Skeleton Test Study Guide

**Skeletal Organization**
- Axial Skeleton
  - Head
  - Neck
  - Trunk
- Appendicular Skeleton (PULP)
  - Pectoral girdle
  - Upper limbs
  - Lower limbs
  - Pelvic girdle

**Function of Skeletal System**
1. Support
2. Protection
3. Body Movement - place of attachment for muscles
4. Hematopoiesis (creates blood)
5. Inorganic Salt Storage - Ca, P, Mg, Na, & K
6. Energy Storage

**Bone Composition**
- Cells - 35%
  - **osteoprogenitor cells** - undergo mitosis and become osteoblasts
  - **osteoblasts** - form bone matrix by secreting collagen
  - **osteocytes** - mature bone cells
  - **osteoclasts** - destroy bone matrix; important for growth, maintenance, and repair
- Inorganic Salts - 65%
  - primarily **Calcium Phosphate**

<table>
<thead>
<tr>
<th>Compact VS. Spongy</th>
<th>Pictures</th>
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<tbody>
<tr>
<td>Compact bone</td>
<td><img src="image1.png" alt="Compact bone" /></td>
</tr>
<tr>
<td>Yellow marrow in medullary cavity</td>
<td><img src="image2.png" alt="Yellow marrow" /></td>
</tr>
<tr>
<td>Remnant of epiphyseal plate</td>
<td><img src="image3.png" alt="Remnant" /></td>
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<tr>
<td>Spongy bone</td>
<td><img src="image4.png" alt="Spongy" /></td>
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<tr>
<td>Compact bone</td>
<td><img src="image5.png" alt="Compact" /></td>
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### Compact VS. Spongy

<table>
<thead>
<tr>
<th>Structure</th>
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<tbody>
<tr>
<td><strong>Solid, dense, and smooth</strong></td>
<td><strong>Trabeculae</strong> - needle-like pieces of bone</td>
</tr>
<tr>
<td><strong>Haversian System</strong> (structural unit)</td>
<td>lots of open spaces between trabeculae</td>
</tr>
<tr>
<td>o elongated cylinders cemented together (osteons)</td>
<td>nourished by diffusion from nearby Haversian Canals</td>
</tr>
<tr>
<td>o composed of . . .</td>
<td></td>
</tr>
<tr>
<td>■ <strong>osteocytes</strong> - spider shaped cells which lie in lacunae; produce matrix</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● matrix of collagen + calcium salts that form concentric lamellae (layers) around a canal</td>
</tr>
<tr>
<td>■ <strong>Haversian canal</strong> - center canal that contains blood vessels and nerves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Canaliculi - connect lacunae of osteocytes</td>
</tr>
<tr>
<td></td>
<td>● <strong>Volkmann's canals</strong></td>
</tr>
<tr>
<td></td>
<td>o connect blood + nerve supply of adjacent haversian systems</td>
</tr>
<tr>
<td></td>
<td>o perpendicular to Haversian Canals</td>
</tr>
</tbody>
</table>

### Bone Classification

- Classified by shape
  - a. Long bones
  - b. Short Bones
  - c. Flat Bones
d. Irregular Bones  
e. Sesamoid (round) Bones  
f. Wormian Bones (in skull)

Parts of a Long Bone

- **Diaphysis**
  - central medullary cavity → **yellow marrow** (fat storage)
  - collar of compact bone surrounds medullary cavity
  - supportive function

- **Epiphysis**
  - spongy bone surrounded by thin layer of compact bone
  - **red marrow** (hematopoiesis)
  - **Epiphyseal line** = remnant of growth plate
    - junction between diaphysis and epiphyses
    - point where growth occurred

- **Periosteum**
  - fibrous covering to diaphysis
  - richly supplied with blood
    - **Nutrient Foramen** = passage way in bone for nutrient artery
  - **Osteogenic layer** = osteoblast + osteoclasts
  - site for muscle to attach (tendons)/ protection + nourishment for bone

- **Endosteum**
  - inner lining of medullary cavity
- layer of osteoblast + osteoclasts
- aids in bone remodeling

- **Articular Cartilage**
  - hyaline cartilage on epiphyses
  - shock absorber + forms synovial

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**Bone Development**

- **Embryonic Skeleton**
  - hyaline cartilage
  - begins ossification (solidification) at 6-7 weeks → continuous through adulthood
  - 2 patterns

**Bone Growth**

1. **Longitudinal**
   - During infancy and childhood → length by growth in epiphyseal plates
2. **Appositional**
   - growth in width
Growth at the Epiphyseal Plate

1. 1st layer of cells
   ➢ closest to the end of epiphysis
   ➢ resting cells
   ➢ anchors epiphyseal plate to epiphysis

2. 2nd layer of cells
   ➢ many rows of young cells
   ➢ undergoing mitosis

3. 3rd layer of cells
   ➢ older cells
   ➢ left behind when new cells appear
   ➢ enlarging and becoming calcified

4. 4th layer of cells
   ➢ thin
   ➢ dead cells
   ➢ calcified extracellular matrix

Homeostasis of Bone Tissue

- **Reabsorption** - action by osteoclasts + parathyroid hormone
  - expands medullary cavity

- **Deposition** - action by osteoblasts + calcitonin
  - adding of new bone to epiphysis
Life Span Changes
- decrease in height around 30 years
- calcium level falls
- bones become brittle
- osteoclasts outnumber osteoblasts (more breaking down than creating)
- spongy bone weakens before compact bone
- bone loss rapid in menopausal women
- hip fractures common
- vertebral compression fractures common

Factors Affecting Bone Development, Growth, and Repair
- Deficiency of Vitamin A
  - retards bone development
- Deficiency of Vitamin C
  - results in fragile bones
- Deficiency of Vitamin D
  - Rickets + Osteomalacia
- Insufficient Thyroid Hormone
  - delays bone growth
- Sex Hormones
  - promote bone formation; stimulate ossification of epiphyseal plates
- Physical Stress
  - stimulates bone growth
- insufficient growth hormone
  - Dwarfism
- excessive growth hormone
  - Gigantism + Acromegaly

Other Abnormalities
- Cleft Palate
- Osteoporosis
  - loss of calcified bone; weak bones
- Polydactyly
  - extra digits
- Scoliosis (too curvy side to side) + lordosis (really bent lumbar) + kyphosis (hump back)
Fractures

- Green stick, fissured, comminuted, transverse, oblique, and spiral

**Clinical Application + green boxes**

1. **Sickle cell disease**
   - inherited
   - severe bone pain
     - low oxygen conditions = abnormal hemoglobin which can block bone arteries in patients

2. child’s long bones are still growing if a radiograph shows epiphyseal plates
   - if damaged, could cause ceased growing or produce uneven growing
     - epiphyseal plates may be altered surgically to even out growing
   - **bone cancer** = abnormal osteoclasts destroying bone tissue while cancer of prostate gland has opposite effect
     - if prostate cancer spreads to bone, it can stimulate osteoblasts
       - this promotes formation of new bone on surfaces of bony trabeculae (needle-like spongy bone pieces)

3. natural substances can be used to treat bone tissue
   - **Dwarfism** = growth hormone
     - once donated but is now produced by recombinant DNA technology (bacteria that is given the human gene and produces the protein)
     - **Bone Morphogenetic Protein (BMP)** also used in recombinant DNA technology
used spinal fusion procedure was once done taking bone chips from the patient's pelvis (painful)
  ● replaced with a new protein that was less painful and did not cause growth in untargeted regions; also useful in Cleft Palate

4. Astronauts experience 1% bone mass loss per month in space
   ● osteoblasts activity decreases; osteoclast activity increase
     ○ greater loss in spongy bone
     ○ researchers predict 50% bone loss could occur to a several year long period such as a mission to mars

5.  

6. **Biomineralization** - the combining of minerals with organic molecules (like bones)
   ● Ancient Mayan skulls have teeth composed of nacre
     ○ used today for filling in lost bone in upper jaw because our body does not reject but it even promotes bone growth

7. **Osteoporosis** - skeletal system loses bone mass and mineral content as we age so old people are more likely to break bones than younger people
   ● hereditary and environmental (alcoholism)
   ● high risk in menopause
   ● Dual-energy X-ray absorptiometry is recommended for people over the age of 65 to test for bone mineral density
can be treated

8. **Mastoiditis** - mastoid process becomes infected
   - microorganisms can get into air cells in ear; can infect brain

9. **Cleft Palate** - fusion of palatine process of maxillae is incomplete at birth
   - trouble with breastfeeding
   - artificial plate inserted within the mouth/ special type of nipple on bottles for resolution

10. in some adults, the frontal suture remains open and never closes in the 6th year (line down forehead)

11. **Spondylosis** - fracture in the inferior and superior articulating process
    - results from gymnasts, pole vaulters, high jumpers, etc hyperextending and rotating vertebrae

12. **Spondylolisthesis** - occurs when the vertebrae slips out of place
    - most common is the 5th lumbar vertebrae

13. **Sternal Angle** - the line of union between the sternum and the manubrium; projects slightly forward

14. **Sternal Puncture** - sample of red blood marrow in the spongy bone of sternum (easy to reach)

15. **Cleidocranial Dysplasia** - shoulders bend and meet over the chest
    - scapulae are stunted/missing
    - **Arnold head** - fontanels atop the head never closed after arnold was kicked by a horse (malfuctioning gene that instructs certain cells to specialize as bone

16. sudden activity of an otherwise inactive forearm can cause fractures or breakage
    - you're supposed to work up to high activity over time

17. **polydactyly** - hereditary + common in amish people

18. **hip pointer** - common injury in contact sports; bruising the soft tissue and bone associated with the anterior iliac spine
    - protective padding prevents this

19. **Patellar Dislocation** - patella slips to one side because of unnatural movement or forceful blow
    - strengthening knee muscles and wearing protective padding can prevent this

20. **Osgood-Schlatter disease** - painful swelling of bony projection of tibia
    - overusing thigh muscles to straighten lower limbs irritates area

21. **Clubfoot** - common birth defect in infant’s feet
    - casts on both feet, surgery, or special shoes fixes the problem