Bone Under Pressure

Model how bone grows, rebuilds, and bears weight

HS-AP3-1 "Develop a model to illustrate the microscopic structure, development of, maintenance of, and function of compact and spongy bone."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline microscopic structures, circle cell types, and write D, M, or F beside details about development, maintenance, or function to plan your model.

Inside a Landing

1. When a basketball player lands, a shinbone must resist bending without becoming too heavy. Its shaft has a dense outer wall of compact bone. Inside that wall, many osteons run lengthwise. Each osteon has rings of mineral-rich matrix around a central canal carrying blood vessels. Osteocytes, mature bone cells, sit in small spaces called lacunae between the rings. Tiny canaliculi connect these cells to one another and to the canal, allowing nutrients and wastes to move. This organized wall resists bending, while its blood supply keeps living cells working.

2. Near the ends of the shinbone, spongy bone forms a network of thin struts called trabeculae. Spaces between the struts hold marrow and blood vessels, so most trabeculae do not need central canals like osteons. The struts follow common paths of force, supporting a landing while using less material than a solid block. Early in life, this long bone begins as a cartilage model. Bone replaces much of that cartilage as osteoblasts build mineralized matrix and osteoclasts remove tissue. Cartilage at growth plates near the ends allows the bone to lengthen until those plates close.

3. Growth ends, but rebuilding does not. Osteoclasts dissolve small areas of old bone, and osteoblasts deposit new matrix that later hardens with minerals. Some osteoblasts become osteocytes trapped inside the matrix; these cells sense strain and help signal where repair is needed. During regular weight-bearing activity, formation and removal can help keep the shinbone suited to its loads. During prolonged bed rest, less strain can shift the balance toward bone loss, which may thin trabeculae and weaken the structure. Compact bone also undergoes remodeling, so neither region is a fixed, lifeless shell.

2 ANSWER WITH EVIDENCE

Use the passage

1. In a compact-bone model, where should you place a blood vessel, and how should you show nutrients reaching osteocytes?

2. How would you draw and label spongy bone to show how it supports a landing without being solid?

3. What changes should a model show to explain how a cartilage model becomes a longer shinbone?

4. Add two contrasting arrows to a remodeling model, one for osteoclasts and one for osteoblasts. What should each arrow show, and what can happen during prolonged bed rest?

3 YOUR TURN

Your own words

Draw two labeled panels of the same shinbone, one while it is growing and one during prolonged bed rest as an adult. Show compact and spongy microstructure in both, use labeled arrows to explain growth and remodeling, and write two sentences comparing how the bone changes.

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PART 1 · READ AND MARK

Underline microscopic structures, circle cell types, and write D, M, or F beside details about development, maintenance, or function to plan your model. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In a compact-bone model, where should you place a blood vessel, and how should you show nutrients reaching osteocytes?	**Place the vessel in an osteon's central canal. Show nutrients moving through canaliculi to osteocytes in lacunae.**
2	How would you draw and label spongy bone to show how it supports a landing without being solid?	**Draw a network of trabeculae along paths of force, with marrow and blood vessels in the spaces between them.**
3	What changes should a model show to explain how a cartilage model becomes a longer shinbone?	**Show bone replacing much of the cartilage as osteoblasts build mineralized matrix and osteoclasts remove tissue. Show cartilage at growth plates near the ends allowing lengthening until the plates close.**
4	Add two contrasting arrows to a remodeling model, one for osteoclasts and one for osteoblasts. What should each arrow show, and what can happen during prolonged bed rest?	**Show osteoclasts removing old bone and osteoblasts depositing new matrix. During prolonged bed rest, removal may exceed formation, thinning trabeculae and weakening bone.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Growing panel: A compact shaft wall contains an osteon with a central canal, rings, and osteocytes connected by canaliculi; spongy trabeculae surround marrow near an end. Arrows show cartilage at a growth plate allowing lengthening, osteoblasts adding mineralized matrix, and osteoclasts removing tissue. Adult bed-rest panel: The same structures appear without an open growth plate; arrows show osteoclasts removing old bone and osteoblasts adding new matrix, with thinner trabeculae. The growing shinbone lengthens at its cartilage growth plate as bone replaces cartilage. During prolonged bed rest, reduced strain may shift remodeling toward bone loss and weaken the adult shinbone.

Accept models that place osteons in compact bone and trabeculae with marrow spaces in spongy bone. Arrows should distinguish growth at a cartilage growth plate from ongoing remodeling, and show bed-rest bone loss as a possibility, not a certainty.