The Anatomy of Long Bone

The long bone consists of a shaft (diaphysis) with an expansion (metaphysis) at each end. The diaphysis is a hollow tube. Its walls are composed of the diaphysis but tapers of to become the thin shell of each metaphysis. The central space within the diaphysis contains the bone marrow. The growth plate is where calcification of cartilage takes place. At the cessation of growth, the epiphyses, composed of cancellous bone, become fused with the adjacent metaphyses.

Bone as a Composite Material

Bone is a composite of collagen and hydroxyapatite. Apatite crystals are very stiff and strong. The Young’s modulus of bone (18 GPa in tension in human femur) is intermediate between apatite (165 GPa) and collagen (1.24 GPa). [Note: For comparison, the Young’s modulus of steel is 200 GPa]. As a good composite material, the bone’s strength is higher than that of either apatite or collagen, since the softer component prevents the stiff one from brittle cracking, while the stiff component prevents the soft one from yielding.

Figure 1. (A) The parts of a long bone. (B) The basic structure of compact bone.