The Appendicular Skeleton

- Pectoral girdle
  - Attaches the upper limbs to the trunk
- Pelvic girdle
  - Attaches the lower limbs to the trunk
- Upper and lower limbs differ in function
  - Share the same structural plan

The Pectoral Girdle

- Consists of the clavicle and the scapula
- Pectoral girdles do not quite encircle the body completely
  - Medial end of each clavicle articulates with the manubrium and first rib
  - Laterally—the ends of the clavicles join the scapulae
  - Scapulae do not join each other or the axial skeleton

The Pectoral Girdle

- Provides attachment for many muscles that move the upper limb
- Girdle is very light and upper limbs are mobile
  - Only clavicle articulates with the axial skeleton
  - Socket of the shoulder joint (glenoid cavity) is shallow
    - Good for flexibility, bad for stability

Articulated Pectoral Girdle

Clavicles
Scapulae

- Lie on the dorsal surface of the rib cage
- Located between ribs 2–7
- Have three borders
  - Superior
  - Medial (vertebral)
  - Lateral (axillary)
- Have three angles
  - Lateral, superior, and inferior

Structures of the Scapula

(a) Right scapula, anterior aspect

(b) Right scapula, posterior aspect

(c) Right scapula, lateral aspect

The Upper Limb

- 30 bones form each upper limb
- Grouped into bones of the:
  - Arm
  - Forearm
  - Hand

Arm

- Region of the upper limb between the shoulder and elbow
- Humerus
  - The only bone of the arm
  - Longest and strongest bone of the upper limb
  - Articulates with the scapula at the shoulder
  - Articulates with the radius and ulna at the elbow
Forearm

- Formed from the radius and ulna
- Proximal ends articulate with the humerus
- Distal ends articulate with carpal bones
- Radius and ulna articulate with each other at the proximal and distal radioulnar joints
- The interosseous membrane
  - Interconnects radius and ulna
- In anatomical position, the radius is lateral and the ulna is medial

Ulna and Radius

- **Ulna**
  - Main bone responsible for forming the elbow joint with the humerus
  - Hinge joint allows forearm to bend on arm
  - Distal end is separated from carpal bones by intercartilage
  - Plays little to no role in hand movement
- **Radius**
  - Superior surface of the head of the radius articulates with the capitulum
  - Medially—the head of the radius articulates with the radial notch of the ulna
  - Contributes heavily to the wrist joint
  - Distal radius articulates with carpal bones
  - When radius moves, the hand moves with it
Hand

- Includes the following bones
  - Carpus—wrist
  - Metacarpals—palm
  - Phalanges—fingers

Carpus

- Forms the true wrist—the proximal region of the hand
- Gliding movements occur between carpals
- Composed of eight marble-sized bones
- Carpal bones
  - Are arranged in two irregular rows
  - Proximal row from lateral to medial
    - Scaphoid, lunate, triquetral, and pisiform
  - Distal row from lateral to medial
    - Trapezium, trapezoid, capitate, and hamate
- A mnemonic to help remember carpals:
  - Sally left the party to take Carmen home

Metacarpus

- Five metacarpals radiate distally from the wrist
- Metacarpals form the palm
  - Numbered 1–5, beginning with the pollex (thumb)
  - Articulate proximally with the distal row of carpals
  - Articulate distally with the proximal phalanges

Phalanges

- Numbered 1–5, beginning with the pollex (thumb)
- Except for the thumb, each finger has three phalanges
  - Proximal, middle, and distal
**Pelvic Girdle**

- Attaches lower limbs to the spine
- Supports visceral organs
- Attaches to the axial skeleton by strong ligaments
- Acetabulum is a deep cup that holds the head of the femur
  - Lower limbs have less freedom of movement
    - Are more stable than the arm
- Consists of paired hip bones (coxal bones)
- Hip bones unite anteriorly with each other
- Articulates posteriorly with the sacrum

**Bones of the Pelvic Girdle**

- Ilium
  - Large, flaring bone
  - Forms the superior region of the coxal bone
  - Site of attachment for many muscles
  - Articulation with the sacrum forms sacroiliac joint

- Ischium
  - Forms posteroinferior region of the coxal bone
  - Anteriorly—joins the pubis
  - Ischial tuberosities
    - Are the strongest part of the hip bone

- Pubis
  - Forms the anterior region of the coxal bone
  - Lies horizontally in anatomical position
  - Pubic symphysis
    - The two pubic bones are joined by fibrocartilage at the midline
  - Pubic arch—inferior to the pubic symphysis
    - Angle helps distinguish male from female pelves

**The Pelvic Girdle**

- Consists of three separate bones in childhood
  - Ilium, ischium, and pubis
- Bones fuse, retain separate names to regions of the coxal bone
- Acetabulum
  - A deep hemispherical socket on lateral pelvic surface
Lateral and Medial Views of the Hip Bone

Figure 8.8b, c

Ilium
Ischium
Pubis

Ilium
Ala
Tubercle of the iliac crest
Anterior gluteal line
Posterior gluteal line
Posterior superior iliac spine
Greater sciatic notch
Posterior inferior iliac spine
Ischial body
Ischial spine
Lesser sciatic notch
Ischial tuberosity
Ischium
Ischial ramus

Inferior gluteal line
Acetabulum
Pubic body
Iliac crest
Anterior superior iliac spine
Anterior inferior iliac spine
Arcuate line
Pubic tubercle
Superior ramus of pubis
Inferior ramus of pubis

Posterior
superior
iliac spine
Obturator foramen
Body of the ilium
Ischium
Ischial ramus

Auricular surface
Ischial spine
Posterior inferior iliac spine
Articular surface of pubis (at pubic symphysis)

True and False Pelves

• Bony pelvis is divided into two regions
• **False** (greater) pelvis—bounded by alae of the iliac bones
• **True** (lesser) pelvis—inferior to pelvic brim
  • Forms a bowl containing the pelvic organs

True and False Pelves

Plane through midpelvis
Anterior abdominal wall
False pelvis
Pelvic brim, defining pelvic inlet
Symphysis surface
True pelvis
Coccyx

(b) True and false pelves

Pelvic Structures and Childbearing

• Major differences between male and female pelvis
• Female pelvis is adapted for childbearing
  • Pelvis is lighter, wider, and shallower than in the male
  • Provides more room in the true pelvis

Female and Male Pelves

<table>
<thead>
<tr>
<th>Table 8.2 (1 of 2)</th>
<th>Comparison of the Male and Female Pelves continued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td>Female</td>
</tr>
<tr>
<td>Symphysis</td>
<td>Width, shorter; sexual curvature is accentuated</td>
</tr>
<tr>
<td>Coccyx</td>
<td>More rectally upright</td>
</tr>
<tr>
<td>Greater sacral notch</td>
<td>Wider and sturdy</td>
</tr>
</tbody>
</table>

Female and Male Pelves

<table>
<thead>
<tr>
<th>Table 8.3 (2 of 2)</th>
<th>Comparison of the Male and Female Pelvis continued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td>Female</td>
</tr>
<tr>
<td>Pudendal notch</td>
<td>Wider, more symmetrical</td>
</tr>
<tr>
<td>Pubic outlet</td>
<td>Wider, trochlearly more symmetrical</td>
</tr>
<tr>
<td>Promontorium</td>
<td>More, trochlearly more symmetrical</td>
</tr>
</tbody>
</table>

Table 8.2 (1 of 2)

Table 8.3 (2 of 2)
The Lower Limb

- Carries the entire weight of the erect body
- Bones of lower limb are thicker and stronger than those of upper limb
- Divided into three segments
  - Thigh, leg, and foot

The Thigh

- The region of the lower limb between the hip and the knee
- **Femur**—the single bone of the thigh
  - Longest and strongest bone of the body
  - Ball-shaped head articulates with the acetabulum

Structures of the Femur

![Image of the Femur](image)

**Figure 8.10b**

Patella

- Triangular **sesamoid bone**
- Imbedded in the tendon that secures the quadriceps muscles
- Protects the knee anteriorly
- Improves leverage of the thigh muscles across the knee

Leg

- Refers to the region of the lower limb between the knee and the ankle
- Composed of the tibia and fibula
  - **Tibia**—more massive medial bone of the leg
    - Receives weight of the body from the femur
  - **Fibula**—stick-like lateral bone of the leg
- Intertosseous membrane
- Connects the tibia and fibula
- Tibia articulates with talus at the inferior end
- Forms the ankle joint
- Fibula does not contribute to the knee joint
  - Stabilizes the ankle joint

Structures of the Tibia and Fibula

![Image of the Tibia and Fibula](image)

**Figure 8.11a, b**
The Foot

- Foot is composed of:
  - Tarsus, metatarsus, and the phalanges
- Important functions:
  - Supports body weight
  - Acts as a lever to propel body forward when walking
  - Segmentation makes foot pliable and adapted to uneven ground

Tarsus

- Makes up the posterior half of the foot
- Contains seven bones called tarsals
- Body weight is primarily borne by the talus and calcaneus
- Trochlea of the talus
  - Site of articulation with the tibia
  - Other tarsals are:
    - Cuboid and navicular
    - Medial, intermediate, and lateral cuneiforms

Metatarsus

- Consists of five small long bones called metatarsals
- Numbered 1–5 beginning with the hallux (great toe)
- First metatarsal supports body weight

Phalanges of the Toes

- 14 phalanges of the toes
  - Smaller and less nimble than those of the fingers
  - Structure and arrangement are similar to phalanges of fingers
  - Except for the great toe, each toe has three phalanges
    - Proximal, middle, and distal
Bones of the Foot

- Facet for lateral malleolus
- Navicular
- Intermediate cuneiform
- Lateral cuneiform
- Calcaneus
- Cuboid
- Fifth metatarsal

(c) Lateral view

Arches of the Foot

- Foot has three important arches
  - Medial and lateral longitudinal arch
  - Transverse arch

Arches of the Foot

(a) Lateral aspect of right foot

(b) X-ray, medial aspect of right foot; keystone of medial longitudinal arch at arrow.

Lower Limb and Pelvis

Table 8.3

Disorders of the Appendicular Skeleton

- Bone fractures
- Hip dysplasia
  - Head of the femur slips out of acetabulum
- Clubfoot
  - Soles of the feet turn medially
The Appendicular Skeleton Throughout Life

- Growth of the appendicular skeleton
  - Increases height
  - Changes body proportions
- Upper/lower body ratio changes with age
  - At birth, head and trunk are 1.5 times as long as lower limbs
  - Lower limbs grow faster than the trunk
  - Upper/lower body ratio of 1 to 1 by age 10

Changes in Body Proportions

- Few changes occur in adult skeleton until middle age, when
  - Skeleton loses mass
  - Osteoporosis and limb fractures become more common