THE SKELETAL SYSTEM

THE BONE TISSUE

FUNCTIONS OF THE BONE:
1. Support
2. Protection
3. Assistance in movement
4. Mineral homeostasis (storage and release)
5. Blood cell production (hemopoiesis)
   → red bone marrow
6. Triglyceride storage
   → yellow bone marrow

STRUCTURE OF BONE
1. Diaphysis
   → bone’s shaft or body
2. Epiphyses
   → proximal and distal end of bone
3. Metaphyses
   → contain epiphyseal plate
4. Articular cartilage
   → thin layer of hyaline cartilage covering the part of the epiphysis where the bone forms an articulation with another bone
5. Periosteum
   → surrounds the external bone surface
6. Medullary cavity or Marrow cavity
   → hollow, cylindrical space within diaphysis
7. Endoosteum
   → thin membrane that lines the internal bone surface

HISTOLOGY OF BONE TISSUE
- **Bone**, or osseous tissue, contains an abundant extracellular matrix that surrounds widely separated cells
- Extracellular matrix: 25% water, 25% collagen fibers, and 50% crystallized mineral salts
- **Hydroxyapatite** – \([\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2]\)
- **Calcification** → Mineral salts are deposited in the framework formed by the collagen fibers of the extracellular matrix, they crystallize and the tissue hardens
TYPES OF CELLS IN BONE TISSUE

a. **Osteogenic cells**
   → unspecialized stem cells derived from mesenchyme
   → the tissue from which almost all connective tissues are formed

b. **Osteoblasts**
   → bone-building cells

c. **Osteocytes**
   → mature bone cells
   → main cells in bone tissue, and maintain its daily metabolism

d. **Osteoclasts**
   → huge cells derived from the many fusion of as many as 50 monocytes

RESORPTION
→ breakdown of bone extracellular matrix

COMPACT BONE TISSUE
- Osteons or Haversian system
- Perforating or Volkmann’s canal
- Central or Haversian canal
- Lacunae

SPONGY BONE TISSUE
- does not contain Osteons
- Trabeculae

BLOOD AND NERVE SUPPLY
- Periosteal arteries and veins
- Nutrient artery and veins
  → passes through the nutrient foramen
- Metaphyseal arteries and veins
- Epiphyseal arteries and veins
BONE FORMATION

INTRAMEMBRANOUS OSSIFICATION
1. Development of the ossification center
2. Calcification
3. Formation of trabeculae
4. Development of the periosteum

ENDOCHONDRAL OSSIFICATION
1. Development of the cartilage model
2. Growth of the cartilage model
   - Interstitial growth
     → increase length
   - Appositional growth
     → increase thickness
3. Development of the primary ossification center
4. Development of the medullary (marrow) cavity
5. Development of the secondary ossification center
6. Formation of articular cartilage and the epiphyseal plate

BONE GROWTH

GROWTH IN LENGTH
→ interstitial growth of cartilage on the epiphyseal side of epiphyseal plate
→ replacement of cartilage on the diaphyseal side of the epiphyseal plate
→ in the epiphyseal growth plate
  1. Zone of resting cartilage
  2. Zone of proliferating cartilage
  3. Zone of hypertrophic cartilage
  4. Zone of calcified cartilage
→ epiphyseal line – epiphyseal plate fades; bone has stopped growing in length

GROWTH IN THICKNESS
→ appositional growth

BONE REMODELING
→ the ongoing replacement of old bone tissue by new bone tissue

BONE RESORPTION
→ the removal of minerals and collagen fibers from bone by osteoclasts

BONE DEPOSITION
→ the addition of minerals and collagen fibers to bone by osteoblasts

FACTORS AFFECTING BONE GROWTH AND BONE REMODELLING
1. Minerals
2. Vitamins
3. Hormones

REPAIR OF A BONE FRACTURE
1. Formation of fracture hematoma
   → mass of blood forms around the site of the fracture
2. Fibrocartilaginous callus formation
   → mass of repair tissue consisting of collagen fibers and cartilage that bridges broken ends of the bone
3. Bony callus formation
   → the fibrocartilage is converted to spongy bone
4. Bone remodeling
   → compact bone replaces spongy bone around the periphery of the fracture

ROLE IN CALCIUM HOMEOSTASIS
- Bone stores 99% of total body calcium
- Parathyroid hormone (PTH)
  → regulates Ca^{2+} exchange
  → stimulates formation of calcitriol
  (active form of Vitamin D)

FACTORS AFFECTING BONE GROWTH AND BONE REMODELLING
1. Minerals
2. Vitamins
3. Hormones
- **Calcitonin (CT)**
  → inhibits the activity of osteoclasts; speeds blood $\text{Ca}^{2+}$ uptake by bone

**DEMINERALIZATION**
→ the loss of calcium and other minerals from bone extracellular matrix
**TYPES OF BONES**

1. **Long bones**
   - Generally longer than wide.
   - Have a shaft with heads at both ends.
   - Contain mostly compact bone
   - Examples: femur, humerus

2. **Short bones**
   - Generally cube-shape
   - Contain more spongy bone than compact
   - Examples: Carpals, tarsals

3. **Flat bones**
   - Thin and flattened like pancakes.
   - Usually curved
   - They have two thin layers of compact bone sandwiching a layer of spongy bone
   - Examples: skull, ribs, sternum

4. **Irregular bones**
   - Do not fit into other bone classification categories
   - Irregular shape
   - Example: Vertebrae
### Table 6.1 Bone Markings

<table>
<thead>
<tr>
<th>Name of Bone Marking</th>
<th>Description</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Projections that are Sites of Muscle and Ligament Attachment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuberosity (too′ber-os′i-te)</td>
<td>Large rounded projection; may be roughened</td>
<td></td>
</tr>
<tr>
<td>Crest</td>
<td>Narrow ridge of bone; usually prominent</td>
<td></td>
</tr>
<tr>
<td>Trochanter (tro-kan′ter)</td>
<td>Very large, blunt; irregularly shaped process (the only examples are on the femur)</td>
<td></td>
</tr>
<tr>
<td>Line</td>
<td>Narrow ridge of bone; less prominent than a crest</td>
<td></td>
</tr>
<tr>
<td>Tubercle (too′ber-kl)</td>
<td>Small rounded projection or process</td>
<td></td>
</tr>
<tr>
<td>Epicondyle (ep′i-kon′dil)</td>
<td>Raised area on or above a condyle</td>
<td></td>
</tr>
<tr>
<td>Spine</td>
<td>Sharp, slender, often pointed projection</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>Any bony prominence</td>
<td></td>
</tr>
</tbody>
</table>

### Table 6.1 Bone Markings (continued)

<table>
<thead>
<tr>
<th>Name of Bone Marking</th>
<th>Description</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surfaces that Form Joints</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>Bony expansion carried on a narrow neck</td>
<td></td>
</tr>
<tr>
<td>Facet</td>
<td>Smooth, nearly flat articular surface</td>
<td></td>
</tr>
<tr>
<td>Condyle (kon′dil)</td>
<td>Rounded articular projection, often articulates with a corresponding fossa</td>
<td></td>
</tr>
</tbody>
</table>

### DEPRESSIONS AND OPENINGS

For passage of vessels and nerves:

- Foramen (fo-ra′men): Round or oval opening through a bone
- Groove: Furrow
- Fissure: Narrow, slitlike opening
- Notch: Indentation at the edge of a structure

Others:

- Fossa (fos′sh): Shallow basinlike depression in a bone, often serving as an articular surface
- Meatus (me-a′tus): Canal-like passageway
- Sinus: Cavity within a bone, filled with air and lined with mucous membrane

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THE AXIAL SKELETON

SKULL
→ cranium
→ 22 bones
→ cranial bones (8) – form the cranial cavity
  - frontal bone (1)
  - parietal bones (2)
  - temporal bones (2)
  - occipital bone (1)
  - sphenoid bone (1)
  - ethmoid bone (1)
→ facial bones (14) – form the face
  - nasal bones (2)
  - maxillae (2)
  - zygomatic bones (2)
  - mandible (1)
  - lacrimal bones (2)
  - palatine bones (2)
  - inferior nasal conchae (2)
  - vomer (1)

CRANIAL BONES

FRONTAL BONE
→ forms the forehead (the anterior part of the cranium), the roofs of the orbit (eye sockets), and most of the anterior part of the cranial floor

PARIELTAL BONES
→ form the greater portion of the sides and roof of the cranial cavity

TEMPORAL BONES
→ form the inferior lateral aspects of the cranium and part of the cranial floor

OCCIPITAL BONE
→ forms the posterior part and most of the base of the cranium

SPHENOID BONE
→ lies at the middle part of the base of the skull
→ the keystone of the cranial floor because it articulates with all the other cranial bones, holding them together

ETHMOID BONE
→ spongelike in appearance
→ located on the midline in the anterior part of the cranial floor medial to the orbits
→ forms:
  a. part of the anterior portion of the cranial floor
  b. the medial wall of the orbits
  c. the superior portion of the nasal septum, a partition that divides the nasal cavity into right and left sides
THE SKELETAL SYSTEM

d. most of the superior sidewalls of the nasal cavity

FACIAL BONES

NASAL BONES
→ meet at the midline
→ from the bridge of the nose

MAXILLAE
→ form the upper jawbone
→ articulate with every bone of the face except the mandible (lower jawbone)

ZYGOMATIC BONES
→ cheekbones
→ form the prominences of the cheeks and part of the lateral wall and floor of each orbit

LACRIMAL BONES
→ smallest bones of the face
→ form a part of the medial wall of each orbit

PALATINE BONES
→ form the posterior portion of the hard palate, part of the floor and lateral wall of the nasal cavity, and a small portion of the floors of the orbits

INFERIOR NASAL CONCHAE
→ separate bones that are not part of the ethmoid bone
→ form a part of the inferior lateral wall of the nasal cavity and project into the nasal cavity

VOMER
→ roughly triangular bone on the floor of the nasal cavity that articulates superiorly with the perpendicular plate of ethmoid bone and inferiorly with both the maxillae and palatine bones along the midline
→ forms the inferior portion of the nasal septum

MANDIBLE
→ lower jawbone
→ largest, strongest facial bone
→ only movable skull bone (other than the auditory ossicles)

NASAL SEPTUM
→ vertical partition that divide the nose into left and right sides
→ consists of bone and cartilage
  ▪ vomer
  ▪ septal cartilage
  ▪ perpendicular plate of the ethmoid bone

ORBITS
→ contains the eyeball and associated structures
→ made up of 7 bones:
  ▪ frontal
  ▪ sphenoid
  ▪ ethmoid
  ▪ palatine
  ▪ zygomatic
  ▪ lacrimal
  ▪ maxilla

FORAMINA
→ openings for blood vessels, nerves, or ligaments

UNIQUE FEATURES OF THE SKULL

SUTURE
→ an immovable joint in most cases in an adult skull that holds most skull bones together
THE SKELETAL SYSTEM

a. Coronal suture
   → unites frontal bone and both parietal bones
b. Sagittal suture
   → unites the two parietal bones on the superior midline of the skull
c. Lambdoid suture
   → unites the two parietal bones to the occipital bone
d. Squamous sutures
   → unite the parietal and temporal bones on the lateral aspects of the skull

PARANASAL SINUSES
→ cavities within certain cranial and facial bones near the nasal cavity

FONTANELS
→ “soft spots”
→ areas of unossified mesenchyme
   a. Anterior fontanel
      → largest fontanel
      → located at the midline between the two parietal bones and the frontal bone
   b. Posterior fontanel
      → located at the midline between the two parietal bones and the occipital bone
   c. Anterolateral fontanel
      → located laterally between the frontal, parietal, temporal and sphenoid bones
   d. Posterolateral fontanel
      → located laterally between the parietal occipital, and temporal bones

HYOID BONE
→ unique component of the axial skeleton
→ It does not articulate with any other bone

VERTEBRAL COLUMN
→ spine, backbone, or spinal column
→ composed of series of bones called vertebrae
   ➢ 7 cervical vertebrae
   ➢ 12 thoracic vertebrae
   ➢ 5 lumbar vertebrae
   ➢ 1 sacrum
   ➢ 1 coccyx
NORMAL CURVES OF THE VERTEBRAL COLUMN
- Cervical curve
- Thoracic curve
- Lumbar curve
- Sacral curve

THORAX
→ refers to the entire chest
→ thoracic cage – a bony enclosure formed by the sternum, ribs and their costal cartilages, and the bodies of the thoracic vertebrae
STERNUM
→ breastbone
→ a flat, narrow bone located in the center of the anterior thoracic wall that measures about 15cm (6 in) in length
→ 3 parts:
  o Manubrium
  o Body
  o Xiphoid process

RIBS
→ 12 pairs; numbered 1 to 12 from superior to inferior
→ give structural support to the sides of the thoracic cavity

○ True (vertebrosternal) ribs – ribs that have costal cartilages and attach directly to the sternum (first 7 pairs)

○ False ribs – either attach indirectly to the sternum or do not attach to the sternum at all (remaining 5 pairs)

○ Vertebrochondral ribs – attach to the sternum indirectly (8th, 9th, and 10th pairs of ribs)

○ Floating (vertebral) ribs – do not attach to the sternum at all (11th and 12th pairs of ribs)
THE APPENDICULAR SKELETON

PECTORAL (SHOULDER) GIRDLE
→ attaches the bones of the upper limbs to the axial skeleton
→ 4 bones (2 clavicle, 2 scapula)

- **CLAVICLE**
  → collarbone
  → slender, S-shaped
  → lies horizontally across the anterior part of the thorax superior to the first rib

- **SCAPULA**
  → shoulder blade
  → large, triangular, flat bone
  → situated in the superior part of the posterior thorax between the levels of the second and seventh ribs

UPPER LIMB (EXTREMITY)
→ 60 bones (30 bones in each limb)
  → 2 humerus
  → 2 ulna
  → 2 radius
  → 16 carpals
  → 10 metacarpals
  → 28 phalanges

- **HUMERUS**
  → arm bone
  → longest and largest bone of the upper limb
  → articulates proximally with the scapula and distally at the elbow with the radius and ulna

- **ULNA**
  → located on the medial aspect of the forearm
  → longer than the radius
THE SKELETAL SYSTEM

- **RADIUS**
  - Smaller bone of the forearm
  - Located on the lateral aspect of the forearm

- **CARPALS**
  - Wrist (carpus)
  - Consists of 8 bones joined together by ligaments
  - Articulations among carpal bones are called intercarpal joints
    - Scaphoid
    - Lunate
    - Triquetrum
    - Pisiform
    - Trapezium
    - Trapezoid
    - Capitate
    - Hamate

- **PHALANGES**
  - Digits
  - Make up the distal part of the hand
  - 14 phalanges
    - Proximal phalanx
    - Middle phalanx
    - Distal phalanx

PELVIC (HIP) GIRDLE
- 2 hip bones, also called coxal/pelvic bones or os coxa
- The hip bones unite anteriorly at a joint called **pubic symphysis**

  - **ILIUM**
    - Largest of the 3 components of the hip bone
  
  - **ISCHIUM**
    - The inferior, posterior portion of the hip bone
    - Strongest of the 3 components of the hip bone
  
  - **PUBIS**
    - Pubic bone
    - Anterior and inferior part of the hip bone

- **PELVIC BRIM**
  - Divides the bony pelvis into superior and anterior portions

- **FALSE PELVIS**
  - The portion of the bony pelvis superior to the pelvic brim
  - BORDERED BY THE LUMBAR VERTEBRAE POSTERIORLY, THE UPPER PORTIONS OF THE HIP BONES LATERALLY, AND THE ABDOMINAL WALL ANTERIORLY
• **TRUE PELVIS**
  → the portion of the bony pelvis inferior to the pelvic brim
  → it has an inlet, an outlet, and a cavity
  → bounded by the sacrum and coccyx posteriorly, inferior portions of the ilium and ischium laterally, and the pubic bones anteriorly

**LOWER LIMB (EXTREMITY)**
→ 60 bones (30 bones in each limb)
  • 2 femur
  • 2 patella
  • 2 tibia
  • 2 fibula
  • 14 tarsals
  • 10 metatarsals
  • 28 phalanges

  • **FEMUR**
    → thigh bone
    longest, heaviest, and strongest bone in the body

  • **PATELLA**
    → kneecap
    → a small, triangular bone
    → located anterior to the knee joint

  • **TIBIA**
    → shin bone
    → larger, medial, weight-bearing bone of the leg

  • **FIBULA**
    → parallel and lateral to the tibia
    → considerably smaller than the tibia

  • **TARSALS**
    → ankle (tarsus)
    • talus
    • calcaneus
      → largest and strongest tarsal bone
    • navicular
    • third (lateral) cuneiform
    • second (intermediate) cuneiform
    • first (medial) cuneiform
    • cuboid

  • **METATARSALS**
    → intermediate region of the foot (metatarsus)
    → numbered I to V (or 1 to 5)
ARCHES OF THE FOOT

1. LONGITUDINAL ARCH
   a. Medial longitudinal arch
      → originates at the calcaneus, rises to the talus and descends through
      • proximal phalanx
      • middle phalanx
      • distal phalanx
      • the navicular, the three cuneiforms, and the heads of the three medial metatarsals
   b. Lateral longitudinal arch
      → begins at the calcaneus, rises at the cuboid and descends to the heads of the two lateral metatarsals

2. TRANSVERSE ARCH
   → between the medial and lateral aspects of the foot
   → formed by the navicular, three cuneiforms, and the bases of the five metatarsals

DEVELOPMENT OF THE SKELETAL SYSTEM

○ Skull
   • begins development during the 4th week after fertilization
   • neurocranium
      → forms the bones of the skull
   • viscerocranium
      → forms the bones of the face

○ Vertebrae and ribs
   • derived from the portions of cube-shaped masses of mesoderm called somites
   • notochord
      → a solid cylinder of mesodermal cells that induces (stimulates) the mesenchymal cells

○ Skeleton of the limbs
   • middle of the 4th week after fertilization, the upper limbs buds appear
   • about 2 days later, the lower limb buds appear
   • 6th week, hand plates and foot plates develop
ARTICULATIONS

Joints (articulation, arthrosis) - point of contact between bone and cartilage, or between bone and teeth.

*Arthrolgy - scientific study of joints.
*Kinesiology - study of motion of the human body.

Joint Classifications
A. Structural Classification

1. Fibrous joints - there is no synovial cavity and the bones are held together by dense irregular connective tissue that is rich in collagen fibers.
2. Cartilaginous joints - there is no synovial cavity and the bones are held together by cartilage.
3. Synovial joints - the bones forming the joint have a synovial cavity and are united by the dense irregular connective tissue of an articular capsule, and often by accessory ligaments.

B. Functional Classification

1. Synarthrosis - an immovable joint. The plural is synarthroses.
2. Amphiarthrosis - a slightly movable joint. The plural is amphiarthroses.
3. Diarthrosis - a freely movable joint. The plural is diarthroses. All are synovial joints; have a variety of shapes and permit several different types of movements.

> Fibrous joints
a. Suture - composed of a thin layer of dense irregular connective tissue; occur only between bones of the skull.

*Synostosis (bony bone) - there is a complete fusion of two separate bones into one bone.
b. Syndesmoses - there is a greater distance between the articulating surfaces and more dense irregular connective tissue than in suture.
*gomphosis (dentoalveolar) - articulations between the roots of the teeth and their sockets in the maxillae and mandible.

c. Interosseous Membranes - binds neighboring long bones and permits slight movement.
Cartilaginous joints

a. **Synchondrosis** - is a cartilaginous joint in which the connecting material is hyaline cartilage.

b. **Symphysis** - the ends of the articulating bones are covered with hyaline cartilage, but a broad, flat disc or fibrocartilage connects the bone.

Synovial joints

Structure of the Synovial Joints

a. **Joint Capsule** - sleeve-like extension of each of the articulating bones. It forms a complete casing around the ends of the bones, thereby binding them to each other.

b. **Synovial membrane** - moist, slippery membrane that lines the inner surface of the joint capsule. It secretes synovial fluid, which lubricates and nourishes the inner joint surfaces.

c. **Articular cartilage** - thin layer of hyaline cartilage covering and cushioning the articular surfaces of bones.

d. **Joint Cavity** - small space between the articulating surfaces of two bones of the joint.

e. **Menisci (articular disk)** - pads of fibrocartilage located between the articulating ends of bones; divides the joint cavity into two separate cavities.
   
   *the knee joint contains two menisci.*

g. **Bursae** - cushion the joint and facilitate movement of tendons.

   *bursa* - closed pillowlike structure.

Types of Movements at Synovial Joints


2. **Angular movement** - an increase or decrease of angle between articulating bones.
   
   a. **Flexion** - decrease in the angle between articulating bones.
   
   b. **Extension** - increase in the angle between articulating bones.
   
   c. **Lateral flexion** - movement of the trunk sideways to the right or left at the waist.
   
   d. **Hyperextension** - extension beyond the anatomical position.
   
   e. **Abduction** - movement of a bone away from the midline.
   
   f. **Adduction** - movement of a bone toward the midline.
   
   g. **Circumduction** - movement of distal end of a body part in a circle.

3. **Rotation** - a bone revolves around its own longitudinal axis.
4. **Special Movements**- occur only at certain joints.
   a. **Elevation**- an upward movement of a part of a body.
   b. **Depression**- a downward movement of a part of a body.
   c. **Protraction**- movement of a part of the body anteriorly in the transverse plane.
   d. **Retraction**- a movement of a protracted part of the body back to the anatomical position.
   e. **Inversion**- movement of the sole medially at the intertarsal joints.
   f. **Eversion**- movement of the sole laterally at the intertarsal joints.
   g. **Dorsiflexion**- bending of the foot at the ankle or talocrucal joint in the direction of the dorsum.
   h. **Plantar Flexion**- bending of the foot at the ankle or talocrucal joint in the direction of the plantar or inferior surface.
   i. **Supination**- movement of the forearm at the proximal and distal radioulnar joints in which the palm is turned anteriorly.
   j. **Pronation**- movement of the forearm at the proximal and distal radioulnar joints in which the distal end of the radius crosses over the distal end of the ulna and the palm is turned posteriorly.
   k. **Opposition**- movement of the thumb at the carpometacarpal joint in which the thumb moves across the palm to touch the tips of the fingers on the same hand.

**Types of Synovial Joints**

1. **Planar Joints**- permit back-and-forth and side-to-side movements between the flat surfaces of bones.
2. **Hinge Joints**- permit only flexion and extension.

3. **Pivot Joints**- permit the head to turn from side-to-side; enables the palm to turn anteriorly and posteriorly.
4. **Condyloid Joints**- permits flexion-extension and abduction-adduction.
5. **Saddle Joints**- permits flexion-extension, abduction-adduction and rotation.
6. **Ball and Socket**- permits flexion-extension, abduction-adduction and rotation.

**Selected Joints of the Body**

1. **Temporomandibular joint**- between the condyle of the mandible and mandibular fossa and articular tubercle of the temporal bone.
2. **Shoulder Joint**- between the head of the humerus and the glenoid cavity of the scapula.
3. **Elbow joint**- between the trochlea of the humerus, the trochlear notch of the ulna and the head of the radius.
4. **Hip (coxal) Joint**- between the head of the femur and acetabulum of the hip bone.
5. **Knee Joint**- between the patella and patellar surface of the femur; the lateral condyle of the femur, the lateral meniscus, and lateral condyle of the femur, the medial meniscus and the medial condyle of the tibia.
THE SKELETAL SYSTEM

SYNOVIAL JOINTS

- Hinge joint
- Pivot joint
- Ball-and-socket joint

- Elbow
- Leg
- Shoulder

- Condyloid joint
- Gliding joint
- Saddle joint

- Wrist
- Tarsus
- Thumb
Mechanism of Disease

A. Skeletal Tissues

1. Malignant Tumors of Bone and Cartilage

- **Osteosarcoma** (osteogenic sarcoma) – most common primary malignant tumor of skeletal tissue. - appears more frequently in males.

- **Chondrosarcoma** - malignant tumor of hyaline cartilage that arises from chondroblast.

2. Metabolic Bone Diseases

- **Osteoporosis** - bone resorption outpaces bone deposition. - due to depletion of calcium from the body.

- **Osteopenia** - low bone mass

- **Dowager's hump** - abnormal backward curvature of the spine.

- **Rickets** - demineralization of loss of minerals from bone related to vitamin D deficiency.

- **Osteomalacia** - adult rickets - softening of the bones as a result of calcium depletion.

- **Scurvy** - vitamin C deficiency - ulceration and hemorrhage in almost any area of the body because of lack of normal collagen synthesis in connective tissue.

- **Paget's Disease** - osteitis deformans - characterized by proliferation of osteoclast and compensatory increased osteoblastic activity.

- **Osteomyelitis** - bacterial infection of bone marrow tissue - **Pathogen**: staphylococous aureus

3. Growth and Development Disorders

- **Giantism** - abnormally increased in height.

- **Acromegaly** - excess pituitary growth hormone - Increased diameter of all bones.

- **Dwarfism** - person is abnormally short.

- **Pituitary Dwarfism** - abnormally low level of pituitary growth hormone affect the whole body.

- **Achondroplastic dwarfism** - results in disproportionately short long bones.

- **Osteogenesis imperfecta** - very brittle bones that are easily fractured.

B. Skeletal System

- **Cleft lip** - maxillae don't form normally.

- **Cleft Palate** - palatine processes of the maxillae don't fuse with one another.

- **Balloon Kyphoplasty** - used to treat the vertebral compression fractures that occur in osteoporosis.

- **Vertebroplasty** - injecting of bone cement
1. **Bone Fractures**

   a. **Pathological or Spontaneous fractures** - bone is so weak that it fractures under very little stress and in the absence of any significant trauma.

   b. **Stress fractures** - occurs in absence of any clinically visible damage to bone or surrounding tissue.

   c. **Displaced or Open fracture** - also known as compound fracture; one broken bone projects through surrounding tissue and skin.

   d. **Non-displayed or Closed fracture** - also known as simple
fracture; it does not produce a break in the skin.

e. Impacted fracture- one end if the broken bone being driven into the marrow cavity or diaphysis of the other bone segment.

f. Complete fracture- involves a break across the entire section of bone.

g. Incomplete Fracture- involves only a partial break; the bone fragments still being partially joined.

h. Dentate fracture- fragmented end of the bone being jagged and opposing each other, fitting together like teeth on a gear.

i. Comminuted fracture- crushed bone fragments that lie between or near the broken ends of the bone are small and appeared crumbled.

j. Avulsion fracture- bone fragments are pulled free of the underlying bone surface by some force or trauma.

k. Linear fracture- involves a fracture line parallel to the bone’s long axis.

l. Transverse fracture- a fracture line at right angle to the bone’s long axis.

m. Oblique fractures- slanted or diagonal, angles to the longitudinal axis of the bone.

n. Spiral fracture- fractures line spirals around the long axis of the bone.

o. Hairline fracture- fracture line is visible but very small and the opposing bone segments remain fully aligned.

p. Depressed fracture- a fractured skull bone being pushed downward into the cranial or substance of the brain.

q. Greenstick fracture- an incomplete fracture in a long bone in which he bone is bent on one side but broken on the outer arc of the bend.

r. Pott fracture- a break of the lower part of the tibia that often results in serious ankle injury in athletes.

s. Colles fracture- a break in the distal end of the radius that is common in osteoporosis.

t. Le Fort fractures- fractures in the face and base of the skull.

u. Hangman’s fracture- fracture of posterior elements in the upper cervical spine (specially the axis)

v. Osgood-Schlatter Disease- partial separation of bone fragments from the surface of the tibial tuberosity.

Treatment for Fractures

*Orthopedics- medical specialty dealing with skeletal injury and diseases.
*Creptitus*- the sound of bone fragments rubbing together.

1. **Closed Reduction**- the fractures ends of the bone are properly aligned by manipulation without the need for surgery.

2. **Open Reduction**- a surgical procedure is required to align the broken ends of the bone.

**Mastoiditis**- inflammation of the air spaces within the mastoid portion of the temporal bone.

**Otitis Media**- middle ear infection

**Mastoidectomy**- surgical removal of the diseased mastoid portion of the temporal bone

2. **Abnormal Spinal Curvatures**
   
a. **Lordosis**- an exaggeration of the convex curve of the lumbar region

b. **Kyphosis**- an exaggeration of the concave curve of thoracic region

   *Scheuermann Disease*- kyphosis can develop in children at puberty.

   c. **Scoliosis**- an abnormal bending of the spine to the side, which accompanied by secondary abnormal curvatures.

   *Milwaukee brace*- the traditional treatment of scoliosis.

   - worn on the upper part of the body 23 hours per day for up to several years.

   *Trascutaneous stimulation*- muscles on the side of the vertebral column are electrically stimulated to contract and pulled the vertebrae into a more normal position.

C. **Articulations**

1. **Herniated disk**- herniated nucleus pulposus (HNP)
   - slipped disk

2. **Patellar bursitis**- housemaid’s knee.

3. **Sprained Ankle**- caused by an internal rotation injury to the anterior talofibular ligament.

4. **Olecranon Bursitis**- inflammation of the bursa associated with prolonged pressure
Non-inflamatory Joint Disease

1. **Osteoarthritis**- “wear and tear”
   - Degeneration and fracturing of articular cartilage and by abnormal formation of new bone.
   *Heberden nodes* - swelling deformities of the **distal** interphalangeal joints.
   *Bouchard nodes* - swelling deformities of the **proximal** interphalangeal joints.

2. **Dislocation (subluxation)** - the articular surfaces of bones forming the joint are no longer in proper contact

3. **Sprain** - acute musculoskeletal injury to the ligamentous structures surrounding a joint that disrupts the continuity of the synovial membrane.

**Inflamatory Joint Disease**

1. **Arthritis**- general name for many different inflammatory joint diseases.
   *Rheumatoid arthritis* - chronic inflammation of many different tissues and organs of the body.

**Arthroplasty**- partial replacement of a diseased joint with an artificial device called **prosthesis**.

**Pannus**- aggregation of inflammatory cell, granulation tissue and fibroblast.

**TNF blockers**- tumor necrosis factor. Influencing the altered immune system response in rheumatoid arthritis.

*Juvenile rheumatoid arthritis (JRA)*- joint inflammatory process often destroys the growth of epiphyseal cartilage and the growth of long bone.

*Gouty arthritis* - excess blood levels of uric acid, a nitrogenous waste, are deposited as sodium urate crystals within the synovial fluid of joints and in other tissues.