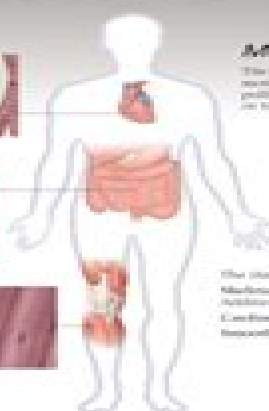




PHYSIOLOGY SERIES

Muscle Action



Muscles of the body

The muscular system consists of both the skeletal system to allow a wide variety of motions, including bending, sitting and standing, flexion/extension, or rotation, pulling structures together. Muscles can attach to bone through a tendon, or else to other muscles.

Muscle action—smiling

The end of a facial muscle, the zygomatic major, attaches to the zygomatic bone. The other end connects distally to the corner of the mouth. When the muscle contracts, the corner of the mouth turns diagonally towards the cheek and the side. Another aspect of smiling is the contraction of the orbicular oris muscle, causing the skin under the eye to wrinkle.

Muscle types

There are three types of muscle: cardiac, smooth and skeletal. **Cardiac muscle** provides the power that enables us to pump under continuous control. **Skeletally striated muscle** provides the force needed to move various blood back to the heart. **Smooth muscle** provides the overall force to move the blood through the muscular system. **Smooth muscle** moves urine and feces through the digestive system.



Skeletal muscle action

A skeletal muscle works by contracting, resulting in pulling force through a tendon connected to bone. In flexion, the biceps brachii muscle contracts and the longer brachii muscle relaxes, moving the lower arm upward. The muscle that produces the action is called the **agonist**, and the opposing muscle is called the **antagonist**. This movement is initiated by the action of an opposing muscle. When the lower arm is extended, the longer brachii muscle becomes the **agonist**, and the biceps brachii muscle acts as the **antagonist**.



Lever



Class 1 lever

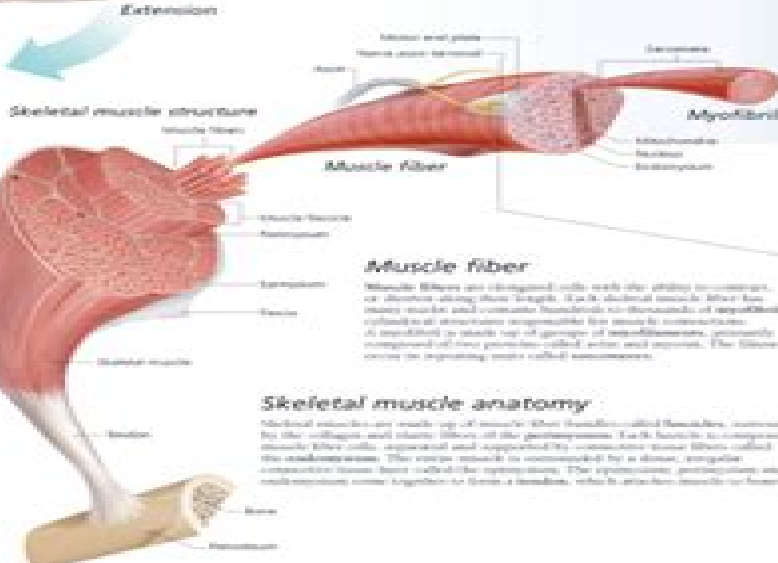
Levers are devices that move at a fixed point, or fulcrum. Force is applied against a load in a straight line. A lever, composed of muscle and bone as a point, can change the direction, speed and distance of movement. Class 1 levers change the direction of the force, and are uncommon. When Class 1 levers are used, the force can move a longer load, but both speed and distance traveled are reduced. Examples include the neck. Class 2 levers move the weight in the same direction as the force. The gain in distance traveled and speed, but least force is required.



Class 2 lever



Class 3 lever



Muscle fiber

Muscle fibers are elongated cells with the ability to contract, or shorten along their length. Each skeletal muscle fiber has many nuclei and contains hundreds to thousands of myofibrils. Voluntary striated muscles responsible for moving a locomotion. It is composed of two groups of myofibrils, previously composed of two proteins called actin and myosin. The filaments move by repeating units called sarcomeres.

Skeletal muscle anatomy

Skeletal muscles are made up of muscle fibers (bundles) called **fascicles**, surrounded by the collagen and elastic fibers of the perimysium. Each fascicle is composed of muscle fiber cells, separated and supported by connective tissue fibers called the **endomysium**. The entire muscle is surrounded by a dense, irregular connective tissue layer called the **epimysium**. The epimysium, perimysium and endomysium come together to form a **tendon**, which attaches muscles to bone.

At rest



Contracting



Sliding filament theory

The sliding filament theory describes the mechanism of muscle contraction. In a sarcomere the proteins actin is bound to thin filaments, and the myosin protein is on thick filaments. The myosin molecules have a long tail and an attached head. During a contraction the myosin heads attach to the thin filaments, then lift, pulling the thin filaments towards the myosin center. The myosin heads release, then attach to the next protein on the actin filament.

Axon terminal



Neuromuscular synapse

Muscles contract when a signal from the nervous system travels through a motor neuron (a type of nerve cell) to a muscle cell. The motor neuron carries the message to an **axon terminal**, or **synaptic bulb**. At the synaptic bulb, the nerve cell releases the **neurotransmitter** into the **synaptic cleft**. The neurotransmitter binds to receptors on the muscle cell membrane, transferring the impulse to the muscle cell.

The effects of neurotransmitters are short-lived, because the cleft has to be cleared first before action. The neurotransmitter molecules are either broken down by enzymes (acetylcholinesterase and monoamine oxidase) or reabsorbed (serotonin).

Muscles In Action Activity Guide

Rachel Sandford



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