Muscles in Motion

Connect fiber structures and motor units to muscle force.

HAP.5.2 "Describe the structure and function of the skeletal muscle fiber and the motor unit."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each muscle fiber structure and circle the words that tell what it does. Number the steps that carry a signal from a motor neuron to a shortening fiber.

What Lifts the Bottle?

1. Imagine lifting a water bottle from a desk. The biceps muscle contains many long, cylindrical skeletal muscle fibers. Each fiber is one muscle cell wrapped in a membrane called the sarcolemma. Inside it, bundles called myofibrils run along its length. Each myofibril is made of repeating units called sarcomeres. Within a sarcomere, thin actin filaments and thick myosin filaments overlap. When myosin pulls actin inward, the filaments slide past one another and the sarcomere shortens. Many shortening sarcomeres make a fiber shorten and pull on a tendon attached to bone.

2. A fiber does not decide to contract on its own. A signal travels down a motor neuron to its branch ending at a neuromuscular junction, the narrow contact region between nerve and muscle. There, the neuron releases acetylcholine, which binds to receptors and starts an electrical signal along the sarcolemma and into the fiber. That signal causes the sarcoplasmic reticulum, a membrane network inside the fiber, to release calcium ions. Calcium allows myosin to bind to actin and pull. When calcium is pumped back into the reticulum, the pulling stops and the fiber can relax.

3. One motor neuron and all the muscle fibers it activates form a motor unit. A neuron may branch to reach many fibers, but each skeletal muscle fiber usually receives input from only one motor neuron. When that neuron sends a signal, its motor unit's fibers contract together. To lift a heavier bottle, the nervous system can recruit more motor units; it can also increase how often active neurons send signals. Motor units with fewer fibers allow finer control, while units with many fibers contribute more force at once. The number of active motor units helps match muscle force to the task.

2 ANSWER WITH EVIDENCE

Use the passage

1. Trace how structures inside a skeletal muscle fiber make it shorten, starting with myofibrils and ending with the whole fiber.

2. Explain how the sarcolemma and sarcoplasmic reticulum work together to start contraction.

3. Describe which cells belong to a motor unit and what happens to its fibers when the motor neuron sends a signal.

4. Explain two ways the nervous system can increase muscle force when lifting a heavier bottle.

3 YOUR TURN

Your own words

Compare turning a tiny dial with pushing a stuck door. In one paragraph, explain how motor unit size and recruitment fit each action, then describe what happens inside the fibers to produce force.

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PART 1 · READ AND MARK

Underline each muscle fiber structure and circle the words that tell what it does. Number the steps that carry a signal from a motor neuron to a shortening fiber. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Trace how structures inside a skeletal muscle fiber make it shorten, starting with myofibrils and ending with the whole fiber.	**Myofibrils contain repeating sarcomeres. Myosin pulls actin so the filaments slide and the sarcomeres shorten. Many shortening sarcomeres make the fiber shorten.**
2	Explain how the sarcolemma and sarcoplasmic reticulum work together to start contraction.	**An electrical signal travels along the sarcolemma and into the fiber. It causes the sarcoplasmic reticulum to release calcium, which allows myosin to bind to actin and pull.**
3	Describe which cells belong to a motor unit and what happens to its fibers when the motor neuron sends a signal.	**A motor unit contains one motor neuron and all the muscle fibers it activates. When the neuron signals, those fibers contract together.**
4	Explain two ways the nervous system can increase muscle force when lifting a heavier bottle.	**It can recruit more motor units and increase how often active motor neurons send signals.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Turning a tiny dial needs precise control, so motor units with fewer fibers are useful. Pushing a stuck door needs more force, so the nervous system recruits more motor units, including units with many fibers. In both actions, motor neurons signal their fibers, causing calcium release inside them. Myosin pulls actin, sarcomeres shorten, and the fibers pull to move the body.

Accept descriptions that correctly link structures to their functions without naming every structure. For the open task, look for a contrast between fine control and greater force, plus an accurate account of how fibers shorten.