

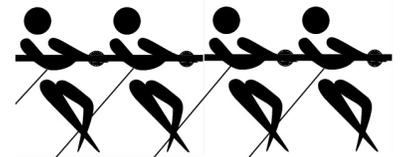
Mechanism of Muscle Contraction Analogies.

A nerve impulse (action potential) spreads through the t-tubules and sarcoplasmic reticulum of a muscle cell. The sarcoplasmic reticulum releases Calcium ions (Ca⁺⁺) into the sarcoplasm. The Ca⁺⁺ bind to the troponin of the actin complex. The troponin changes shape and pulls the tropomyosin off of the cross bridge binding sites of the actin. The cross bridges of the myosin bind to the binding sites on the actin and pull. ATP then binds to the cross bridge. ATP breaks down into ADP and supplies the energy needed to release the cross bridge from the binding site and reset to it's original position. This cycle continues until the nerve impulse stops. At that point, the Ca⁺⁺ reabsorbed into the sarcoplasmic reticulum. The troponin returns to its original shape and pushes the tropomyosin back over the binding sites. The cross bridges can no longer bind and the contraction stops.

My tug of war example

One group of people are lined up to play a tug-of-war style contest. Using a rope, they will be pulling a weight towards them as fast as they can. They will be using a rope that has knots tied in it to make it easier to grab. Until the competition begins, the rope is covered by a sheild that prevents the people from cheating by grabbing the rope too soon. When the competition begins, someone blows a horn to signal the start. The referee presses a button which supplies electricity to a spring loaded motor that pulls the sheild off of the rope. With the rope, and its knots exposed, the people grab the knots with their arms and pull with their body weight, which does not take much arm strength. Each time they pull the rope closer, half of the people on that team have to let go, reach forward with their arms and grab the next knot. Reaching forward is difficult and they have to use a lot of energy to grab that next knot. When they reach the time limit in the competition, the electricity to the motor turns off and the motor pushes the sheild back over the knots on the rope. This blocks the people from grabbing the rope any more and the pull is over.

In this analogy, I have used the following things to play the part of the different muscle elements. In the space provided next to each element, explain why the action being done by thing in the tug of war analogy is similar to what the muscle part is doing in a muscle contraction.



Actin = the rope

Myosin = the people

Cross bridges = the peoples arms

Cross bridge binding sites = knots on the rope

Tropomyosin = a sheild covering the rope

Troponin = the motor that moves the sheild

ATP = energy for the muscles in their arms

Calcium ions = the electricity for the motor

Nerve impulse = the starters horn