

Principles of Anatomy and Physiology
14th Edition
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WILEY


CHAPTER 8
The Skeletal System:
The Appendicular Skeleton

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The Appendicular Skeleton

The 126 bones of the appendicular skeleton are primarily concerned with **movement**.

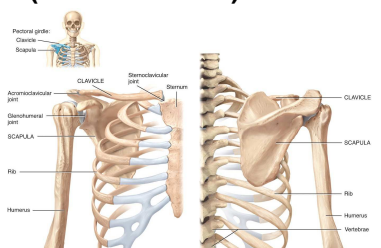
- As “appendages” to the central skeleton, these bones include those of the **upper and lower limbs** (including the girdles that attach them to the axial skeleton).



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Pectoral (Shoulder) Girdle

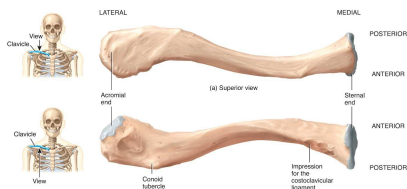
The two **pectoral (shoulder) girdles** include a **clavicle (collar bone)** and a **scapula (shoulder blade)**.



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Pectoral (Shoulder) Girdle

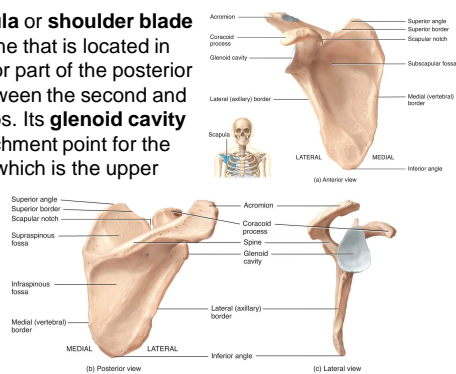
The **clavicle (collarbone)** is S-shaped. Its medial (sternal) end articulates with the manubrium of the sternum and its lateral (acromial) end articulates with the acromion of the scapula.



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Pectoral (Shoulder) Girdle

The **scapula or shoulder blade** is a flat bone that is located in the superior part of the posterior thorax between the second and seventh ribs. Its **glenoid cavity** is the attachment point for the **humerus** which is the upper arm bone.

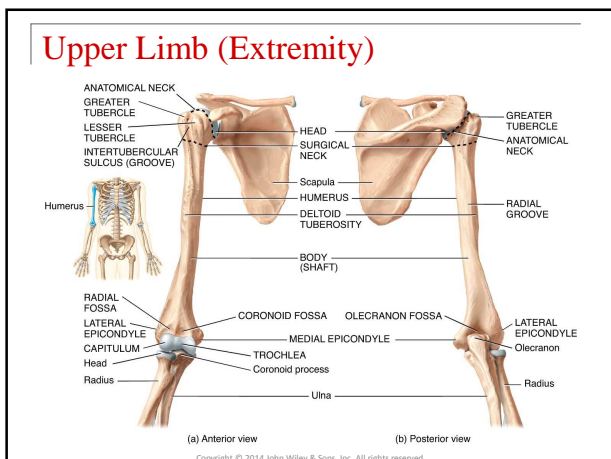


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Upper Limb (Extremity)

The **humerus, or arm bone** articulates with the scapula proximally (its rounded head fits into the glenoid cavity) and with the **radius** and **ulna** distally (the trochlea articulates with the ulna and the capitulum with the radius).

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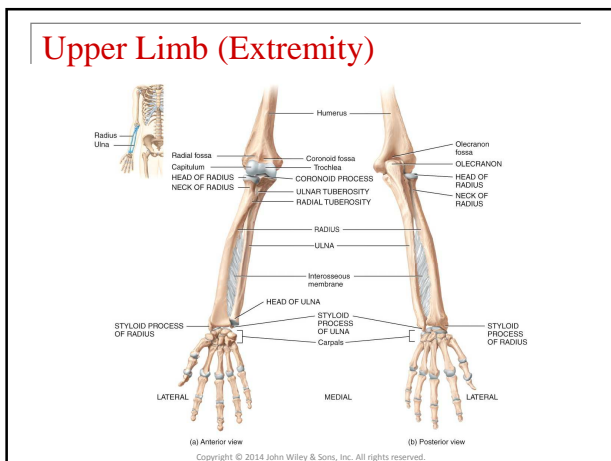


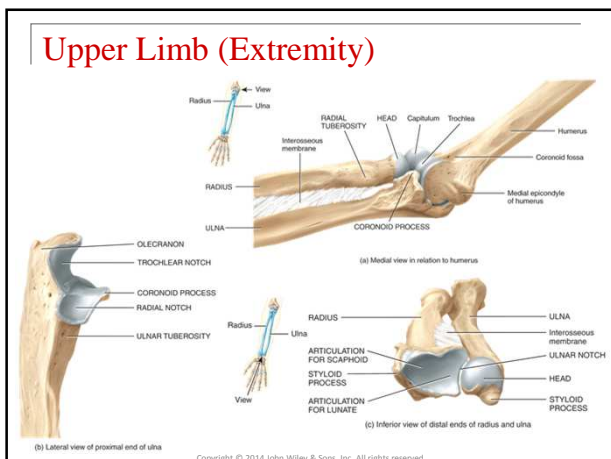
Upper Limb (Extremity)

The **ulna** and **radius** are the two bones of the forearm. The **olecranon** and **coronoid process** at the proximal end of the ulna form the **trochlear notch** which wraps around the trochlea of the humerus making up the elbow joint.

The radius is located on the lateral (thumb) side of the forearm. The articulation of its head with the capitulum of the humerus and with the ulna allow the forearm to rotate.

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Upper Limb (Extremity)

The **carpal (wrist) bones** are 8 small bones connected to each other by ligaments. They are arranged in two rows of four bones each. The proximal row (**scaphoid, lunate, triquetrum, pisiform**) articulates with the distal radius and ulna. The distal row (**trapezium, trapezoid, capitate, hammate**) articulates with the **metacarpals (hand bones)**.

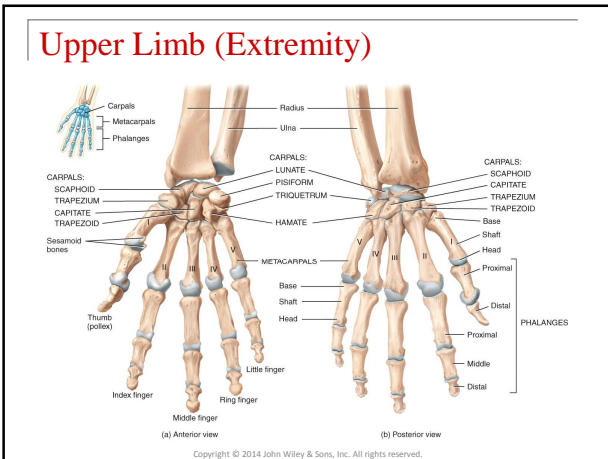
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Upper Limb (Extremity)

The **five metacarpals (hand bones)** make up the palm and back of the hand. They are numbered I through V (or 1–5) starting with the thumb. Their bases articulate with the distal carpals while their heads articulate with the proximal **phalanges**.

The **phalanges** are the bones of the digits (fingers). There are 14 in all. The thumb contains 2 (proximal and distal) while the other 4 fingers contain 3 each (proximal, middle and distal).

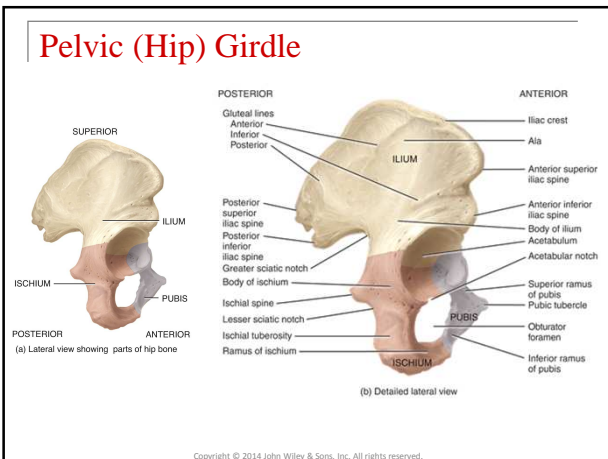
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Pelvic (Hip) Girdle

The **pelvic (hip) girdle** is made up of two **hip bones (os coxa, coxal bones)** that articulate with the sacrum posteriorly. Each hip bone is actually made up of three individual bones: the **ilium**, the **ischium**, and the **pubis (pubic bone)**. The two bones articulate anteriorly at the pubic bones (**pubic symphysis**). There is a disc of **fibrocartilage** between the two bones. The three individual bones fuse into one hip bone by the age of 23.

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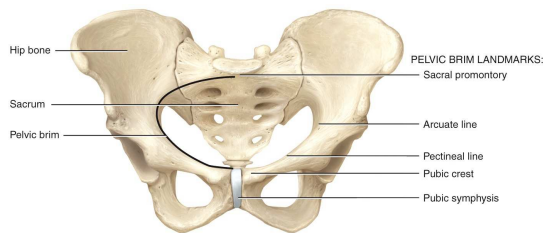
Pelvic (Hip) Girdle

The head of the **femur (thighbone)** articulates with the **acetabulum** of the hip bone as a ball and socket joint. The acetabulum is composed of parts of all three of the bones that make up the hip bone.

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Pelvic (Hip) Girdle

The pelvis is divided into a superior and an inferior portion by the **pelvic brim** which is where the abdomen meets the pelvic cavity.



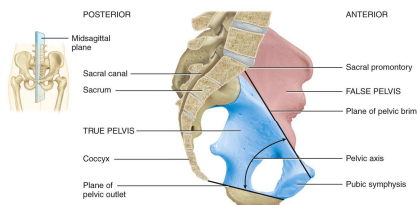
(a) Anterosuperior view of pelvic girdle

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Pelvic (Hip) Girdle

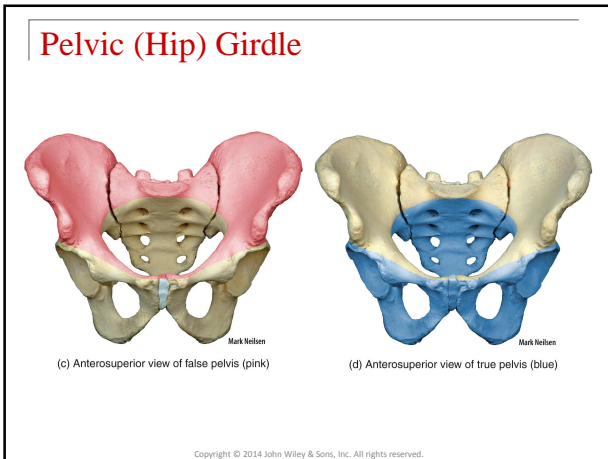
The area of the bony pelvis superior to the pelvic brim is known as the **false (greater) pelvis**.

The area of the bony pelvis inferior to the pelvic brim is known as the **true (lesser) pelvis**.



(b) Midsagittal section indicating locations of true and false pelvis

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Pelvic (Hip) Girdle

The male and female pelves differ in several ways. The bones of the male pelvis are usually larger and heavier. Differences in the female pelvis are mainly associated with the requirements of pregnancy and childbirth. The female pelvis is wider and shallower than that of the male.

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Pelvic (Hip) Girdle

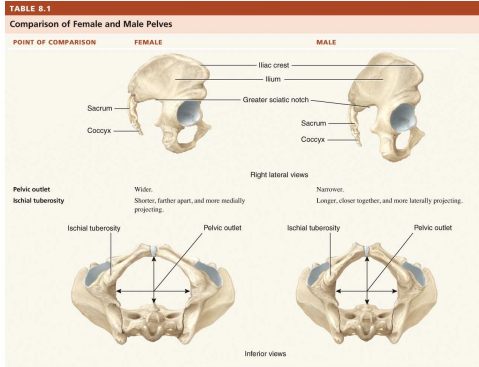
TABLE 8.1 Comparison of Female and Male Pelves		
POINT OF COMPARISON	FEMALE	MALE
General structure	Light and thin.	Heavy and thick.
False (greater) pelvis	Shallow.	Deep.
Pubic brim (inlet)	Wide and more oval.	Narrow and heart-shaped.
Acetabulum	Small and faces anteriorly.	Large and faces laterally.
Obturator foramen	Oval.	Round.
Pubic arch	Greater than 90° angle.	Less than 90° angle.

Anterior views

Iliac crest	Less curved.	More curved.
Ilium	Less vertical.	More vertical.
Greater sciatic notch	Wide (about 90°).	Narrow (about 70°; inverted V).
Coccyx	More movable and more curved anteriorly.	Less movable and less curved anteriorly.
Sacrum	Shorter, wider (see anterior views), and less curved anteriorly.	Longer, narrower (see anterior views), and more curved anteriorly.

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Pelvic (Hip) Girdle

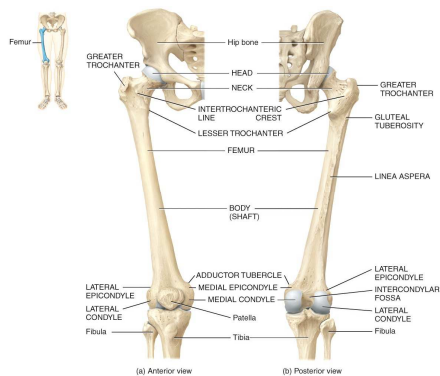


Lower Limb (Extremity)

The **femur (thighbone)** is the longest, heaviest and strongest bone in the body. The proximal end (head) inserts into the acetabulum of the hip bone (**hip joint**). The distal end articulates with the **tibia (shinbone) (knee joint)** and **patella (kneecap)**.

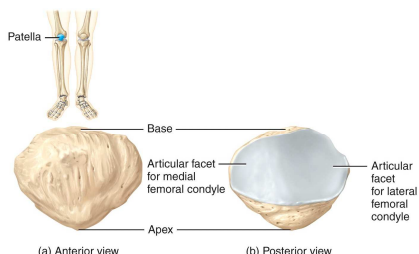
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Lower Limb (Extremity)



Lower Limb (Extremity)

The **patella (kneecap)** is a triangular bone that develops in the quadriceps tendon. It articulates on its posterior surface with the femur.



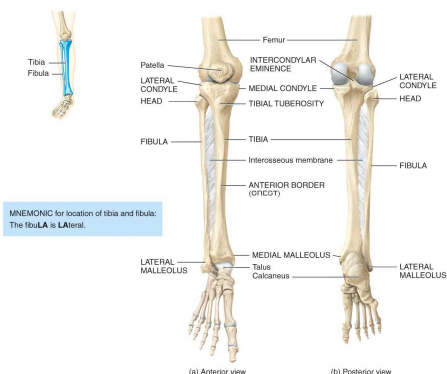
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Lower Limb (Extremity)

The lower leg consists of the **tibia (shinbone)** and the **fibula**. The tibia's proximal end articulates with the femur and its distal end with the **talus** bone of the ankle. The **tibial tuberosity** on the anterior surface is the point of attachment for the patellar ligament.

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Lower Limb (Extremity)



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Lower Limb (Extremity)

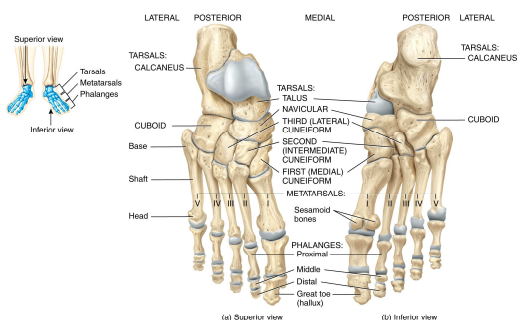
The **tarsus (ankle)** contains **7 tarsal bones**. These are the **talus, calcaneus (heel), navicular, 3 cuneiform (medial-1st, intermediate-2nd and lateral-3rd)** and the **cuboid**.

The **metatarsus (foot bones)** is made up of **5 metatarsal bones**. Just like the metacarpals, they are numbered I through V (1–5) starting with the big toe. They make up the sole and dorsal surface of the foot. The proximal ends articulate with the 3 cuneiform bones and the cuboid. The distal ends articulate with the **proximal phalanges**.

The **phalanges** are arranged exactly like those of the hand. The big toe has a **proximal and distal phalanx** and the other toes have a **proximal, middle and distal phalanx**.

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Lower Limb (Extremity)



MNEMONIC for tarsals:
 Tall Centers Never Take Shots From Corners.
 Talus Calcaneus Navicular Third cuneiform Second cuneiform First cuneiform Cuboid

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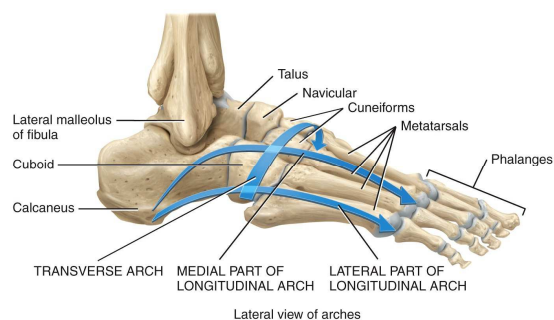
Lower Limb (Extremity)

The foot has two **arches** that are supported by ligaments and tendons. The purpose of the arches is to allow the foot to support the weight of the body, provide leverage while walking and distribute the body's weight over the foot.

The foot has two arches: the **longitudinal arch** which is made up of a medial and a lateral portion and the **transverse arch**.

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Lower Limb (Extremity)



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Development of the Skeletal System

Most skeletal tissue arises from the middle primary germ layer in embryos known as the **mesoderm**. Most of the skull arises from the outer layer called the **ectoderm**.

Skull bones develop in 2 ways: The **neurocranium** forms the bones of the skull itself. It is divided into the **cartilaginous neurocranium** (hyaline cartilage that undergoes **endochondral ossification**) and the **membranous neurocranium** that undergoes intramembranous ossification.

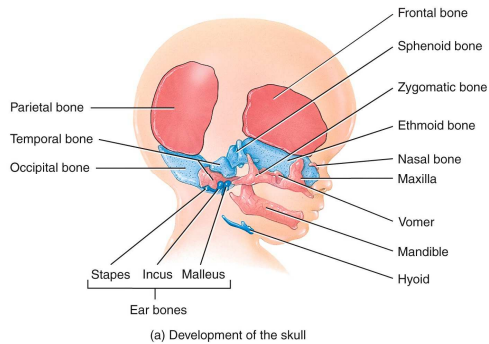
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Development of the Skeletal System

The bones of the face form from the **viscerocranium**. This is also divided into 2 parts: The **cartilaginous viscerocranium** comes from cartilage of the pharyngeal arches. This forms the ear bones and hyoid bone. The **membranous viscerocranium** comes from mesenchyme of the first pharyngeal arch, undergoes intramembranous ossification and forms the facial bones.

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Development of the Skeletal System



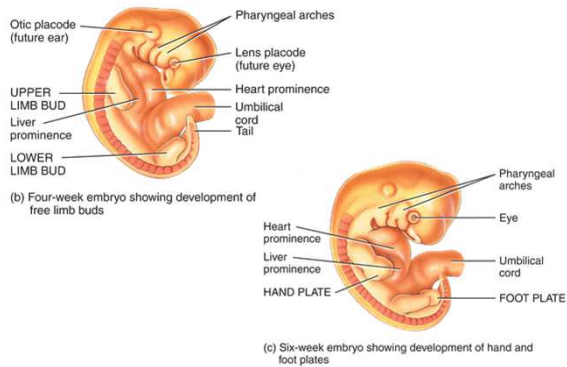
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Development of the Skeletal System

The skeleton of the limb girdles and limbs is derived from mesoderm. Between week 4 and week 8 after fertilization, there is an extensive amount of growth and development in the formation of the upper and lower limbs.

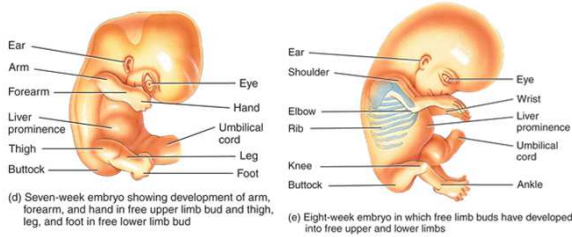
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Development of the Skeletal System



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Development of the Skeletal System



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The Skeletal System and Homeostasis

The skeletal system plays an important role in the homeostasis of every system in the body. Both directly and indirectly, the skeletal system ensures the proper functioning of these systems.

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FOCUS on HOMEOSTASIS

CONTRIBUTIONS OF THE SKELETAL SYSTEM FOR ALL BODY SYSTEMS

- Bones provide support and protection for internal organs
- Bones store and release calcium, which is needed for proper functioning of most body tissues

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End of Chapter 8

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