal radioulnar joint
  - Proximally, the head of the radius articulates with the radial notch of the ulna
  - Distally, the head of the ulna articulates with the ulnar notch of the radius

Ex. 8E Carpals, Metacarpals, & Phalanges
- The hand is composed of the wrist, the palm, and the fingers
  - The wrist, or carpus, is made up of 8 carpals bones arranged in two rows
  - The palm of the hand has 5 metacarpal bones
- Each finger, with the exception of the thumb or 1st digit, is composed of 3 phalanges
  - Proximal phalanx
  - Middle phalanx
  - Distal phalanx
- The joints of the hand include the carpometacarpal, metacarpophalangeal, and interphalangeal joints
8.3 Pelvic (Hip) Girdle

- Objectives
  - Identify the bones of the pelvic girdle and their principle markings

- The lower limb is directly anchored to the axial skeleton by a sacroiliac joint which links the pelvic bone to the sacrum
- Based on the position of its major joints and component bones, the lower limb is divided into the gluteal region (the major bones forming the hip girdle), thigh, leg, and foot
  - The gluteal region is between the iliac crest and hip joint
  - The thigh is between the hip and the knee joint
  - The leg is between the knee and the ankle
  - The foot is distal to the ankle

- In the gluteal region, the pelvic girdle is made up of two os coxae, or hip bones
  - Each coxal (hip) bone consists of 3 bones that fuse together
    - Ilium
    - Ischium
    - Pubis

- On the right and left sides, the os coxae are joined posteriorly to the sacrum, and anteriorly to one another at the pubic symphysis (made of fibrocartilage)
  - The free part of the lower limb below the hip joint is composed of 30 different bones

- The ilium is the largest of the three hip bones, it forms the superior lateral prominence of the pelvis (iliac crest)
  - Consists of a superior ala and inferior body which forms the acetabulum (the socket for the head of the femur)
  - Greater sciatic notch allows passage of the sciatic nerve

- The ischium constitutes the inferior and posterior part of the hip bone
  - Its most prominent feature is the ischial tuberosity, the part that meets the chair when you are sitting

- The pubis is the anterior and inferior part of the hip bone
  - It has superior and inferior rami and a body

8.4 False & True Pelves

- Objectives
  - Distinguish between the false and true pelves
  - Explain why the false and true pelves are important clinically
• The false pelvis is separated from the true pelvis by the pelvic brim
  • The pelvic brim is a line from the sacral promontory to the upper part of the pubic symphysis
  • The false pelvis lies above this line
  • It contains no pelvic organs except the urinary bladder (when full), the lower intestines, and the uterus, uterine tubes, and ovaries

• The true pelvis is the bony pelvis inferior to the pelvic brim
  • It has an inlet, an outlet and a cavity
  • Surrounds the pelvic cavity and houses the rectum and urinary bladder, the vagina in females, and the prostate in males
  • The pelvic axis is the path of childbirth during the first and second stages of labor

8.5 Comparison of Female & Male Pelves
• Objectives
  • Compare the principal differences between female and male pelves

• Compared to the female pelvis, the male pelvis
  • Is larger, heavier, and more narrow
  • Has a smaller inlet and outlet
  • Has a pubic arch angle of < 90°
  • Has more prominent markings for muscle attachments

• Compared to the male pelvis, the female pelvis
  • Is rounder, has a flared iliac crest, and a wider pelvic opening to assist childbirth
  • It also has a pubic arch angle of > 90° and a more moveable pubic symphysis
  • Has a more flexible coccyx

8.6 Lower Limb (Extremity)
• Objectives
  • Identify the bones of the lower limb and their principal markings

• Each of the two lower limbs contains 30 bones
  • The lower limb is directly anchored to the axial skeleton by a sacroiliac joint which links the pelvic bone to the sacrum
  • Based on the position of its major joints and component bones, the lower limb is divided into the gluteal region (the major bones forming the hip girdle), thigh, leg, and foot
  • The gluteal region is between the iliac crest and hip joint
  • The thigh is between the hip and the knee joint
  • The leg is between the knee and the ankle
  • The foot is distal to the ankle

Ex. 8G Femur & Patella
• The femur is the longest, heaviest, and strongest bone in the thigh, and in the entire body
  • Proximally, the head articulates with the acetabulum of the hip bone forming the hip (coxal) joint
  • The neck (distal to head) is a common site of fracture
  • Distally, the medial and lateral femoral condyles articulate with the tibia to form the knee joint
  • The femur also articulates with patella

• The greater and lesser trochanters are projections where large muscles attach
• The gluteal tuberosity and linea aspera are attachment sites for the large hip muscles
• The femur has sites for attachment of the knee muscles at the medial and lateral epicondyles (above the femoral condyles)

• The patella (knee cap) is the largest and only named sesamoid bone in the body
  • A thick articular cartilage lines the posterior surface
  • At the distal femur, the patella forms the patellofemoral joint where it functions to increase the leverage of the quadriceps muscles
  • Runner’s knee (patellofemoral stress syndrome) is a common sports injury

Ex. 8H Tibia & Fibula
• Of the two bones in the leg, the tibia (always medial) is the largest and bears all the weight
  • The lateral and medial condyles at the proximal end articulate with the femur
  • It articulates distally with the talus of the ankle and the fibula
  • The fibula is the smaller, laterally placed bone of the leg
    • It is non-weight bearing
    • The head forms the proximal tibiofibular joint
    • At the distal end, the lateral malleolus articulates with the tibia and the talus at the ankle

• Much like the forearm bones, the tibia and fibula are joined by an interosseous membrane
  • The distal end of the leg bones form the medial and lateral malleoli of the ankle

Ex. 8I Foot
• The tibia and fibula articulate with the talus bone of the ankle to form the ankle “mortise” (ankle joint)
  • There are many similarities between the hand of the upper limb and the foot of the lower limb
    • The ankle, or tarsus, is made up of 7 tarsal bones arranged to form the ankle mortise, heel, and arches
    • The largest and strongest tarsal bone, the calcaneus, forms the heel
  • Like the palm of the hand, the sole of the foot has 5 bones – in this case called metatarsals.
    • The metatarsals also participate in forming the arches of the
• Each toe with the exception of the hallux (big toe) is composed of 3 phalanges
  • Proximal phalanx
  • Middle phalanx
  • Distal phalanx

• The joints of the foot include the tarsometatarsal, metatarsophalangeal, and interphalangeal joints

• The longitudinal and transverse foot arches support the weight of the body while providing spring and leverage to the foot when walking. Flatfeet occur when the arches decrease or “fall”

• Most bones form from the mesoderm by intramembranous or endochondral ossification
  – Much of the skeleton of the skull arises from ectoderm

• Bones of the limbs develop from limb buds, which consist of mesoderm and ectoderm

8.7 Development of the Skeletal System

• Objectives
  • Describe the development of the skeletal system