

# MICROSCOPIC ANATOMY OF COMPACT BONE

- Many osteons make up compact bone; each osteon is a tall circular pillar with a large central canal
  - Each osteon is made of many concentric **lamella**
    - Lamella are made of collagen fibers, glycoproteins and calcium salts (noncellular matrix secreted by **osteoblasts**)
    - Lamella are separated by spaces, called **lacuna**, where osteocytes reside
      - ✓ Lacuna of neighboring lamella are connected by **canaliculi** (connection necessary for nutrient diffusion); osteocytes extend processes through these canaliculi so that the far-spread osteocytes are in communication with one another.
  - The **central canal** functions as the passageway for blood vessels and nerves.
  - Perforating canals (perpendicular to central canals) connect neighboring osteons and deliver blood and nerves to the medulla

## Chemical Composition of bone

- **Osteoblasts** lay down the bone matrix. Collagen fibers and glycoproteins are “organic” (which means they have carbon in them). These fibers give bone its flexibility. The calcium salts are inorganic (mineral) components that give bone its hardness.
- When blood calcium is low, **parathyroid hormone** stimulates **osteoclasts** to dissolve calcium salts within bone matrix and release them into the blood stream. If this happens regularly without replenishment, the bone weakens.

**Brittle bone disease:** genetic disease in which a mutation in a collagen gene prevents bone matrix from having its typical flexibility.

**Rickets:** usually caused by a calcium or vitamin D deficiency that prevents adequate calcium deposition in the bone. If it occurs during childhood, the child’s bones will bow outward. They are flexible, but not strong enough.

## Bone Development

**Ossification:** formation of bone

Cells involved:

1. **osteoprogenitor** cells—cells (found lining compact bone inside and out) that divide to produce any of the following:
  - a. **osteoblasts**—secrete calcium matrix and collagen fibers to **form** osteons
  - b. **osteocytes**—mature osteoblasts that no longer secrete matrix. If they die, the bone matrix breaks down.
  - c. **osteoclasts**—break down bone matrix and move calcium into blood (as needed by the body)

## Bone Remodeling and Repair

- a. ~10% of your bones are replaced every year; bone can be remodeled and made strongest in areas where most stress is found (consider the differences in bone remodeling in a soccer player and a ballerina)
- b. osteoclasts are large cells that are capable of **moving** along the surface, scraping apart bone matrix as they travel. Secrete lysosomal enzymes and HCl (break down collagen and calcium, respectively). They are closely related to WBCs, which are also able to move and break things down.
- c. Control of Remodeling
  - **Hormonal control:** 99% of body’s calcium is in the bones. Parathyroid hormone (PTH) is released when blood calcium levels fall too low. PTH stimulates osteoclast activity, which releases calcium into the blood. Estrogen inhibits osteoclast activity.
  - **Responses to mechanical stresses**
    - \***Wolff’s Law:** bones remodel in response to demands placed upon them
      - example: largest bone projections occur where big muscles attach
    - \*Cellular signaling induces mechanical remodeling
      - available calcium is somehow “called” to sites of greatest mechanical stress