

UNIT 5 – BONE PHYSIOLOGY

5 FUNCTIONS OF THE SKELETAL SYSTEM

1. SUPPORT

- RIGID, STRONG BONE SUITED FOR WEIGHT BEARING & MAJOR SUPPORTING ELEMENT OF THE BODY

2. PROTECTION

- BONE IS HARD, PROTECTS ORGANS IT SURROUNDS
 - EXAMPLES: BRAIN, LUNGS, HEART

3. MOVEMENT

- MUSCLES ATTACH TO BONES BY TENDONS & CONTRACTION OF MUSCLES CAUSES BONE TO MOVE
- LIGAMENTS CONNECT BONES & CARTILAGE COVERS ENDS & JOINTS

5 FUNCTIONS OF THE SKELETAL SYSTEM

4. STORAGE

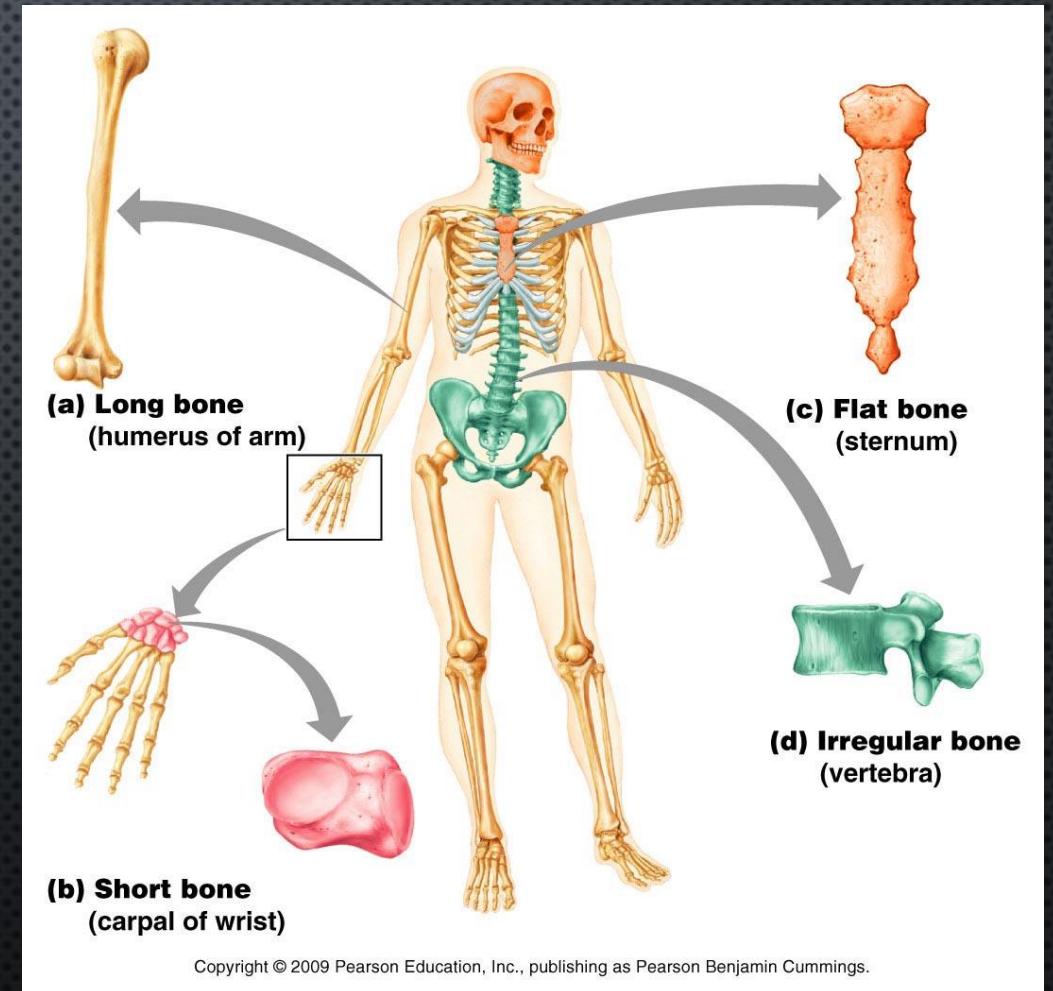
- EXCESS MINERALS IN BLOOD ARE TAKING INTO BONE & STORED
- BLOOD LEVELS FALL & BONES RELEASE MINERALS (SUCH AS PHOSPHORUS & CALCIUM)
- STORES FAT

5. BLOOD CELL PRODUCTION

- BONE MARROW GIVES RISE TO BLOOD CELLS & PLATELETS

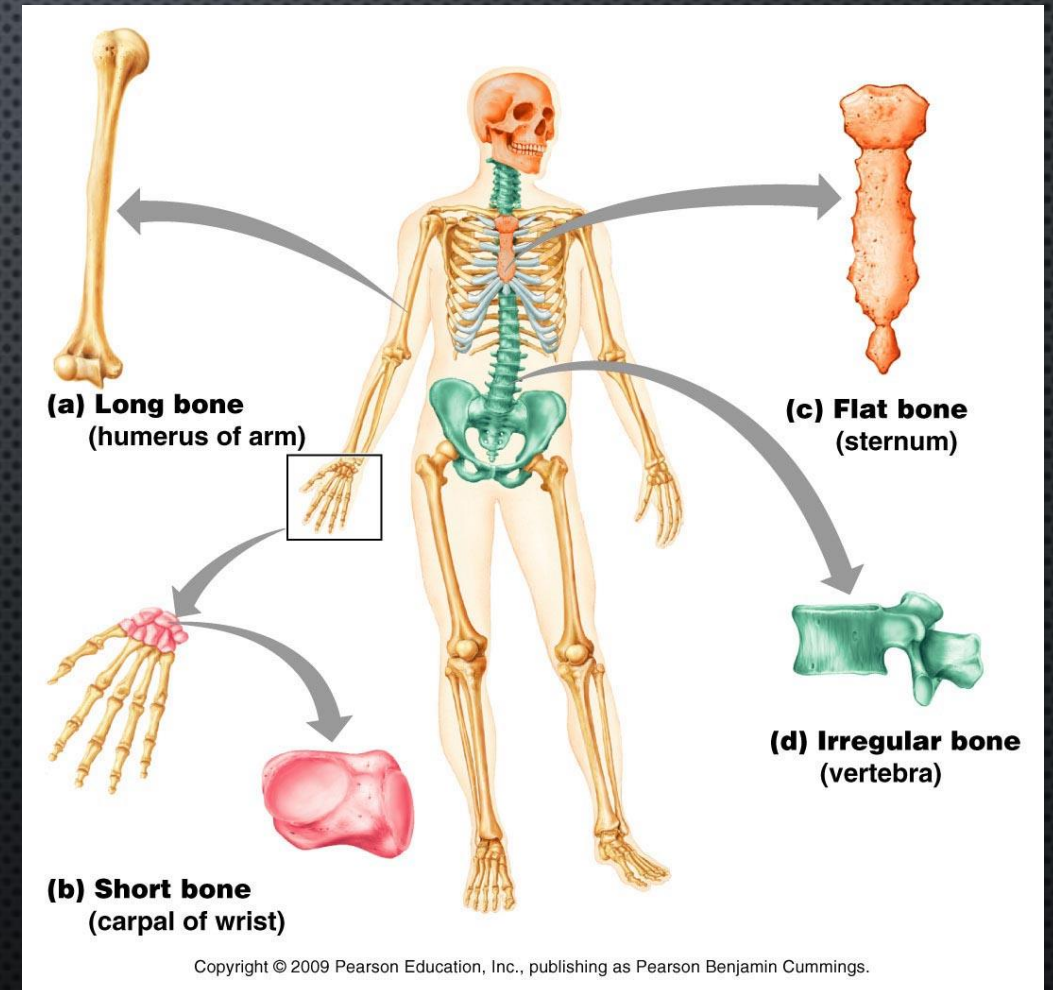
CLASSIFICATION OF BONES

- LONG BONES
 - LONGER THAN THEY ARE WIDE
 - EXAMPLES: UPPER & LOWER LIMBS
- SHORT BONES
 - BROAD AS THEY ARE LONG
 - CUBE-SHAPED AND/OR ROUND
 - EXAMPLES: TARSALS & CARPALS
- FLAT BONES
 - THIN, FLAT, & CURVED
 - EXAMPLES: SKULL (PARIETAL), STERNUM, SCAPULAE

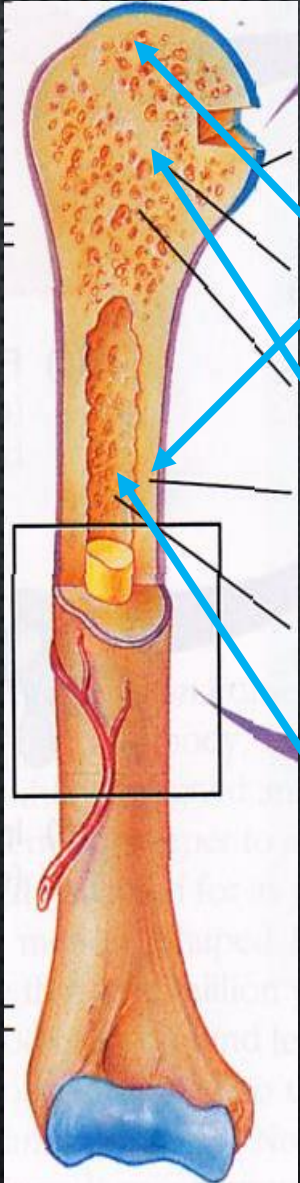


CLASSIFICATION OF BONES

- IRREGULAR BONES
 - DON'T FIT IN THE OTHER CATEGORIES
 - EXAMPLES: FACE & VERTEBRAE
- SESAMOID
 - SESAME SEED
 - EXAMPLES: PATELLA, SMALL & FLAT
- SUTURAL BONES
 - WORMIAN BONES
 - BORDERS LIKE A JIGSAW PUZZLE



GROSS STRUCTURE OF LONG BONES



- DIAPHYSIS
 - SHAFT
 - MADE OF COMPACT BONE
- EPIPHYSES (PROXIMAL & DISTAL)
 - THE ENDS OF THE LONG BONE
 - THIN LAYER OF COMPACT BONE ENCLOSING AN AREA FILLED WITH SPONGY BONE
- EPIPHYSEAL LINE
 - REMNANT OF THE EPIPHYSEAL PLATE
- EPIPHYSEAL PLATE
 - CAUSE THE GROWTH OF A LONG BONE
 - HYALINE CARTILAGE PLATE EVENTUALLY BECOMES COMPLETELY REPLACED BY BONE, LEAVING ONLY THE EPIPHYSEAL LINES TO MARK THEIR PREVIOUS LOCATION
- MEDULLARY CAVITY
 - YELLOW MARROW & RED MARROW IS FOUND THERE

GROSS ANATOMY OF BONE

- PERIOSTEUM

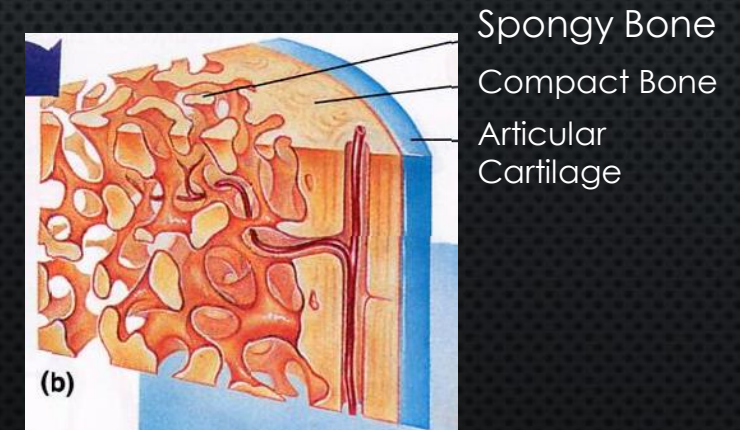
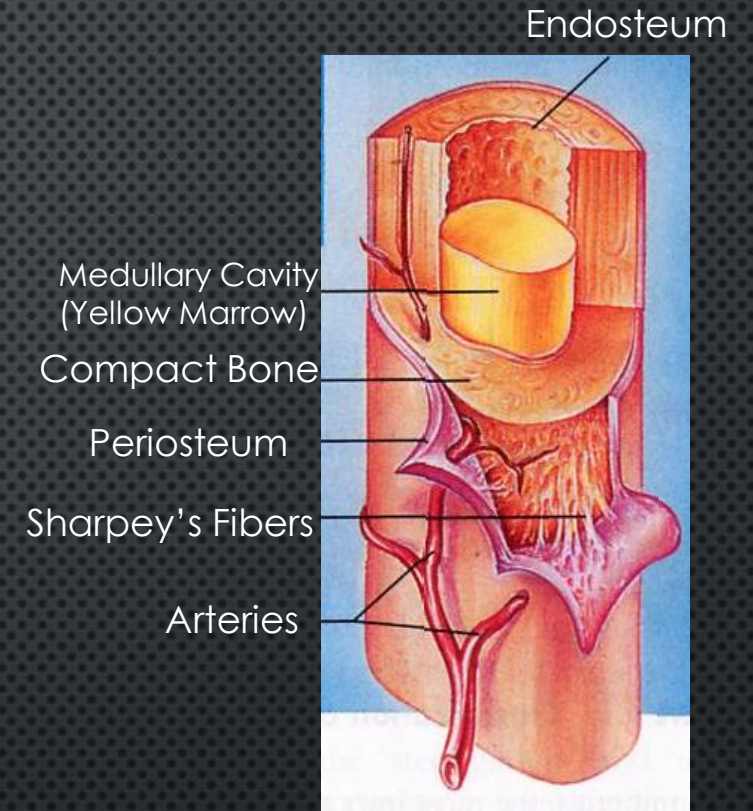
- FIBROUS CONNECTIVE TISSUE MEMBRANE THAT COVERS THE DIAPHYSIS
 - *SHARPEY'S FIBERS* SECURE THE PERIOSTEUM TO THE UNDERLYING BONE

- ARTICULAR CARTILAGE

- GLASSY HYALINE CARTILAGE
- PROVIDES A SMOOTH, SLIPPERY SURFACE THAT DECREASES FRICTION AT JOINT SURFACES
- LOCATED ON THE EPIPHYSES OVER A THIN LAYER OF COMPACT BONE ENCLOSING AN AREA FILLED WITH SPONGY BONE

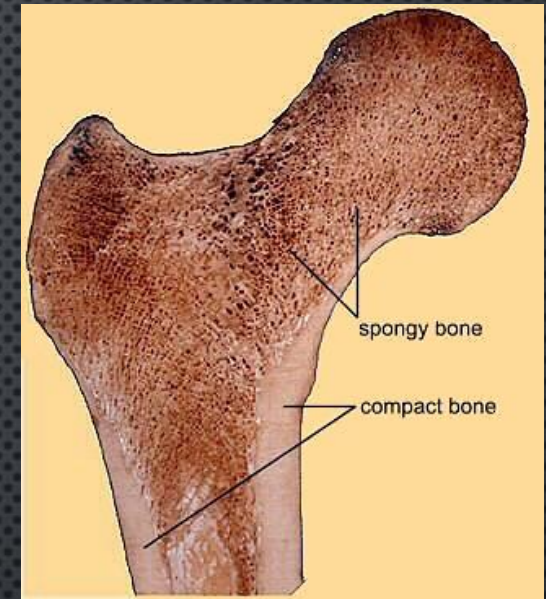
- MEDULLARY CAVITY

- STORAGE AREA FOR ADIPOSE TISSUE (YELLOW MARROW)
- IN INFANTS, THIS AREA FORMS BLOOD CELLS (RED MARROW)
- IN ADULT BONES, RED MARROW IS CONFINED TO THE CAVITIES OF SPONGY BONE OF FLAT BONES AND THE EPIPHYSES OF SOME LONG BONES



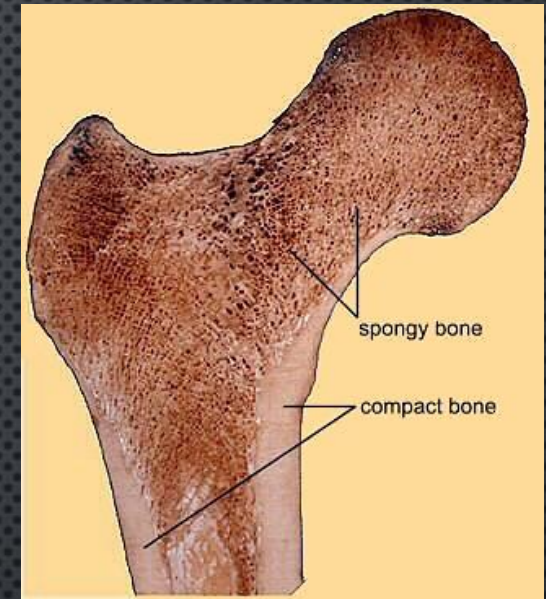
COMPACT BONE

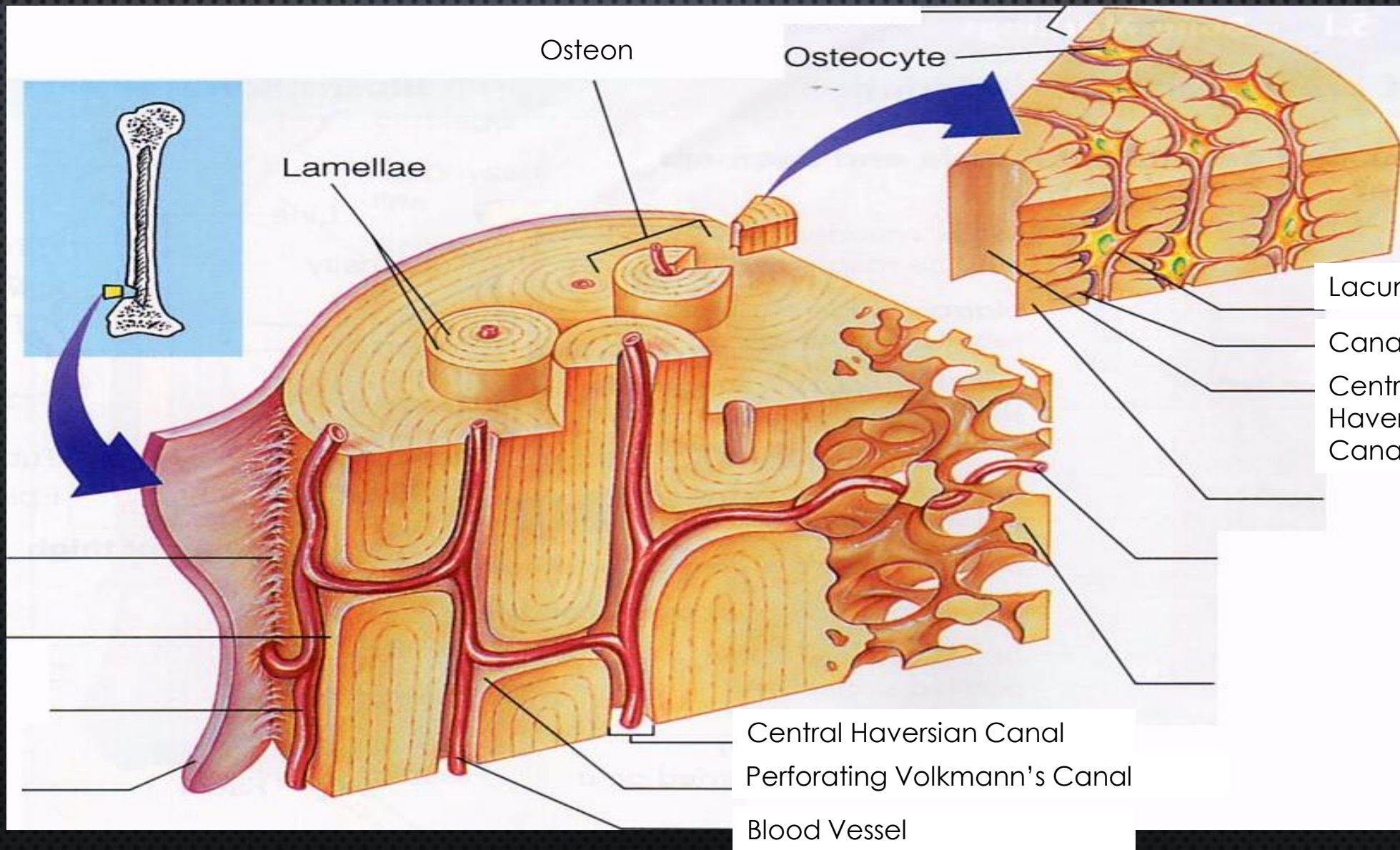
- COMPACT BONE IS MORE DENSE THAN CANCELLOUS BONE
- FUNCTIONAL UNIT = OSTEON (HAVERSIAN SYSTEM)
 - CONSISTS OF A SINGLE HAVERSIAN CANAL, CONTENTS & CONCENTRIC LAMELLAE (CONCENTRIC LAYERS) & OSTEOCYTES
- OSTEOCYTES RECEIVE NUTRIENTS & ELIMINATE WASTE THROUGH CANALS IN COMPACT BONE
 - BLOOD VESSELS FROM THE PERIOSTEUM ENTER BONE THROUGH THE VOLKMANN'S CANALS
- COMPACT BONE IS THICKEST WHERE STRESS IS GREATEST & OSTEONS RUN PARALLEL IN LONG BONES TO THE AXIS OF THE SHAFT



SPONGY BONE

- AKA CANCELLOUS BONE
- DOES NOT HAVE OSTEONS IN CONCENTRIC LAYERS
- MATRIX HAS CONNECTING RODS & PLATES OF BONE CALLED TRABECULAE
- TRABECULAE CONSISTS OF SEVERAL LAMELLAE WITH OSTEOCYTES THAT ARE LOCATED BETWEEN THE LAYERS
- TRABECULAE ARE ORIENTED ALONG LINES OF STRESS WITHIN BONES





Osteon

Osteocyte

Lamellae

Lacuna

Canaliculus

Central Haversian Canal

Central Haversian Canal
Perforating Volkmann's Canal
Blood Vessel

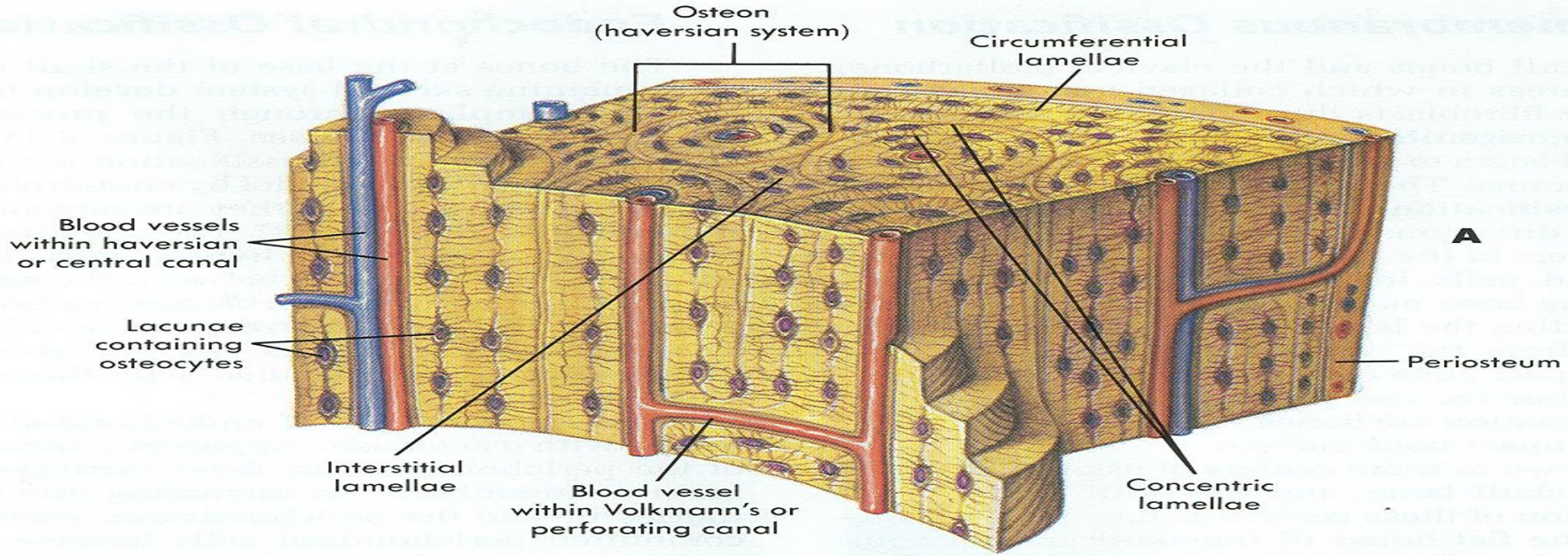
MICROSCOPIC ANATOMY OF BONE

- OSTEOCYTES
 - MATURE BONE CELLS
- LACUNAE
 - TINY CAVITIES WITHIN THE MATRIX ARRANGED IN CONCENTRIC CIRCLES AROUND CENTRAL (HAVERSIAN) CANALS
- OSTEON OR HAVESIAN SYSTEM
 - COMPLEX CONSISTING OF CENTRAL CANAL & MATRIX RINGS
 - CENTRAL CANALS RUN LENGTHWISE THROUGH THE BONY MATRIX, CARRYING BLOOD VESSELS AND NERVES TO ALL AREAS OF BONE

MICROSCOPIC ANATOMY OF BONE

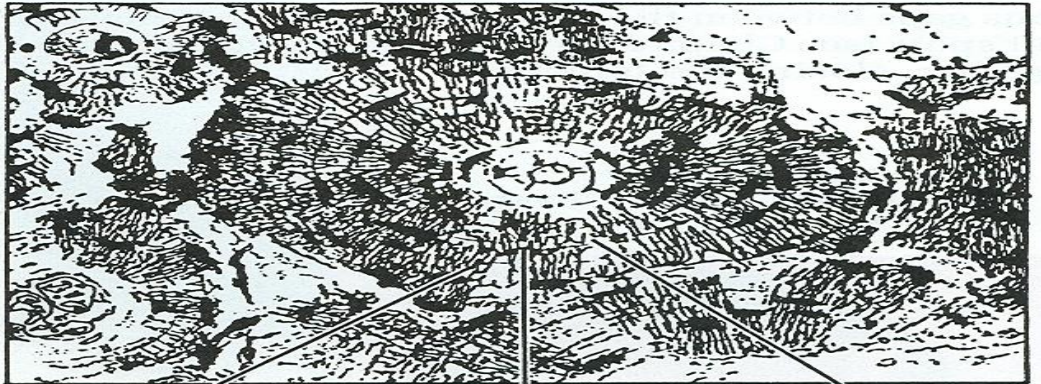
- CANALICULI
 - TINY CANALS RADIATE OUTWARD FROM THE CENTRAL CANALS TO ALL LACUNAE
 - FORM A TRANSPORTATION SYSTEM THAT CONNECTS ALL THE BONE CELLS
- PERFORATING (VOLKMANN'S) CANALS
 - COMMUNICATION PATHWAY FROM THE OUTSIDE OF THE BONE TO ITS INTERIOR (AND THE CENTRAL CANALS)
 - RUN INTO THE COMPACT BONE AT RIGHT ANGLES TO THE SHAFT
- THE CALCIUM SALTS DEPOSITED IN THE MATRIX GIVE BONE ITS HARNESS WHEREAS THE ORGANIC PARTS (ESPECIALLY THE COLLAGEN FIBERS) PROVIDE FOR BONE'S FLEXIBILITY AND GREAT TENSILE STRENGTH

COMPACT BONE



A

B



Canaliculi Osteocyte in a lacuna Lamella

CALCIUM

- BONES ARE ESSENTIAL IN MAINTAINING CALCIUM LEVELS IN THE BLOOD
- BONE IS THE PRIMARY STORAGE SITE OF CALCIUM
- MOST ABUNDANT MINERAL IN THE BODY
 - 99% IS IN BONE
- CALCIUM IS USED FOR MUSCLE CONTRACTION & NERVE CELL POTENTIALS
- HIGH LEVELS CAN CAUSE CELLS TO BE NON-REACTIVE & LOW LEVELS CAN CAUSE CONVULSION
- CALCIUM MOVES INTO BONE WITH OSTEOLASTS AND OUT OF BONE WITH OSTEOCLASTS
- WHEN BLOOD LEVELS FLUCTUATE, BLASTS & CLASTS CHANGE TO MEET THE NEED
- PARATHYROID HORMONE
 - PRIMARY REGULATOR OF BLOOD CALCIUM
- PH CAN STIMULATE OSTEOCLAST ACTIVITY & STIMULATE UPTAKE IN THE SMALL BOWEL BY CREATING MORE VITAMIN D

NUTRITION

- BONE GROWTH REQUIRES OSTEOLASTS & CHONDROBLASTS TO PROLIFERATE
- CALCIUM IS CRITICAL!
 - FOR GROWTH & VITAMIN D IS NECESSARY FOR CALCIUM ABSORPTION IN THE SMALL INTESTINE
 - LACK OF CALCIUM RESULTS IN RICKETS IN KIDS AND OSTEOMALCIA IN ADULTS
 - VITAMIN D IS ONLY SOLUBLE IN FAT, SO DISEASES THAT INTERFERE WITH FAT ABSORPTION AFFECT VITAMIN D
- VITAMIN C IS CRITICAL FOR COLLAGEN SYNTHESIS
 - SCURVY IS THE MALADY WHERE A PERSON IS DEFICIENT IN VITAMIN C WHICH CAUSES BONES DEFICIENT IN COLLAGEN
 - COLLAGEN IS ALSO IMPORTANT IN CONNECTIVE TISSUE PRODUCTION
 - SCURVY CAUSES POOR WOUND HEALING & EASY HEMORRHAGE