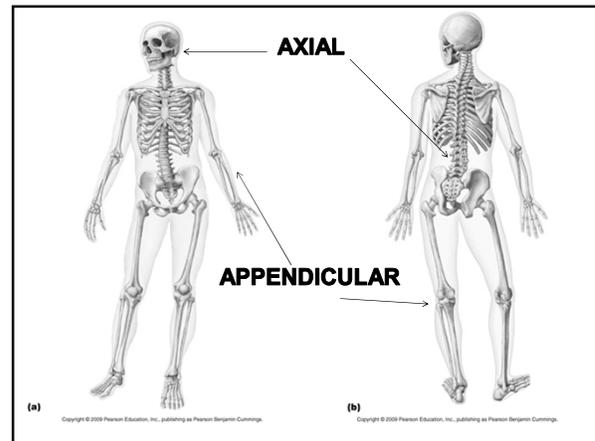


Chapter 5 The Skeletal System (made of bones & articulations)

Did you know...

- It takes 10 years for the cell structure of the skeleton to completely rejuvenate itself. That means you have a "new" skeleton every 10 years!
- Humans have the same number of neck bones as giraffes



- Parts of the skeletal system
 - Bones
 - Joints (articulations)
 - Cartilages
 - Ligaments/Tendons
- Two Division of Skeleton:
 - 1) Axial skeleton – skull, vertebrae, ribs (bones located along midline of body)
 - 2) Appendicular skeleton – upper/lower limbs, pectoral girdle, pelvic girdle

- ### 2 Major Divisions
- Axial skeleton
 - Includes the 80 bones of the head and trunk, including the vertebral column and thoracic region
 - Appendicular skeleton
 - Includes the 126 bones of the arms and legs, pelvis/hip and shoulders
 - That's **206** bones
 - We are actually born with more! WHY??

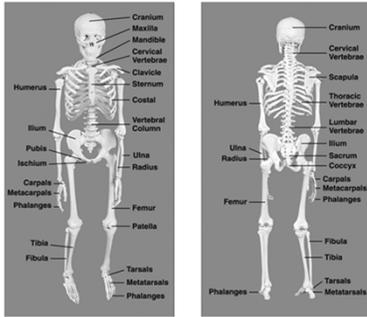
Bones of the Body

Table 13-1 Bones of the Body

Part of Skeleton	Body Part	Body Part Division	Names of Bones
Axial skeleton	Skull (28)	Cranium (8)	Frontal (1), parietal (2), temporal (2), occipital (1), sphenoid (1), ethmoid (1)
		Face (14)	Nasal (2), maxillary (2), zygomatic (2), mandible (1), lacrimal (2), palatine (2), inferior concha (2), vomer (1)
		Ear bones (6)	Malleus (2), incus (2), stapes (2)
	Hyoid (1)		
	Spinal column (26)		Cervical vertebrae (7), thoracic vertebrae (12), lumbar vertebrae (5), sacrum (1), coccyx (1)
	Sternum and ribs (25)		Sternum (1), true ribs (14), false ribs (10)
Appendicular skeleton	Upper extremities (64)		Clavicle (2), scapula (2), humerus (2), radius (2), ulna (2), carpal (16), metacarpals (19), phalanges (28)
	Lower extremities (62)		Coxal bones (2), femur (2), patella (2), tibia (2), fibula (2), tarsals (14), metatarsals (10), phalanges (28)

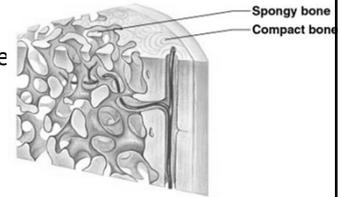
- ### 5 Functions of Bones
- **Support** of the body
 - **Protection** of soft organs
 - **Movement** (along with skeletal muscles)
 - **Storage** of minerals (Ca⁺ & P) and fats
 - **Hematopoiesis** → blood cell formation
- Slide 5.2

Figure 13-1 Common Skeletal Bones



2 Types of Bone Tissue

- Compact
 - Looks smooth and is very dense; provides strength
- Spongy
 - Lots of open space



Classification of Bones on the Basis of Shape

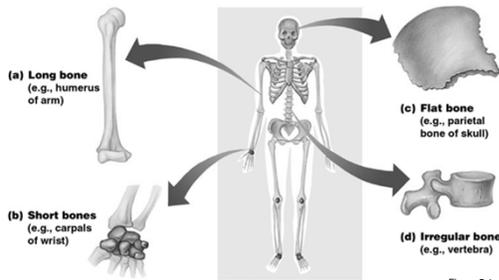


Figure 5.1

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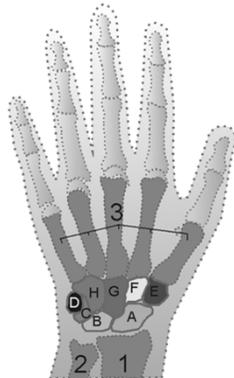
Slide 5.4c

Bone Types

- Long
- Short
- Flat
- Irregular (sesamoid)

Short Bones

- Cube-shaped
- Contains SPONGY bone
- Wrists (carpals) and ankles (tarsals)
- Sesamoid bones—patella (kneecap)



Flat Bones

- Flat, thin, curvy
- Spongy bone sandwiched by compact bone
- Examples:
 - Scapula (shoulder blade)
 - Ribs
 - Skull



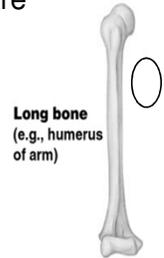
Irregular Bones

- Bones that don't fit into any other category
- Examples:
 - Vertebral column
 - Hip/Pelvic bones



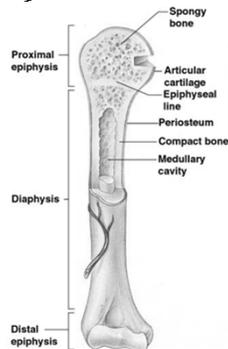
Long Bone Anatomy

- Typically longer than they are wide
- Have a shaft (**diaphysis**) with heads (**epiphyses**) at both ends
- Contain mostly compact bone
 - Examples: Femur, humerus



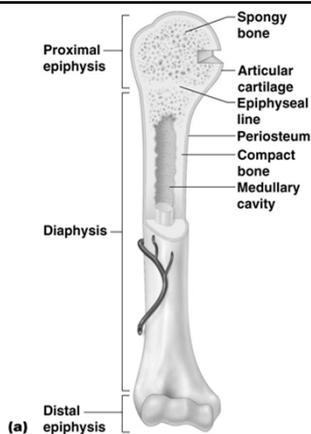
Long Bones—Anatomy/Parts (Humerus, Femur, Tibia)

- **Diaphysis**
 - Shaft
 - made of compact bone;
 - supports
- **Periosteum**
 - **membrane** that covers the diaphysis
- **Epiphysis**
 - **ends** of the bone
 - made of spongy bone



Long Bones—Anatomy/Parts (continued)

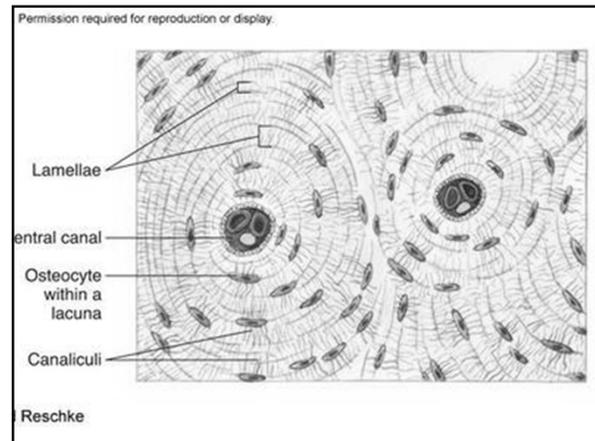
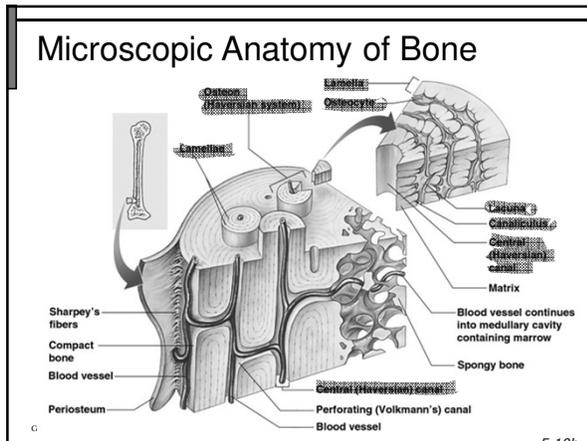
- **Marrow Cavity**—also called the **medullary cavity**
 - Middle of the shaft
 - Red marrow found in diaphysis of infants
 - Yellow marrow develops in adults; red becomes inactive and yellow becomes fat.
- **Endosteum**—lines the marrow cavity
- **Articular cartilage**
 - covers the epiphyses
 - made of hyaline cartilage
 - functions as “shock absorbers”-----reduces friction at joints



Bones by Shapes

Table 13-2 Bones by Shape

Shape of Bone	Examples
Long	Femur, humerus, radius, ulna, tibia, fibula
Short	Tarsal, carpal, metatarsal, metacarpal
Flat	Cranium, costal, scapula, sternum
Irregular	Vertebrae, mandible, ilium, ossicle, patella



Microscopic Anatomy of Bone

Haversian System (Osteon): A unit of bone

- **Lamellae**
 - Rings around the central canal
 - Sites of lacunae
- **Lacunae**
 - Cavities containing bone cells (**osteocytes**)
 - In lamellae

Microscopic Anatomy of Bone

- **Canaliculi**
 - Tiny canals
 - Connect lacunae to the **Haversian** canal
 - Form a transport system; provides **nourishment**

Figure 5.3

Microscopic Anatomy of Bone

- **Central (Haversian) canal**
 - Opening in the center of an osteon
 - Carries blood vessels and nerves
- **Perforating (Volkman's) canal**
 - Canal perpendicular to the central canal
 - Carries blood vessels and nerves from outside the **osteon**

Figure 5.3

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Changes in the Human Skeleton

- In embryos, the skeleton is primarily hyaline cartilage
- During development, much of this cartilage is replaced by bone (**ossification**)
- Cartilage remains in isolated areas
 - Bridge of the nose
 - Parts of ribs
 - Joints

Bone Growth

- Epiphyseal plates allow for growth of long bone during childhood
 - New cartilage is continuously formed
 - Older cartilage becomes ossified
 - Cartilage is broken down
 - Bone replaces cartilage

Bone Growth

- Bones are remodeled and lengthened until growth stops
 - Bones change shape somewhat
 - Bones grow in width

Types of Bone Cells

- **Osteocytes**
 - Mature bone cells
- **Osteoblasts (build)**
 - Bone-forming cells
- **Osteoclasts (kill)**
 - Bone-destroying cells
 - Break down bone matrix for remodeling and release of calcium
- Bone remodeling is a process by both osteoblasts and osteoclasts

Types of Ossification

- **Intramembranous (within membranes)**
 - Occurs in bones of infants
 - **Fontanelles—soft spots on baby’s head; important in childbirth & shaping skull**
 - Frontal & Parietal—last one to close
 - Parietal & Occipital—1st one to close
 - Temporal & Occipital
- **Endochondral (within cartilage)**
 - Starts in diaphysis & grows to epiphysis
 - **Epiphyseal plate**

Long Bone Formation and Growth

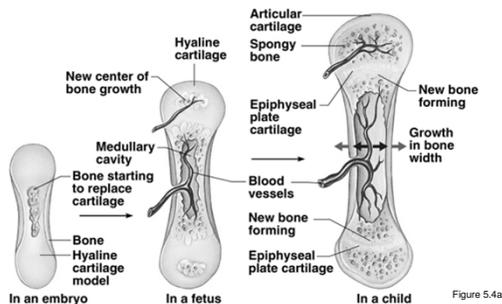


Figure 5.4a

Bone Growth

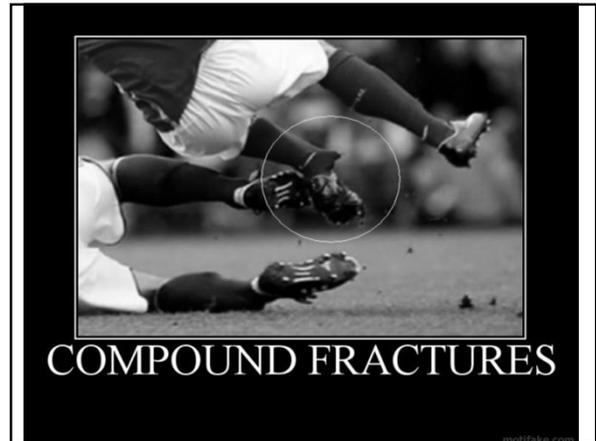
- **Epiphyseal plates** allow for growth of long bone during childhood
- Epiphyseal *lines* are remnants of the epiphyseal plate

Who is older?



Bone Fractures

- A break in a bone
- Types of bone fractures
 - Closed (simple) fracture – break that does not penetrate the skin
 - Open (compound) fracture – broken bone penetrates through the skin
- Bone fractures are treated by reduction and immobilization
 - Realignment of the bone



Common Types of Fractures

Fracture type	Illustration	Description	Comment
Comminuted		Bone breaks into many fragments.	Particularly common in the aged, whose bones are more brittle.
Compression		Bone is crushed.	Common in porous bones
Depressed		Broken bone portion is pressed inward.	Typical of skull fracture.
Impacted		Broken bone ends are forced into each other.	Commonly occurs when one attempts to break a fall with outstretched arms
Spiral		Ragged break occurs when excessive twisting forces are applied to a bone.	Common sports fracture.
Greenstick		Bone breaks incompletely, much in the way a green adult.	Common in children, whose bones are more flexible than those of

Table 5.2

Repair of Bone Fractures

- Hematoma (blood-filled swelling) is formed
- Break is splinted by fibrocartilage to form a callus
- Fibrocartilage callus is replaced by a bony callus
- Bony callus is remodeled to form a permanent patch

Stages in the Healing of a Bone Fracture

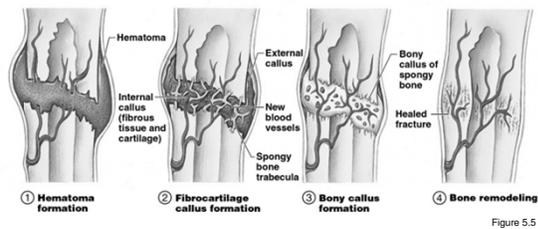


Figure 5.5

Joints

- Two or more bones join together at a joint
- Three types of joints
 - Immovable (synarthrosis)
 - Slightly movable (amphiarthrosis)
 - Freely movable (diarthrosis)

Disorders of the Skeletal System

- Arthritis
 - A group of disorders evidenced by inflammation of a joint, pain and stiffness during movement
- Avulsion fracture
 - Occurs when a ligament or tendon pulls off part of a bone during an injury
- Bursitis
 - Inflammation of the sac around a joint that is caused by trauma or irritation

Disorders of the Skeletal System (continued)

- Carpal tunnel syndrome
 - A disorder caused by pressure on the median nerve of the wrist due to repetitive use or trauma
- Degenerative joint disease
 - Also called osteoarthritis, usually associated with aging; it is the most common form of arthritis

Disorders of the Skeletal System (continued)

- Dislocation
 - When bones move out of their proper location, usually in the shoulder or hip
- Fracture
 - A broken bone caused by trauma
- Gout
 - A painful swelling of a joint that results from the buildup of uric acid crystals, most commonly in the great toe

Disorders of the Skeletal System (continued)

- Herniated disk
 - A ruptured or “slipped” disk between vertebrae
- Kyphosis
 - Also called “hunchback” or “humpback,” is an abnormal curvature of the thoracic part of the spine
- Lordosis
 - Also called “swayback,” is an abnormal curvature of the lumbar spine

Disorders of the Skeletal System (continued)

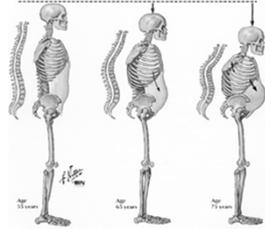
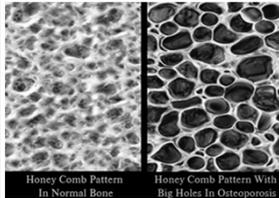
- Spina Bifida
 - A congenital condition of the spinal column
- Osteoma
 - A bone tumor
- Osteomalacia (Rickets)
 - Seen in children; a softening of the bones caused by vitamin D and calcium deficiency

Disorders of the Skeletal System (continued)

- Osteomyelitis
 - A bacterial infection of the bone
- Osteoporosis
 - A weakening of the bones

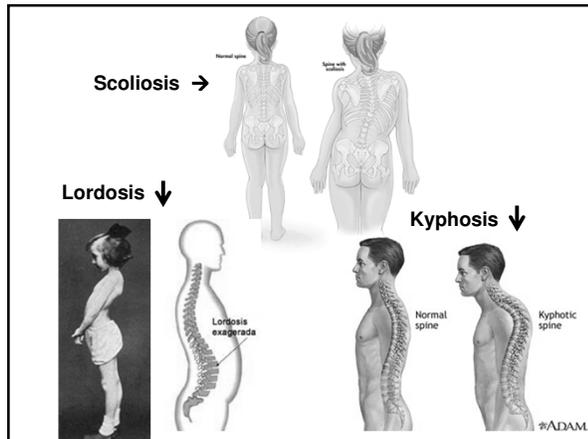
Osteoporosis

- A bone-thinning disease that results from:
 - Hormonal imbalance
 - Poor diet (lack of calcium, protein, vitamin D)
 - Insufficient exercise



Disorders of the Skeletal System (continued)

- Rheumatoid arthritis
 - Pain and stiffness in the joints caused by thickening of the synovial membrane
- Scoliosis
 - An abnormal lateral spinal curvature



Assessment Techniques

- Bone x-rays
- Bone marrow aspiration
- Bone marrow biopsy
- Radionuclide bone scan
- Computed axial tomography (CAT)
- Magnetic resonance imaging (MRI)
- Bone densitometry

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Treatments & Innovations

- Bone substitutes and repairs
 - Surgical implants for cranial and joint injuries
 - Bone regeneration