كلية طب الأسنان
Faculty Of Dental Medicine

THE SKELETAL SYSTEM

General Anatomy Laboratory | Study Guide

OBJECTIVES

- Know how to differentiate between bone and cartilage.
- Know the divisions of the skeleton.
- Know the types of bone.
- Describe the structure of bone.

PLAN

1. Introduction & Definitions
2. Structure & Classification
3. Morphology & Histology
4. Internal & External Structure
5. Development, Growth & Pathology

1. INTRODUCTION & DEFINITIONS

INTRODUCTION

The human skeleton is the bony framework that supports the body and protects internal organs.

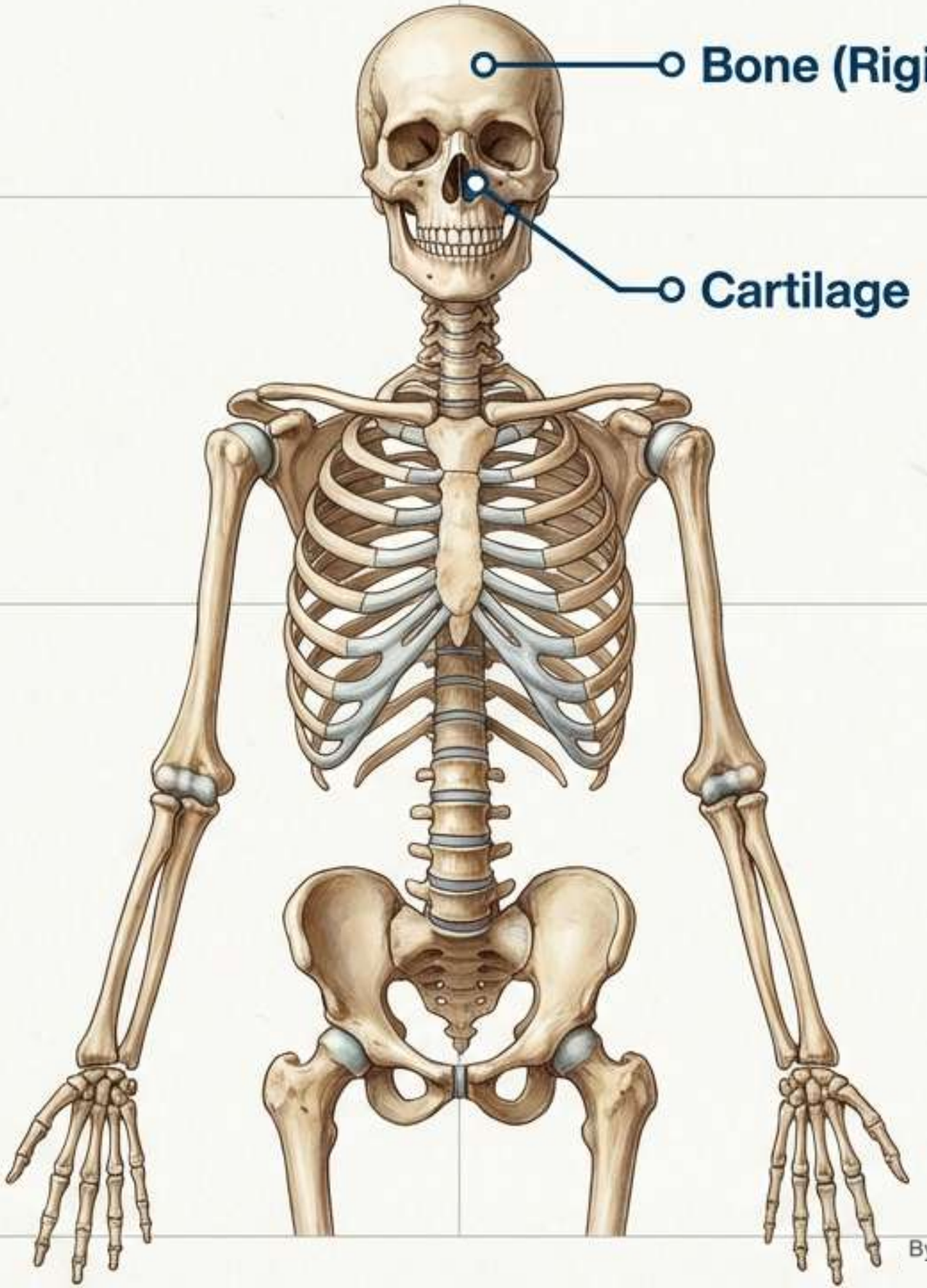
- Made up of: Bones and Cartilage.
- Osteology: The study of bones.
- Adult Skeleton: Made up of 206 bones and weighs around 20% of the body's weight [Ref: Q6 A].
- Supernumerary bones: May exist (inconstant bones).

DEFINITION: BONE

A highly specialized and rigid connective tissue [Ref: Q1 A, Q6 C] formed by cells called osteocytes.

Examples: Bones of the skull, bones of the limbs.

Note: Bone is a 'Phosphocalcique' reservoir [Ref: Q1 E].



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2. DEFINITIONS: CARTILAGE & TYPES

CARTILAGE:

An elastic and semi-rigid connective tissue formed by cells called chondrocytes.

Characteristic: It has no nerves or blood vessels.

1. HYALINE CARTILAGE

- Formed by spherical chondrocytes, rich in collagen fibers.
- Most common type.
- Locations: The joints (articular) [Ref: Q4 B]

  Ribs (costal)

  Larynx

  Trachea/Bronchi

  Nose.

2. ELASTIC CARTILAGE

- Contains elastic fibers.
- Locations: Ear and epiglottis.

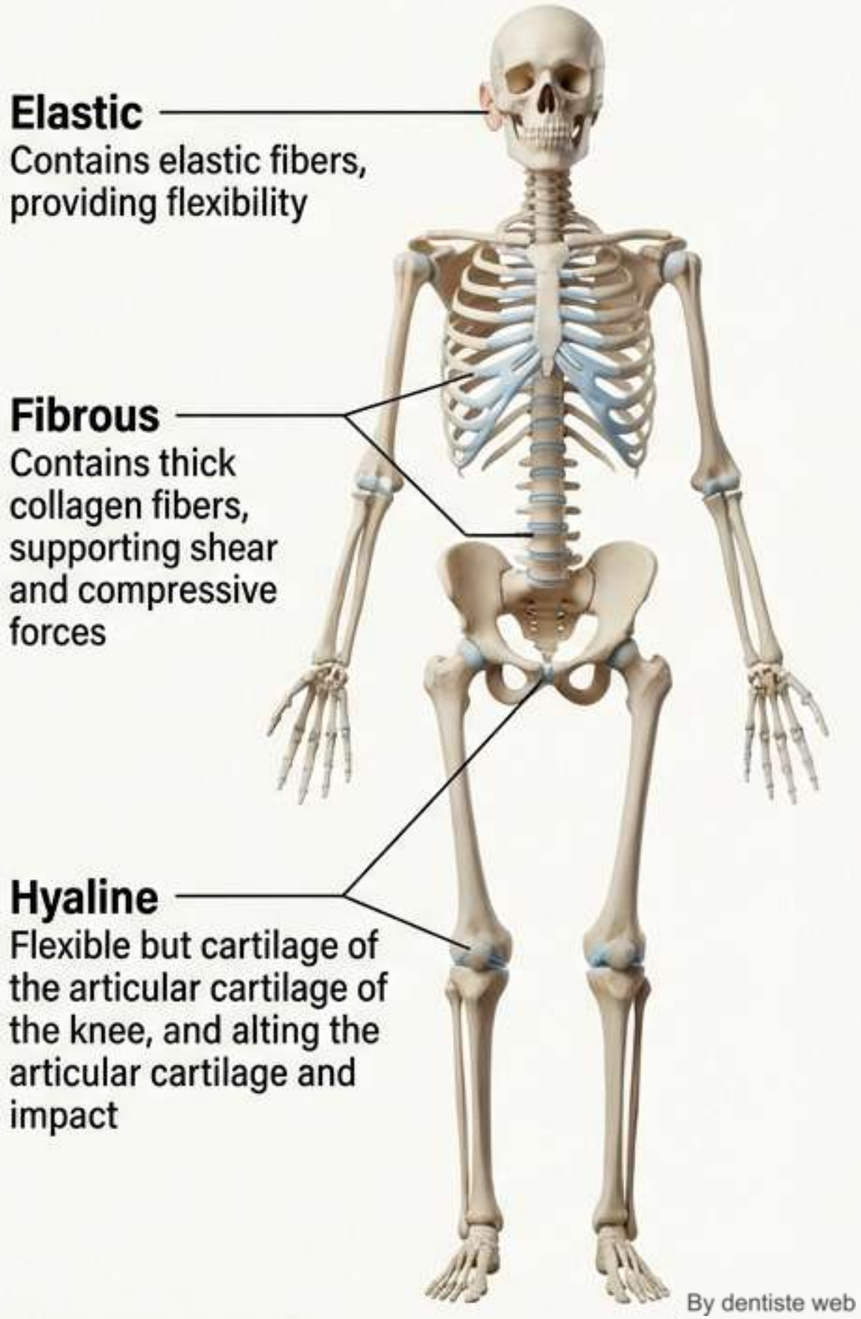
3. FIBROUS CARTILAGE

- Thick collagen fiber bundles + alternating chondrocytes.
- Locations (Compression areas):

  Intervertebral discs

  Knee menisci

  Labrums.



3. FUNCTIONAL ANATOMY & 4. STRUCTURE

FUNCTIONAL ANATOMY OF CARTILAGE

The essential role is mechanical.

- Protects joint surfaces from wear and tear.
- Provides attachment for muscles.
- Allows passages (e.g., trachea) to remain permanently open.

STRUCTURE OF THE HUMAN SKELETON

Consists of an Axial skeleton to which the Appendicular skeleton skeleton is attached [Ref: Q11 A, Q12 A, Q13 E, Q14 A].

A. THE AXIAL SKELETON

Forms the body's axis and supports it. Includes:

- Skull & Hyoid bone
- Spine (Vertebral Column) [Ref: Q9]
- Ribs and Sternum [Ref: Q9]

B. THE APPENDICULAR SKELETON

Corresponds to the limbs ("appendages").

- Attaches to axial skeleton via the shoulder girdle and pelvic girdle [Ref: Q16 B].

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5. CLASSIFICATION OF BONES (PART 1)

LONG BONES

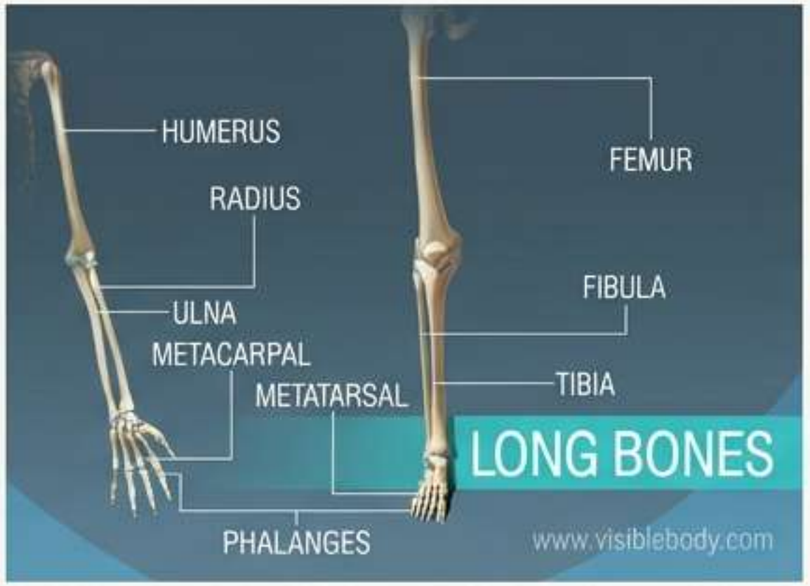
- Length is greater than width and thickness [Ref: Q3 A, Q8 A, Q10 A, Q15 B, Q17 B].
- Have a shaft (diaphysis) and two ends (epiphyses) [Ref: Q3, Q13 D, Q14 D].
- Example: The Humerus [Ref: Q15 E, Q17 E].

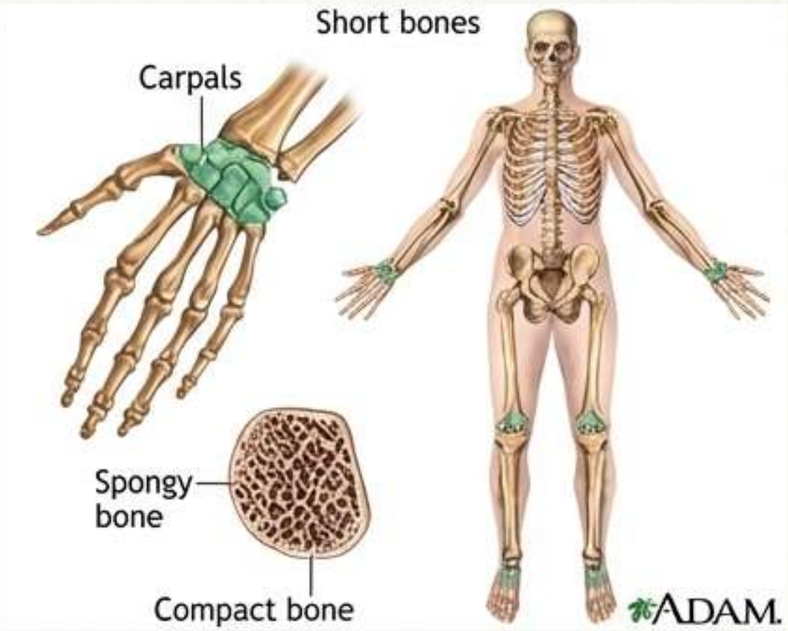
FLAT BONES

- Length and width are more important than thickness.
- Example: The Scapula (shoulder bone) [Ref: Q12 B].
- Other Examples: Sternum, Cranial bones.

SHORT BONES

- All three dimensions are equal.
- Example: The Carpal bones of the wrist [Ref: Q12 C].





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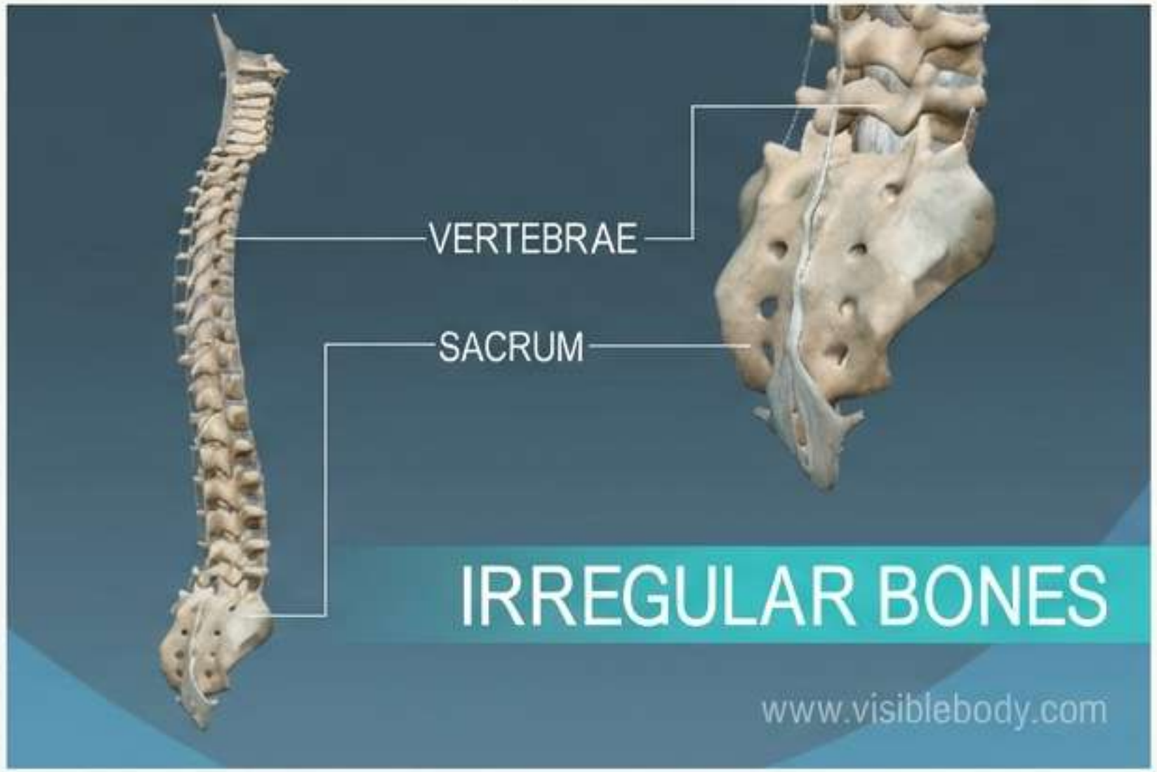
5. CLASSIFICATION (PART 2) & 6. MORPHOLOGY

IRREGULAR BONES

- Unclassifiable shapes.
- Example: Vertebrae, Maxillary bone.

SPECIAL TYPES

- **Sesamoid bones**: Embedded in tendons (e.g., Patella).
- **Vomer bones**: Variable, located between skull bones.



BONE MORPHOLOGY

Surface features: Protrusions (eminences), Depressions (cavities), Foramina (holes).

A. PROTRUSION (ELEVATION)

1. **Articular**:
   - Head
   - Condyle [Ref: Q4 C]
2. **Non-articular** (Insertion for ligaments/muscles):
   - Processes, Tuberosities, Tubercles, Spines, Crests.

6. MORPHOLOGY (CONT.) & 7. BONE TISSUE

B. DEPRESSION (CAVITY)

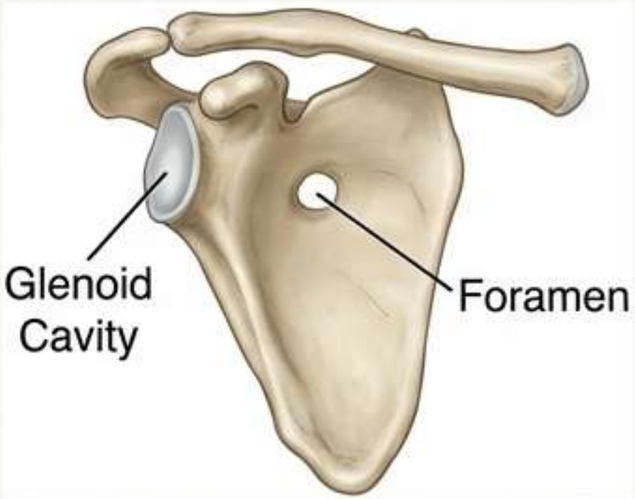
- Articular: Forms a joint (e.g., Glenoid cavity of scapula).
- Non-articular: Muscle insertion or vessel passage (Dimples, Furrows).

C. FORAMEN

- Opening for nerves or vessels.

D. INCISURES

- Indentations on the edge.



BONE TISSUE: THE CELLS

1. Osteoblasts: Form bone tissue; secrete collagen necessary for ossification. [Ref: Q7 C]
2. Osteoclasts: Cells that destroy bone (resorption) while osteoblasts rebuild it [Ref: Q7 C].
3. Osteocytes: Come from osteoblasts; maintain calcium-phosphorus balance.
4. Border cells: Located on surface.

7. INTERNAL STRUCTURE: THE PERIOSTEUM

1. THE PERIOSTEUM

- Fibrous membrane that covers the entire surface of the bone [Ref: Q2 A, Q7 B].
- EXCEPTION: Does NOT cover cartilaginous (articular) surfaces [Ref: Q2 D].

COMPOSITION:

- Inner osteogenic layer.
- Outer fibrous layer.

FUNCTIONS:

- Allows muscles and tendons to attach.
- Richly vascularized and innervated.
- Ensures bone growth in width.
- Ensures bone consolidation (fracture repair).

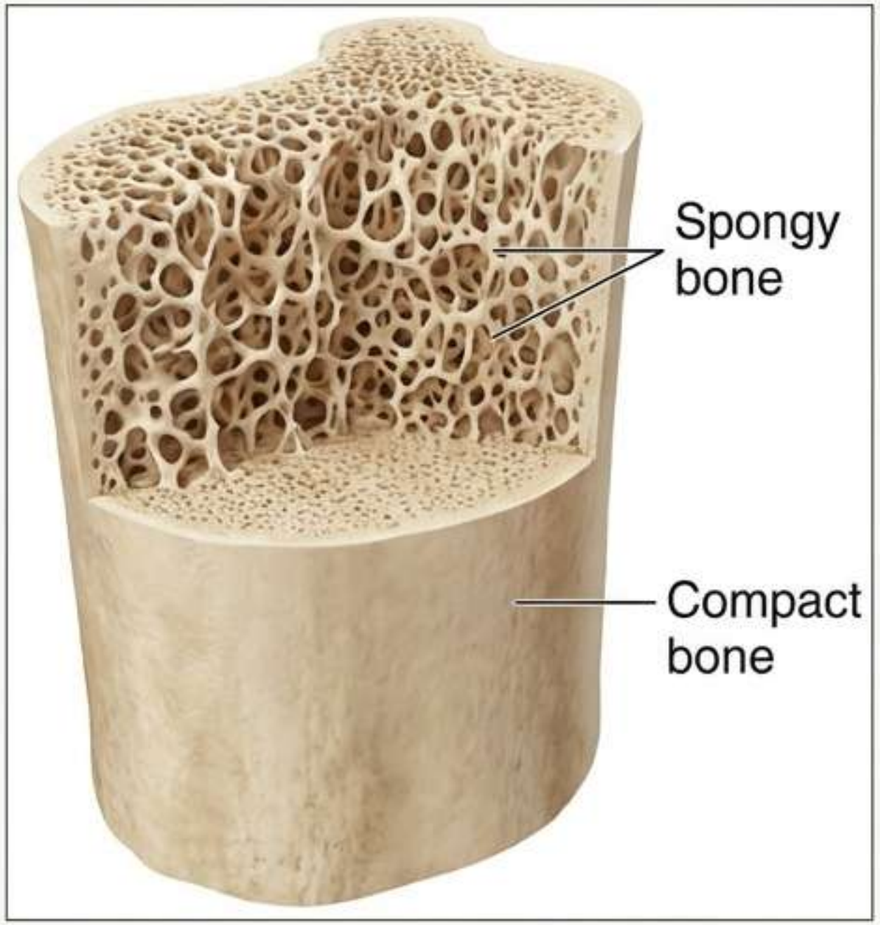
7. INTERNAL STRUCTURE: BONE TYPES

2. COMPACT BONE

- Very dense, uniform, and hard.
- Formed by Osteons (Haversian system) and bone lamellae.
- Accounts for 80% of bone surface area.

3. SPONGY BONE (CANCELLOUS)

- Brittle and hollowed out by bone lamellae.
- Location: Contained in the Epiphyses of long bones [Ref: Q2 C, Q2 D].
- Forms the intermediate layer of flat and short bones.



7. INTERNAL STRUCTURE: CAVITIES & MARROW

4. THE BONE CAVITY

- Empty/Air-filled: Paranasal sinuses.
- Filled with substance: Medullary canal.
- Endosteum: Osteogenic membrane covering cavities (fracture consolidation role).

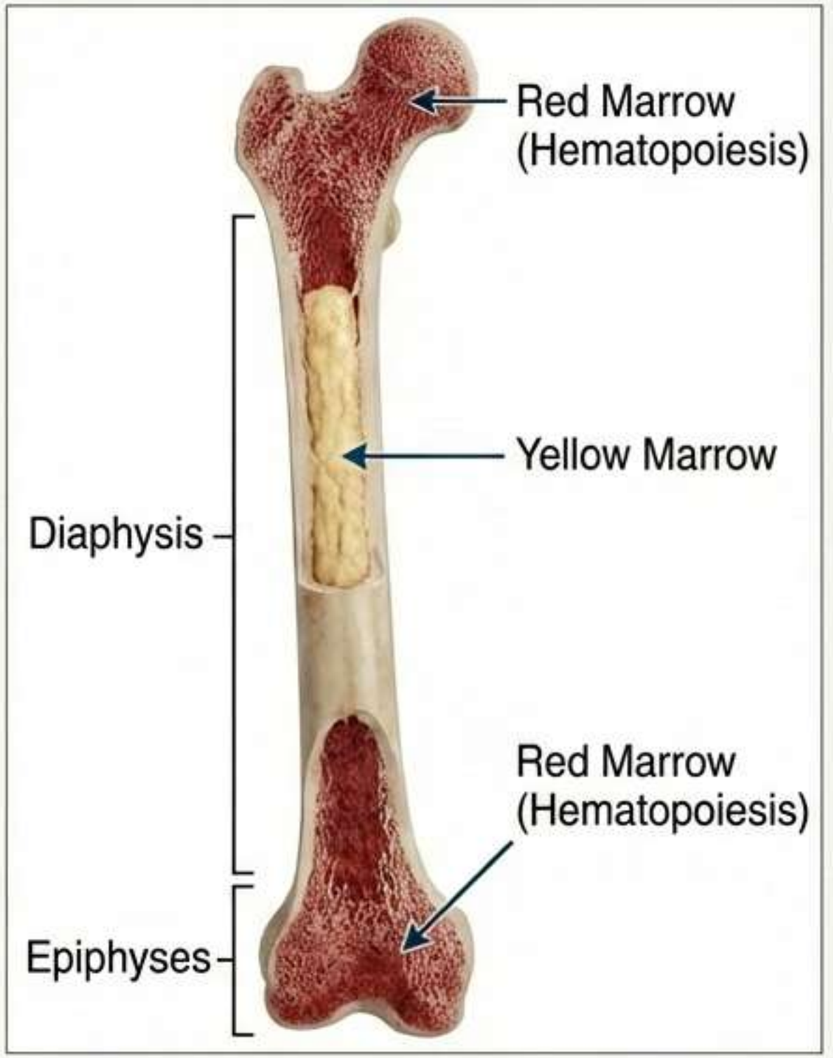
BONE MARROW

Yellow Marrow:

- Fatty mass.
- Occupies the center of the diaphysis in adults [Ref: Q7 A].

Red Marrow (Hematopoiesis):

- Produces blood cells (100-150 billion RBCs/day).
- Occupies spongy bone.
- *Note: Found in diaphysis in children, but restricted to spongy bone in adults.*



7. EXTERNAL STRUCTURE: LONG BONES

1. DIAPHYSIS (SHAFT)

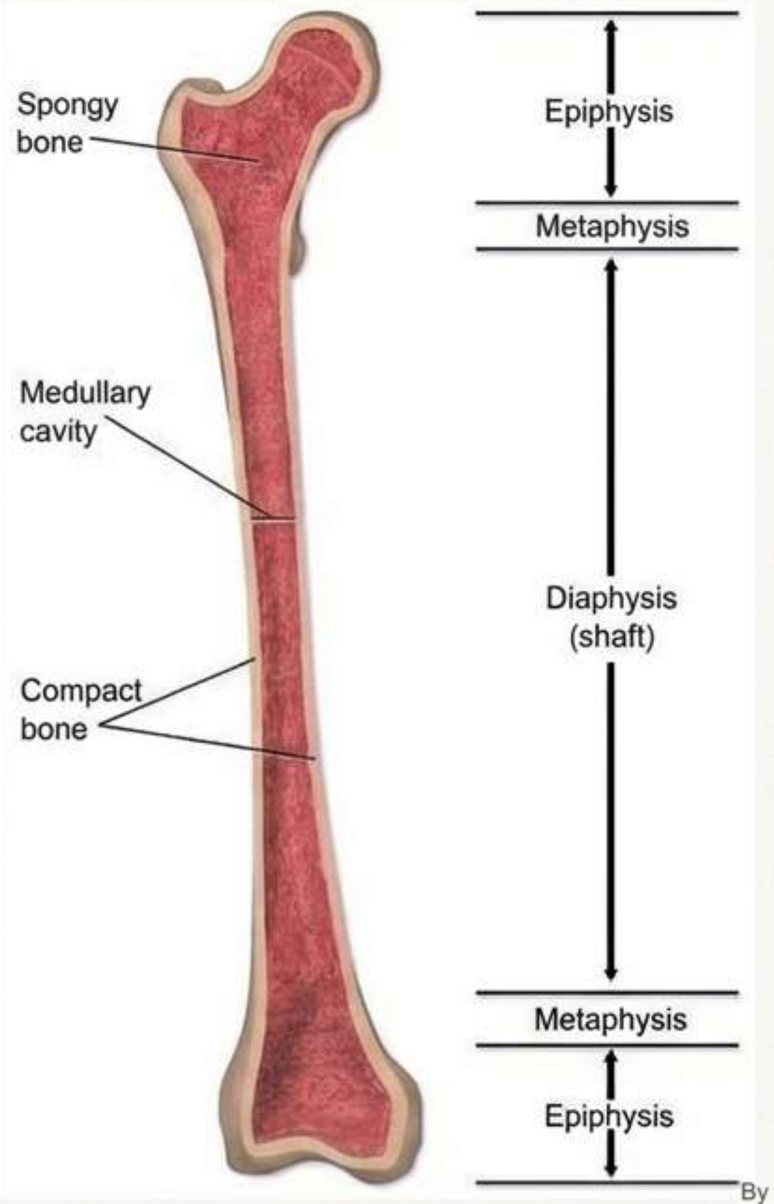
- Compact bone hollowed out by the central cavity [Ref: Q7 A].
- Contains red marrow (child) or yellow marrow (adult).

2. EPIPHYSES (ENDS)

- Located at ends of diaphysis.
- Formed of spongy tissue [Ref: Q2 D].
- Covered by cartilaginous articular surfaces [Ref: Q4 B, Q8 E].

3. METAPHYSIS

- Segment between epiphysis and diaphysis.
- Contains growth cartilage in children [Ref: Q7 D, Q7 E].



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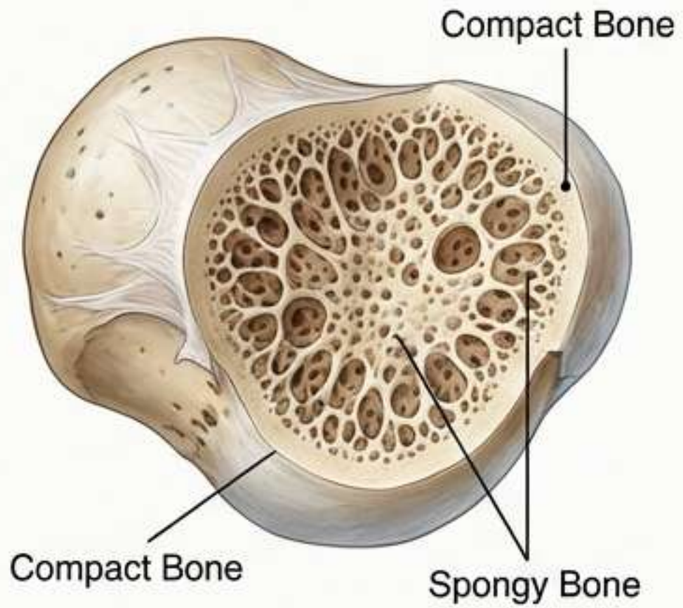
7. EXTERNAL STRUCTURE: SHORT, FLAT & IRREGULAR

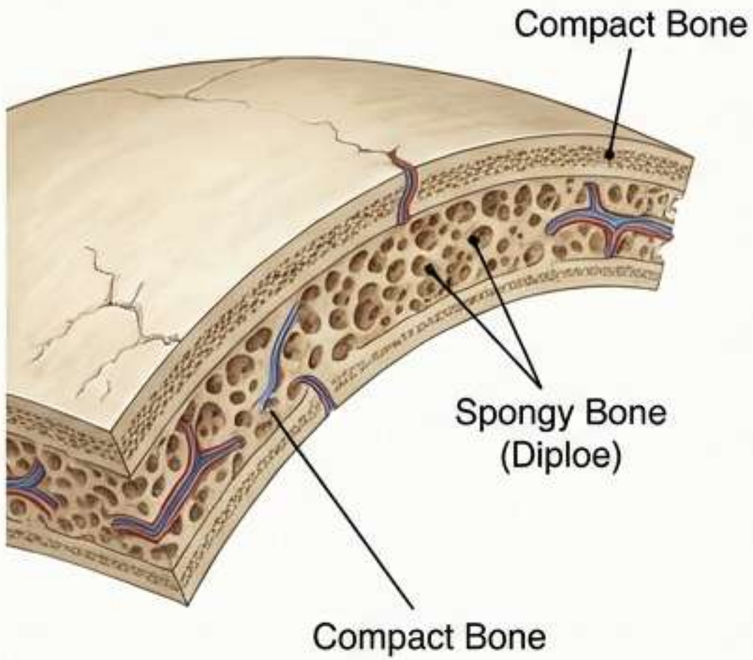
2. SHORT BONES

Structure: A layer of spongy substance and marrow contained within a thin layer of compact substance. Covered by periosteum.



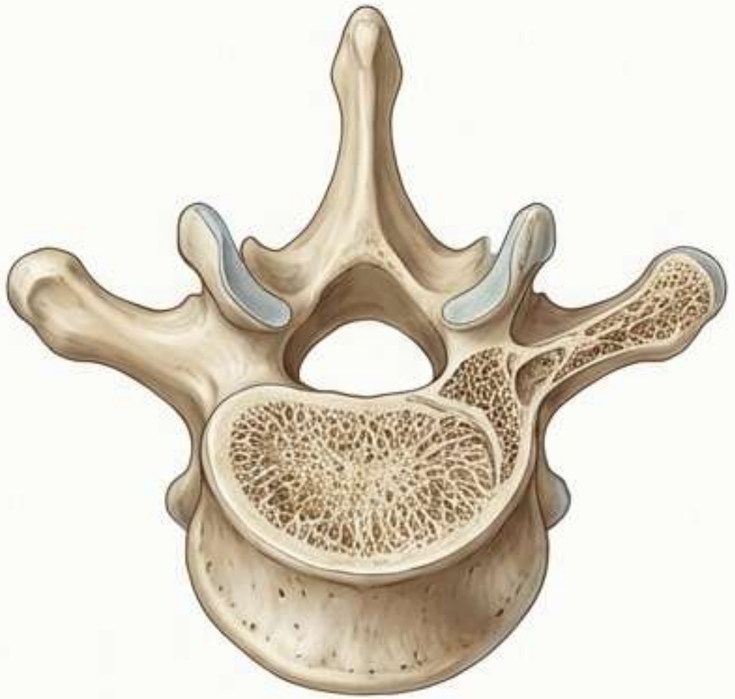
3. FLAT BONES

Structure: Two layers of compact bone surrounding a layer of spongy bone.



4. IRREGULAR BONES

Structure: Combine these different structures.



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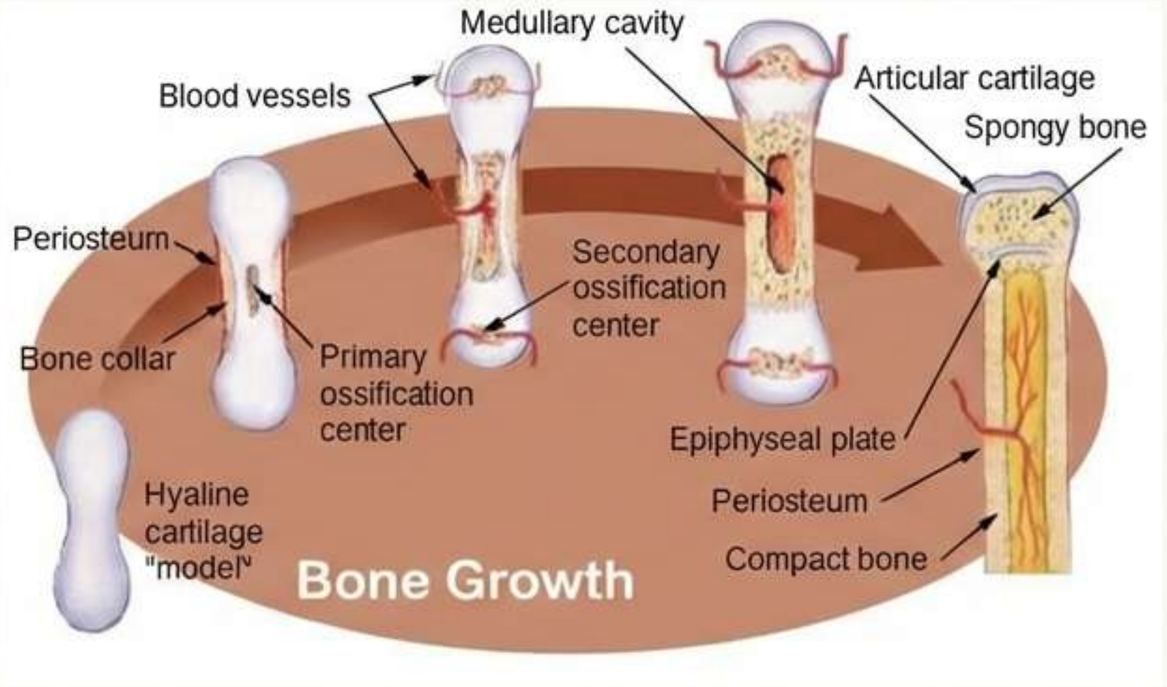
8. DEVELOPMENT (OSTEOGENESIS) & 9. GROWTH

OSTEOGENESIS (Two Types)

1. **Endochondral (Cartilaginous):** Hyaline cartilage replaced by bone. (Long/Short bones).
2. **Fibrous (Membranous):** Connective tissue transforms directly to bone. (Flat bones/Skull).



BONE GROWTH (Stops age 25-28)

- **Growth in Width:** Ensured by the **Periosteum**.
- **Growth in Length:** Ensured by the Growth Plate (cartilage) located at the metaphysis [Ref: Q7 E, Q8 D, Q10 E].
- **Flat Bones:** Grow at bone **sutures.**

10. VASCULARIZATION & INNERVATION

LONG BONES ARTERIES

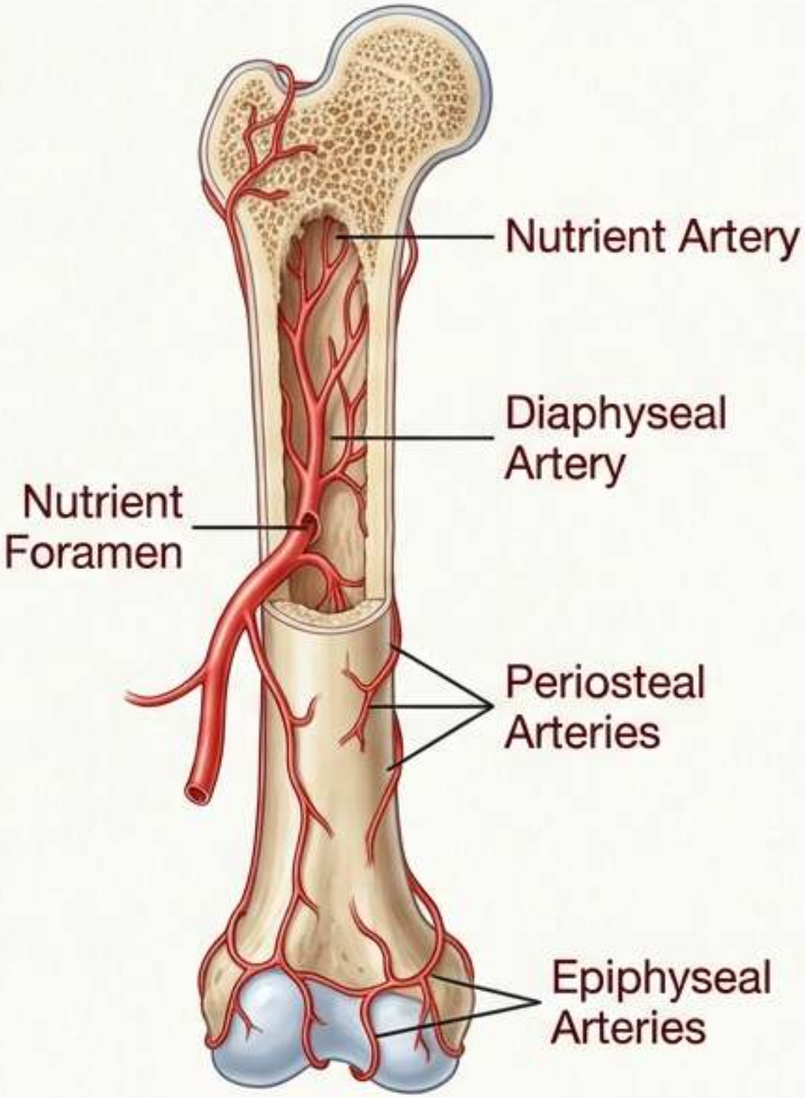
1. **Diaphyseal arteries:** Enter through the nutrient foramen [Ref: Q3 D].
2. **Epiphyseal arteries:** Form a periarticular circle.
3. **Periosteal arteries.**

FLAT & SHORT BONES

- **Flat:** Numerous arteries entering nutrient foramen.
- **Short:** Only periosteal arteries.

NERVES

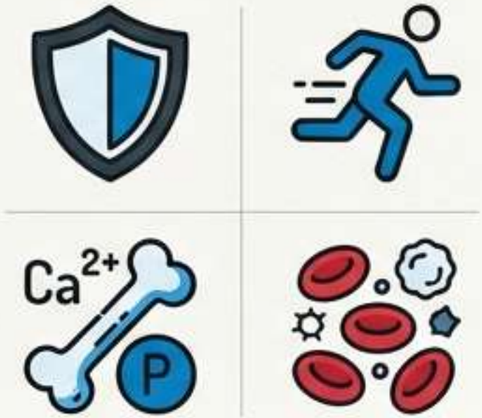
- Satellite to arteries.
- Vasomotor and sensory.



11. FUNCTIONAL ANATOMY & PATHOLOGY

FUNCTIONAL ANATOMY

1. **Framework & Protection:** Protects organs [Ref: Q5 D].
2. **Mobility:** Enables movement thanks to joints [Ref: Q6 B].
3. **Mineral Reserve:** Particularly Calcium and Phosphorus [Ref: Q1 E, Q5 A].
4. **Hematopoiesis:** Production of blood cells in bone marrow [Ref: Q1 C, Q5 B].



BONE DISORDERS

- **Fractures:** Traumatic disorder.
- **Osteoporosis:** Resorption > Formation.
- **Osteomalacia:** Bone demineralization.
- **Osteoarthritis:** Cartilage disease.
- **Paget's disease:** Accelerated bone remodeling.