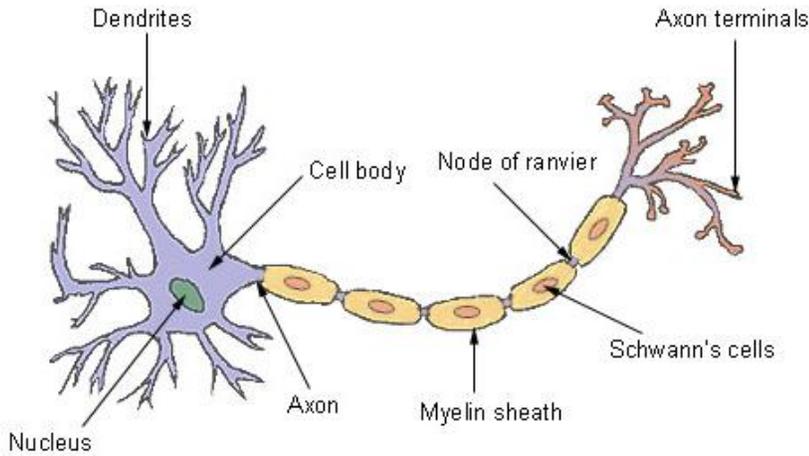


Ch. 48 & 49 Nervous System

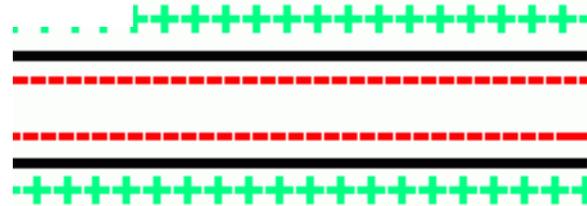
Structure of a Typical Neuron



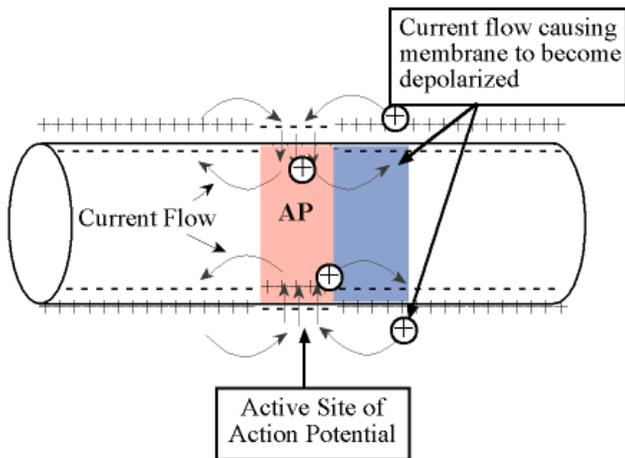
When an impulse travels down an axon covered by a myelin sheath, the impulse must move between the uninsulated gaps called nodes of Ranvier that exist between each Schwann cell.

RESTING POTENTIAL:

Nerve cell membrane is polarized by $\text{Na}^+\text{-K}^+$ pump
Sodium is on the outside
Potassium is on the inside



Direction of Action Potential →



ACTION POTENTIAL:

Stimulus opens gated ion channels.
Sodium ions rush into cell

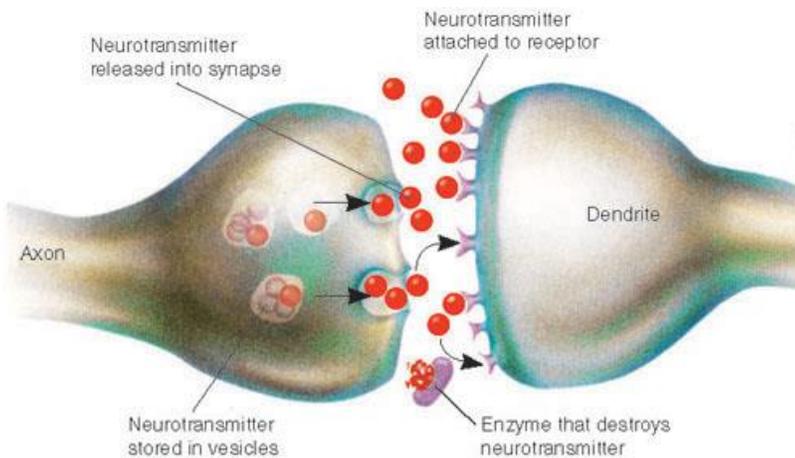
Cell is **DEPOLARIZED**
Charge on membrane flips
Potassium ions move outside,
and sodium ions stay inside

HYPERPOLARIZATION:

More potassium ions are on the outside than there are sodium ions on the inside.

REFRACTORY PERIOD puts everything back to beginning: Na^+ and K^+ are returned to their original sides: Na^+ on the outside and K^+ on the inside. While the neuron is busy returning everything to normal, it doesn't respond to any incoming stimuli.

Each neuron has a threshold level — the point at which there's no holding back. "All-or-none" means that if a stimulus doesn't exceed the threshold level and cause all the gates to open, no action potential results however, after the threshold is crossed, there's no turning back: Complete depolarization occurs and the stimulus will be transmitted.



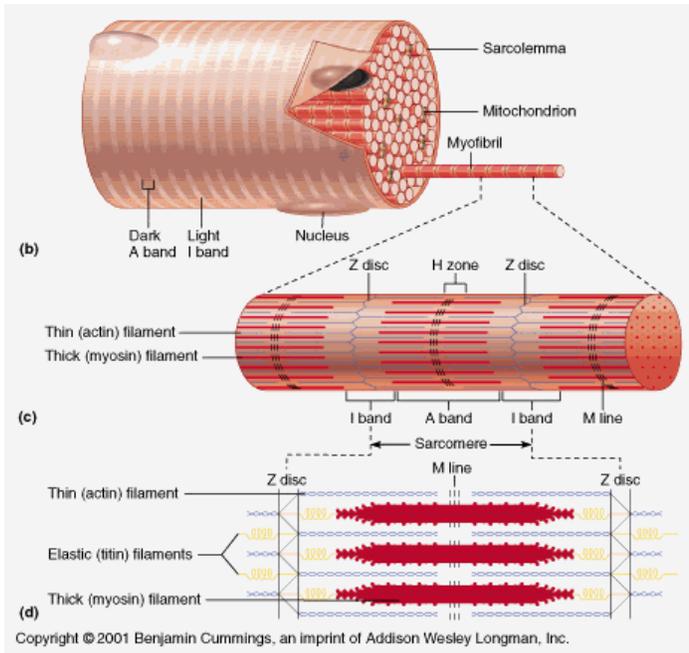
Synapse or synaptic cleft separates the axon of one neuron and the dendrites of the next neuron. Neurons don't touch. The signal must traverse the synapse to continue on its path through the nervous system.

DEPOLARIZATION OPENS GATED ION CHANNELS and CALCIUM IONS (Ca^{++}) are allowed to ENTER the cell. Calcium ions cause VESICLES TO FUSE with cell membrane and release vesicles containing ACETYLCHOLINE (neurotransmitter) into the SYNAPTIC CLEFT.

ACETYLCHOLINE DIFFUSES across space and binds to specific RECEPTOR PROTEINS on POST SYNAPTIC MEMBRANE causing depolarization of next cell membrane.

Receptor releases acetylcholine into synapse and ACETYLCHOLINESTERASE enzyme breaks it down and it is RECYCLED. The chemicals go back into the membrane so that during the next impulse, when the synaptic vesicles bind to the membrane, the complete neurotransmitter can again be released.

MUSCLE CONTRACTION

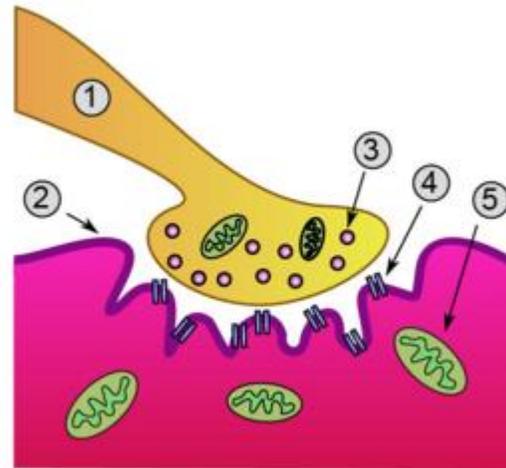


THIN FILAMENTS made of ACTIN, TROPONIN, and TROPOMYOSIN.

THICK FILAMENTS made of MYOSIN

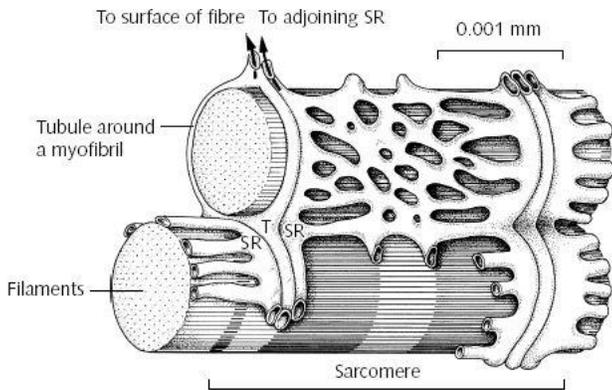
ACETYLCHOLINE released in SYNAPSE depolarizes muscle cell membrane.

ACTION POTENTIAL travels through T-TUBULES to SMOOTH ER (SARCOPLASMIC RETICULUM) of muscle cell.



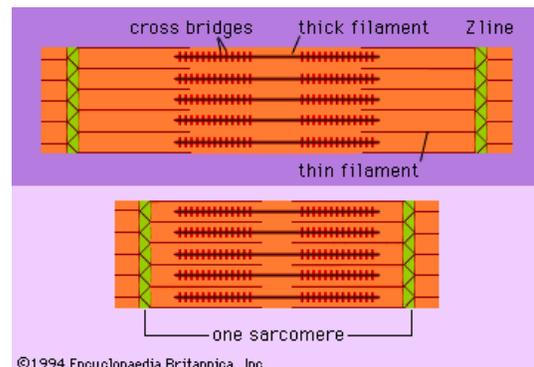
Release of Ca^{++} ions from SARCOPLASMIC RETICULUM causes contraction of muscle fibers.

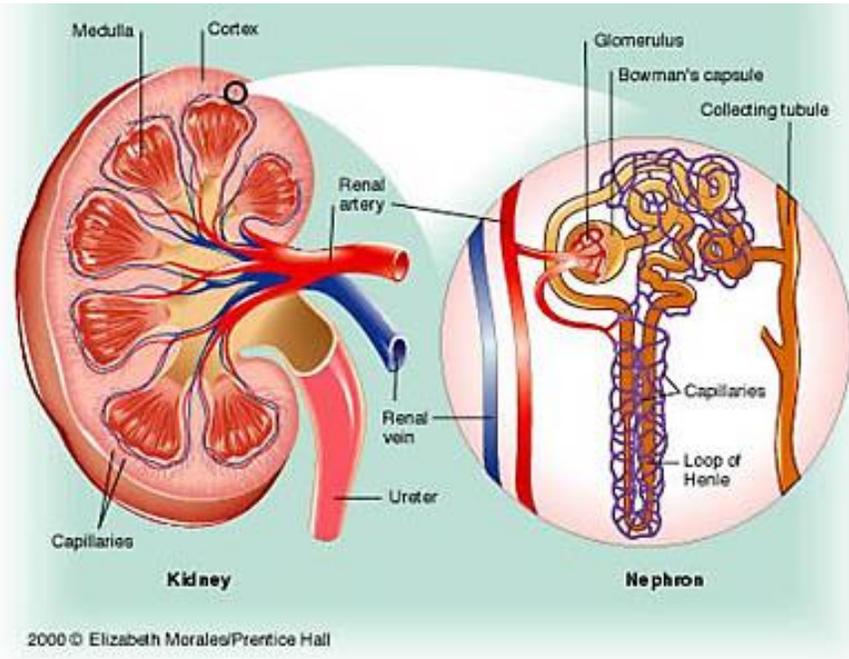
Requires Calcium ions and ATP



Sliding of filaments results in contraction of fiber

When signal is over, CALCIUM IONS are reabsorbed by SARCOPLASMIC RETICULUM

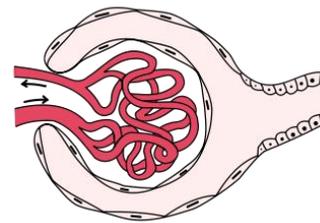




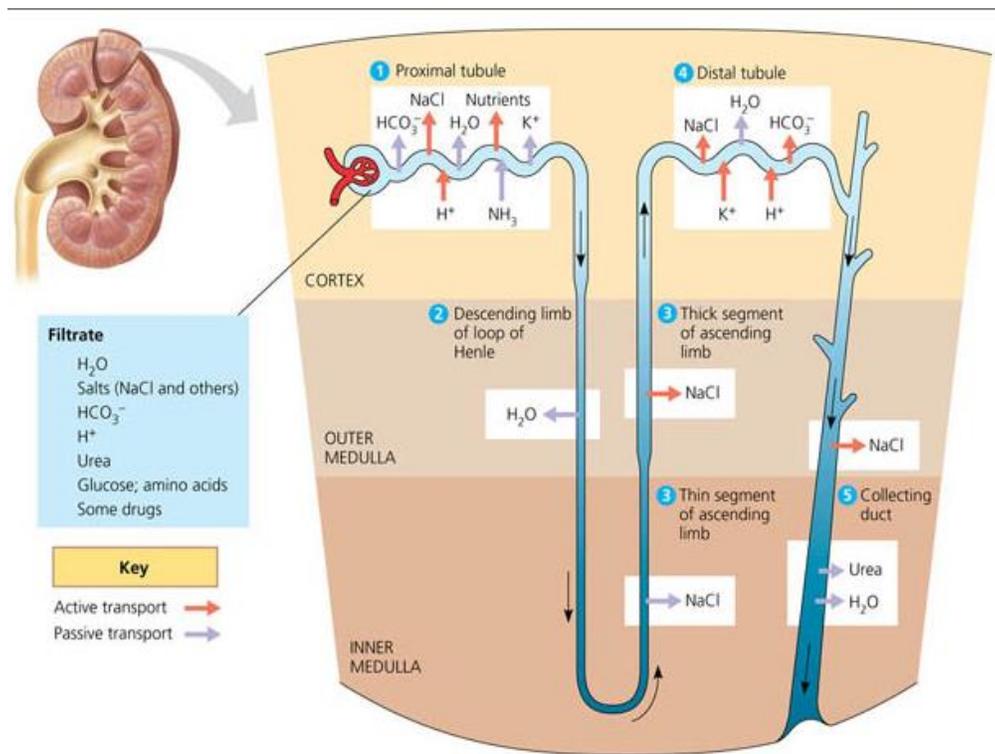
KIDNEY

Functional unit = NEPHRON
makes urine by:

- filtering small molecules and ions from blood
- reclaiming the needed amounts of useful materials
- Surplus or waste molecules & ions are left to flow out as urine.



Blood enters the **GLOMERULUS** (blood vessel tuft) under pressure causing water, small molecules, and ions (but not macromolecules like proteins) to filter through the capillary walls into the **BOWMAN'S CAPSULE**.



Filtrate (basically blood plasma minus proteins) flows into **PROXIMAL TUBULE** where **ALL GLUCOSE, AMINO ACIDS, >90% of the urea, and ~60% of inorganic salts** are reabsorbed by active transport

As these solutes are removed, a large volume of the water follows them by **osmosis**

As the fluid flows into the **DESCENDING** segment of the **LOOP OF HENLE**, water continues to leave by osmosis because the interstitial fluid is very hypertonic.

This is caused by the active transport of Na⁺ out of the tubular fluid as it moves up the **ASCENDING** segment of the loop of Henle. In the **DISTAL TUBULES**, more sodium is reclaimed by active transport, and still more water follows by osmosis. Final adjustment of the sodium and water content of the body occurs in the **COLLECTING TUBULES**.