Skeletal System

The skeletal System . . .

- What are the general components of the skeletal system?
- What does the skeletal system do for you & how does it achieve these functions?

Components

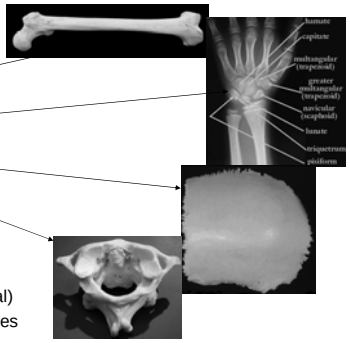
- The skeletal system includes:
  - Bones
  - Cartilages
    - Mainly hyaline & fibrocartilage
  - Joints
  - Ligaments
  - Other connective tissues
    - Such as adipose, areolar…

General Functions

- Functions of the Skeletal System
  - Support against gravity
  - Protection of soft internal organs
  - Leverage for muscle action
    - Insertions & origins
  - Storage
    - Calcium, phosphorous, other inorganic salts
    - Fat - energy
  - Blood cell production

Bone Structure - Macroscopic

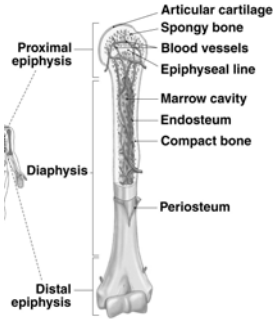
- Bone Shapes:
  - Long
  - Short
  - Flat
  - Irregular



Other: Wormian (sutural) & Sesamoid bones

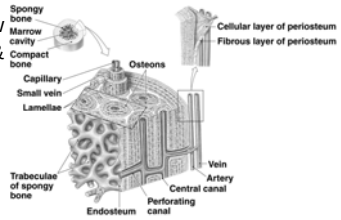
Bone Structure: The generic bone

- The shaft of a bone = **diaphysis**
- The ends of a bone = **epiphyses**
  - Covered with articular cartilage
- The cavity of a bone = **marrow cavity**
  - Loose connective tissue
- Outer covering = **periosteum**
  - Point of attachment for?
  - Also location of many blood vessels & nerves
- Inner lining = **endosteum**
  - Lines marrow cavity
  - Active during growth & remodeling
- Bone tissue present
  - **Spongy** (cancellous) in epiphyses & marrow cavity
  - **Compact** in shaft and lining periphery of bone



Composition of Bones: Microscopic

- Tissues Present in bone
  - Dense connective tissue – the periosteum
    - An outer fibrous layer
    - An inner cellular (osteogenic layer)
  - Loose connective tissue – bone marrow
  - osseous – compact & spongy
  - cartilage – hyaline
  - Blood
  - nervous



Composition of Bone: Microscopic

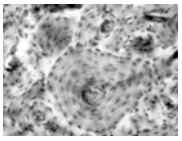
- Osseous or bone tissue has:
  - Specialized cells
    - 2% of bone weight
  - Strong flexible matrix
    - Calcium phosphate crystals
      - Two-thirds of bone weight
    - Collagen fibers

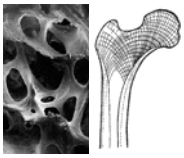
Cells of Osseous Tissue

- Osteoblasts
  - Responsible for bone deposition (laying down new bone) = osteogenesis
- Osteocytes
  - Responsible for maintenance of bone tissue in the lacunae of the osteon
    - Recycle the mineral components
- Osteoclasts
  - These cells are derived from white blood cells
  - multi-nucleate cells
  - Involved with bone resorption (osteolysis) by secreting enzymes that dissolve bony matrix

Organization of Bone Tissue

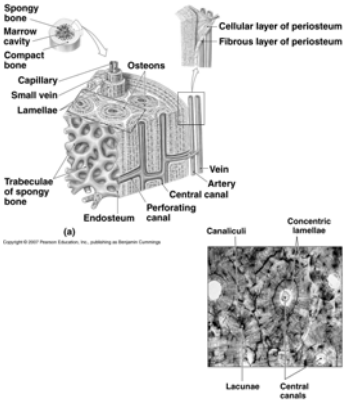
- Bone that is highly organized is called compact bone
  - Organized units are called osteons
- Bone that is not in a highly compacted structure is spongy bone
  - plates are called trabeculae
  - Trabeculae in large help to increase the strength of bone





The Osteon

- Basic functional unit of compact bone; columnar & cylindrical in shape
  - Strong in long axis of bone
  - Concentric layers of *osteocytes*
  - Concentric layers of matrix (*lamellae*)
  - *Central* (*Haversian*) canal
    - Axial tunnel for blood vessels
  - *Perforating* canal (Volkmann's)
    - Radial tunnel for blood vessels
- Osteocytes communicate via small canals through the lamallae called canliculi

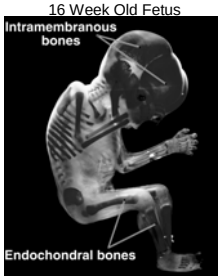


Bone Formation & Growth

- Two methods of forming bones

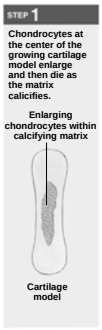
  1. Intramembranous Ossification
     - *Ossification*—Process of converting other tissues to bone
     - Forms flat bones
     - *Stem cells* differentiate to osteoblasts
     - Produces spongy bone, then compact bone
  2. Endochondral Ossification

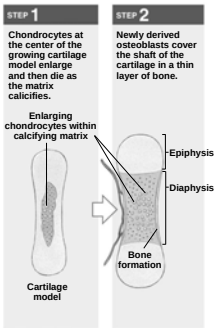
Bone Formation in 16 Week Old Fetus

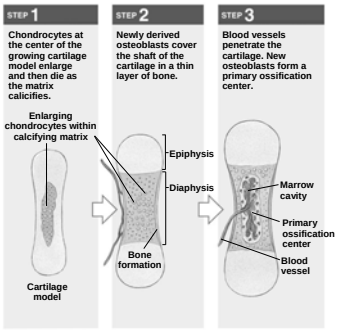


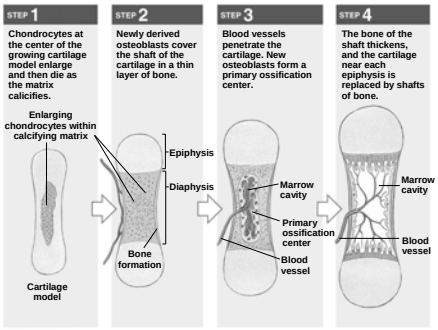
Bone Formation and Growth

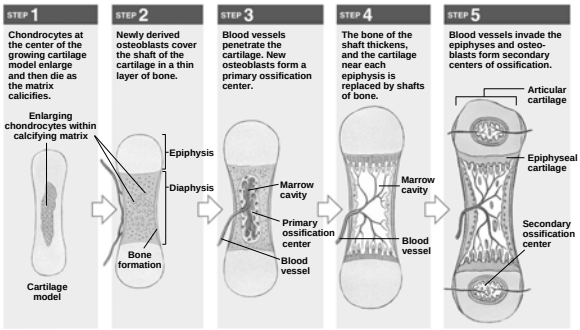
- Endochondral Ossification
  - Most bones formed this way
  - *Cartilage model* replaced by bone
  - Replacement begins in middle (diaphysis)
  - Replacement follows in ends (epiphyses)







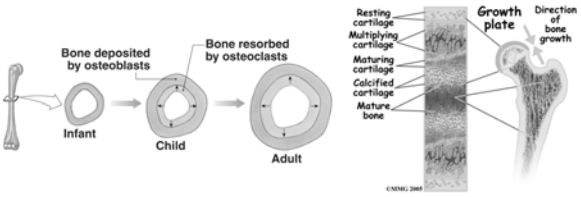




PLAY Endochondral Ossification

Bone Growth

Appositional vs. Transitional Bone Growth



Bone Formation and Growth

- Requirements for Normal Bone Growth
  - Minerals
    - Calcium, phosphate
  - Vitamins
    - Vitamin D_3
    - Vitamin C
    - Vitamin A
  - Hormones
    - Growth Hormone
    - Sex hormones, thyroid hormone, others

Bone Remodeling/Homeostasis

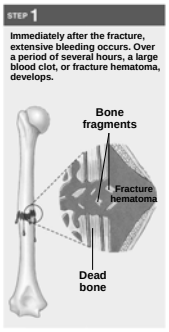
- Role of Remodeling in Support
  - *Remodeling*—Continuous breakdown and reforming of bone tissue
  - Shapes reflect applied loads
  - Mineral turnover enables adapting to new stresses

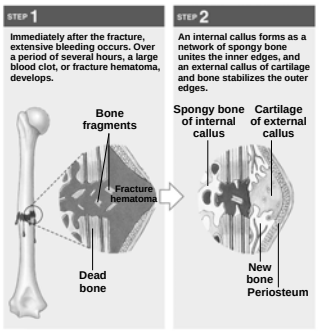
Bone Remodeling/Homeostasis

- Homeostasis and Mineral Storage
  - Bones store calcium
    - Contain 99% of body calcium
    - Store up to two kg calcium
    - Hormones control storage/release
      - *PTH*, *calcitriol* release bone calcium
      - *Calcitonin* stores bone calcium
    - Blood levels kept constant

Bone Remodeling/Homeostasis

- Injury and Repair
  - *Fracture*—A crack or break in a bone
  - Steps in fracture repair
    - Fracture *hematoma*
    - Mitoses in periosteum, endosteum
      - Internal callus
      - External callus
    - Bone remodeling





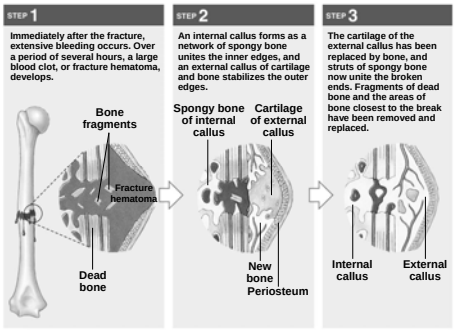
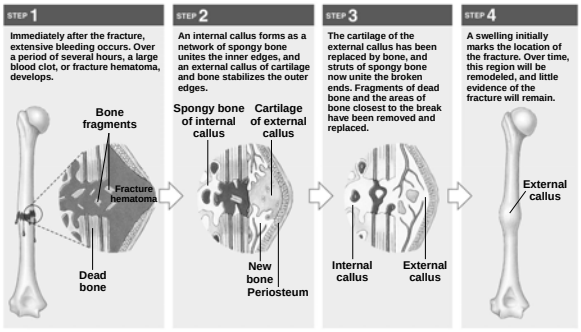


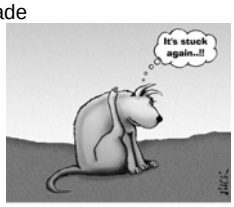
Figure 6-7
4 of 5



PLAY Steps in the Repair of a Fracture

Aging and the Skeletal System

- *Osteopenia*—Less than normal ossification (mineral content) in bone
  - Osteopenia starts before age 40
    - Women lose 8% per decade
    - Men lose 3% per decade
  - *Spongy* bone most affected
    - *Epiphyses*
    - Vertebrae
    - Jaws

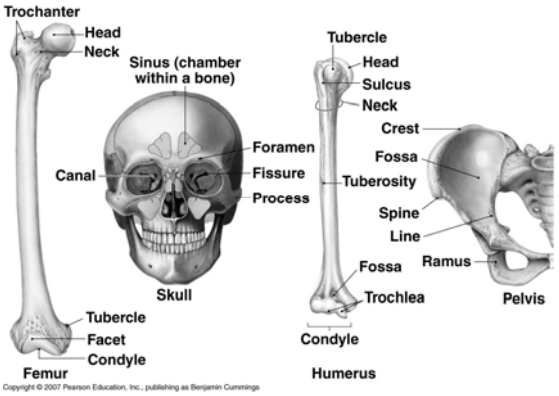


Canis Osteoarthritis.

The Skeleton - Terms

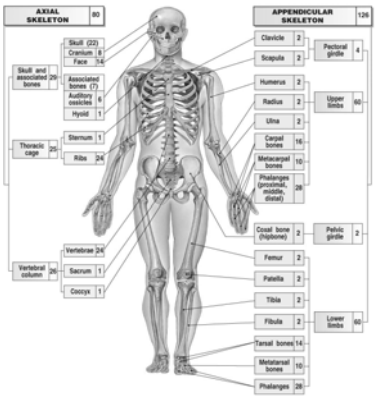
TABLE 6-1 *An Introduction to the Surface Features of Bones*

GENERAL DESCRIPTION	ANATOMICAL TERM	DEFINITION
Elevations and projections (general)	Process	Any projection or bump
	Ramus	An extension of a bone making an angle with the rest of the structure
Processes formed where tendons or ligaments attach	Trochanter	A large, rough projection
	Tuberosity	A smaller, rough projection
	Tubercle	A small, rounded projection
	Crest	A prominent ridge
	Line	A low ridge
	Spine	A pointed process
Processes formed for articulation with adjacent bones	Head	The expanded articular end of an epiphysis, separated from the shaft by a neck
	Neck	A narrow connection between the epiphysis and the diaphysis
	Condyle	A smooth, rounded articular process
	Trochlea	A smooth, grooved articular process shaped like a pulley
	Facet	A small, flat articular surface
Depressions	Fossa	A shallow depression
	Sulcus	A narrow groove
Openings	Foramen	A rounded passageway for blood vessels or nerves
	Canal	A passageway through the substance of a bone
	Fissure	An elongate cleft
	Sinus	A chamber within a bone, normally filled with air



The Skeleton Divisions

- Axial
  - Creates the support basis for the arms and legs
  - Provides protection for the brain & spinal cord, as well as the heart & lungs
- Appendicular
  - The arms & legs
  - Provide movement of the body



Higgins - control yourself & sit down!