

# Muscle Cell Contraction

## Basic Information

- Muscles can only contract, they cannot lengthen under their own power. (Muscles are lengthened by their antagonists, muscles pulling in the opposite direction.)
  - Muscle cells are fused into longer units during embryology forming long multinucleated cells called *muscle fibers*.
  - The interior of muscle fibers consists of alternating thick(myosin) and thin(actin) filaments.
  - The contractile unit of the muscle fiber is the sarcomere.
  - Sacromeres contract when the thick and thin filaments slide past one another.
  - ATP provides the energy for contraction and the actual movement is produced by "heads" or "knobs" of thick filaments(myosin) attaching to thin filaments(actin) and bending.
  - Like neurons, muscle cells are capable of experiencing an "action potential".
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## The Sliding Filament Model

Examine the diagrams in your text book as you review this material.

1. It is easy to get confused by the excessive terminology associated with this model. It is best to keep the terminology to a minimum.

### Bare bones terminology:

*Actin*- the protein that makes up the thin filaments. (Memory Trick: The "tin" in actin could mean "thin".)

*Myosin*- the protein that makes up the thick filaments.

*Z lines*- the dark lines at each end of the sarcomere.

*Sarcomere*- the unit of contraction in muscle fibers.

2. As the muscle fibers contract the distance between the Z lines shortens.
3. The thick and thin filaments do not shorten as the sarcomere contracts.
4. The thick and thin filaments slide past each other during contraction.
5. Myosin provides the power for contraction through the bending of heads against the stationary actin.
6. Each of about 350 myosin heads attaches and re-attaches to the myosin at a rate of 5 times per

second. This has been described by some biologists as a rachet action, as in a wrench.

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## **How Nerve Impulses are Passed Along to Muscle Cells**

1. Nerve endings on muscle cells are called neuromuscular junctions. These are a synapses.
2. The neurotransmitter released at these synapses is acetylcholine.
3. When acetylcholine is received by the muscle cell membrane the muscle cell becomes permeable to ions and the membrane develops an action potential much like neurons do.
4. This action potential is passed into the cell along the muscle fibers endoplasmic reticulum(a.k.a. sarcoplasmic reticulum). This causes  $\text{Ca}^{+}$  ions to pour into the Muscle fiber(cell).
5. The presence of  $\text{Ca}^{+}$  ions allows the ATP/myosin reactions to occur, thus causing contraction. The  $\text{Ca}^{+}$  ions remove a blocking protein from the actin allowing the myosin heads to attach and move.

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