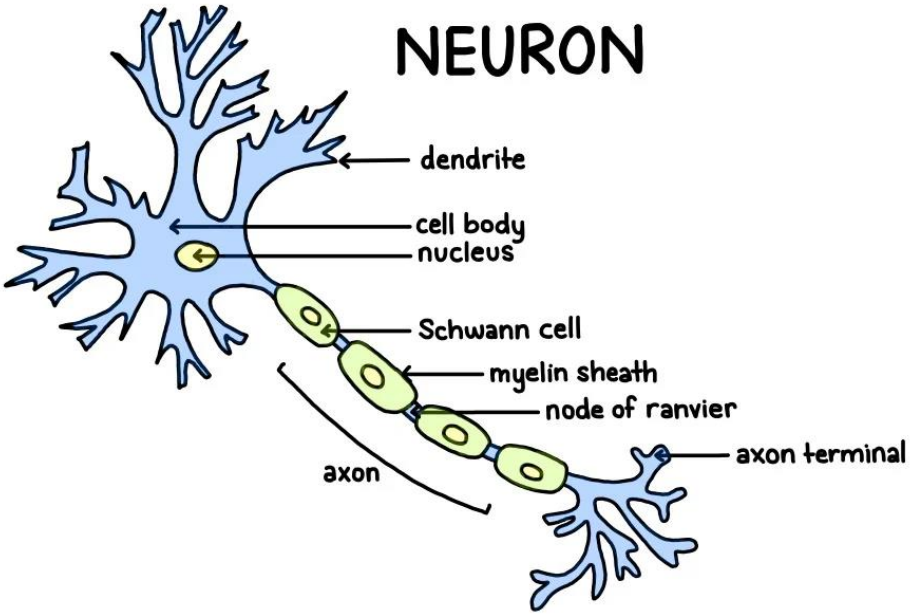
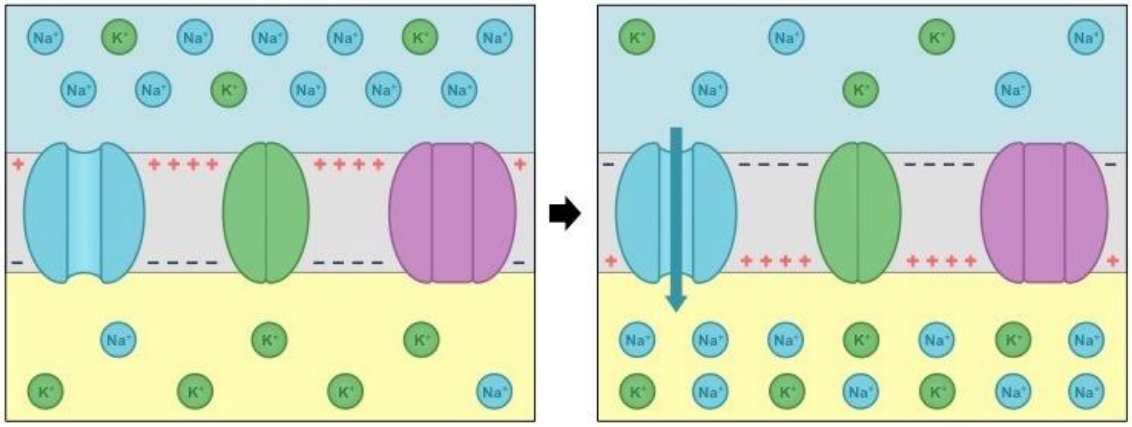
Neurons:

- convert chemical to electrical signals.
- Made up of soma (cell body), dendrites (convert the chemical info to electrical), and axon (where the electrical signal travels along)
- Axon:
    - covered by the myelin sheath (produced by Schwann Cells) which increased rate of travel (saltatory conduction) because the signal can jump between gaps in the sheath (Nodes of Ranvier)



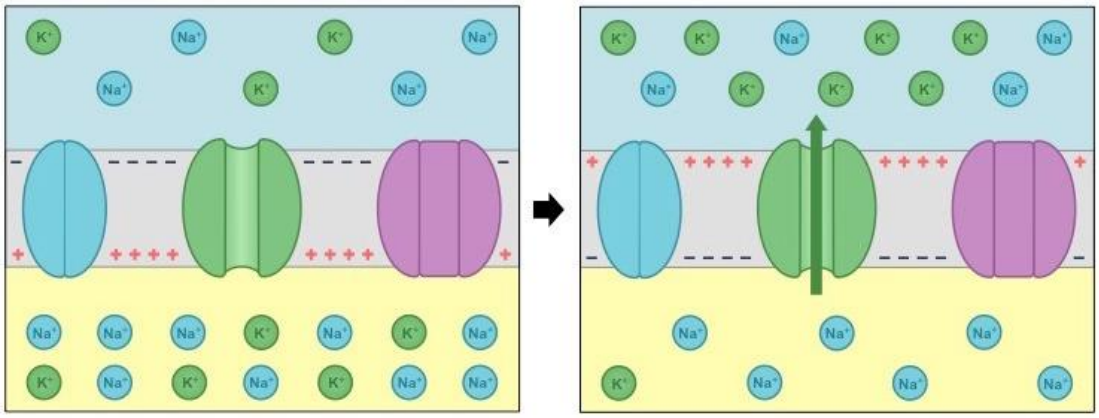
- Resting Potential
    - Net -70 mV
    - Salty Banana: 3 Na+ out and 2 Ka+ in continuously pumped in the neuron.
- Depolarization:
    - When there is an impulse, the sodium channel opens and Na+ passively diffuses into the neuron so that there is now a net (+30 mV)



Before: Na^+ out ; K^+ in (*inside: –70 mV*)

After: Na^+ influx (*inside: +30 mV*)

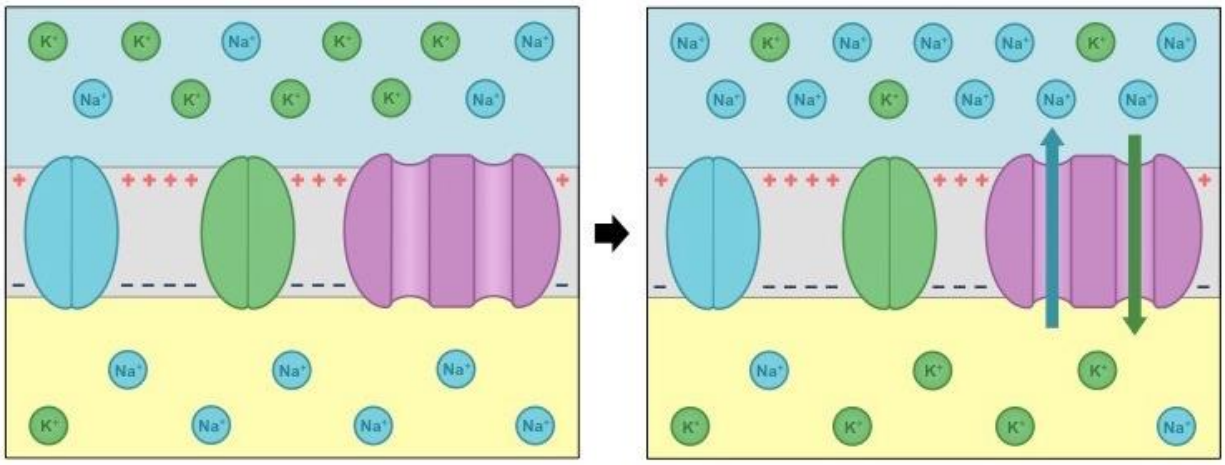
- If threshold potential is reached (-55mV) – minimum level of depolarization action potential is generated and voltage-gated ion channels can open (All or Nothing principle)
- Repolarization:
    - Potassium channels open and Ka+ passively diffuses outside the neuron (now there is a net -80 mV)

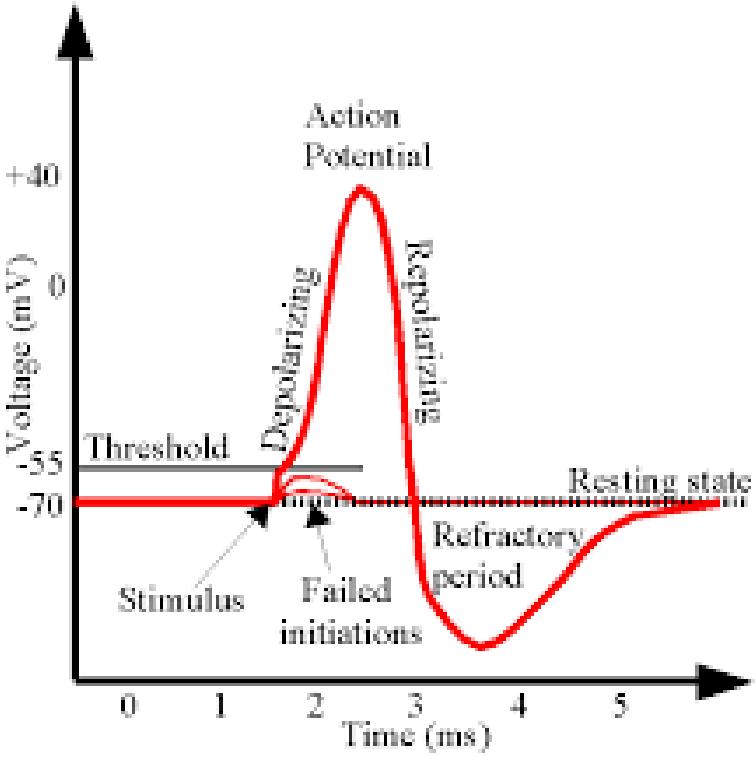


Before: Na^+ in ; K^+ in (*inside: +30 mV*)

After: K^+ efflux (*inside: –80 mV*)

- Refractory Period:
    - Sodium-Potassium pump opens, and the neuron is reset so that Na+ is outside the cell again and Ka+ is inside -> returns to a net -70 mV.





Oscilloscope: instrument to measure membrane potential in neurons

Synapse: Area between two neurons.

- When action potential reaches axon terminal, the calcium channel opens and Calcium ions (vesicles) flow into the pre-synapse which carry neurotransmitters.

- The Ca2+ ions fuse with the cell membrane and neurotransmitters enter the synaptic gap via exocytosis.

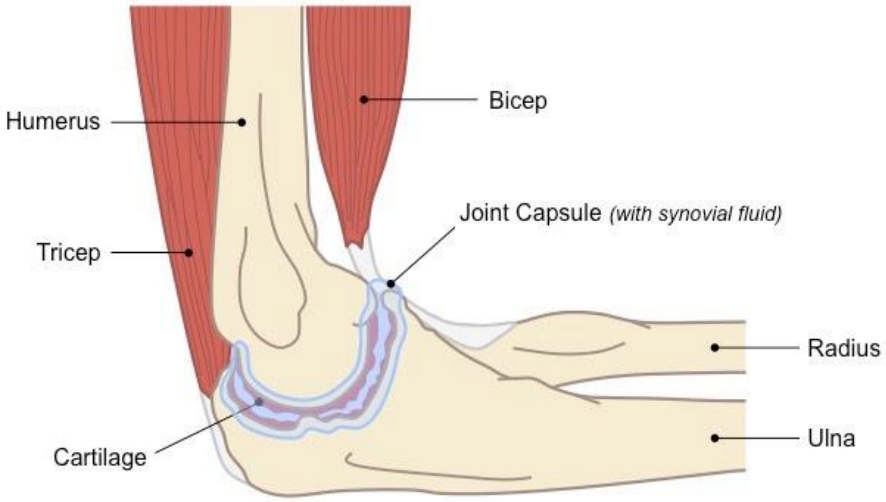
- The neurotransmitters then bind to receptors in the post synapse which generate the sodium channels to open in the next neuron.

Acetylcholine: Neurotransmitter for muscle contractions
- Bind to receptors on muscle fibers and are broken down by acetylcholinesterase into choline and acetyl CoA.
- Choline is reabsorbed into the pre-synapse.

Noenicitinoids: bind to acetylcholine receptors in insects so that it cannot be broken down -> overstimulation -> paralysis (good pesticides but can kill good insects too like bees and indirectly kill insectivores)

Muscles:

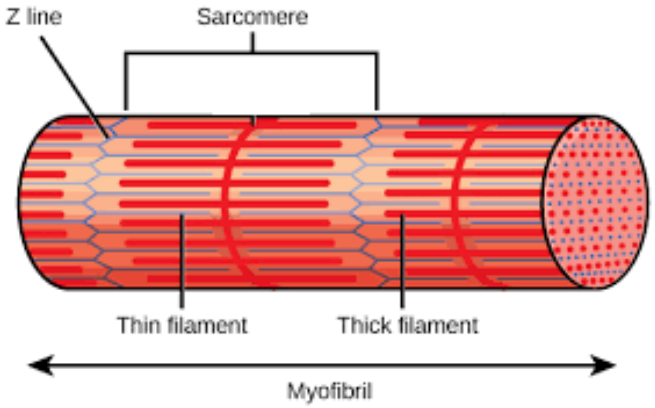
Synovial joints: fluid filled space between two bones to allow for movement in relation to each other (articulation)
Humerus, Radius, Ulna: bones that are attached to bicep (flexor) and triceps (extender)
Joint capsule: seals the joints to prevent dislocation.
- cartilage: covers bones to prevent friction
- synovial fluid: lubrication to prevent friction.
- Antagonistic muscle pairs: When one contracts the other relaxes:
    - biceps and triceps
    - Flexor and extensor muscles in grasshopper.

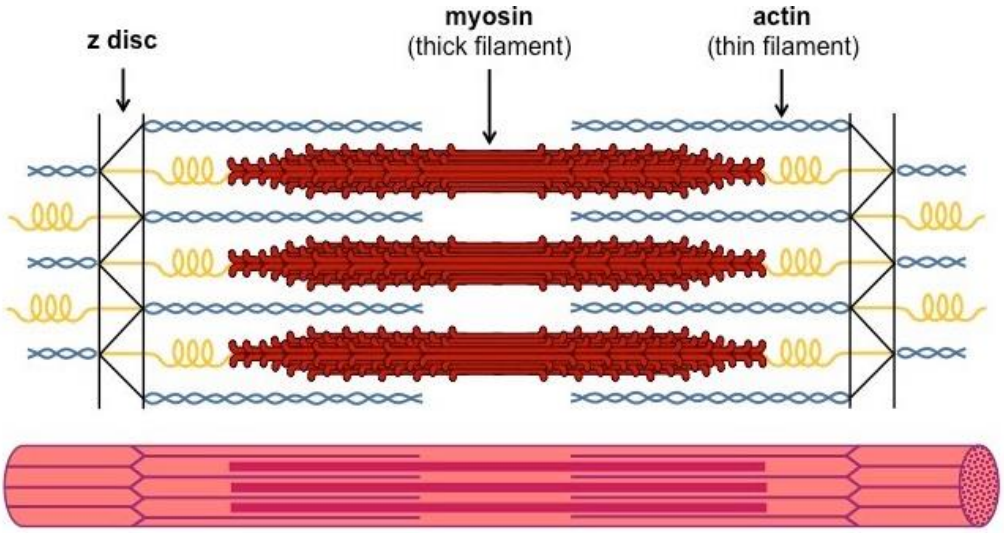


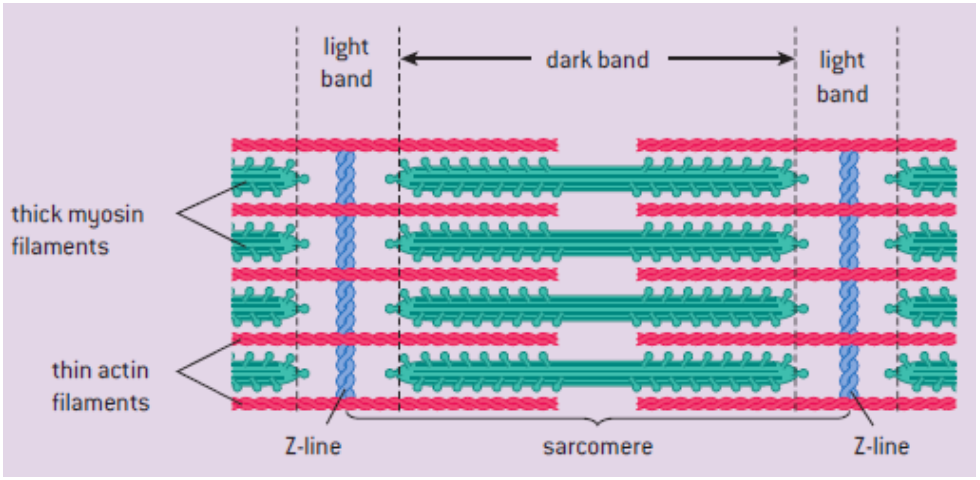
Skeletal Muscles are made of muscle fibers surrounded by sarcolemma.
- long and multinucleate since it is a bundle of muscle cells
- muscle fibers are made up of myofibrils.
- Myofibrils made of sarcomeres.
- Sarcomeres are between two Z-bands.

Z lines have actin filaments that connect to them (thin bands)
- Thick myosin filaments between actin filaments.

- Myosin filaments have heads

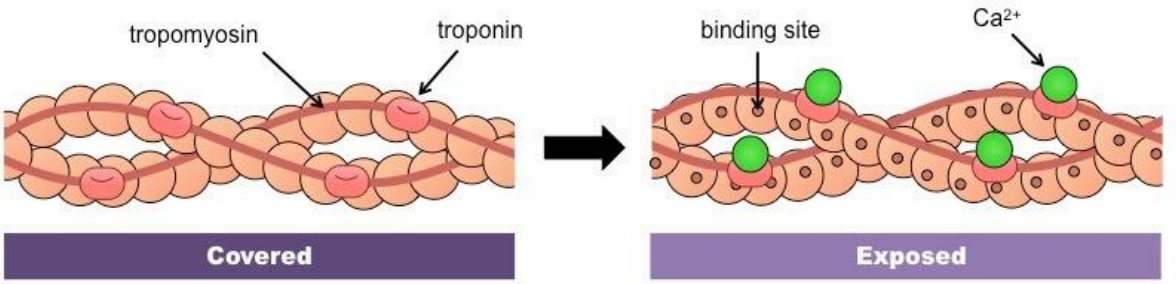




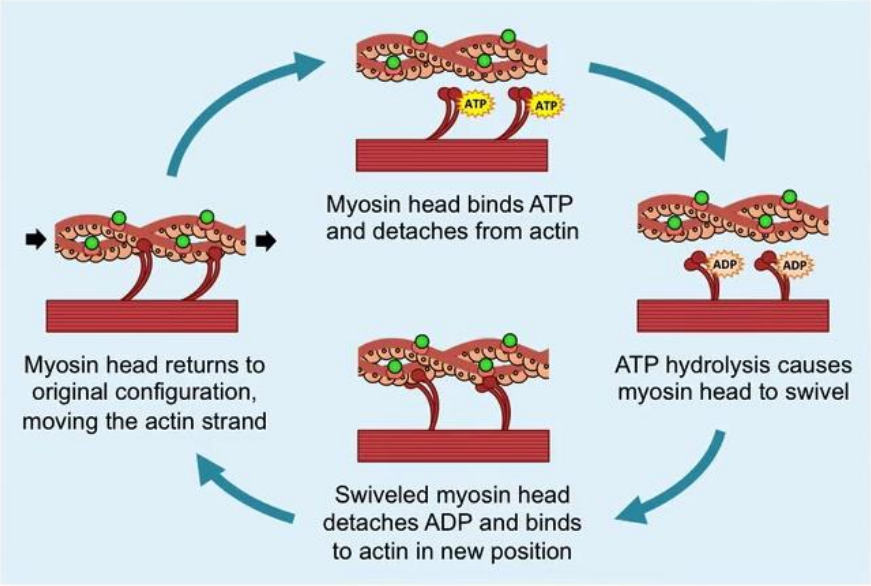


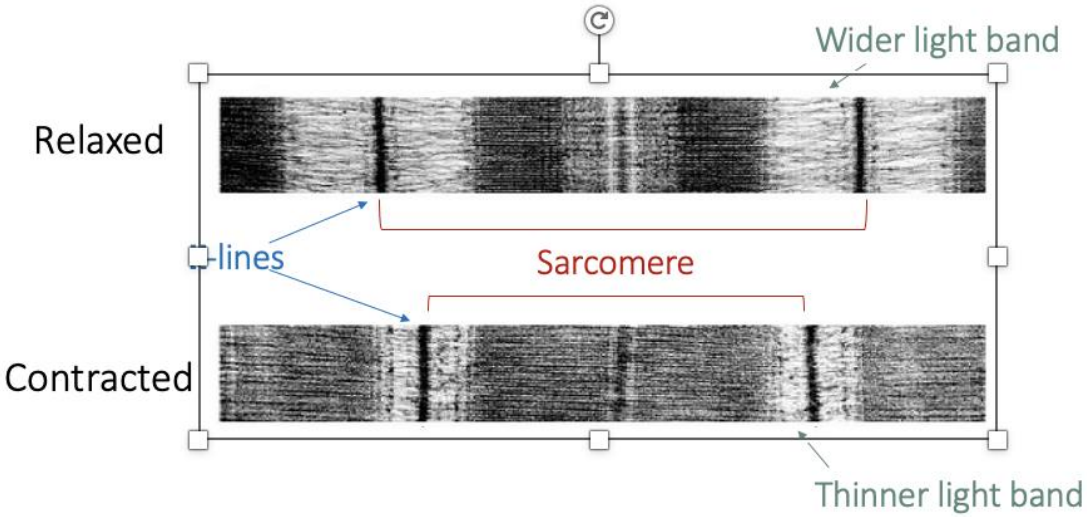
Muscle contraction:

- Action potential from motor neuron-> acetylcholine -> depolarization within sarcolemma -> release of calcium ions via sarcoplasmic reticulum.
- Actin filaments have tropomyosin and troponin which bind to in (blocking complex) -> calcium ions bind to troponin exposing the binding site for myosin head.



- Myosin heads on myosin filaments attach the actin filaments at binding sites to form a cross-bridge
- ATP binds to the myosin head breaking the cross-bridge
- ATP hydrolysis -> ADP causes myosin head to swivel moving towards next actin binding site.
- Myosin head binds to the actin site forming crossbridge again and return to original configuration fulling the actin along the myosis in sliding movement.
- Constant swiveling motion of the myosin heads pull the z lines closer together overall contracting the muscle fiber as a whole.




Wider light band
Relaxed
Z-lines
Sarcomere
Contracted
Thinner light band