

Visual Anatomy & Physiology  
First Edition

Martini & Ober

Chapter 7  
The Axial and Appendicular  
Skeleton  
Lecture 14

1

---

---

---

---

---

---

---

---

Lecture Overview

- Axial Skeleton
  - Hyoid bone
  - Bones of the orbit
  - Paranasal sinuses
  - Infantile skull
  - Vertebral column
    - Curves
    - Intervertebral disks
  - Ribs

2

---

---

---

---

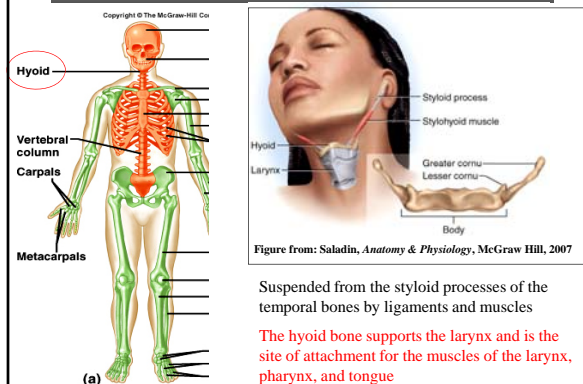
---

---

---

---

The Axial Skeleton – Hyoid Bone



---

---

---

---

---

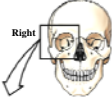
---

---

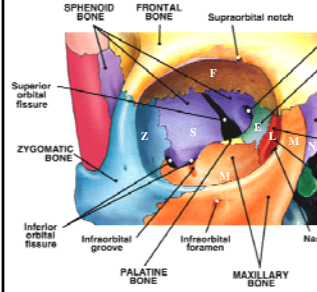
---

## Axial Skeleton – the Orbit

Figure: Martini, *Anatomy & Physiology*, Prentice Hall, 2001



See Fig. 7.20 in Hole's Textbook



- Optic canal** – Optic nerve; ophthalmic artery
- Superior orbital fissure** – Oculomotor nerve, trochlear nerve, ophthalmic branch of trigeminal nerve, abducens nerve; ophthalmic vein
- Inferior orbital fissure** – Maxillary branch of trigeminal nerve
- Infraorbital groove** – Infraorbital nerve, maxillary branch of trigeminal nerve, infraorbital artery
- Lacrimal sulcus** – Lacrimal sac and tearduct

\*Be able to label a diagram of the orbit for lecture exam

---

---

---

---

---

---

---

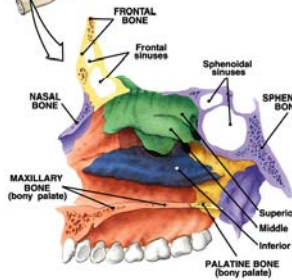
---

---

---

## Nasal Cavities and Sinuses

Figure: Martini, *Anatomy & Physiology*, Prentice Hall, 2001



**Paranasal sinuses are air-filled, mucous membrane-lined chambers connected to the nasal cavity.**

**Superior wall of nasal cavities is formed by frontal, ethmoid, and sphenoid bones**

**Lateral wall of nasal cavities formed by maxillary and lacrimal bones and the conchae**

**Functions of conchae are to create swirls, turbulence, and eddies that:**

- direct particles against mucus
- slow air movement so it can be warmed and humidified
- direct air to superior nasal cavity to olfactory receptors

---

---

---

---

---

---

---

---

---

---

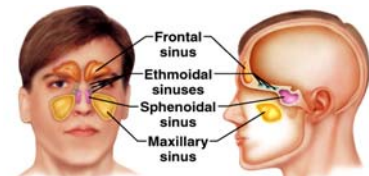
## Axial Skeleton - Sinuses

Sinuses	Number	Location
Frontal sinuses	2	Frontal bone above each eye and near the midline
Sphenoidal sinuses	2	Sphenoid bone above the posterior portion of the nasal cavity
Ethmoidal sinuses	2 groups of small spaces	Ethmoid bone on either side of the upper portion of the nasal cavity
Maxillary sinuses	2	Maxillary bones lateral to the nasal cavity and extending from the floor of the orbits to the roots of the upper teeth

Table Figure from: Hole's Human A&P, 12<sup>th</sup> edition, 2010

**Sinuses are lined with mucus membranes.**

**Inflammation of these membranes is called sinusitis.**



**Know the locations of the sinuses**

---

---

---

---

---

---

---

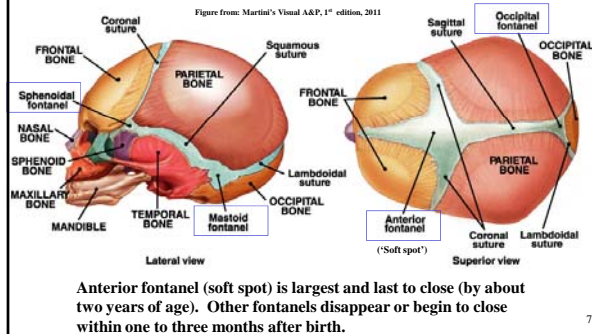
---

---

---

## Infantile Skull

Fontanels – fibrous membranes in the fetal/infant skull to allow 1) movement of the skull bones and 2) brain growth.




---

---

---

---

---

---

---

---

---

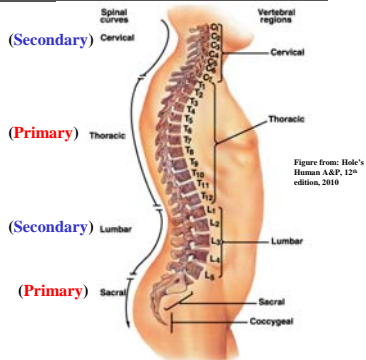
---

## Axial Skeleton - Vertebral Column

- cervical vertebrae (7)
- thoracic vertebrae (12)
- lumbar vertebrae (5)
- sacrum
- coccyx

Primary curves are present at birth. These are also called "accommodation" curves since they accommodate the organs of the thorax and pelvis.

Secondary curves do not develop until several months after birth as infants begin to hold their head up and stand. These are also called compensation curves because they shift the weight of the trunk over the lower limbs.



Primary curves appear FIRST = Sacral, Thoracic

---

---

---

---

---

---

---

---

---

---

## Spinal Curvature of Newborn Infant



Figure from: Saladin, Anatomy & Physiology, McGraw Hill, 2007

---

---

---

---

---

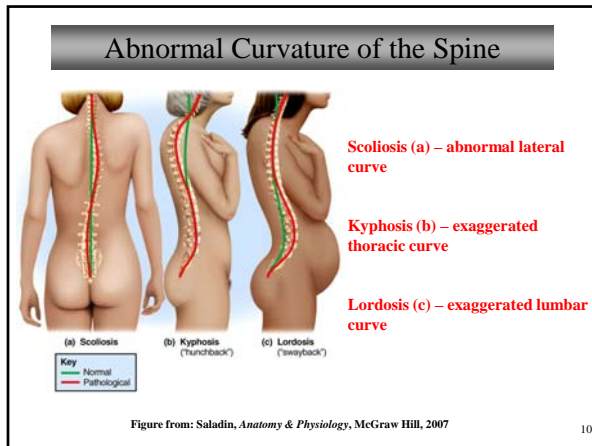
---

---

---

---

---




---

---

---

---

---

---

---

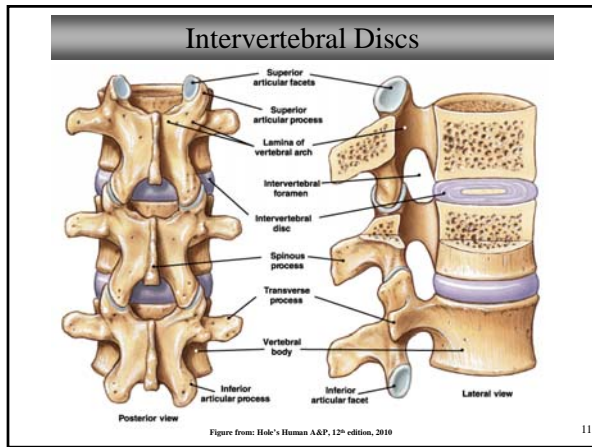
---

---

---

---

---




---

---

---

---

---

---

---

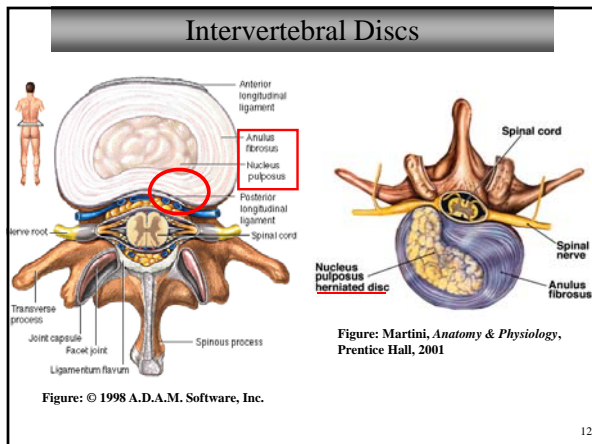
---

---

---

---

---




---

---

---

---

---

---

---

---

---

---

---

---

## Axial Skeleton - Thoracic Cage

- Ribs
- Sternum
- Thoracic vertebrae
- Costal cartilages
  
- Supports shoulder girdle
- Protects viscera
- Role in breathing

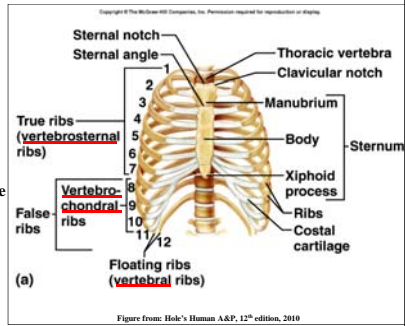


Figure from: Hole's Human A&P, 12<sup>th</sup> edition, 2010

13

---

---

---

---

---

---

---

---

---

---

---

---

## Lecture Overview

- Appendicular Skeleton
  - Review of pectoral girdle
  - Shoulder joint; dislocations
  - Review of bones of upper limb and hand
  - Review of the pectoral girdle
    - Divisions of the pelvis
    - Male-female pelvic differences
  - Comparison of the pectoral and pelvic girdles
  - Review of bones of the leg and foot
  - Arches of the foot

14

---

---

---

---

---

---

---

---

---

---

---

---

## Review of Upper Limb

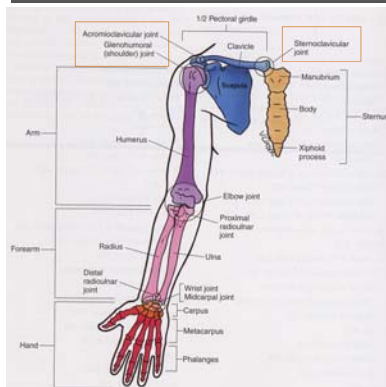


Figure from: Moore & Agur, *Essential Clinical Anatomy*, Lippincott, Williams & Wilkins, 2002

15

---

---

---

---

---

---

---

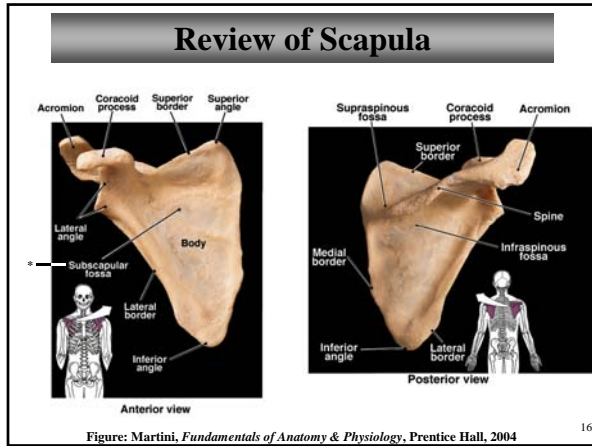
---

---

---

---

---




---

---

---

---

---

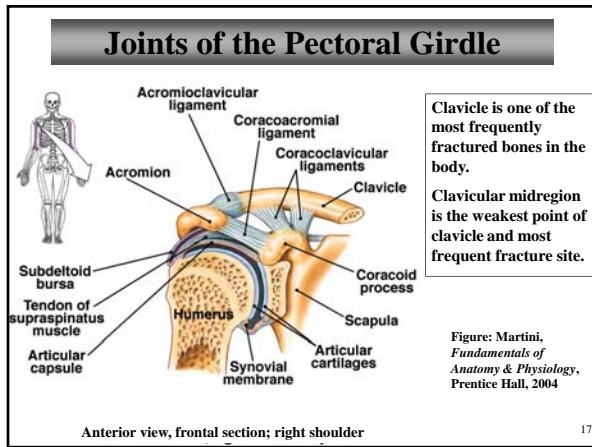
---

---

---

---

---




---

---

---

---

---

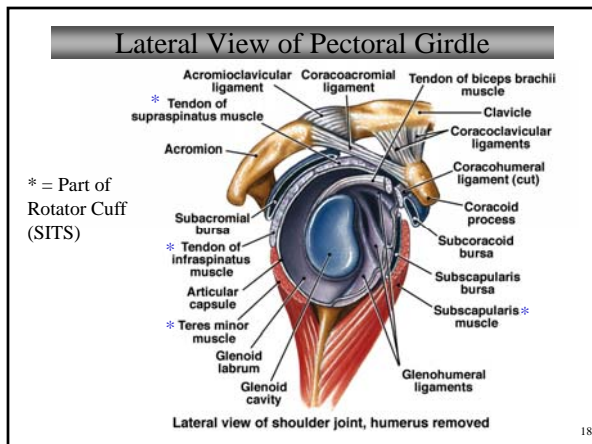
---

---

---

---

---




---

---

---

---

---

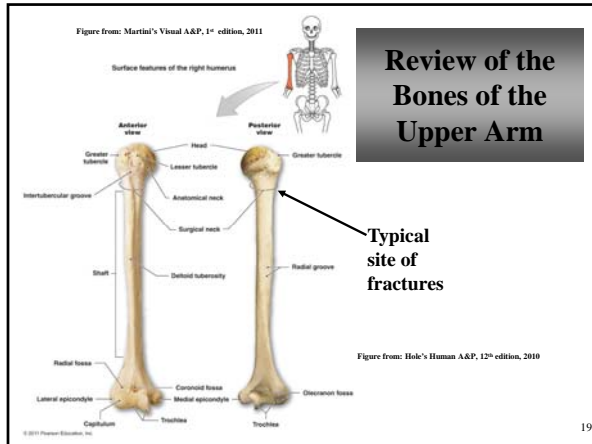
---

---

---

---

---




---

---

---

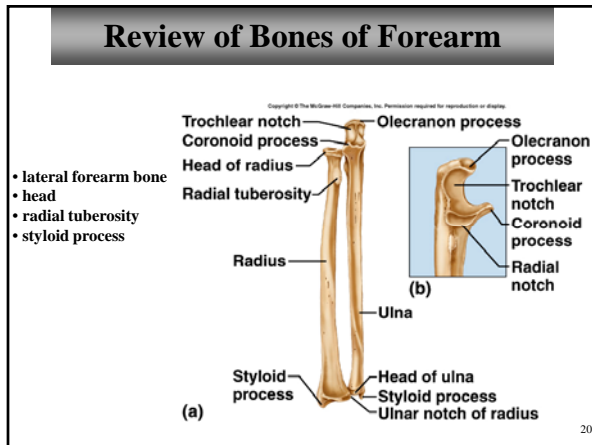
---

---

---

---

---




---

---

---

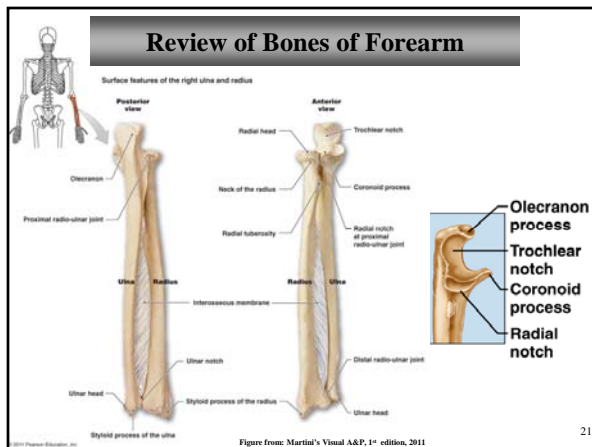
---

---

---

---

---




---

---

---

---

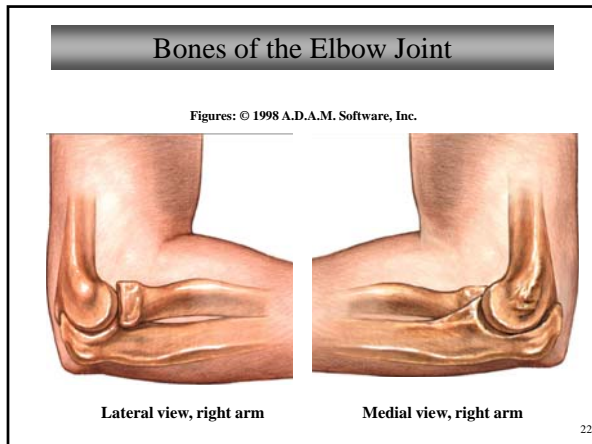
---

---

---

---






---

---

---

---

---

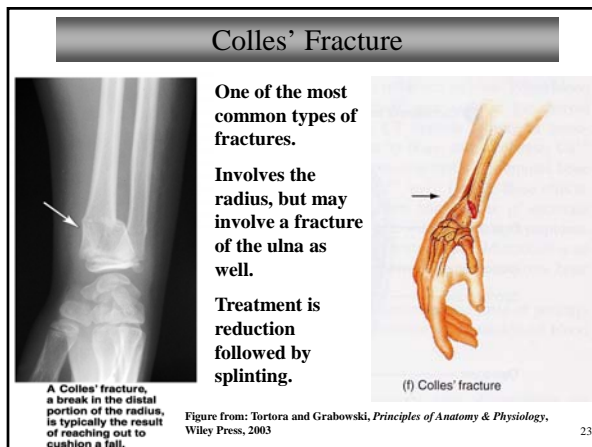
---

---

---

---

---




---

---

---

---

---

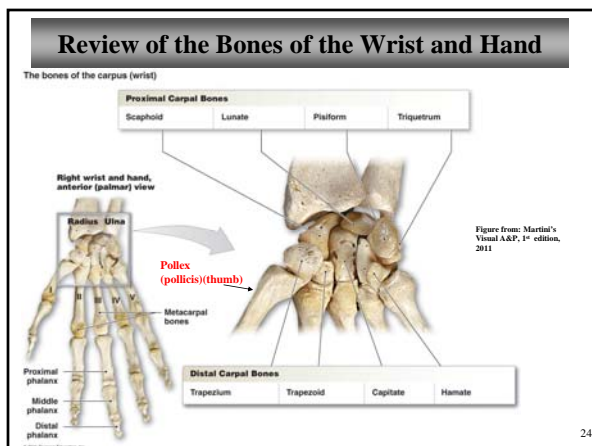
---

---

---

---

---




---

---

---

---

---

---

---

---

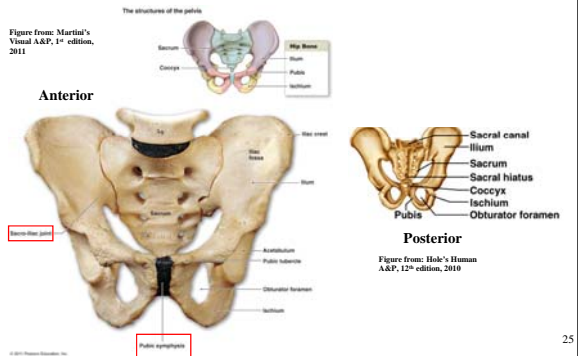
---

---



## Review of the Pelvic Girdle

Figure from: Martin's Visual A&P, 1<sup>st</sup> edition, 2011



25

---

---

---

---

---

---

---

---

---

---

## Review of the Bones of the Pelvis

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

- hip (coxae) bones
- **ilium**
  - iliac crest
  - iliac spines
  - greater sciatic notch
- **ischium**
  - ischial spines
  - lesser sciatic notch
  - ischial tuberosity
- **pubis**
- obturator foramen
- acetabulum
  - ilium
  - ischium
  - pubis

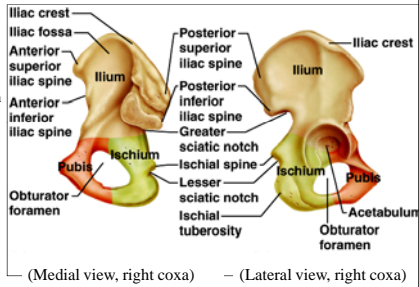


Figure from: Hale's Human A&P, 12<sup>th</sup> edition, 2010

26

---

---

---

---

---

---

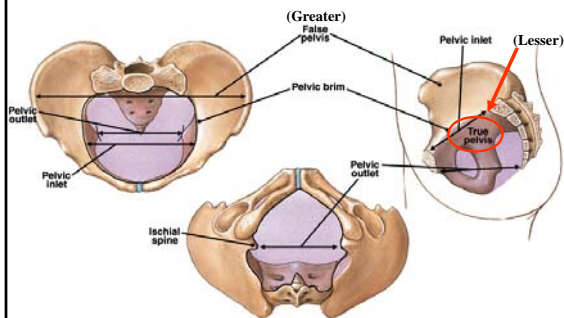
---

---

---

---

## Review of the Divisions of the Pelvis



Pelvic brim = (sacral promontory, sacral ala, arcuate line, pectineal line, pubic crest) x 2

Figure from: Martin's Visual A&P, 1<sup>st</sup> edition, 2011

27

---

---

---

---

---

---

---

---

---

---

### Male-Female Pelvic Differences

Figure from: Martini's Visual A&P, 1<sup>st</sup> edition, 2011

90° or less  
Male

100° or more  
Female

1. Iliac bones are more flared in the female; hips are broader
2. Pubic angle is greater in the female pelvis
3. Greater distance between the ischial spines in the female pelvis
4. Broader, flatter pelvis in females; wider, more circular pelvic inlet
5. Less projection of sacrum and coccyx into the pelvic outlet in the female pelvis

28

---

---

---

---

---

---

---

---

---

---

### Comparison of Pectoral and Pelvic Girdles

	Pectoral Girdle	Pelvic Girdle
<b>Articulation with vertebral column</b>	None	Direct (sacroiliac joint)
<b>Joint sockets for limbs</b>	Shallow – maximize movement	Deep – maximize strength
<b>Overall characteristic</b>	Maximum movement, reduced strength	Maximum strength, reduced movement

29

---

---

---

---

---

---

---

---

---

---

### Review of Bones of Lower Limb

Figure from: Holt's Human A&P, 12<sup>th</sup> edition, 2019  
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

- Femur
- Patella
- Tibia
- Fibula
- Tarsals
- Metatarsals
- Phalanges

(b)

(c) Lateral view

(d) Posterior view

30

---

---

---

---

---

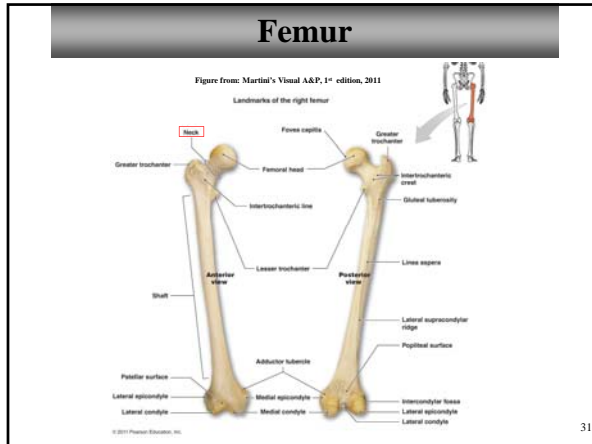
---

---

---

---

---




---

---

---

---

---

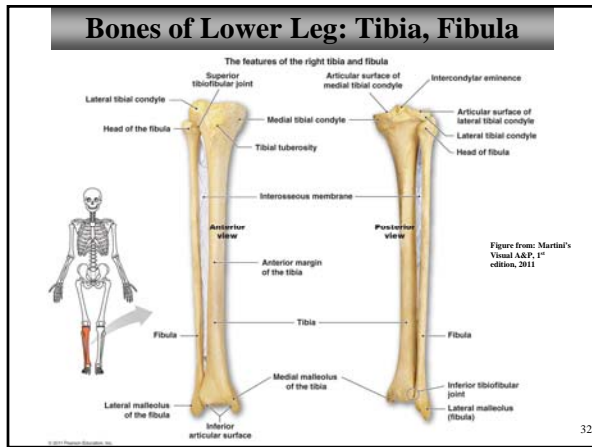
---

---

---

---

---




---

---

---

---

---

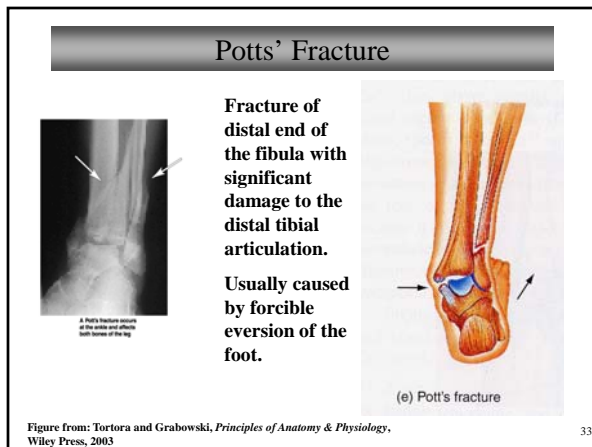
---

---

---

---

---




---

---

---

---

---

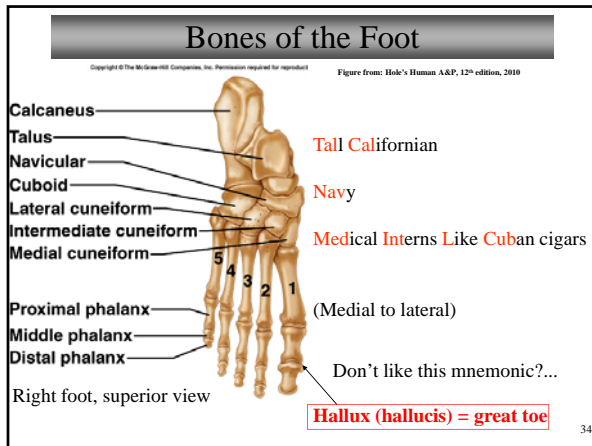
---

---

---

---

---




---

---

---

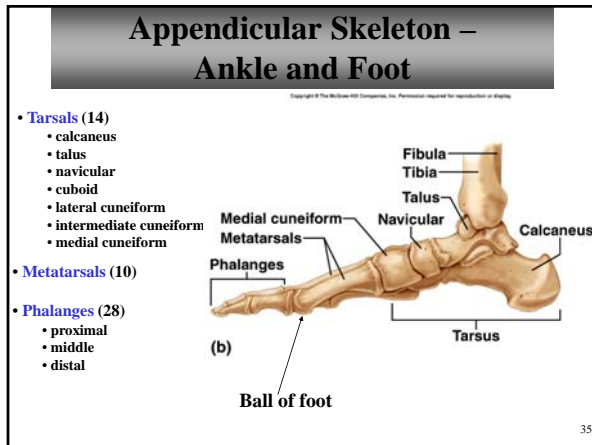
---

---

---

---

---




---

---

---

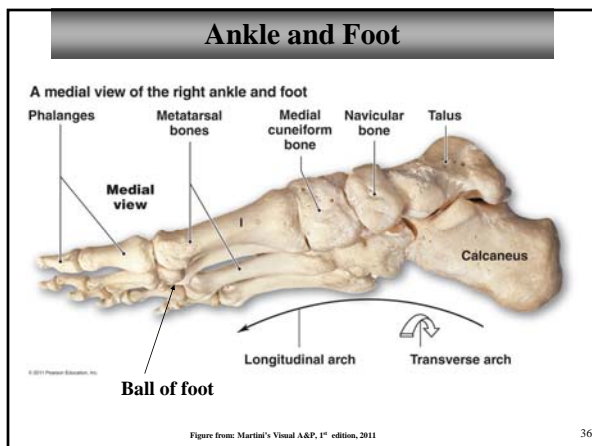
---

---

---

---

---




---

---

---

---

---

---

---

---

### Arches of the Foot

Figure from: Tortora and Grabowski, *Principles of Anatomy & Physiology*, Wiley Press, 2003

**Arches of the foot**

- enable it to support the body weight
- ideally distribute body weight over hard and soft tissues
- provide leverage when walking

**Flatfoot** – Height of medial longitudinal arch is decreased  
**Clawfoot** – Medial longitudinal arch is abnormally elevated

37

---

---

---

---

---

---

---

---

---

---

### Arches of Foot – Top View

Figure from: Hole's Human A&P, 12<sup>th</sup> edition, 2010  
 © Elsevier/HR Company, Inc. Permission required for reproduction or display.

**Longitudinal arch**

- Medial Arch (instep)** – Calcaneus, talus, navicular, three cuneiforms, and medial three metatarsals
- Lateral Arch** – Calcaneus, cuboid, lateral two metatarsals
- Transverse Arch** – Cuboid, cuneiforms, bases of metatarsals

**You should know the names and positions of each of the arches**

38

---

---

---

---

---

---

---

---

---

---

### Review

- The **hyoid bone**
  - Suspended from styloid processes of temporal bones
  - Supports larynx
  - Site of muscle attachments
  - Often fractured during manual strangulation
- The **orbit** includes seven bones of the skull
  - Frontal
  - Sphenoid
  - Ethmoid
  - Palatine
  - Zygomatic
  - Lacrimal
  - Maxilla

**Cranial**

**Facial**

39

---

---

---

---

---

---

---

---

---

---

## Review

- The **paranasal sinuses**
  - air-filled chambers that connect with the nasal cavity
  - Formed by the frontal, sphenoid, ethmoid, and maxillary bones
  - Produce mucus and serve as resonating chambers
- The **infantile skull**
  - Contains soft spots
    - Fibrous CT membranes
    - Called fontanels
  - The anterior fontanel
    - Largest
    - Last to close (about 18-24 months after birth)

40

---

---

---

---

---

---

---

---

## Review

- The **vertebral column**
  - **Primary curves** (accommodation)
    - Thoracic and sacral
    - Present at birth
  - **Secondary curves** (compensation)
    - Cervical and lumbar
    - Develop as head is held up and weight-bearing begins
  - **Intervertebral disks**
    - Shock absorbers between vertebral bones
    - Permit movement
    - Outer fibrocartilage – annulus fibrosus
    - Inner soft, pulpy core – nucleus pulposus

41

---

---

---

---

---

---

---

---

## Review

- The **thoracic cage**
  - Protects the heart, lungs, thymus, and other structures in the thoracic cavity
  - Serves as an attachment point for muscles involved in respiration, positioning the vertebral column, and moving the pectoral girdle and upper limbs
- The thoracic cage consists of the
  - Thoracic vertebrae
  - The ribs
  - The sternum (breastbone)
- True, or **vertebrosternal**, ribs (7 pairs) are attached to the sternum by costal cartilages
- There are 5 pairs of false ribs
  - Ribs 8-10 are **vertebrochondral** ribs
  - Ribs 11 and 12 are floating, or **vertebral**, ribs

42

---

---

---

---

---

---

---

---

## Review

- The **pectoral girdle** consists of the clavicle and scapula
  - Does not articulate with vertebral column
  - Designed for movement rather than strength
- The **pelvic girdle** consists of the paired hip bones, or coxae
  - Each coxa is formed by fusion of three bones:
    - Ilium
    - Ischium
    - Pubis
  - Articulates with vertebral column via the sacroiliac joint
  - Designed for strength rather than range of movement

43

---

---

---

---

---

---

---

---

## Review

- The divisions of the pelvis include
  - True (lesser) pelvis
    - Encloses the pelvic cavity
    - Bony edge of the true pelvis is the pelvic brim and the enclosed space is called the pelvic inlet
  - False (greater) pelvis
    - Area above the pelvic brim
  - The pelvic outlet is bounded by the coccyx, ischial tuberosities, and the inferior border of the pubic symphysis

44

---

---

---

---

---

---

---

---

## Review

- The arches of the foot
  - Function of arches
    - enable it to support the body weight
    - ideally distribute body weight over hard and soft tissues
    - provide leverage when walking
  - Longitudinal arches
    - Lateral
    - Medial (fallen arches; clawfoot)
  - Transverse arch

45

---

---

---

---

---

---

---

---