

Bone Function and Structure

BONE FUNCTION & STRUCTURE



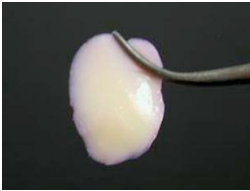
CLICK ON SKELETON FOR
SCHOOL HOUSE ROCK VIDEO

INTRODUCTION TO BONES

- very active tissue
- contains bone tissue, cartilage, dense connective tissue, blood, and nervous tissue
- classified based on location and shape
 - location: axial and appendicular
 - shape (p. 175): long (limb bones), short (wrist, ankle, patella), flat (sternum, scapula, ribs, most skull bones), and irregular (hip, vertebrae)

SKELETAL CARTILAGES

- function: provide flexibility to skeleton
- made mostly of water making it very resilient
- surrounded by perichondrium (dense connective tissue) that acts as a girdle and supplies nutrients to chondrocytes
- 3 types: hyaline, elastic, fibrocartilage



SKELETAL CARTILAGE

- hyaline - support with flexibility and resilience
 - articular cartilage - covering ends of bones that form joints
 - costal cartilage - connects ribs to sternum
 - respiratory cartilage - larynx
 - nasal cartilage - supports external nose
- elastic - able to withstand repeated bending
 - external ear and epiglottis
- fibrocartilage - highly compressible and great tensile strength
 - discs between vertebrae and knee menisci

SUPPORT & PROTECT

- give shape (framework)
 - head, face, thorax, limbs
- support body weight
 - lower limbs, pelvis, and backbone
- protects organs
 - skull - eyes, ears, brain
 - rib cage and shoulder girdle - heart and lungs
 - pelvic girdle - lower abs and internal reproductive organs



BODY MOVEMENT

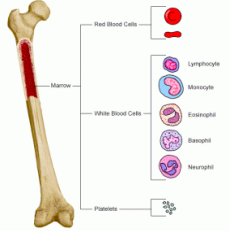
- work with muscles
- levers
 - rigid rod or bar
 - fulcrum or pivot
 - object
 - energy source
- bending and extending upper arm
 - bones of the forearm (rod)
 - elbow (fulcrum)
 - hand (object)
 - muscles (energy source)
 - biceps brachii - bends
 - triceps brachii - extends



Bone Function and Structure

BLOOD CELL FORMATION

- a.k.a. hematopoiesis
- red marrow forms RBC, WBC, platelets
found in the spongy bones of the skull, ribs, sternum, clavicles, vertebrae and hip bones
- yellow marrow stores fat
found mostly in cavities of long bones
can become red marrow if the body needs more blood

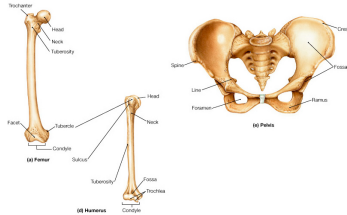


STORAGE OF INORGANIC SALTS

- vital metabolic processes require calcium
muscle contraction, nerve impulse conduction, blood clotting
- extracellular matrix of bone stores calcium salts
mostly calcium carbonate
magnesium (Mg), sodium (Na), potassium (K) and carbonate ions
- negative feedback
low blood calcium, osteoclasts break bone down
osteoclast = bone destroying cell
high blood calcium, osteoblasts form new bone
osteoblast = bone building cell

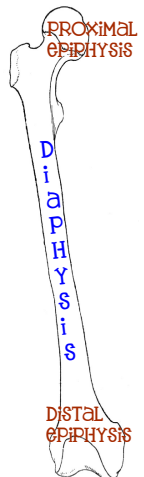
BONE MARKINGS

- a bone's shape makes possible its functions
- processes (projections) provide sites where ligaments and tendons attach
- grooves and openings form passageways for blood vessels and nerves
- depressions of one bone may articulate with a process of another



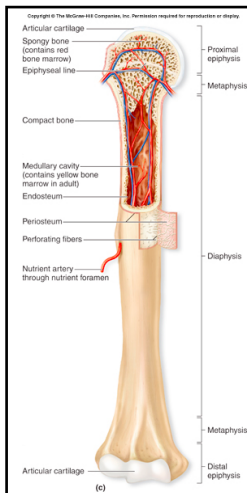
5 PARTS OF A LONG BONE

- epiphysis - ends of a bone
articulate (form joints) with other bones
proximal epiphysis - end nearest body
distal epiphysis - end farthest from body
outside - compact bone
inside - spongy bone
covered in articular (hyaline) cartilage
- diaphysis - long axis of a bone
thick collar of compact bone



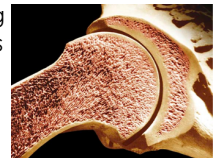
5 PARTS OF A LONG BONE

- periosteum (around bone) - tough, vascular covering of fibrous tissue
covers entire bone EXCEPT for articular surfaces
helps form and repair bone tissue
- medullary cavity - hollow chamber
contains fat (yellow marrow)
- endosteum (within bone) - thin layer of cells that line the medullary cavity



COMPACT VS. SPONGY BONE

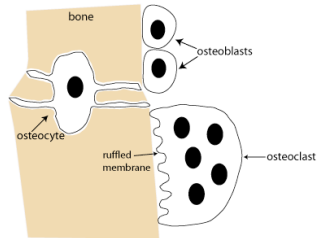
- both are strong and resist bending
- compact bone - walls of diaphysis
NO spaces
osteons
- spongy bone - epiphyses
a.k.a. cancellous bone
trabeculae - honeycomb of small needle-like or flat projections along lines of stress
spaces between the plates reduce the bones weight
spaces filled with red or yellow bone marrow



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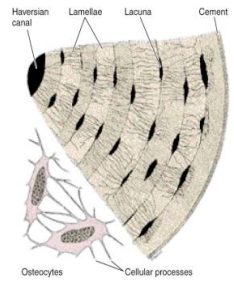
MICROSCOPIC STRUCTURE

- 4 bone cells
 - osteogenic - bone stem cell
 - osteocytes - bone cell
 - osteoblast - bone-forming cells
 - osteoclast - bone destroying cells

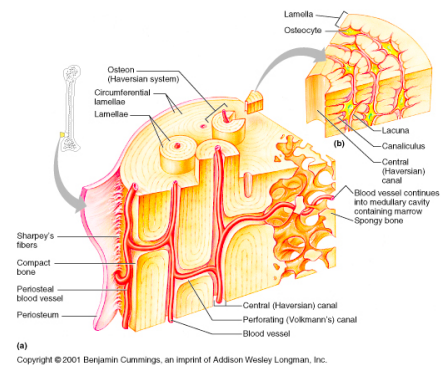
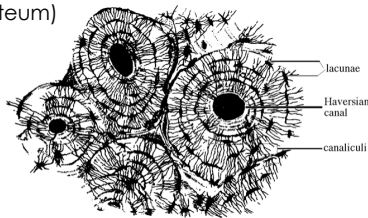


MICROSCOPIC STRUCTURE

- compact bone
 - osteon (Haversian system) - tiny weight-bearing pillars
 - group of hollow tubes
 - arranged like tree rings
 - called lamellae help resist twisting
 - osteocytes in lacunae (sm. pocket of cells) live at lamellar junctions
 - canaliculi - tiny canals that connect osteocytes



- central canals - center of osteon
 - a.k.a. Haversian canals
 - blood vessels (capillaries) and nerve fibers
- perforating canals
 - a.k.a. Volkmann's canals
 - run at right angles to central canals
 - allows the inside of bone to communicate with the outside (periosteum)

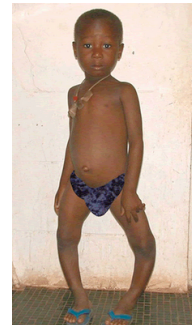


CHEMICAL COMPOSITION

- organic components
 - cells - osteogenic cells, osteocytes, osteoblasts, osteoclasts
 - osteoid - organic matrix (ground substance and collagen fibers)
 - *gives bone flexibility and tensile strength (resist stretch and twist)
- inorganic components
 - mineral salts - a.k.a. hydroxyapatites (calcium phosphates)
 - *gives bone hardness
- right combination of organic and inorganic components makes bone strong without being brittle

OSTEOMALACIA & RICKETS

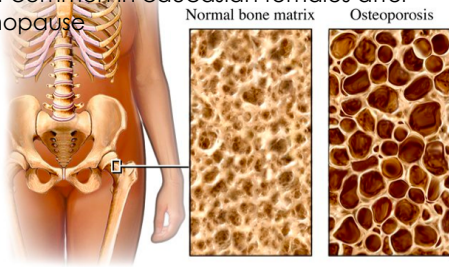
- osteomalacia
 - bone disorders that result in soft or weak bones
 - pain when weight is put on affected bones
- rickets
 - osteomalacia in children
 - bowled legs and deformities of the pelvis, skull, and rib cage common
- causes - insufficient calcium in diet or a vitamin D deficiency



Bone Function and Structure

OSTEOPOROSIS

- bone mass peaks at about 35 years
- osteoclast activity greater than osteoblast
- osteoporosis occurs when the skeletal system loses bone volume and mineral content due to increased osteoclast activity
- bones become porous and light making them weak
- most common in caucasian females after menopause



Paget's Disease

- rate of bone growth and destruction becomes distorted leading to fragile or misshapen bones
- usually localized to spine, pelvis, femur, and skull
- characterized by pain and diagnosed through X-rays



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NORMAL HUMERUS

Paget's HUMERUS