

BONE AND SCALES

Bone is the primary skeletal tissue of vertebrates. In addition to making up the skeleton, it also is present in the scales of some vertebrates.

Developmentally, bone is derived from two sources. Dermal or membrane bone forms many of the superficial, flat bones of the top (dorsal) portion of the skull and some bones in the pectoral girdle. These bones were especially numerous in the roof of the skull of early vertebrates. Dermal bone forms in the connective tissues of the dermis of the skin. Bone-forming cells called osteoblasts line up along connective-tissue fibers and begin depositing bone. Bony fibers coalesce into the latticework that makes up a flat bone.

Endochondral bone forms many of the long bones and the ventral and posterior bones of the skull. It develops by replacing the cartilage that formed early in development (figure 1a). As the cartilage-based bone develops, osteoblasts lay down a collar of bone around the middle region, the diaphysis. Cartilage cells in the diaphysis break down, beginning the formation of the marrow cavity. Eventually, this cavity fills with bone marrow, in which blood cells form. Bone formation proceeds toward the ends of a bone. The cartilage near the end of the bone, however, continues to grow and results in further bone elongation. Each end of the bone is an epiphysis. In mammals, a secondary ossification center occurs in each epiphysis and forms bony caps on the ends of the bone. However, a cartilaginous plate, the epiphyseal plate, remains between the epiphysis and the diaphysis and is the site of cartilage growth and bone elongation. Bone growth continues until maturity. Except for thin cartilages at the ends of bones that provide gliding surfaces for joints, bone replaces all cartilage of an endochondral bone at maturity, and growth stops.

Fish scales are composed, in part, of dermal bone. Osteoblasts in the dermis of the skin lay down a core of bone. Other dermal cells lay down a layer of dentine, which is similar to bone, around the bony core. Then, epidermal cells lay down a covering of enamel (figure 1b). Enamel is one of the hardest tissues in the vertebrate body and also occurs on teeth.

The scales of the skin of reptiles and the legs of birds form entirely in the epidermis of the skin and do not contain bone. These scales are composed of many layers of epidermal cells (figure 1c). Keratin and phospholipids are incorporated into the outer, horny layers of a scale to reduce water loss across the skin. As chapter 30 explains, the feathers of birds are modified epidermal scales.

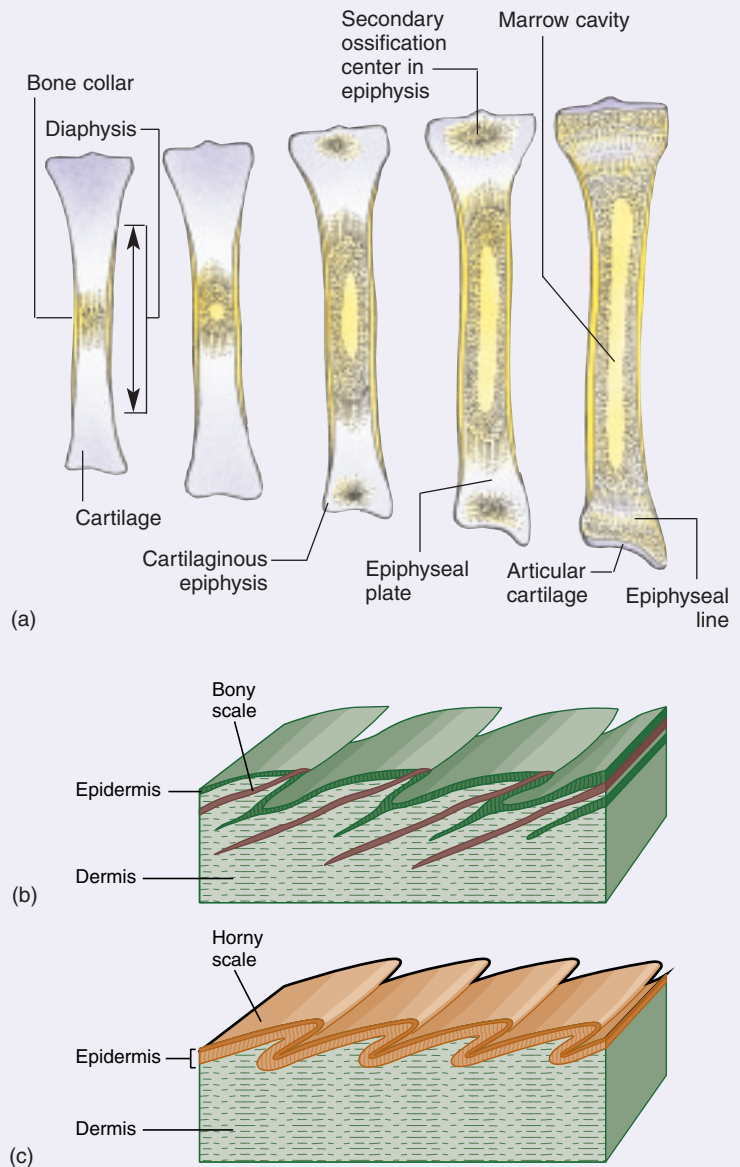


FIGURE 1
Bone and Scales. (a) The formation of endochondral bone. (b) Dermal scales of a fish. (c) Epidermal scales of a reptile. (Miller/Harley: *Zoology*, 5th ed. © The McGraw-Hill Companies.)