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Lecture 6

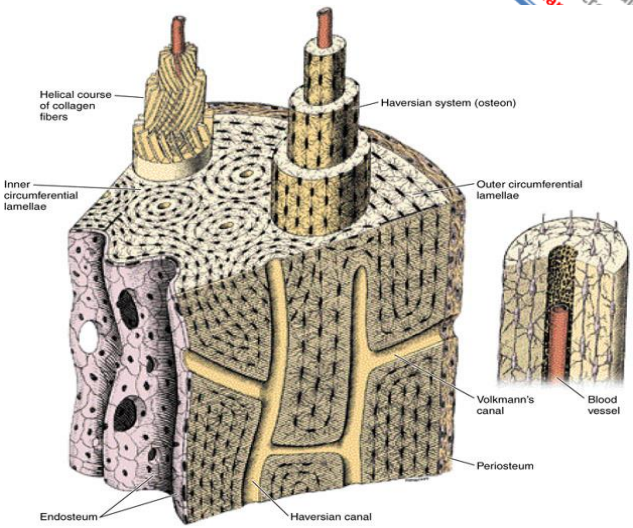
Bone

As the main constituent of the adult skeleton,

1. *Bone tissue supports fleshy structures,*
2. *Protects such vital organs as those in the cranial and thoracic cavities.*
3. *Harbors the bone marrow, where blood cells are formed.*
4. *Bone also serves as a reservoir of calcium, phosphate, and other ions that can be released or stored in a controlled fusion to maintain constant concentrations of these important ions in body fluids.*
5. *Bones form a system of levers that multiply the forces generated during skeletal muscle contraction and transform them into bodily movement.*

This mineralized tissue confers mechanical and metabolic functions to the skeleton.

Bone is a specialized connective tissue composed of intercellular calcified material, (the bone matrix), and 3 cell types: osteocytes (Gr. Osteon, bone +kytos, cell), which are found in cavities (lacunae) within the matrix, osteoblasts (Osteon, bone + blasts, germ), which synthesize the organic components of the matrix, and osteoclast (Osteon, bone + klastos, broken), which are multinucleated giant cells involved in the resorption and remodeling of bone tissue.



Schematic drawing of the wall of a long-bone diaphysis showing 3 types of lamellar bone: Haversian system and outer and inner circumferential lamellae. The protruding Haversian system on the left shows the orientation of collagen fibers in each lamella. At the right is a haversian system showing lamellae, a central blood capillary (there are also small nerves, not shown), and many osteocytes with their processes.

are unable to diffuse through the calcified matrix of the bone, the exchanges between osteocytes and blood capillaries depend on communication through the canaliculi (L. canalis, canal), which are thin, cylindrical spaces that perforate the matrix. All bones are lined on both internal and external surfaces by layers of tissue containing osteogenic cells–endosteum on the internal surface and peristeum on the external surface, because if its hardness, bone is difficult to section with the microtome, and special technique that permits the observation of the cells and organic matrix is based on the decalcification of bone preserved by standard fixatives. The mineral is removed by immersion in solution containing calcium-chelating substance (ethylene diamine tetra acetic acid) [EDTA] the decalcified tissue is then embedded, sectioned and stained**.**

Bone cells

Osteoblasts: osteoblasts are responsible for the synthesis of the organic component of bone matrix (type I collagen, proteoglycans, and glycoproteins). Depositions of the inorganic component of bone also

depend on the presence of viable osteoblasts. Osteoblasts are exclusively located at the surfaces of bone tissue, side by side, in a way that resembles simple epithelium. When they are actively engaged in matrix synthesis. Osteoblasts have cuboidal to columnar shape and basophilic cytoplasm when their synthesizing activity declines, they flatten and cytoplasmic basophilia declines

Some osteoblasts are gradually surrounded by newly formed matrix and become osteocytes. During this process a space called a lacuna is formed lacuna are occupied by osteocytes and their extension along with a small amount of extra cellular no calcified matrix

Osteocytes

Osteocytes which derive from osteoblast lie in the lacunae situated between lamella of matrix. only one osteocyte is found in each lacuna, the thin cylindrical matrix canaliculi house cytoplasmic processes of osteocytes processes of adjacent cells make contact via gap junction and molecules are passed via this structures from cell to cell, some molecular exchange between osteocytes and blood vessels also takes place through the small amount of extracellular substance located between osteocytes (and their processes) and the bone matrix this exchange can provide nourishment for a chain of about 15 cells

Schematic drawing of 2 osteocytes and part of a haversian system. Collagen fibers of contiguous lamellae are sectioned at different angles. Note the numerous canaliculi that permit communication between lacunae and with the haversian canals. Although it is not apparent in this simplified diagram, each lamella consists of multiple parallel arrays of collagen fibers. In adjacent lamellae, the collagen fibers are oriented in different directions. The presence of large

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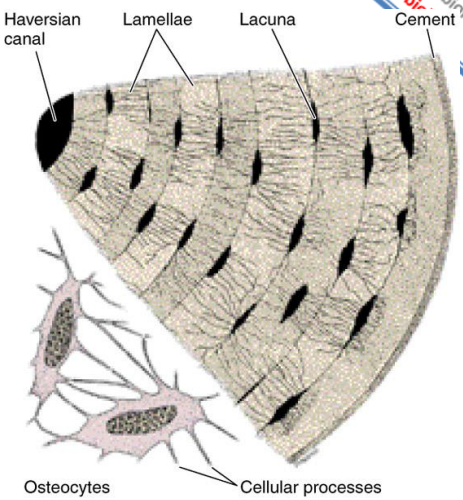
numbers of lamellae with differing fiber orientations provides the bone with great strength, despite its light weight.



When compared with osteoblasts the flat, almond-shaped osteocyte exhibit a significantly reduce rough endoplasmic reticulum and Golgi complex and more condensed nuclear chromatin.

These cells are actively involved in the maintenance of bony matrix and their death is followed by resorption of this matrix

Osteoclasts

While bone matrix is deposited by osteoblasts, it is eroded by osteoclasts, these large (20 to 100Mm in diameter) multi-nucleated (2 to 50 nuclei), cells are a type of macrophage. Like other microphages they develop from monocytes that originated in the hemopoitic tissue of the bone marrow.

These precursor cells are released into the bloodstream and collect at sites of bone reabsoption where they fuse to form the multinucleated osteoclasts. They are found close association with the surface of bone, often in shallow excavations known as Howships lacunae**.**