Inside a Muscle Fiber Lab: Teacher Guide

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Objective. Students will be able to label the parts of a skeletal muscle fiber and relate each part to its function.

Driving question. How can one muscle cell be built to shake a rattle 90 times a second, while another lifts your whole body?

District section

BPS A&P Unit 2, Support and Movement, Chapter 8, Section 8.2 Structure of a Skeletal Muscle (Student Edition pp. 294-300). Used from the district list: labeling Parts of a Skeletal Muscle Fiber (question 6) and Structures within a Sarcomere (question 12); Use the Practices 8.2 Using Models (Tab 1 drawing, question 7); APR Histology: Sarcomere (the real electron microscope picture in Tab 2); Phenomenon Connection CER, Collect Evidence (question 18 is a CER). The Career Connection, Massage Therapist (p. 295), is in the lesson deck, not the lab. **Additions** beyond the district list: the darkness profile measured from a real micrograph, the filament cross-sections, and the measured part volumes of five real muscles in Tab 3.

Where it sits. Monday (Inside a Muscle Lab) went from the whole muscle down to a myofibril. This lab starts at one fiber and goes into the sarcomere. It stops at structure and jobs: the steps of a contraction come Thursday, and the sliding filament model Friday. Do not teach sliding or cross-bridges today.

NYSSLS alignment

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms (fiber, myofibril, sarcomere, filaments; each part's job in the system). **HS-LS1-1.** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells (myosin and actin are proteins; many nuclei run one long cell).

SEP 2 Developing and Using Models: Tab 1 drawing, Tab 2 filament model, questions 6, 7, 12. **SEP 4** Analyzing and Interpreting Data: questions 8 to 10, 14. **SEP 5** Using Mathematics: question 15. **SEP 6** Constructing Explanations: questions 17, 18. **CCC 4** Systems and System Models: Part 1. **CCC 6** Structure and Function: Parts 2 and 3.

Opening: pick a phenomenon

Option	What it is	Notes
Video	Faster Than a Blink: a rattlesnake rattle in slow motion (Earth Unplugged, a re-upload), Deep Look's Look Inside a Rattlesnake's Rattle, and Deep Look's hovering hummingbird short.	All three checked to embed. Start and stop times were set from the length, not watched: preview first.
Activity	Tap Race: tap one finger on the desk as fast as you can for 10 seconds while a partner counts. Divide by 10. Compare to a rattlesnake's 90 shakes a second. 3 minutes, no materials.	Most students get 5 to 7 taps a second. Ask: what would a muscle cell need to go 15 times faster?
Photos	Same Parts, Different Jobs: a coiled timber rattlesnake and a sprinter in the blocks.	Real photos. Both muscles are skeletal muscle.

Part by part

Part 1, Tab 1. The drawing names each part, and students describe what it looks like (questions 1 to 4). The Learn It opens after all six parts and the three Look closely questions. Questions 5 to 7 are apply. The misconception to watch: a fiber is a whole cell, so the nuclei are inside it, not between fibers.

Part 2, Tab 2. The spots are numbered, not named, until the Learn It opens, so students read the data before the vocabulary. The darkness line is measured from the real picture (Louisa Howard, public domain). The Learn It opens after all four spots and the darkest spot. Questions 11 to 13 are apply. The misconception to watch: the A band is named for the thick filaments, so it keeps its length; the I band has only thin filaments. Do not say the bands change length yet.

Part 3, Tab 3. Real volumes from electron microscope studies. The Learn It opens after all three parts and the math. Questions 17 and 18 are apply. The big idea: same parts, different mix, and a fiber has only so much room.

The model and its limits

The Tab 1 drawing is an AI illustration made for this lab, not to scale: real myofibrils are about 1 µm wide and a fiber has hundreds to thousands. Tab 2 darkness is 100 minus the mean brightness within 12 pixels of each spot; the picture's own scale bar does not match textbook sarcomere lengths, so the lab makes no length measurements. The filament model is drawn to line up with the picture, not to scale. Tab 3 values are rounded, from different studies, and not every study measured every part ("not measured" bars).

Sources

Hole's Essentials of Human Anatomy & Physiology, Chapter 8, Section 8.2. OpenStax Anatomy and Physiology 2e, Section 10.2, Skeletal Muscle. Howald, 1985, Journal of Experimental Biology 115 (human vastus lateralis). Suarez and others, 1991, PNAS 88 (hummingbird flight muscle). Schaeffer, Conley and Lindstedt, 1996, Journal of Experimental Biology 199, and Conley and Lindstedt, 1996, Nature 383 (rattlesnake tailshaker). Luff and Atwood, 1971, Journal of Cell Biology 51 (mouse EDL and soleus SR). Pictures are credited on the lab page.