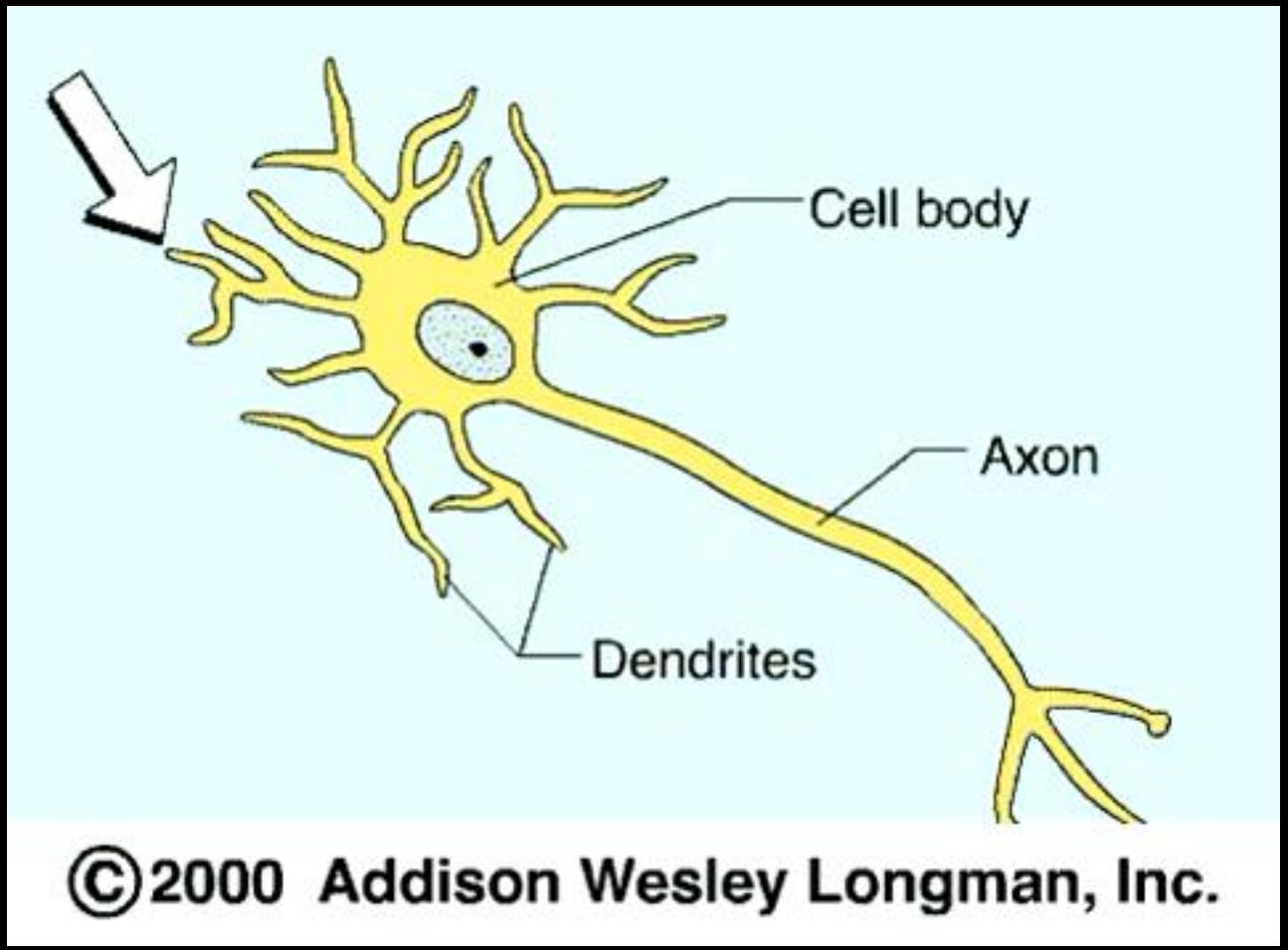
Nervous System

Scope

- Humans have 10^{12} neurons
- You only have 10^{9} DNA bases
- Typical cells are 10 microns in diameter
- Some of your neurons are 3 feet long
- The longest neurons in Giraffe 3 meters
- Complex program directs connections
- You photoreceptors can detect down to 1 photon
- -70 mV across 3nm is equivalent to 200,000V across 1cm

Animation



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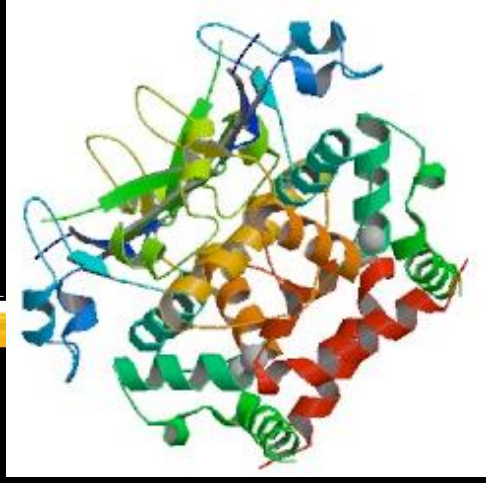
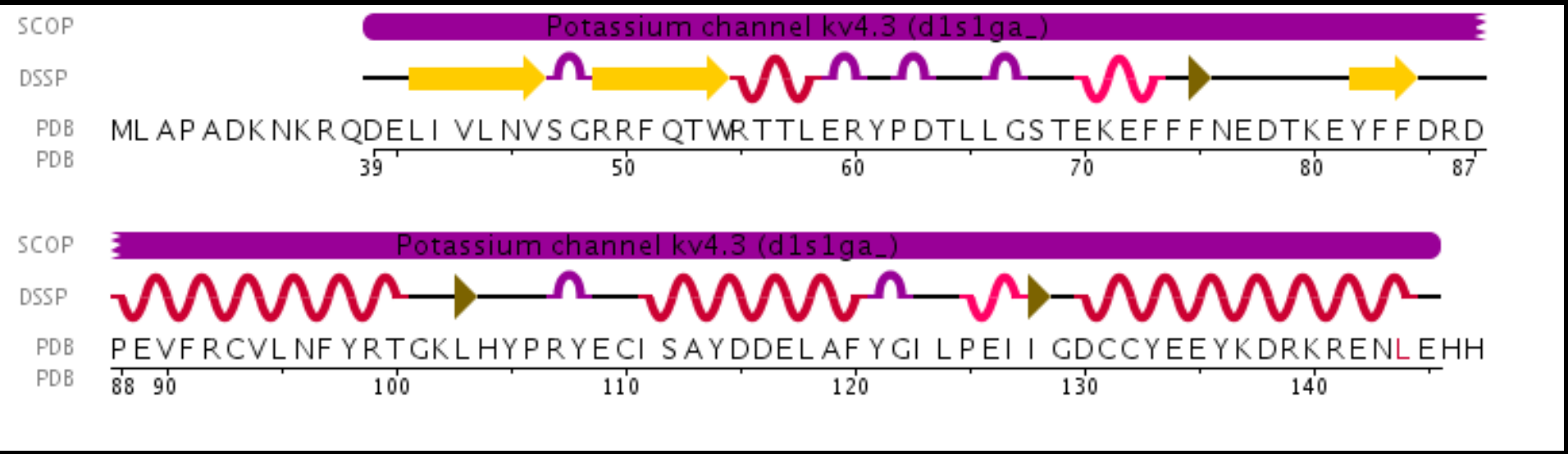


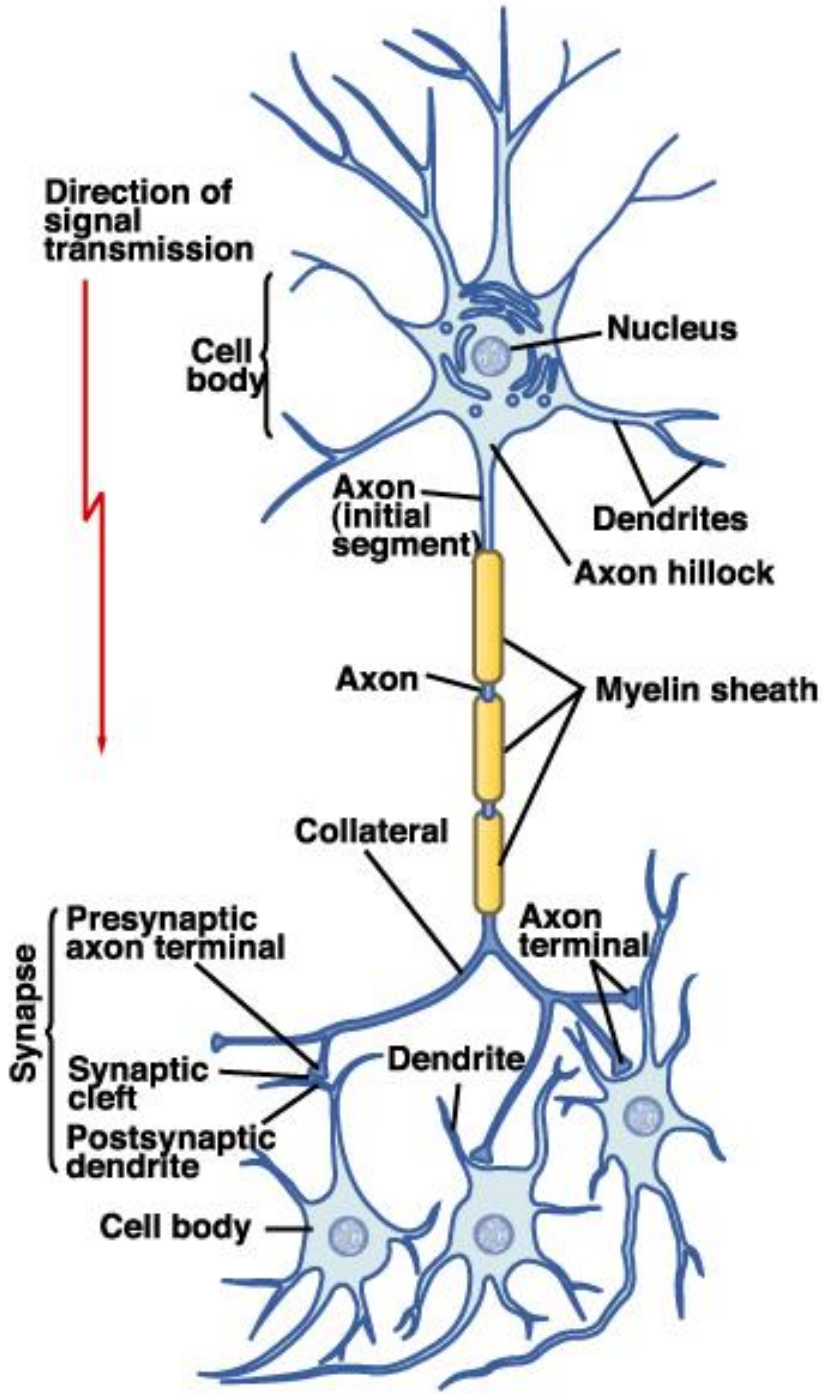
- domains of Kv4 K(+) channels regulate binding to and modulation by KChIP1



Myelin Sheath

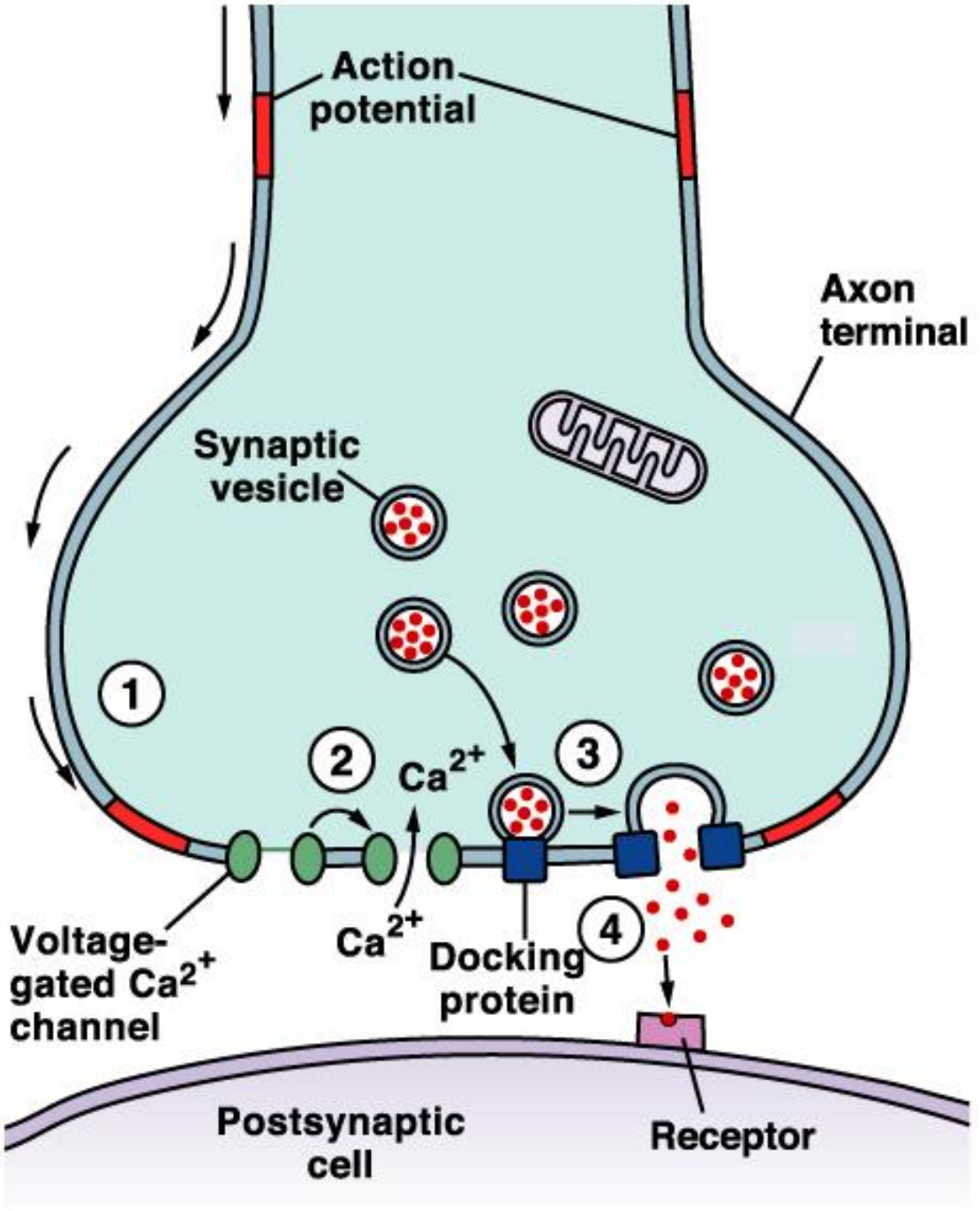
- Wraps around
- Multiple Sclerosis is an autoimmune attack on myelin sheaths resulting in 100 times slower signal propagation along the axon

- Most neurons have a single axon – a long (up to 1m) process designed to convey info away from the cell body.
- Transmit APs from the soma toward the end of the axon where they cause NT release.
- Often branch sparsely, forming collaterals.
- Each collateral may split into telodendria which end in a synaptic knob, which contains synaptic vesicles – membranous bags of NTs.



Synaptic Transmission

- An AP reaches the axon terminal of the presynaptic cell and causes V-gated Ca^{2+} channels to open.
- Ca^{2+} rushes in, binds to regulatory proteins & initiates NT exocytosis.
- NTs diffuse across the synaptic cleft and then bind to receptors on the postsynaptic membrane and initiate some sort of response on the postsynaptic cell.



▶ The Movements of Ions During the Action Potential

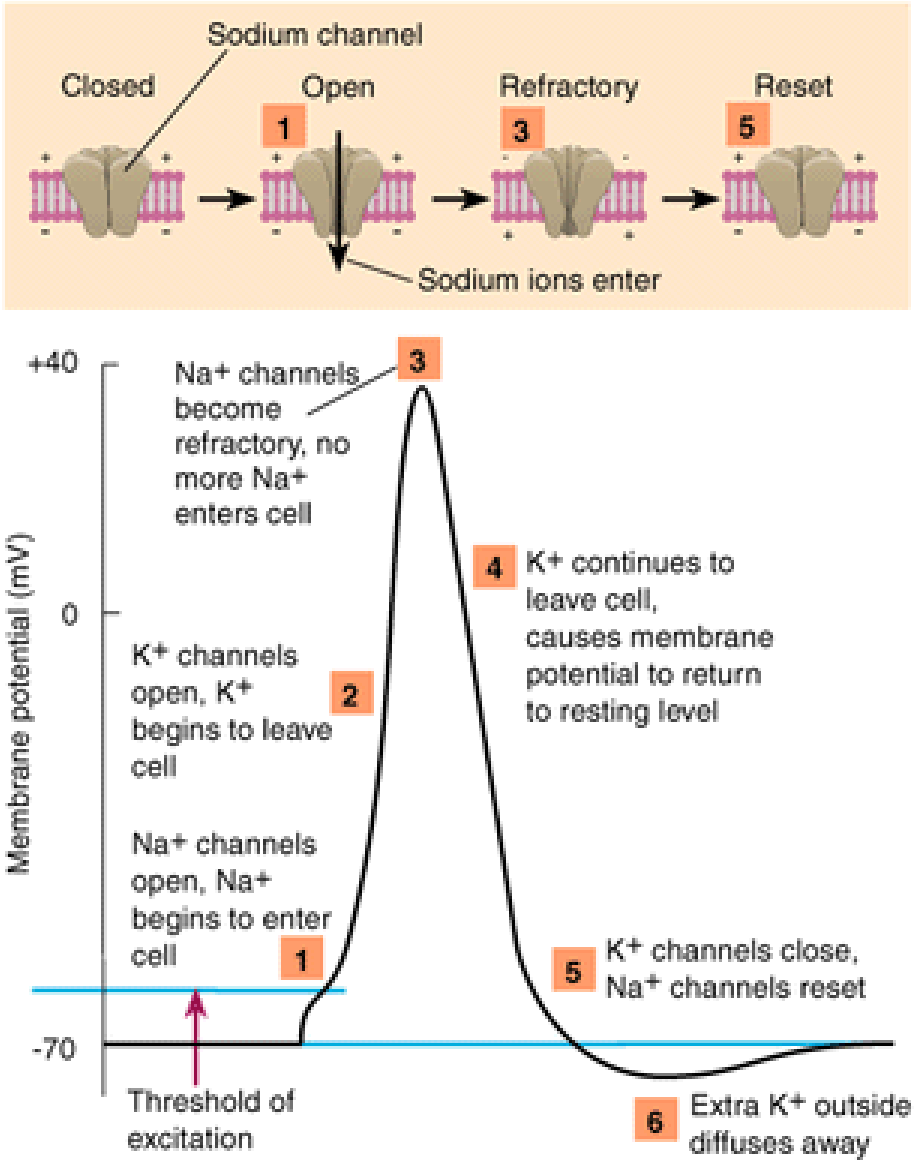
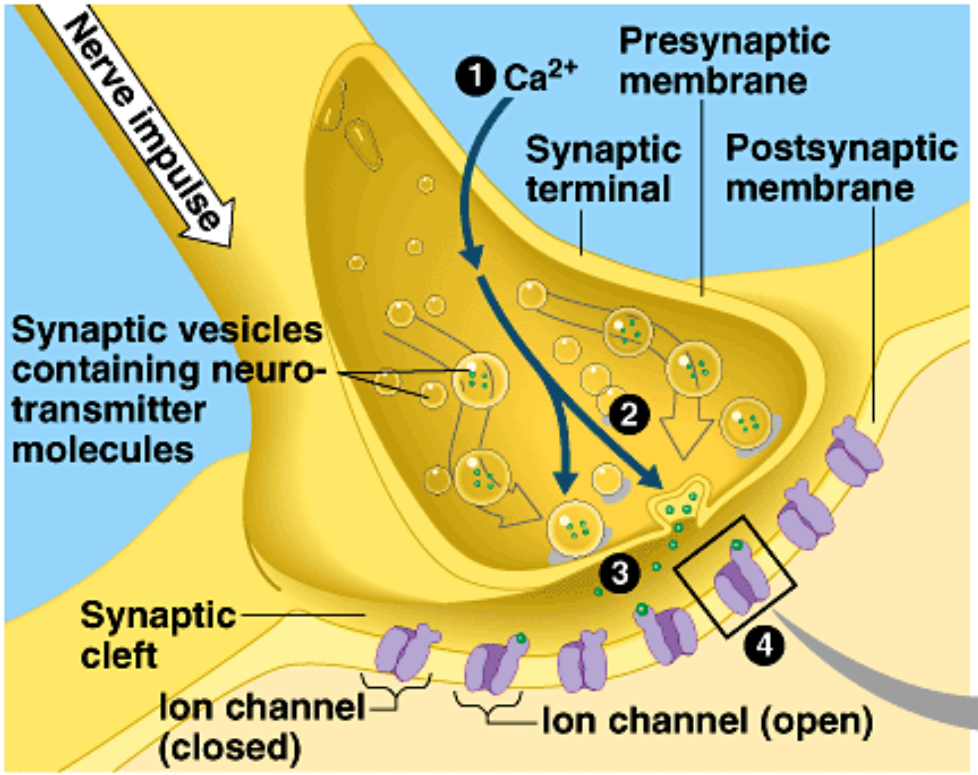
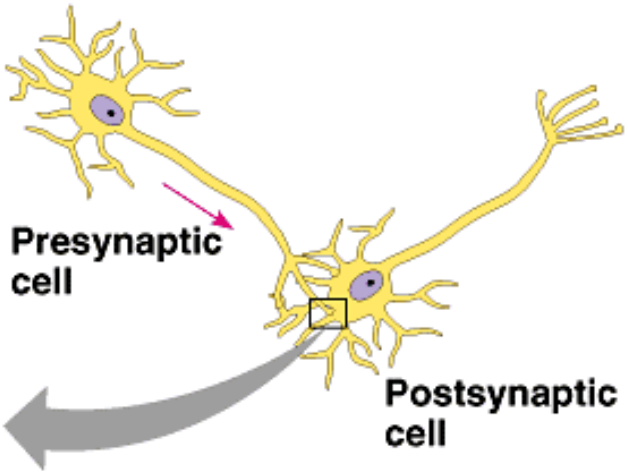
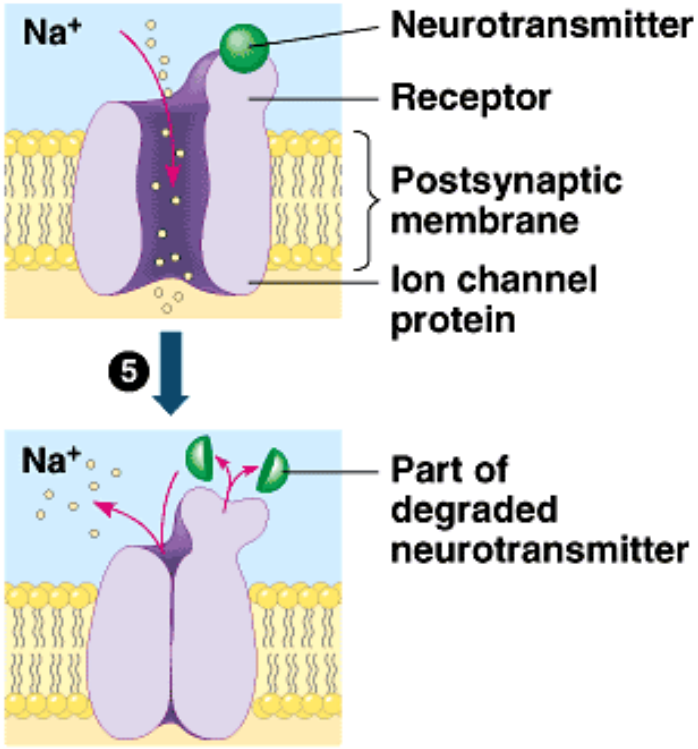


Figure 48.12 A chemical synapse

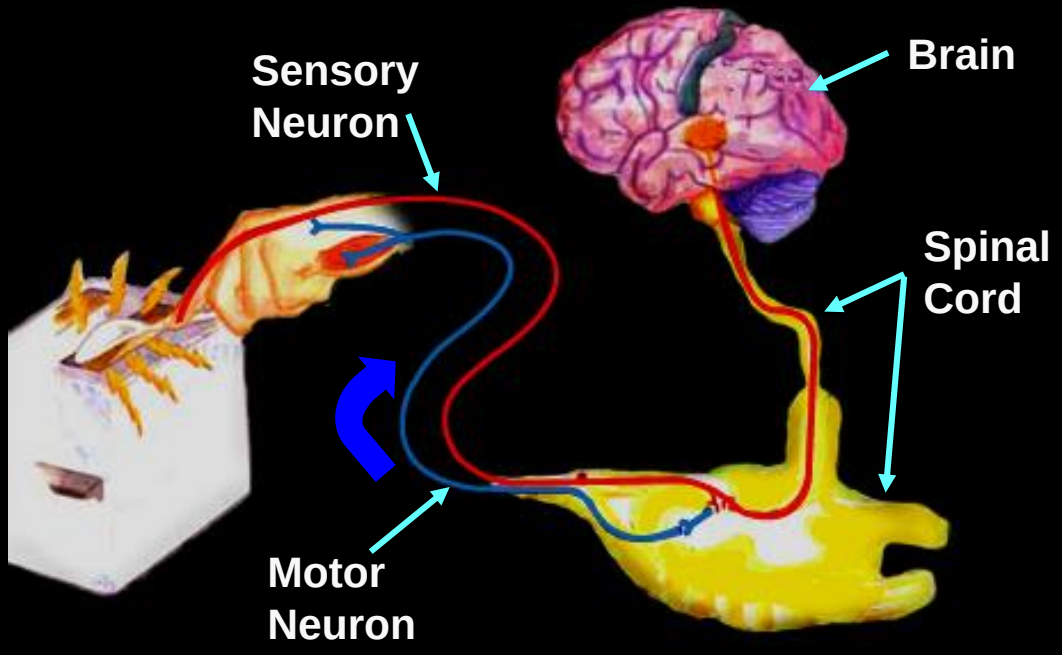






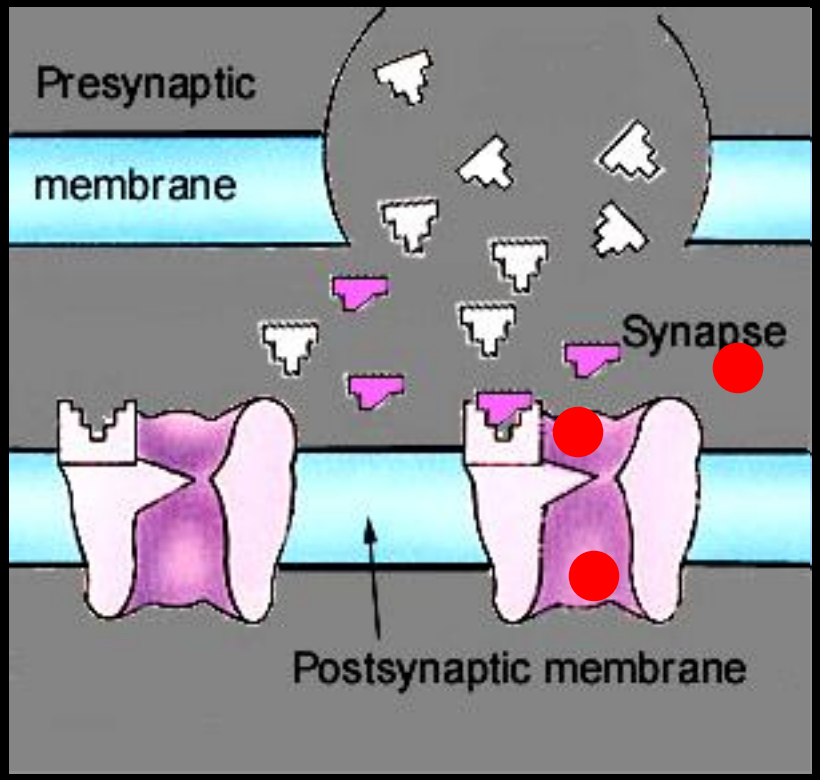
Motor Neurons

- **OUTPUT** From the brain and spinal cord To the muscles and glands.



Some Drugs work on receptors

- Some drugs are shaped like neurotransmitters
- Antagonists : fit the receptor but poorly and block the NT
  - e.g. beta blockers
- Agonists : fit receptor well and act like the NT
  - e.g. nicotine.

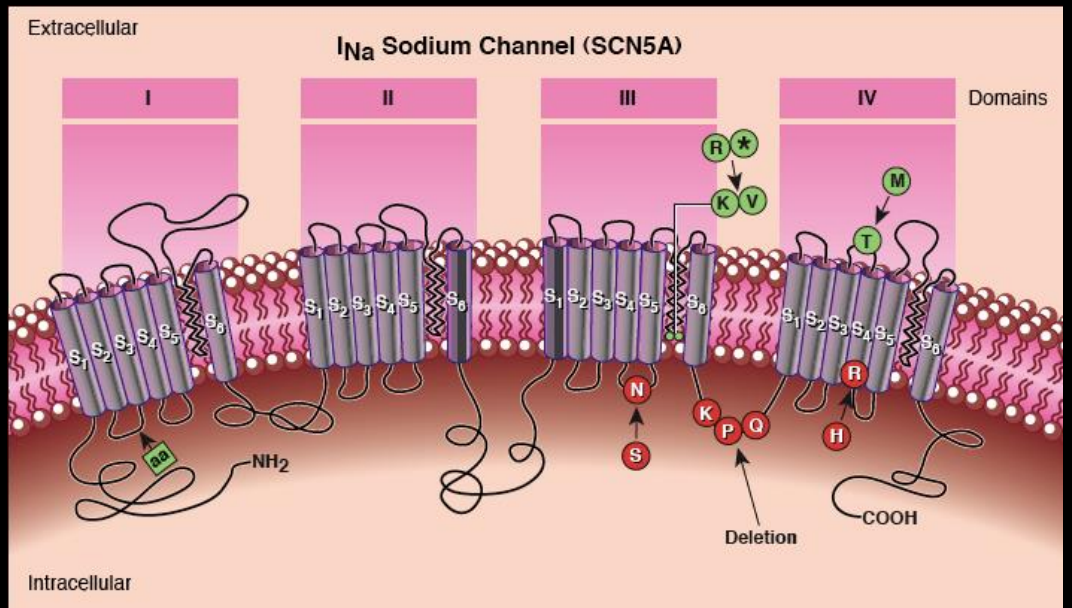


How did they figure this out?

- Patch Clamping
- Put a really small pipette over a ion channel
- Suck up one ion channel so that the membrane blocks the glass tube
- Measure the current flow as you vary voltage across the ion channel
- Insert chemicals to see how they impact the channel

Muscle Interaction

- Calcium channels activated by action potential in nerve
- Cascade through muscle caused by interaction with one muscle
- cellhttp://thevirtualheart.org/



Sushi

- Blowfish have a toxin that irreversibly binds and inhibits the voltage gated sodium channels
- Paralyzes person who consumes it because you cant accomplish action potential

Poison Darts

- Tip with Curare
- Reversibly binds to acetylcholine receptor and blocks connection between nerves and muscles

Sarin

- Inhibits acetylcholinesterase
- You cant relax your muscles