Inside a Muscle Lab: Teacher Guide

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Driving question. What is inside a muscle, what does it do, and what changes when an animal has too much of it?

District section

BPS A&P Unit 2, Support and Movement, Chapter 8, Sections 8.1 Introduction and 8.2 Structure of a Skeletal Muscle (Student Edition pp. 294-300): list the outcomes of muscle actions; describe the connective tissue coverings, fascicles, fibers and tendons; name the major parts of a muscle fiber; describe how a muscle is stimulated. Used from the district list: Theme Activity (structure and function), Explore the Phenomenon: Myostatin Mutations (the Do Now and Q16), Demonstration: Muscle Layers (Tab 2 and the Learn It), Use the Practices 8.1 Analyzing Data (Tab 1), Launch Lab: How's a chicken wing like your arm? (Tab 3 and the tendon slide) and Use the Practices 8.2 Using Models (Q11). **Additions** beyond the district list: the energy data in Tab 1, the real micrograph zoom in Tab 2, and the arm model in Tab 3.

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 (Tab 2 levels; muscle as an organ working with nerves and bones). **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 (touched through actin and myosin, and the myostatin gene in the Do Now).

SEP 2 Developing and Using Models: Tab 2, Question 11. **SEP 3** Investigations: Tab 3 trials, Question 12. **SEP 4** Analyzing and Interpreting Data: Questions 1, 2, 5. **SEP 5** Using Mathematics: Question 7. **SEP 6** Constructing Explanations: Question 16. **CCC 2** Cause and Effect: Tab 3. **CCC 3** Scale, Proportion, and Quantity: Tab 2. **CCC 5** Energy and Matter: Tab 1. **CCC 6** Structure and Function: tendons and wraps.

Opening: pick a phenomenon

Option	What it is	Notes
Video	Meet the Super Cow: Belgian Blue cattle and the myostatin gene (National Geographic clip, a re-upload). Backup: Life Noggin, This Rare Mutation Gives You Massive Muscles.	Both checked to embed. Not watched end to end: preview both.
Activity	Feel Your Muscles Work: hand on the front of the upper arm, bend the elbow against the other hand; then press down on the desk and feel the back of the arm. 2 minutes, no materials.	Same as Tab 1, Step 2.
Photos	Too Much Muscle? A Belgian Blue bull and a typical Angus bull, side by side.	Real photos, both bulls in fields.

Part by part

Part 1, Tab 1. Questions 1 to 3 are explore. The Learn It opens after all four activities and the Feel it step. Questions 4 to 5 are apply, with the job sort in the lab.

Part 2, Tab 2. The levels are named only by number until the Learn It opens, so students describe before they name. Questions 6 to 8 are explore. The Learn It opens after all five levels and the math. Questions 9 to 11 are apply. The misconception to watch: a fiber is a whole cell, not a strand inside a cell.

Part 3, Tab 3. Questions 12 to 14 are explore. The Learn It opens after four trials, one of them hurt. Questions 15 to 16 are apply. The misconceptions to watch: muscles push; tendons and ligaments are the same thing (a tendon joins muscle to bone, a ligament joins bone to bone).

The model and its limits

Tab 1 numbers are for a 70 kg person, from MET values (1 MET is about 81 watts). They are whole-body energy, not muscles only, though the extra above lying down goes mostly to working muscles. Tab 2 widths are rounded typical values, and the photos come from different samples. Tab 3 is a fixed model: the lever arms (4 cm front, 2 cm back) are rounded, and a real lever arm changes as the elbow bends. Contraction (sliding filaments) comes later in the unit.

Sources

Hole's Essentials of Human Anatomy & Physiology 3e, teacher's manual, Chapter 8. Ainsworth and others, 2011 Compendium of Physical Activities (lying 1.0, standing 1.3, walking 3 mph 3.5, running 6 mph 9.8 METs). Murray, Delp and Buchanan, 1995, Journal of Biomechanics, elbow muscle moment arms. OpenStax Anatomy and Physiology 2e, Section 10.2, Skeletal Muscle (fiber widths). McPherron, Lawler and Lee, 1997, Nature, and Schuelke and others, 2004, New England Journal of Medicine, for myostatin. Pictures are credited on the lab page.