Inside a Long Bone Lab: Teacher Guide

mrsajdak.com/longbone · Anatomy & Physiology, Hole's Essentials of Human Anatomy & Physiology 3e, Section 7.2 Bone Structure (pp. 228–232) · one period, about 35 to 40 minutes · © Ryan Sajdak, CC BY-NC-SA 4.0

What students do

The virtual version of the drumstick hands-on lab, built around the macroscopic parts of a long bone. Students compare a real femur sawn the long way with a drawing of a living bone, name and label nine parts, test the shaft as a tube with a fixed amount of bone, then push a model needle through a shin bone at two sites and find out why medicine given into bone reaches the heart.

Tab	Students	Learn It teaches	Sheet
Do Now	A CT scan of a needle in a humerus. How could medicine get from a bone into the blood? What fills a living bone?		A, B
1. Find the parts	Visit seven spots (three on the real bone, four on the drawing). After the Learn It, label nine numbered parts in the lab, with feedback.	diaphysis, epiphysis, compact and spongy bone, articular cartilage, periosteum, endosteum, medullary cavity, marrow; the hollow is not empty	1–4
2. Test the shaft	Measure the shaft and its cavity on the real femur (within 20%, then the lab gives its value). Set the cavity to 0, 11, 20 and 30 mm with the same amount of bone and read strength against bending.	why the shaft is a tube; the job of each part. Then four "which part failed?" cases	5–11
3. Trace the needle	Push a needle to 25 mm at two sites and read where the push jumps and drops.	the layers in order, why the end is used, marrow to veins to heart, the 2011 trial	12–16

Each Learn It box opens only when the student has the data for that part, so no question asks about an idea before it is taught. Questions before each READ FIRST line are data only. In Tab 3 the layers are numbered until the Learn It opens; then their names appear on the picture.

Opening: pick a phenomenon

Option	What it is	Notes
A. Video: A Needle Into Bone	Clip 1: "Arrow EZ-IO System: Proximal Tibia Site Identification and Needle Insertion", Teleflex, 0:00 to 1:00. Clip 2: "Intraosseous Infusion", 0:00 to 1:30. Watch for: where on the leg the needle goes in; why anyone would do this.	Both embed, but neither was watched end to end. Preview on the school network. They may show a needle going into a leg, so warn the class and let students look away.
B. Try it: Find Your Shin Bone (3 min)	Press the flat inner face of the shin below the knee, then the calf. Tap the shin. What is between your finger and the bone? Needs nothing but a leg.	A student who would rather not can use the back of a hand. Do not name the periosteum yet.
C. Photos: The Needle in the Scan	A CT scan of a needle in the top of a humerus, and nurses practicing on a model bone.	The gentlest option: no skin, no blood.

All three lead to the same Observe, Wonder, Predict slide and driving question: *What is a living long bone made of, and what does each part do?* The deck comes back to it at the end.

Standards

NYSSLS	**HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms:

	tissues (compact and spongy bone, cartilage, marrow) in one organ, a long bone, tied to the circulatory system. Touches **HS-LS1-1** through the cells of marrow and periosteum.
SEP 2 Developing and Using Models	Labeling the bone, and model checks on the drawing and the tube (Q3, Q4, Q11).
SEP 4 Analyzing and Interpreting Data	Reading depth and push at two sites (Q12, Q13). The publisher's focal SEP for 7.2.
SEP 5 Using Mathematics	Wall thickness, strength, the 91 to 43 ratio (Q5–Q7, Q15).
SEP 6 Constructing Explanations	Explain it: why a needle in a bone reaches the heart (Q16).
CCC 6 Structure and Function	Each part's shape and its job (Q9, Q10); the tube (Q7, Q8).
CCC 4 Systems and System Models	The bone as an organ joined to the blood system (Q14, Q16).

District curriculum

BPS A&P Unit 2, Section 7.2 Bone Structure (pp. 228–232): describe the macroscopic and microscopic structure of a long bone and list the functions of these parts. The lab serves the district's Labeling Activity *Major Parts of a Long Bone*, Use the Practices 7.2 (Using Models), and the APR dissection *Femur: Anterior and Coronal*. **Additions** beyond the district list: the tube test, the needle model and the first-try data.

Misconceptions to plan for

- **"Bone is dry and dead, and the hollow is empty."** That is a cleaned bone. A living bone has a sleeve, a lining, caps and marrow (Learn It 1, Q4).
- **"The periosteum covers the whole bone."** Not the articular cartilage (Learn It 1).
- **"Hollow means weak."** The tube beats a solid rod with the same bone (Q7, Q8), up to a limit the model leaves out (Q11).

Running it

- Pairs: one clicks, one writes. Tab 1 about 12 minutes, Tab 2 about 13, Tab 3 about 10.
- In the lesson's 44-minute 5E block only Tab 3 is used (Elaborate). Tabs 1 and 2 are the whole lab for an absent student, or a stand-in if the drumsticks are not ready.
- Students write the lab's value for each measurement, so every class gets the same key.
- Pairs with the hands-on lab (Worksheet/AP_HandsOnLab.pdf in the lesson folder): the same parts on a real cooked chicken drumstick.
- Be plain about the needle: this is a real emergency procedure, not something to try. Tab 3 is a drawing of layers and shows no skin or blood.
- The answer key is a separate file, kept off the public site.

Sources

Femur plate: The American Journal of Anatomy (1917), via Wikimedia Commons, Internet Archive Book Images; scale set from a 45 cm femur, an estimate. Parts and functions: Hole's Essentials 3e, Section 7.2 and teacher's manual answers (epiphysis, diaphysis, articular cartilage, periosteum, compact and spongy bone, trabeculae, medullary cavity, endosteum, marrow); red and yellow marrow, Section 7.3. Tube model: strength of a round tube in bending, proportional to $(D^4 - d^4) \div D$; bone area held at $(25^2 - 11^2)$ in units of $\pi/4$ mm^2. Wall of the femoral shaft, 5 to 8 mm: review of radiographic measurements of adult femora. Tibia site: Polat O and others (2018) Applied anatomy for tibial intraosseous access in adults, Clinical Anatomy 31: 593–597 (thinnest cortex just below the tibial tuberosity; suggests a 17 mm cannula past the skin). Needle lengths 15, 25 and 45 mm: FDA summary, EZ-IO. Tab 3 depths and the push scale are a model. Trial: Reades R, Studnek JR, Vandeventer S, Garrett J (2011) Intraosseous versus intravenous vascular access during out-of-hospital cardiac arrest: a randomized controlled trial, Ann Emerg Med 58: 509–516 (182 patients; first-attempt success 91%, 51%, 43%).