



Bones - Solutions

Principal bone cells:

Cell Type	Characteristics	Function
Osteogenic Cells	<ul style="list-style-type: none"> - stem cells - found in periosteum (deep layers) and marrow - high mitotic activity - stress/fractures cause them to multiply more rapidly 	<ul style="list-style-type: none"> - give rise to most other bone cell types (with the exception of osteoclasts)
Osteoblasts	<ul style="list-style-type: none"> - cuboidal/angular - form single layer on growing portions of bone surface under endosteum and periosteum - non-mitotic 	<ul style="list-style-type: none"> - form bone by secreting collagen matrix and calcium salts - secrete <i>osteocalcin</i>, a hormone that stimulates insulin secretion
Osteocytes	<ul style="list-style-type: none"> - former osteoblasts, now trapped in the surrounding calcified matrix - found in lacunae (tiny cavities), which interconnect via canaliculi - cytoplasmic processes extend into the canaliculi - neighboring osteocytes communicate through gap junctions - non-mitotic 	Maintains bone tissue: <ul style="list-style-type: none"> - resorbs and deposits bone matrix - 'strain sensors' – sense stress and secrete signals to regulate bone remodeling - maintains blood $[Ca^{2+}]$ and $[PO^{3-}_4]$
Osteoclasts	<ul style="list-style-type: none"> - develop from bone marrow stem cells - unusually large with up to 50 nuclei due to being fused from multiple stem cells - found in resorption bays; side facing bone surface has <i>ruffled border</i> to increase bone resorption efficiency - non-mitotic 	<ul style="list-style-type: none"> - dissolve bone on the bone surfaces and at sites of old/injured bone

Fill in your charts and compare them to ours at www.vcc.ca/tlc.



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Types of bone tissue:

Type	Characteristics	Function
Compact	<ul style="list-style-type: none"> - dense and hard - makes up ~80% of human skeleton - found under periosteum and in diaphyses of long bones - structural unit is the osteon (Haversian system) composed of concentric lamellae rings - a central canal, containing blood and lymph vessels and nerves, runs down the centre - these vessels and nerves branch off through perforating (Volkmann's) canals 	<ul style="list-style-type: none"> - stronger; provides support and protection
Spongy	<ul style="list-style-type: none"> - has open spaces - makes up ~20% of human skeleton - found in epiphyses of long bones, flat bones, short and irregular bones - lacunae and osteocytes found in trabeculae (lattice-like network) - trabeculae form along lines of stress - also known as cancellous or trabecular bone 	<ul style="list-style-type: none"> - spaces make bones lighter - supports shifts in weight distribution - some spongy bones contain red marrow which carry out hematopoiesis

Practice questions:

- 1) Which bone cells do not originate from osteogenic cells?
- 2) In Paget's disease, the osteoclasts are overactive. What are the implications for a patient's bone structure?
- 3) Osteoporosis thins and weakens bones. To mitigate osteoporosis, it is recommended that one should consume a diet rich in calcium and vitamin D. How does a diet rich in these nutrients diminish the risk of osteoporosis?

Solutions:

- 1) *Osteoclasts – they develop from bone marrow stem cells.*
- 2) *More bone is resorbed than built. Bones become weak and may break easily.*
- 3) *Calcium is necessary for forming hydroxyapatite and building bones; vitamin D helps your intestines absorb calcium from your food. If calcium or vitamin D is deficient, bones become weaker and less dense.*

