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| **Name:** |
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| **Group:** |
| 9B-5 |
| **Basic Science Question:** |
| Define osteoblast, osteoclast, and osteocyte. Describe their relationship in bone. |
| **Report:** |
| Bones are constantly changing in size, shape, and position during an individual’s life. Bone remodeling occurs when cells remove and replace bone at the same site. The purpose of bone remodeling is to repair micro-damage, calcium homeostasis, and shape skeletal growth. This is regulated by mechanical stress on bone, parathyroid hormone, vitamin D, and many other local and systemic factors. Initially, monocytes are recruited by a stimulus from an osteocyte or hormone and fuse into an osteoclast and attach to resting bone. An osteoclast is a multinucleated cell that breaks down bone. The H+ATPase proton pump on the developed ruffled membrane of the osteoclast releases acidic protons and enzymes, exposing organic bone matrix which is degraded by lysosomal protease cathepsin K (Teitelbaum 2007). In addition to normal activation of osteoclasts, immune cells and cytokines influence osteoclast differentiation resulting in osteoclastogenesis induced by immune cells from inflammation. The osteoclast eventually experiences apoptosis, paving the path for bone formation.  Once bone resorption has occurred, new bone is formed. An osteoblast is the cell responsible for building bone. Osteoblasts secrete unmineralized bone called osteoid in layers, which mineralizes into bone matrix. The osteoblast deposits organic matrix made of collagen, non-collagen proteins, and proteoglycans. Calcium and phosphate ions form hydroxyapatite crystals that spread to the matrix causing mineralization (Florencio-Silva 2015). Mature osteoblasts eventually either become bone lining cells or osteocytes while some undergo apoptosis. An osteocyte is a former osteoblast trapped in bone matrix with dendritic processes that sense mechanical stress. They produce chemical signals to communicate with osteoblasts and osteoclasts on bone surface via canaliculi and alter their activity. The relationship of osteoblasts, osteoclasts, and osteocytes are important for regulation of bone resorption and bone formation. A disruption in the balance of bone remodeling, usually when resorption exceeds formation, will cause bone diseases such as osteoporosis to occur. Osteoblasts and osteoclasts are able to communicate via gap junctions, cytokines, and cell-bone matrix. There is also evidence that osteoclasts produce clastokines which control osteoblasts during remodeling (Florencio-Silva 2015). Ultimately, the relationships between osteoblasts, osteoclasts, and osteocytes are imperative for proper bone homeostasis. |
| **References:** |
| Chen, Xiao, et al. “Osteoblast-Osteoclast Interactions.” *Connective Tissue Research*, U.S. National Library of Medicine, Mar. 2018, www.ncbi.nlm.nih.gov/pmc/articles/PMC5612831/.  Florencio-Silva, Rinaldo, et al. “Biology of Bone Tissue: Structure, Function, and Factors That Influence Bone Cells.” *BioMed Research International*, Hindawi Publishing Corporation, 2015, www.ncbi.nlm.nih.gov/pmc/articles/PMC4515490/.  HealthCMi. “Acupuncture Found Effective For Postmenopausal Osteoporosis.” *HealthCMi CEUs*, 20 June 2020, www.healthcmi.com/Acupuncture-Continuing-Education-News/1896-acupuncture-found-effective-for-postmenopausal-osteoporosis.  MC;, Wu Y;Humphrey MB;Nakamura. “Osteoclasts - the Innate Immune Cells of the Bone.” *Autoimmunity*, U.S. National Library of Medicine, pubmed.ncbi.nlm.nih.gov/18365831/.  Office of the Surgeon General (US). “The Basics of Bone in Health and Disease.” *Bone Health and Osteoporosis: A Report of the Surgeon General.*, U.S. National Library of Medicine, 1 Jan. 1970, www.ncbi.nlm.nih.gov/books/NBK45504/.  Teitelbaum, Steven L. “Osteoclasts: What Do They Do and How Do They Do It?” *The American Journal of Pathology*, American Society for Investigative Pathology, Feb. 2007, www.ncbi.nlm.nih.gov/pmc/articles/PMC1851862/. |