



# 2 Bone Structure and Classification

Bone is a specialized form of connective tissue, consisting of cells and matrix. The matrix is mineralized with calcium phosphate (hydroxyapatite crystals), giving it a hard texture and serving as a significant reservoir for calcium. Bone is classified as:

- Compact: dense bone that forms the outer layer of a bone
- Spongy: cancellous bone that contains a meshwork of thin trabeculae or spicules of bone tissue, and is found in the epiphyses of long bones

A typical long bone has the following structural elements:

- Diaphysis: the shaft of the bone
- Epiphysis: two expanded ends of the bone that are covered by articular cartilage
- Metaphysis: lies between the diaphysis and epiphysis, and is a conical region adjacent to the area where active bone growth will occur
- Marrow cavity: the central portion of the shaft of many bones, it contains stem cells that produce blood cells

**COLOR** each of the following features of a long bone, using a different color for each feature:

- 1. Epiphysis (highlight the bracket)
- 2. Metaphysis (highlight the bracket)
- 3. Diaphysis (highlight the bracket)
- 4. Articular cartilage
- 5. Spongy bone
- 6. Periosteum: a thin fibrous connective tissue sheath or capsule that surrounds the shaft of a bone but is not found on the articular surfaces, which are covered by articular cartilage
- 7. Marrow cavity
- 8. Compact bone

Bone formation occurs largely by the deposition of matrix (osteoid) that later becomes calcified, and by resorption of bone. Thus it is a dynamic process just like any other living tissue in the body. Three major types of cells participate in this process:

- Osteoblasts: cells that form new bone by laying down osteoid
- Osteocytes: mature bone cells, formerly osteoblasts, that become surrounded by bone matrix and are responsible for maintaining the bone matrix
- Osteoclasts: large cells that enzymatically dissolve bone matrix and are commonly found at sites of active bone remodeling

**COLOR** the following features of compact bone:

- 9. Osteon
- 10. Vein (color blue)
- 11. Artery (color red)
- 12. Lamellae of bone matrix: with osteocytes embedded within the lamellae
- 13. Osteocytes

Although spongy bone is trabecular, compact bone is organized into osteons (haversian systems), where a central (haversian) canal containing blood vessels is surrounded by concentric layers of matrix, in which osteocytes (mature bone cells) reside.

**Clinical Note:**

Rickets is a disease process where calcium deficiency during active growth leads to matrix formation that is not normally mineralized with calcium. It can occur from a lack of dietary calcium, vitamin D deficiency, or both, because vitamin D is necessary for the normal absorption of calcium by the small intestine.