

The Skeleton

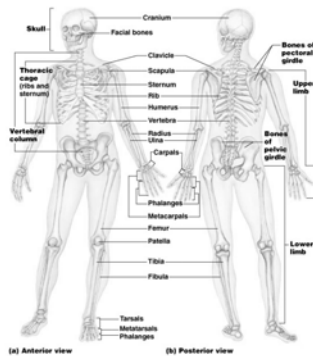
- Consists of bones, cartilage, joints, and ligaments
- Composed of 206 named bones grouped into two divisions
 - Axial skeleton (80 bones)
 - Appendicular skeleton (126 bones)

Bone Markings

- Bone markings may be:
 - Elevations and Projections
 - Processes that provide attachment for tendons and ligaments
 - Processes that help form joints (articulations)
 - Depressions and openings for passage of nerves and blood vessels

The Axial Skeleton

- Formed from 80 named bones
- Consists of skull, vertebral column, and bony thorax



Overview of Skull Geography

- The skull contains smaller cavities
 - Middle and inner ear cavities – in lateral aspect of cranial base
 - Nasal cavity – lies in and posterior to the nose
 - Orbits – house the eyeballs
 - Air-filled sinuses – occur in several bones around the nasal cavity

Cranial Bones

- Formed from eight large bones
 - Paired bones include
 - Temporal bones
 - Parietal bones
 - Unpaired bones include
 - Frontal bone
 - Occipital bone
 - Sphenoid bone
 - Ethmoid bone

Sutures

- Four sutures of the cranium
 - Coronal suture – runs in the coronal plane
 - Located where parietal bones meet the frontal bone
 - Squamous suture – occurs where each parietal bone meets a temporal bone inferiorly
 - Sagittal suture – occurs where right and left parietal bones meet superiorly
 - Lambdoid suture – occurs where the parietal bones meet the occipital bone posteriorly

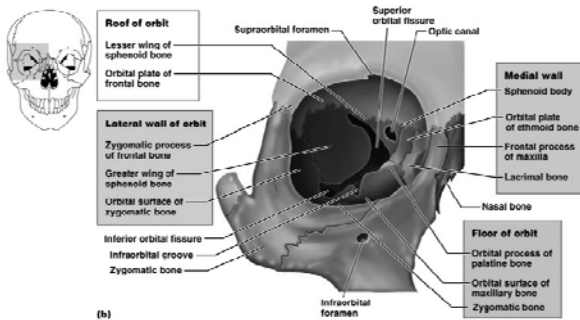
Facial Bones

- Unpaired bones
 - Mandible and vomer
- Paired bones
 - Maxillae, zygomatics, nasals, lacrimals, palatines, and inferior nasal conchae

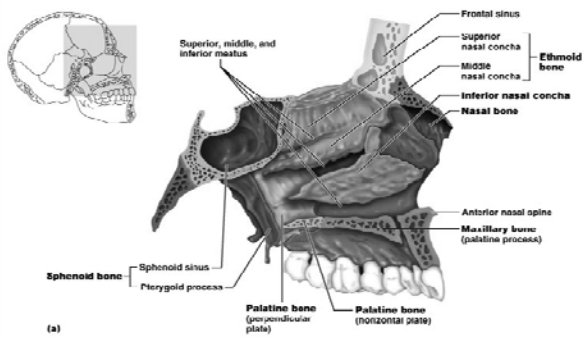
Special Parts of the Skull

- Orbits
- Nasal cavity
- Paranasal sinuses
- Hyoid bone

Orbits



Nasal Cavity



Nasal Septum

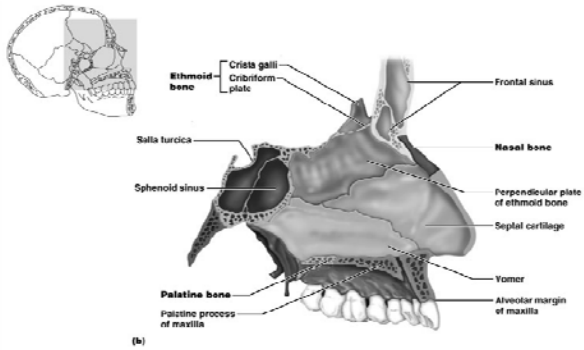


Figure 7.9b

Paranasal Sinuses

- Air-filled sinuses are located within
 - Frontal bone
 - Ethmoid bone
 - Sphenoid bone
 - Maxillary bones
- Lined with mucous membrane
- Serve to lighten the skull

Paranasal Sinuses

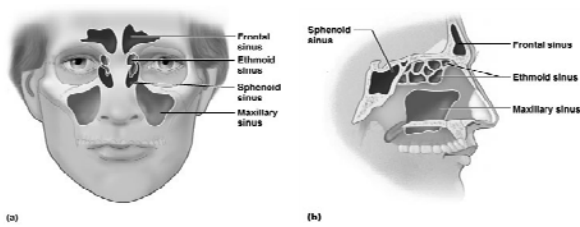


Figure 7.11a, b

The Hyoid Bone

- Lies inferior to the mandible
- The only bone with no direct articulation with any other bone
- Acts as a movable base for the tongue

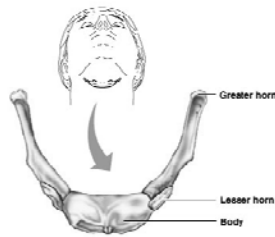
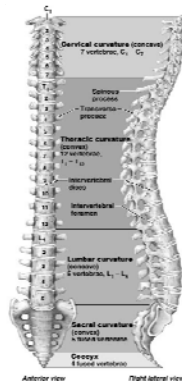


Figure 7.12

The Vertebral Column

- Formed from 26 bones in the adult
- Transmits weight of trunk to the lower limbs
- Surrounds and protects the spinal cord
- With vertebral curves, acts as shock absorber
- Serves as attachment sites for muscles of the neck and back
- Held in place by ligaments
 - Anterior and posterior longitudinal ligaments
 - Ligamentum flavum
 - Supraspinous and interspinous ligaments



Intervertebral Discs

- Cushion-like pads between vertebrae
- Act as shock absorbers
- Compose about 25% of height of vertebral column
- Composed of nucleus pulposus and annulus fibrosus

Intervertebral Discs

- Nucleus pulposus
 - The gelatinous inner sphere of intervertebral disc
 - Enables spine to absorb compressive stresses
- Annulus fibrosus
 - An outer collar of ligaments and fibrocartilage
 - Contains the nucleus pulposus
 - Functions to bind vertebrae together, resist tension on the spine, and absorb compressive forces

Ligaments and Intervertebral Discs

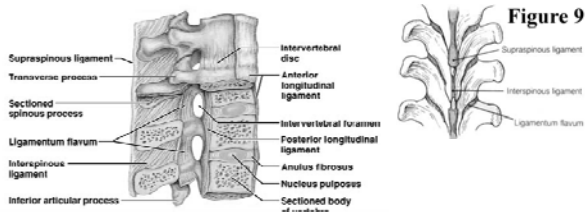
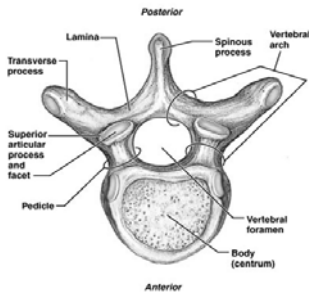


Figure 7.14a

General Structure of Vertebrae



Regions Vertebral Characteristics

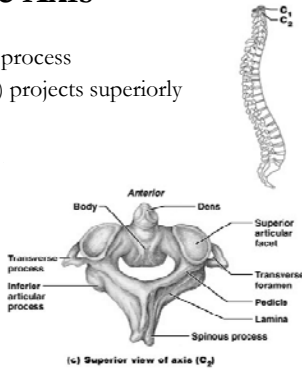
- Specific regions of the spine perform specific functions
- Types of movement that occur between vertebrae
 - Flexion and extension
 - Lateral flexion
 - Rotation in the long axis

Cervical Vertebrae

- Seven cervical vertebrae ($C_1 - C_7$) – smallest and lightest vertebrae
- $C_3 - C_7$ are typical cervical vertebrae
 - Body is wider laterally
 - Spinous processes are short and bifid (except C_7)
 - Vertebral foramen are large and triangular
 - Transverse processes contain transverse foramina
 - Superior articular facets face superoposteriorly

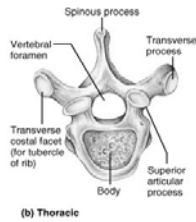
The Axis

- Has a body and spinous process
- Dens (odontoid process) projects superiorly
 - Formed from fusion of the body of the atlas with the axis
 - Acts as a pivot for rotation of the atlas and skull
- Participates in rotating the head from side to side
 - Shaking the head to indicate "no"



Thoracic Vertebrae (T₁ – T₁₂)

- All articulate with ribs
- Have heart-shaped bodies from the superior view
- Each side of the body bears demifacets for articulation with ribs
 - T₁ has a full facet for the first rib
 - T₁₀ – T₁₂ only have a single facet

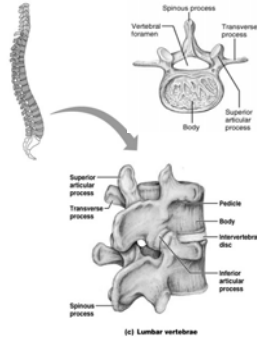


Thoracic Vertebrae

- Spinous processes are long and point inferiorly
- Vertebral foramen are circular
- Transverse processes articulate with tubercles of ribs
- Superior articular facets point posteriorly
- Inferior articular processes point anteriorly
 - Allows rotation and prevents flexion and extension

Lumbar Vertebrae (L₁ – L₅)

- Bodies are thick and robust
- Transverse processes are thin and tapered
- Spinous processes are thick, blunt, and point posteriorly
- Vertebral foramina are triangular
- Superior and inferior articular facets directly medially
- Allows flexion and extension – rotation prevented

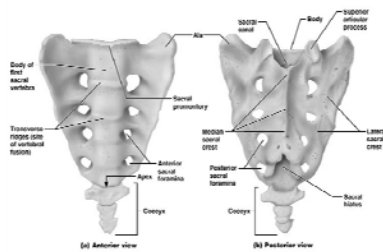


Sacrum (S₁ – S₅)

- Shapes the posterior wall of pelvis
- Formed from 5 fused vertebrae
- Superior surface articulates with L₅
- Inferiorly articulates with coccyx
- Sacral promontory – where the first sacral vertebrae bulges into pelvic cavity
- Center of gravity is 1 cm posterior to sacral promontory

Sacrum

- Sacral foramina
 - Ventral foramina – passage for ventral rami of sacral spinal nerves
 - Dorsal foramina – passage for dorsal rami of sacral spinal nerves



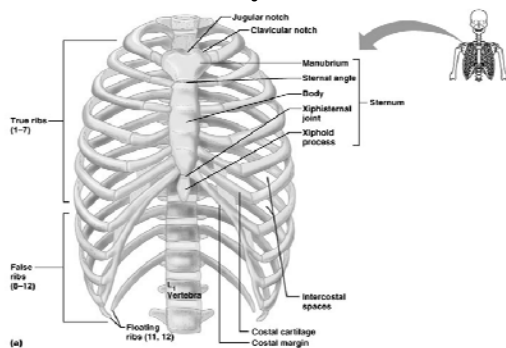
Coccyx

- Is the "tailbone"
- Formed from 3-5 fused vertebrae
- Offers only slight support to pelvic organs

Bony Thorax

- Forms the framework of the chest
- Components of the bony thorax
 - Thoracic vertebrae – posteriorly
 - Ribs – laterally
 - Sternum and costal cartilage – anteriorly
- Protects thoracic organs
- Supports shoulder girdle and upper limbs
- Provides attachment sites for muscles

The Bony Thorax



The Bony Thorax

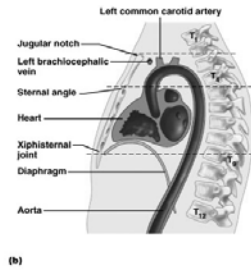


Figure 7.19b

Sternum

- Formed from 3 sections
 - Manubrium – superior section
 - Articulates with medial end of clavicles
 - Body – bulk of sternum
 - Sides are notched at articulations for costal cartilage of ribs 2-7
 - Xiphoid process – inferior end of sternum
 - Ossifies around age 40

Sternum

- Anatomical landmarks
 - Jugular notch – central indentation at superior border of the manubrium
 - Sternal angle – a horizontal ridge where the manubrium joins the body



**Bones, Part 2:
The Appendicular
Skeleton**

The Appendicular Skeleton

- Pectoral girdle attaches the upper limbs to the trunk (axial skeleton)
- Pelvic girdle attaches the lower limbs to the trunk (axial skeleton)
- Upper and lower limbs share the same structural plan, however function is different . . . sometimes



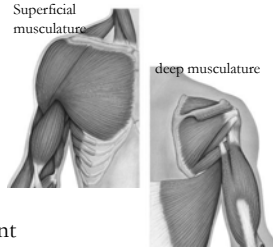
The Pectoral Girdle

- Consists of the clavicle and the scapula
- Pectoral girdles do not quite encircle the body completely
 - The medial ends of the clavicles articulate 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



Clavicles

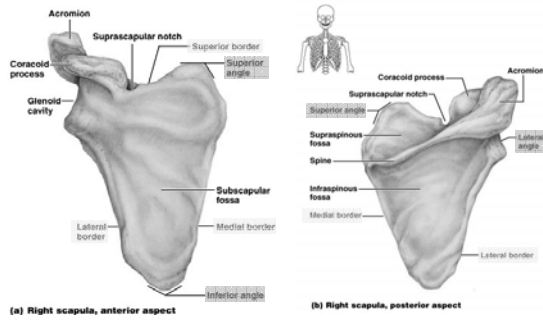
- Structurally:
 - Extend horizontally across the superior thorax
 - Sternal end articulates with the manubrium
 - Acromial end articulates with scapula
- Functionally:
 - Provide attachment for muscles
 - Hold the scapulae and arms laterally
 - Transmit compression forces from the upper limbs to the axial skeleton



Scapulae

- Lie on the dorsal surface of the rib cage
- Located between ribs 2-7
- Have three borders
 - Superior, medial (vertebral), and lateral (axillary)
- Have three angles
 - Lateral, superior, and inferior
- Has pronounced spine which divides the posterior surface into a
 - supraspinous fossa & an infraspinous fossa

Structures of the Scapula



Structures of the Scapula

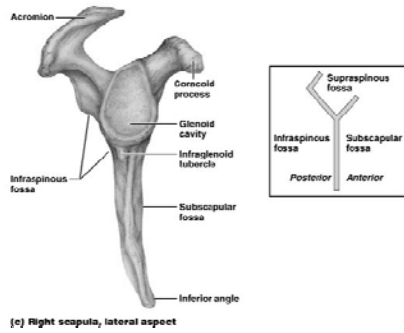


Figure 8.2c

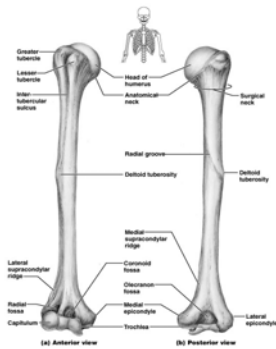
The Upper Limb

- 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

Structures of the Humerus of the Right Arm



Forearm

- Formed from the radius and ulna
- Proximal ends articulate with the humerus
- Distal ends articulate with carpals
- Radius and ulna articulate with each other
 - At the proximal and distal radioulnar joints
- Interconnected by a ligament – the interosseous membrane
- In anatomical position, the radius is lateral and the ulna is medial

Details of Arm and Forearm

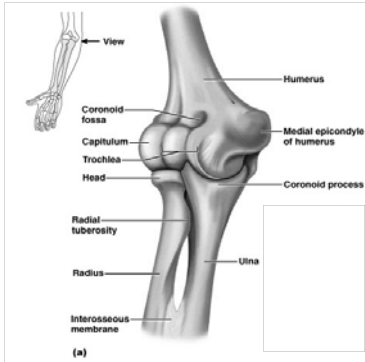
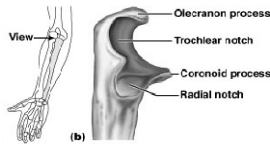


Figure 8.5a

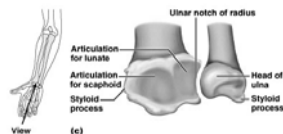
Ulna

- Main bone responsible for forming the elbow joint with the humerus
- Hinge joint allows forearm to bend on arm
- Distal end is separated from carpals by fibrocartilage
- 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



Radius and Ulna

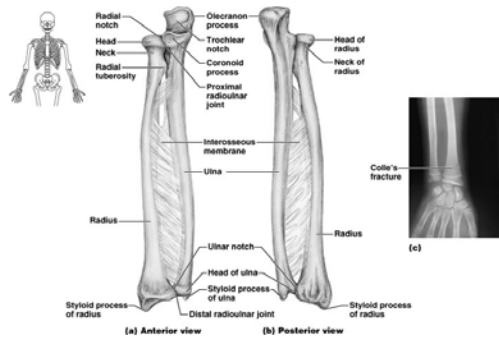


Figure 8.4a-c

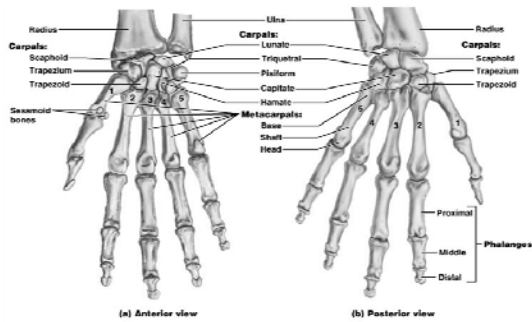
Hand

- 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 arranged in two irregular rows
 - Proximal row from lateral to medial
 - Scaphoid, lunate, triquetrum (triquetrium), and pisiform
 - Distal row from lateral to medial
 - Trapezium, trapezoid, capitate, and hamate
 - Acronym: SLTPTTCH
(Some Lovers Try Positions That They Can't Handle)

Bones of the Hand



Metacarpals & Phalanges

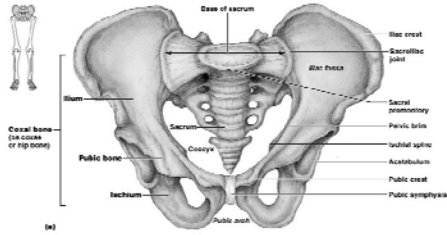
- Five metacarpals radiate distally from the wrist
- Metacarpals form the palm
 - Numbered 1–5, beginning with the pollex (thumb)
 - Articulate proximally with the distal row of carpals
 - Articulate distally with the proximal phalanges
- Phalanges
 - Numbered 1–5, beginning with the pollex (thumb)
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

Bony Pelvis

- A deep, basin-like structure
- Formed by coxal bones, sacrum, and coccyx



Coxal Bones

- Consist of three separate bones in childhood
 - Ilium, ischium, and pubis
- Bones fuse – retain separate names to regions of the coxal bones
- Acetabulum – deep hemispherical socket on lateral pelvic surface

Lateral and Medial Views of the Hip Bone

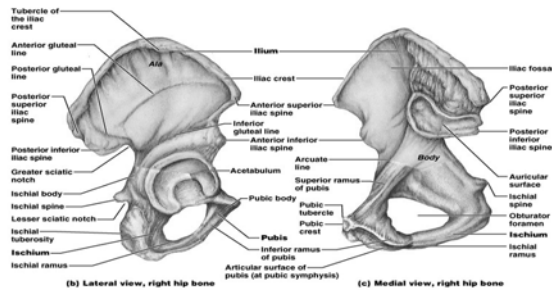
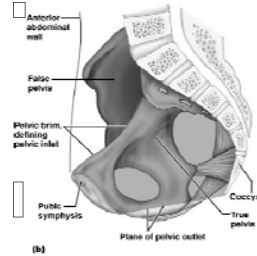


Figure 8.7b, c

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



Female & Male Pelvis

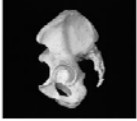
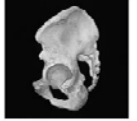


- Major differences between the male and female pelvis
 - Female pelvis is adapted for childbearing
 - Pelvis is lighter, wider, and shallower than in the male
 - Provides more room in the true pelvis
 - Male pelvis is adapted for heavy load handling
 - Acetabulum are larger and wider
 - Coxae bones are thicker
 - Shape
 - Female pelvis is tilted forward to a greater degree than the male pelvis
 - Female pelvis has a round pelvic inlet, while the male pelvic inlet is more heartshaped

Female and Male Pelves

Characteristic	Female	Male
General structure and functional modifications	Tilted forward; adapted for childbearing; true pelvis defines the birth canal; cavity of the true pelvis is broad, shallow, and has a greater capacity	Tilted less forward; adapted for support of a male's heavier build and stronger muscles; cavity of the true pelvis is narrow and deep
Bone thickness	Less; bones lighter, thinner, and smoother	Greater; bones heavier and thicker, and markings are more prominent
Acetabula	Smaller; further apart	Larger; closer
Pubic angle/arch	Broader (80° to 90°); more rounded	Angle is more acute (50° to 60°)
Anterior view		

Table 8.2

Female and Male Pelves

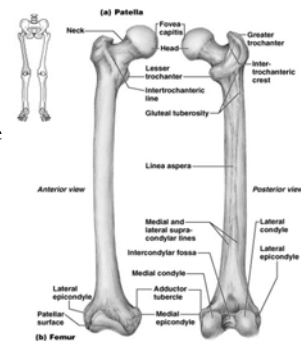
Characteristic	Female	Male
Sacrum	Wide; shorter; sacral curvature is accentuated	Narrow; longer; sacral promontory more ventral
Coccyx	More movable; straighter	Less movable; curves ventrally
Greater sciatic notch	Wide and shallow	Narrow and deep
Left lateral view		
Pelvic inlet (brim)	Wide; oval from side to side	Narrow; basically heart-shaped
Pelvic outlet	Wide; ischial tuberosities shorter, farther apart and everted	Narrower; ischial tuberosities longer, sharper, and point more medially
Posteroanterior view		

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 - femur
 - Leg - tibia & fibula
 - Foot - tarsals, metatarsals, phalanges

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

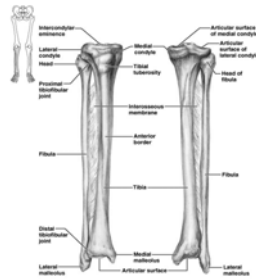


Patella

- 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
 - Stabilizes the leg
- Interosseous membrane – connects the tibia and fibula



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**
 - Talus, Calcaneus, Navicular, Cuboid, First, Second and Third Cuneiform
 - Acronym: TCNCCCC
 - The Crazy Nurse Can't Count Children Correctly
- Body weight is primarily borne by the talus and calcaneus

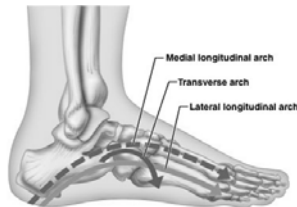


Metatarsus & Phalanges

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

Arches of the Foot

- Foot has three important arches
 - Medial and lateral longitudinal arch
 - Transverse arch
- Arches are maintained by:
 - Interlocking shapes of tarsals
 - Ligaments and tendons



Disorders of the Appendicular Skeleton

- Bone fractures
- Bone spurs
- Hip dysplasia – head of the femur slips out of acetabulum
- Clubfoot – soles of the feet turn medially
