Chapter 8: The Appendicular Skeleton

Figure 8-1
- The appendicular skeleton is made up of all bones other than the axial skeleton, including the bones of the limbs and their supporting elements, the girdles. The appendicular skeleton allows us to move and manipulate objects.

I. The Pectoral Girdle and Upper Limbs, p. 240

Objectives
1. Identify the bones of the pectoral girdle, their functions and features.
2. Identify the bones of the upper limbs, their functions and features.

The Pectoral Girdle, p. 240

Figure 8-2a
- The arms connect to the body at the pectoral girdle (shoulder girdle).
  - The pectoral girdle consists of: 2 clavicles and 2 scapulae, which position the shoulders and provide a base for arm movement
  - The pectoral girdle has no connection with the axial skeleton, except at the manubrium of the sternum.

Figure 8-2b,c
- The clavicles (collarbones) are long, s-shaped bones that originate at the manubrium of the sternum (the pyramidal sternal end) at one end and articulate with the acromion of the scapulae at the other end (the broad, flat acromial end).
- The scapulae (shoulder blades) are broad, flat triangles that articulate with the arm and collarbone.

Figure 8-3a
- The body of the scapula has 3 sides:
  1. superior border
  2. medial border (vertebral border)
  3. lateral border (axillary border)
  - and 3 corners:
    1. superior angle
    2. inferior angle
    3. lateral angle
  - The concave anterior surface of the scapula is called the subscapular fossa.

Figure 8-3b
- The lateral angle (head) of the scapula holds the glenoid cavity, which articulates with the humerus to form the shoulder joint.
• The 2 processes that extend around the glenoid cavity are the anterior coracoid process (smaller) and the posterior acromion (larger). The acromion articulates with the clavicle at the acromioclavicular joint.

**Figure 8-3c**
- The scapular spine is a ridge that crosses the posterior surface of the body, dividing it into 2 regions: the supraspinous fossa and the infraspinous fossa.

*The Upper Limbs, p. 242*

• The upper limbs consist of the arms, forearms, wrists and hands. Anatomically, the arm (brachium) consists of only 1 bone, the humerus.

**Figure 8-4**
- The humerus is the long arm bone that articulates with the pelvic girdle.
  - The epiphysis has 2 projections (the lateral greater tubercle, forming the tip of the shoulder, and the anterior, medial lesser tubercle) separated by the intertubercular groove.
  - The rounded head is the articulating surface contained within the joint capsule. The margin of the joint capsule is the anatomical neck, while the narrow metaphysis is called the surgical neck.
  - The bulge halfway along the shaft is the deltoid tuberosity, where the deltoid muscle attaches. The radial nerve runs through a depression (radial groove) posterior to the deltoid tuberosity.
  - At the distal epiphysis, the medial and lateral epicondyles provide additional surface area for muscle attachment.
  - The condyle of the humerus articulates with the 2 bones of the forearm (ulna and radius), and therefore has 2 articular regions:
    1. The trochlea (including the coronoid fossa and olecranon fossa) articulates with the ulna.
    2. The capitulum (and radial fossa) articulate with the radius

**Figure 8-5**
- The forearm (antebrachium) consists of 2 long bones, the ulna (medial) and the radius (lateral).

• The superior end of the ulna (the olecranon) is the point of the elbow, and the superior lip of the trochlear notch, which articulates with the trochlea of the humerus.
  - The inferior lip of the trochlear notch is the coronoid process.
  - When the forearm is extended, the olecranon fits into the olecranon fossa of the humerus.
  - When the forearm is fully flexed, the coronoid process fits into the coronoid fossa of the humerus.
- The head of the radius fits into the **radial notch**, forming the **proximal radioulnar joint**.
- At its distal end, the ulna narrows into a small **ulnar head** with a prominent **styloid process**, which attaches to the cartilage (**articular disc**) that separates the forearm from the wrist.

- A fibrous sheet, the **interosseous membrane**, connects the lateral margin of the shaft of the ulna to the radius.

- The lateral bone of the forearm, the **radius**, has a disk-shaped *radial head* above the neck, and a **radial tuberosity** below the neck, where the biceps attach.
  - At its distal end, the radius articulates with the ulna at the **ulnar notch**, and with the wrist. The **styloid process** stabilizes the wrist joint.

**Figure 8-6**
- The wrist is made up of 8 **carpal bones**: 4 **proximal carpal bones** and 4 **distal carpal bones**. The articulations of the carpal bones allow the wrist to bend and twist.

- The 4 **proximal carpal bones** are:
  1. **scaphoid bone**:
     - closest to the styloid process of the radius
  2. **lunate bone**:
     - medial to the scaphoid, articulates with the radius
  3. **triaquetrum**:
     - medial to the lunate bone, articulates with the articular disc
  4. **pisiform bone**:
     - anterior to the triquetrum

- The 4 **distal carpal bones** are:
  1. **trapezium**:
     - lateral, articulates with the scaphoid bone
  2. **trapezoid bone**:
     - medial to the trapezium, articulates with the scaphoid bone
  3. **capitate bone**:
     - largest carpal bone, between trapezoid and hamate bones
  4. **hamate bone**:
     - the medial, distal carpal bone

- **Mnemonic**: “Sam Likes To Push The Toy Car Hard”

- The long bones of the hand are the 5 **metacarpal bones**, numbered I-V from lateral (thumb) to medial.

- The proximal finger bones, or **phalanges**, articulate with the metacarpals.
  - The **pollex** (thumb) has 2 phalanges (proximal and distal).
II. The Pelvic Girdle and Lower Limbs, p. 245

Objectives
1. Identify the bones of the pelvic girdle, their functions and features.
2. Identify the bones of the lower limbs, their functions and features.
3. What are the structural and functional differences between the male and female pelvis?

The Pelvic Girdle, p. 245

Figure 8-7
- The pelvic girdle (which is made up of the 2 hipbones or ossa coxae) is heavy because it bears the weight of the body and stress of movement. (The pelvis includes the pelvic girdle plus the sacrum and coccyx).

- Each os coxae is made up of 3 fused bones:
  1. ilium (articulates with the sacrum)
  2. ischium
  3. pubis

- The ilium, ischium and pubis meet at the acetabulum (hip socket) on the lateral surface of the os coxae.
  - The acetabulum articulates with the head of the femur at the smooth lunate surface.
  - The ridge forming the margins of the acetabulum are incomplete at the acetabular notch.

- The main landmark of the ilium is the greater sciatic notch, which accommodates the sciatic nerve

- The landmarks of the ischium include:
  - the ischial spine, which projects above the lesser sciatic notch
  - the ischial tuberosity, the posterior projection you sit on.
  - the ischial ramus, which meets the inferior ramus of the pubis

- Landmarks of the pubis include the superior ramus, which meets the pubic tubercle.
  - The gap between the pubic tubercles (pubic symphysis) is padded with fibrocartilage.

- The hip muscles attach at the obturator foramen, encircled by the ischial and pubic rami. The superior ramus of the pubis bears a ridge (pectineal line) which continues up to the iliac crest as the arcuate line. The depression between the ileac crest and the arcuate line is the iliac fossa.
• The posterior auricular surface of the ilium articulates with the sacrum at the sacroiliac joint, which is stabilized by ligaments attached to the iliac tuberosity.

**Figure 8-8**
• The pelvis consists of the 2 ossa coxae, the sacrum and coccyx. The pelvis is stabilized by ligament attachments between the pelvic girdle, the sacrum and the lumbar vertebrae.

**Figure 8-9**
• The pelvis is divided into:
  1. true pelvis (encloses the pelvic cavity)
  2. false pelvis (the blades of the ilium above the arcuate line)

• The upper edge of the true pelvis is the pelvic brim, which marks the enclosed space of the pelvic inlet.
  - The inferior edges of the true pelvis (the perineum region) form the pelvic outlet. Perineal muscles support the organs of the pelvic cavity.

**Figure 8-10**
• In comparison to the male pelvis, the female pelvis is smoother, lighter, and has less prominent muscle and ligament attachments.

• Modifications for childbearing include:
  - an enlarged pelvic outlet
  - a broad pubic angle (greater than 100 degrees)
  - less curvature of sacrum and coccyx
  - a wider, circular pelvic inlet
  - a broad, low pelvis
  - ilia that project farther laterally, rather than upwards

*The Lower Limbs, p. 249*

• The lower limbs consist of a femur (thigh), patella (kneecap), tibia and fibula (leg), and the bones of the ankle and foot. (Note that, anatomically, only the lower leg is called a leg; the upper leg is the thigh.)

• The main functions of the lower limbs are weight bearing and motion.

**Figure 8-11**
• The femur is the longest, heaviest bone in the body.
  - At its proximal end, the femoral head articulates with the pelvis at the acetabulum, and is attached at the fovea capitis.
  - The narrow neck joins the shaft at an angle formed by the greater and lesser trochanters (tendon attachments).
The edge of the articular capsule is marked by the intertrochanteric line (anterior) and the intertrochanteric crest (posterior).
- The most prominent ridge of the shaft is the linea aspera, which attaches the hip muscles.
- Above the knee joint, the linea aspera divides into the medial and lateral epicondyles. Below them, the medial and lateral condyles, separated by the intercondylar fossa and patellar surface, form part of the knee joint.

Figure 8-12
- The patella (kneecap) is a sesamoid bone formed within the tendon of the quadriceps femoris, which attaches at the broad base. The patellar ligament attaches at the apex.

Figure 8-13
- The tibia (shinbone) supports the body weight. It is larger than and medial to the fibula.
  - The medial and lateral tibial condyles (separated by the intercondylar eminence) articulate with the medial and lateral condyles of the femur.
  - The patellar ligament attaches to the tibial tuberosity.
  - The most prominent feature of the shaft is its sharp anterior margin.
  - The medial projection at the ankle is the medial malleolus.

- The fibula attaches muscles that move the feet and toes. It is smaller than and lateral to the tibia.
  - The fibula articulates with the tibia at the head, and at the inferior tibiofibular joint, and is bound to the tibia by the interosseous membrane.
  - The lateral projection at the ankle is the lateral malleolus.

Figure 8-14a
- The ankle (tarsus) consists of 7 tarsal bones.
  1. talus:
    - carries body weight from the tibia across an articular process called the trochlea
  2. calcaneus (heel bone):
    - transfers weight from the talus to the ground
    - attaches the Achilles tendon
  3. cuboid bone:
    - articulates with the calcaneus
  4. navicular bone:
    - articulates with the talus and 3 cuneiform bones
  5. medial cuneiform
  6. intermediate cuneiform
  7. lateral cuneiform
• **Mnemonic**: “Tom Can Control Not Much In Life”

• The 5 long bones of the foot are the metatarsal bones, numbered I-V from medial to lateral.
  - The metatarsal bones articulate with the toes

• The bones of the toes are phalanges, organized in the same way as the phalanges of the fingers.
  - The big toe (hallux) has 2 phalanges (distal and proximal)
  - The other 4 toes have 3 phalanges (distal, medial and proximal)

**Figure 8-14b**
- The arches of the foot transfer weight from one part of the foot to another.

- The longitudinal arch is divided into:
  - a lateral (calcaneal) portion and
  - a medial (talar) portion

- The transverse arch is formed by a difference in the degree of curvature between the medial and lateral borders of the foot.

**Key**
- The pectoral girdle is highly mobile, and stabilized primarily by muscles.
- The pelvic girdle is more massive, stronger, and less mobile.

**III. Individual Variation in the Skeletal System, p. 253**

**Objectives**
1. How does the skeleton reveal significant information about an individual?
2. What are the skeletal differences between males and females?
3. How does the aging process affect the skeletal system?

- Studying the skeleton of an individual can reveal many characteristics of the person:
  - muscle strength and mass (bone ridges, bone mass)
  - medical history (condition of teeth, healed fractures)
  - sex and age (bone measurements and fusion)
  - body size

**Table 8-1** shows the differences between male and female skeletons.

**Table 8-2** shows age-related changes in the skeleton.

**SUMMARY**
In Chapter 8 we learned:
- The components of the appendicular skeleton.
- The components of the pectoral girdle and their relationship to the axial skeleton.
- The components of the upper limbs and their relationship to the pectoral girdle.
- The components of the pelvic girdle and their relationship to the axial skeleton.
- The components of the lower limbs and their relationship to the pelvic girdle.
- The differences between the male and female pelvis.
- Individual variations and the effects of aging on the skeleton.