Bones Take Shape

Compare two pathways of skeletal growth

HAP.4.4 "Demonstrate an understanding of the growth and development of the skeletal system, differentiating between endochondral and intramembranous ossification."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the starting tissue for each ossification pathway, and circle the places where the femur lengthens and the skull roof expands.

Two Routes to Bone

1. A soccer player heads a ball, then sprints across the field. The skull roof protects the brain, while the femur in the thigh acts as a lever. Both are bone, but they begin by different routes during development. In intramembranous ossification, cells in a sheet of embryonic connective tissue become osteoblasts, cells that build bone. There is no cartilage model first. Many flat bones of the skull roof form this way. In endochondral ossification, a cartilage model comes first and is gradually replaced with bone. Long bones, including the femur, follow this route.

2. In a developing femur, the cartilage model grows before bone replaces much of it. Osteoblasts deposit bone first near the middle of the shaft and later near each end. Cartilage remains at a growth plate between the shaft and each end. There, cartilage cells multiply, and bone replaces older cartilage on the shaft side. As this cycle repeats, the shaft lengthens. During adolescence, the growth plates eventually close as cartilage is replaced by bone, ending lengthwise growth at those plates. Bones can still gain thickness when osteoblasts add bone to their outer surfaces.

3. In the skull roof, osteoblasts form bone directly within connective tissue. Tiny early patches of bone spread and join to form plates. Gaps between the plates leave room for the growing brain. At the edges, flexible joints called sutures allow new bone to be added as the skull expands. Some wider gaps in an infant's skull, called fontanelles, narrow as the surrounding bones grow. The two routes make bone from different starting tissues, but neither produces a finished skeleton at birth. In both routes, osteoblasts add bone while other cells, called osteoclasts, remove bone during remodeling.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the starting tissues differ in intramembranous and endochondral ossification?

2. Explain how a growth plate makes a developing femur longer.

3. How can the skull roof expand as the brain grows if it has no cartilage model?

4. After a femur's growth plates close, can it still gain thickness? Explain how.

3 YOUR TURN

Your own words

A visitor says a child's forearm bone and skull roof both started as cartilage. Write four or five sentences correcting the visitor. Name each pathway and its starting tissue, then explain how the forearm bone lengthens and the skull roof expands.

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PART 1 · READ AND MARK

Underline the starting tissue for each ossification pathway, and circle the places where the femur lengthens and the skull roof expands. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the starting tissues differ in intramembranous and endochondral ossification?	**Intramembranous ossification starts in embryonic connective tissue without a cartilage model. Endochondral ossification starts with a cartilage model.**
2	Explain how a growth plate makes a developing femur longer.	**Cartilage cells multiply at the growth plate, and bone replaces older cartilage on the shaft side. Repeating this cycle lengthens the shaft.**
3	How can the skull roof expand as the brain grows if it has no cartilage model?	**New bone is added at the sutures between skull plates, allowing the skull roof to expand.**
4	After a femur's growth plates close, can it still gain thickness? Explain how.	**Yes. Osteoblasts can add bone to the femur's outer surfaces even after its growth plates close.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

A child's forearm bone began as a cartilage model and developed through endochondral ossification. Bone gradually replaced much of that cartilage. The skull roof developed through intramembranous ossification, with osteoblasts making bone directly in connective tissue. Cartilage grows and is replaced at the forearm bone's growth plates, making the shaft longer. New bone at skull sutures helps the skull roof expand.

Accept either forearm bone as an example of a long bone. In the open response, look for distinct starting tissues and growth mechanisms, not just the names of the pathways.