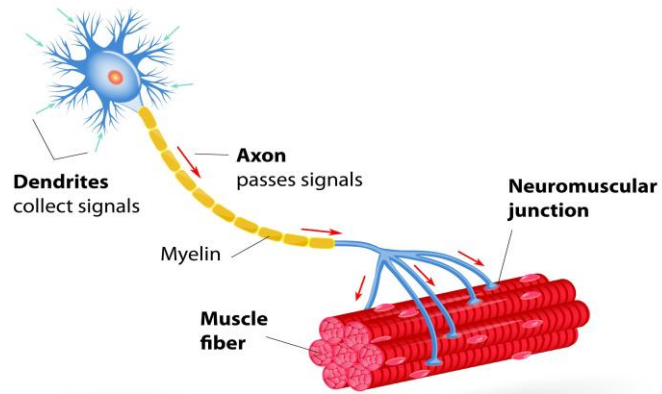
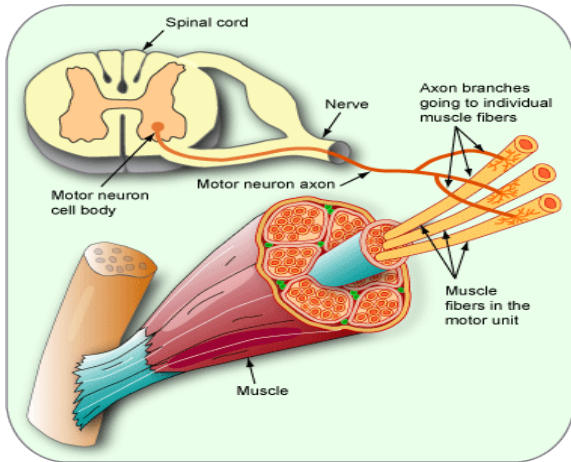


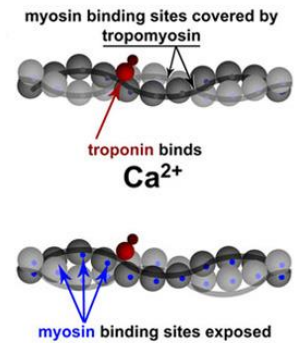
4.1 Draw and label a diagram of a motor unit.



- Nervous system made up of millions of nerve fibers, transferring electrical signals from the brain
 - The central nervous system (CNS) consists of the brain and spinal cord
 - The peripheral nervous system is the arrangement of nerves extending from the spinal cord to other parts of the body
 - **Motor neurons (motoneurons)** are nerves that carry info from the CNS to the muscles and signal for contraction.
- **Structure of neurons**
 - **Cell body** - contained in the spinal cord or in clusters just outside it called ganglia
 - **Dendrites** - link the neuron to other neurons and information to flow
 - **Axon** - main component to nerve signal transmission, similar to an electrical wire. Encased in myelin for insulation.
 - Gaps in myelin called nodes of Ranvier
 - Neuromuscular junction (NMJ) (motor end plate) - where the neuron meets the muscle
 - Small gap between the two called the synapse
- **Motor unit** - a single motor neuron and the muscle it innervates
 - Typically the larger the muscle the more muscle fibers are innervated by each motor neuron. Allows a single motor neuron to generate large muscular forces
 - A small number of muscle fibers per motor neuron gives a small force but great precision (ex eye).
 - When the motor unit is innervated all the muscle fibers attached to it are contracted.
- **Types of motor units (fast/slow twitch)**
 - Type I - slow twitch motor units consist of mainly slow twitch muscle fibers and have slower nerve transmission speeds and small muscle forces.
 - Can maintain contractions for a long period of time
 - Fatigue resistant
 - aerobic
 - Type IIa - fast twitch oxidative (uses oxygen) motor units consist mainly of type IIa muscle fibers and have fast nerve transmissions
 - Stronger contraction forces and are more resistant to fatigue
 - Anaerobic and aerobic
 - Type IIb - fast twitch motor units with mostly fast twitch muscle fibers.
 - Fastest contraction times and largest forces
 - High fatigue rate and can't maintain contractions for a long period of time
 - Anaerobic

- **Mechanics of muscle contraction**

- Striations - muscle fibers that appear striped due to the overlap of actin and myosin proteins within the muscle fiber
- Muscle contraction starts with electrical impulse from brain (either voluntarily or by reflex). Signal travels along motor neuron to the muscle via the NMJ across the synapse.
- When signal reaches here, the neurotransmitter, **Acetylcholine**, is released and changes the electrical state of the muscle.
 - The signal travels through the muscle fibers stimulating the sarcoplasmic reticulum where it releases calcium (Ca^{2+})
 - Myosin binding sites on actin are covered by tropomyosin.
 - Calcium binds to troponin on the tropomyosin which causes it to move and reveal the myosin binding sites on the actin. ATP on the Myosin head is hydrolysed to form ADP + Phosphate
 - Cross bridge formed - myosin heads are shaped like little golf clubs and it is the ends of the heads that attach to the actin. Myosin head remains bound until ATP molecule releases it. As long as there is calcium available cross bridge formation will continue until maximum contraction of the muscle fiber is reached.
 - The motor neuron initiates a resting potential through repolarization. **Cholinesterase**, an enzyme that breaks down acetylcholine, is released and cause the muscle cell to repolarize and relax.
 - Calcium ions are removed from the cell and returned to the sarcoplasmic reticulum via the calcium pump
 - Cross bridge formation is terminated as there is no calcium which means the myosin binding sites on the actin filament are covered by tropomyosin. Myosin heads to a resting state.



	<table border="1"> <tr> <td>What is the contractile unit of muscle called?</td> </tr> <tr> <td>Define what the following terms represent;</td> </tr> <tr> <td>H Zone</td> </tr> <tr> <td>A Band</td> </tr> <tr> <td>Z line</td> </tr> </table>	What is the contractile unit of muscle called?	Define what the following terms represent;	H Zone	A Band	Z line
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- **Control of muscle force**

- When a muscle is signaled to contract, the force of the contraction is appropriate so the body segment moves appropriately
 - Quads require a large force (big muscle group), or a small force like fingers for writing.

