Bone Cells Lab: Teacher Guide

mrsajdak.com/bonecells · Anatomy & Physiology, Hole's Essentials of Human Anatomy & Physiology 3e, Section 7.4 Bone Development, Growth, and Repair (pp. 234 to 237) · one period, about 35 to 40 minutes · © Ryan Sajdak, CC BY-NC-SA 4.0

What students do

The virtual version of the sponge bench lab. Students sort three real micrographs by where each cell sits and how it looks, switch two cell types on and off to move a model tooth, then run one patch of bone day by day and find rates. The answer key is a separate file and stays off the public site.

Tab	Students	Learn It teaches	Sheet
Do Now	Braces move a tooth through solid bone, about 1 mm a month. How? What do bones do after growth stops?		A, B
1. Meet the cells	Pick where each cell sits and how it looks. After the Learn It, five clues.	osteoclast, osteoblast, osteocyte; -clast, -blast, -cyte; acid and enzymes; a walled-in osteoblast becomes an osteocyte	1 to 5
2. Move the tooth	Turn Cell type A and B on or off, run to 6 months, record three settings.	A is the osteoclast, B the osteoblast; the squeezed side and the stretched side; the ligament	6 to 10
3. Run a site	Run three sites to day 180. Find digging and filling rates. Match three cases.	the four steps of remodeling; digging is fast and filling is slow; the balance decides	11 to 17

Each Learn It opens only when the student has the data, so no question asks about an idea before it is taught. Questions 1, 2, 6, 7 and 11 to 13 are explore; 3 to 5, 8 to 10 and 14 to 17 are apply. Tab 2 calls the cells A and B until the Learn It, so the results name them.

Opening: pick a phenomenon

Option	What it is	Notes
A. Video: Braces at Work	Clip 1: "Ever Wonder How Braces Work? Find Out Here!", The Crazy Orthodontist, 0:00 to 1:00. Clip 2: "How Do Braces Move Teeth?", Braces Guide, 0:00 to 0:45. Watch for: which way the teeth move; what holds each tooth in place.	Both return an embed, but neither was watched, and the times are guesses. Preview on the school network. Stop before anyone names the cells.
B. Try it: Both Wrists (3 min)	Paper strip and ruler. Measure both wrists. Which is bigger, and why might that be?	Self-measure only. A gap of 1 or 2 mm is about the size of the error. Treat it as a question.
C. Photos: A Tooth in Bone	A photo of braces and a panoramic X-ray of a different person: every root is set in bone.	The gentlest option.

All three lead to the same Observe, Wonder, Predict slide and driving question: *How can a tooth move through solid bone?* 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: cells in a tissue, in an organ. Touches **HS-LS1-1** through the different jobs of specialized cells.
SEP 2 Developing and Using Models	Reading micrographs, model checks (Q1, Q2, Q10, Q16).

SEP 3 Planning and Carrying Out Investigations	One cell type changed at a time (Q6, Q7).
SEP 5 Using Mathematics	Digging and filling rates; ten cycles (Q12, Q13, Q16).
SEP 6 Constructing Explanations	Explain it: how a tooth moves through bone (Q17).
CCC 6 Structure and Function	How each cell is built fits its job (Q1 to Q5, Q17).
CCC 2 Cause and Effect	A cell off, and what follows (Q6 to Q9).
CCC 7 Stability and Change	Bone that looks the same is being replaced (Q11, Q14 to Q16).

District curriculum

BPS A&P Unit 2, Section 7.4 Bone Development, Growth, and Repair (pp. 234 to 237). The publisher's section objective: explain the roles of osteoblasts, osteocytes and osteoclasts in bone growth, development and repair. The lab serves Use the Practices 7.4, Vocabulary Activity 7.4, and Practice Question 3 (the role of osteoclasts and osteoblasts) and 4 (exercise and bone). **Additions** beyond the district list: the braces case, the tooth model, the site model and the three cases.

Misconceptions to plan for

- **"Osteoclasts are bad: breaking down bone is damage."** Clearing old bone is how bone stays strong (Learn It 3).
- **"Bone is finished once you stop growing."** Bone keeps being replaced for life (Q11, Q15).
- **"The tooth pushes the bone out of the way."** Bone does not squeeze aside. Cells remove it and add it (Q8, Q9).

Running it

- Pairs: one clicks, one writes. Tab 1 about 12 minutes, Tab 2 about 10, Tab 3 about 15.
- 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 sponges are not ready.
- What the model leaves out: Tab 2 moves a tooth at exactly 1 mm a month, and shows no osteocytes. Tab 3 has one site at a time. Real gain from load is partly bone added to the outer surface, not only overfilled pits. The three sites are made up.

Sources

Clarke B. Normal bone anatomy and physiology. Clin J Am Soc Nephrol 2008; 3 Suppl 3: S131 to 9 (resorption about 2 to 4 weeks, formation about 4 to 6 months; osteocyte mechanosensation). Florencio-Silva R and others. Biology of bone tissue. BioMed Res Int 2015 (osteocytes 90 to 95% of bone cells, up to 50 processes each, lifespan up to 25 years; osteoblasts 4 to 6%). Wazwaz F and others, 2023, as reported in a search summary: pooled canine movement of 0.97 mm at one month (secondary source; the original was not opened). Pit depth about 50 µm is set from reported mean wall thickness near 52 µm. Hole's Essentials 3e Teacher Manual, Section 7.4. The answer key is a separate file, off the public site.