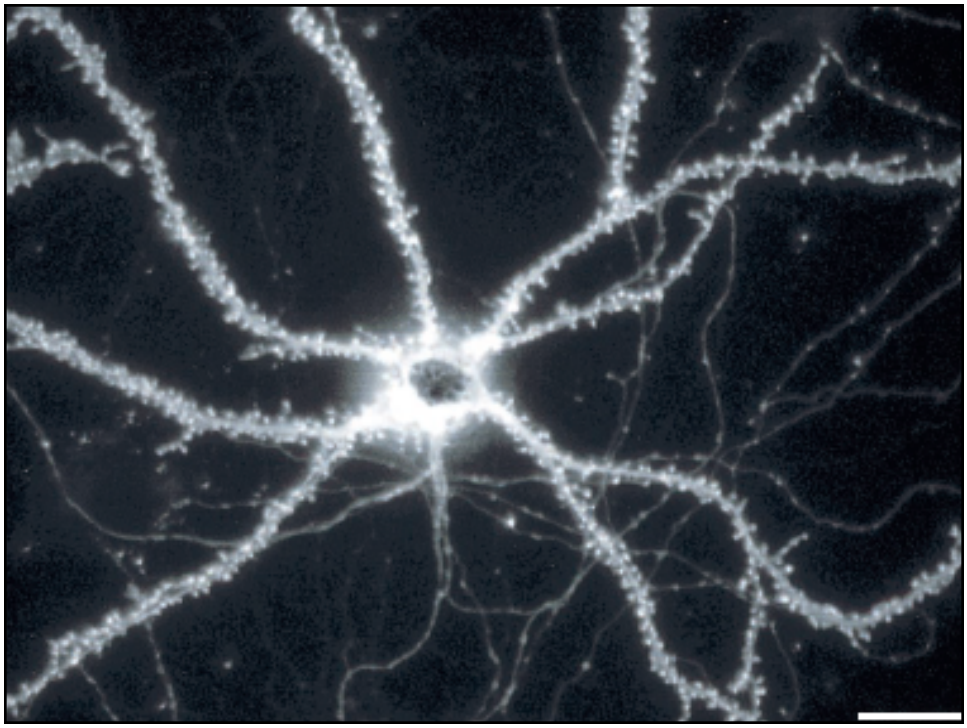
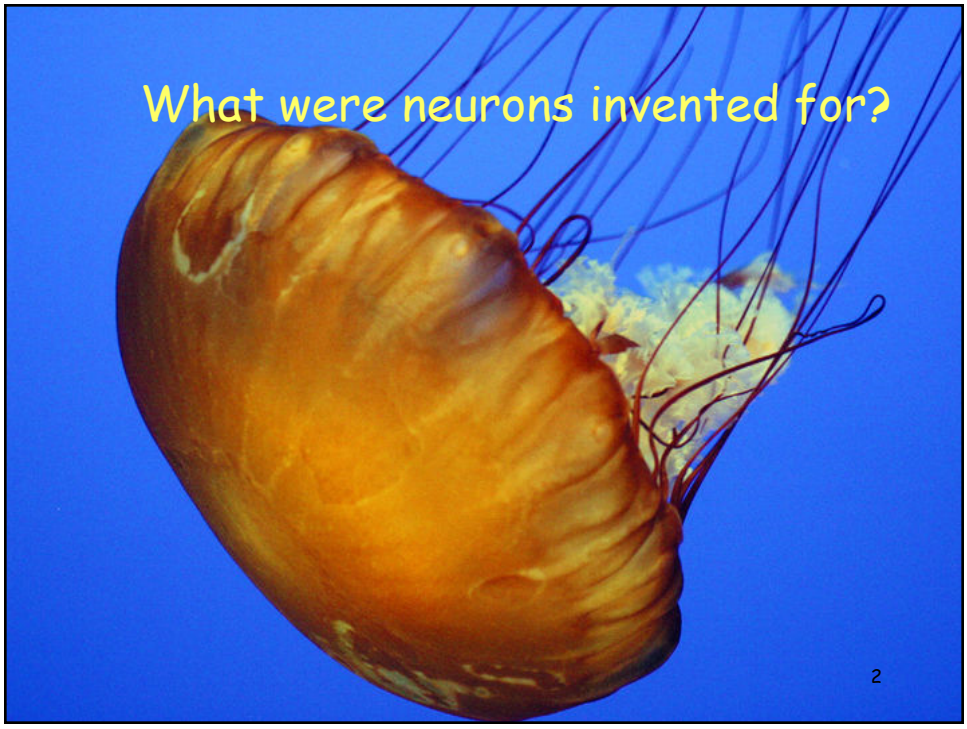


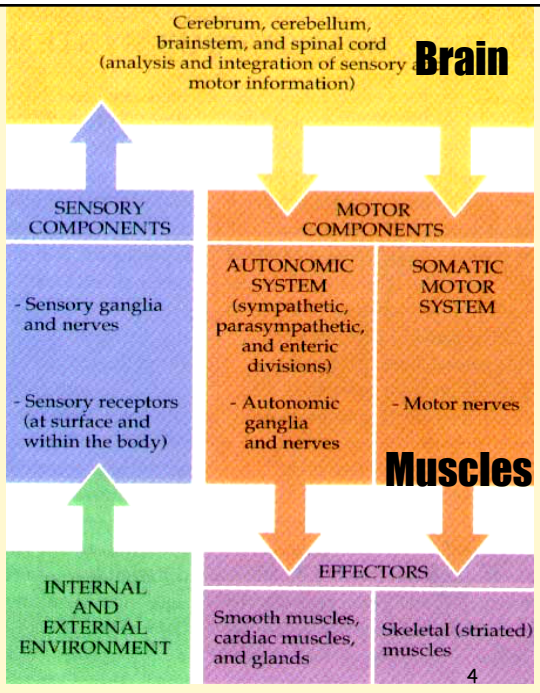

What were neurons invented for?
2

"To move things is all that mankind can do…for such the sole executant is muscle, whether in whispering a syllable or in felling a forest."

Charles Sherrington 1924

3

"Sensorimotor system"

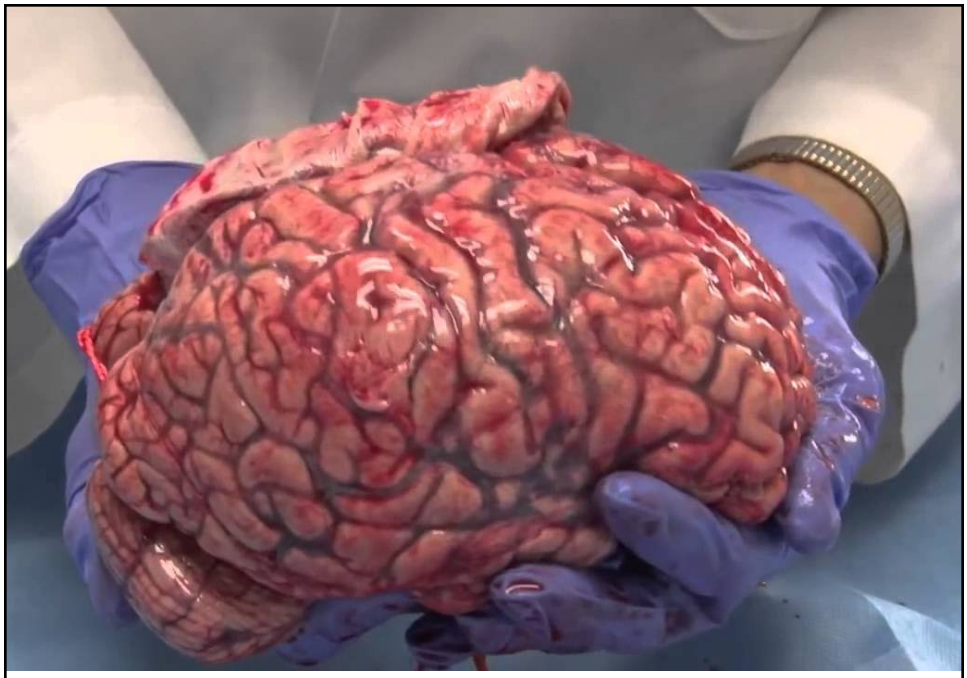


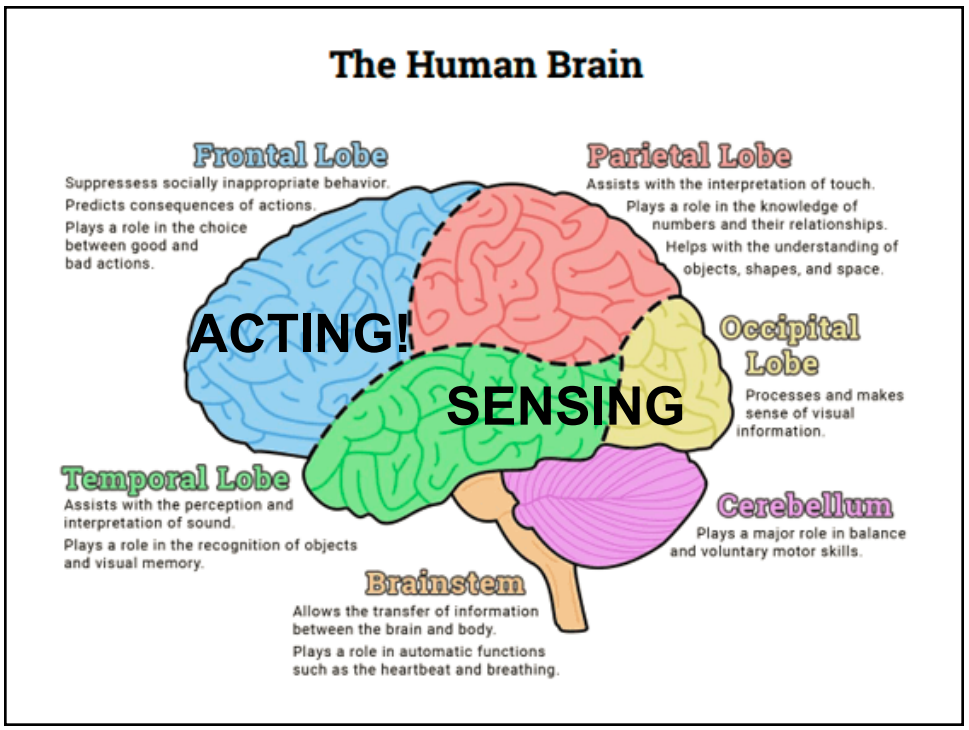
4

Lab 1: Neurons and the Brain (and Matlab)

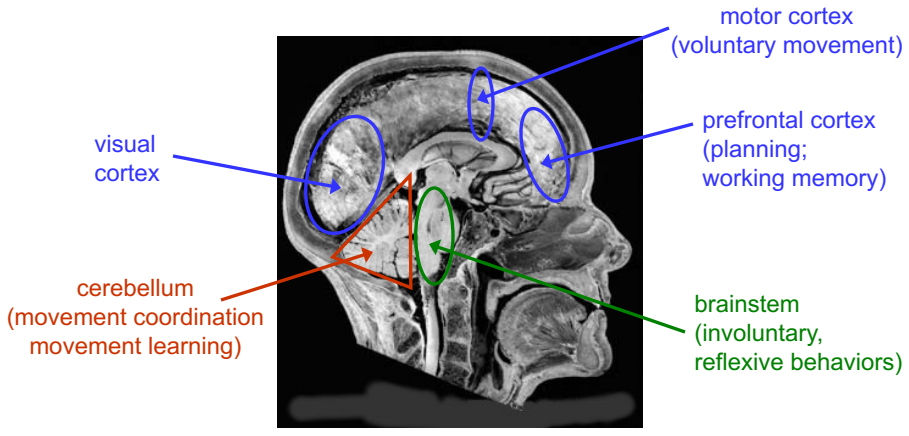
Neuroscience primer:
- Brain & neuron
- Membrane potential
- Action potential
- Synaptic transmission

- Lab part 1: Neurons in Matlab
- Lab part 2: Brain in 3D Online

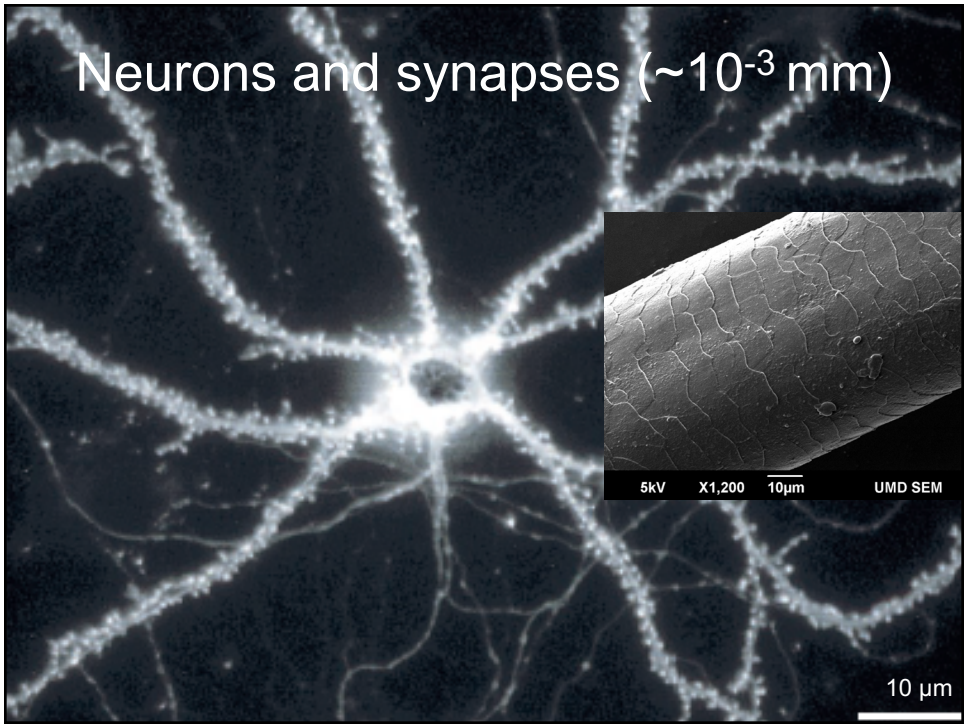




The Brain



- Approximately 10^{11} neurons in a human brain
- Approximately 10^{15} synapses connecting them



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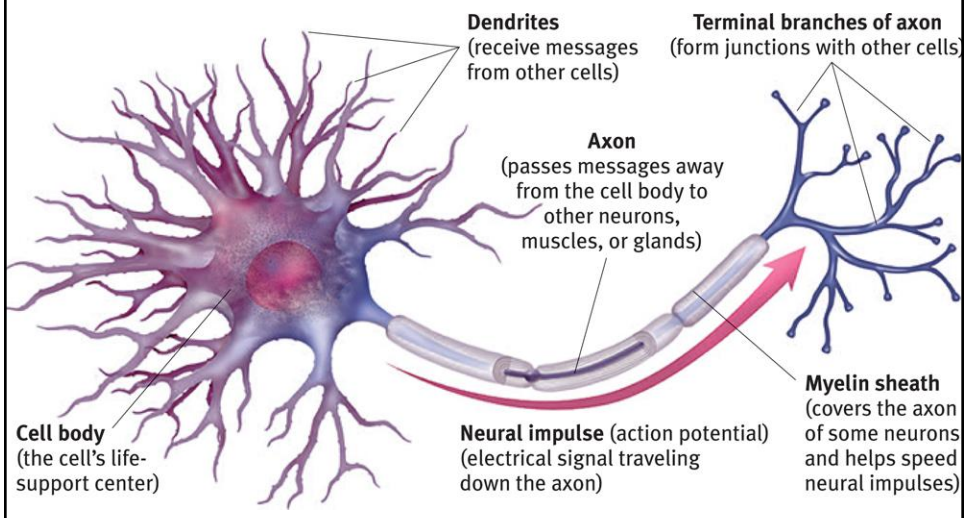
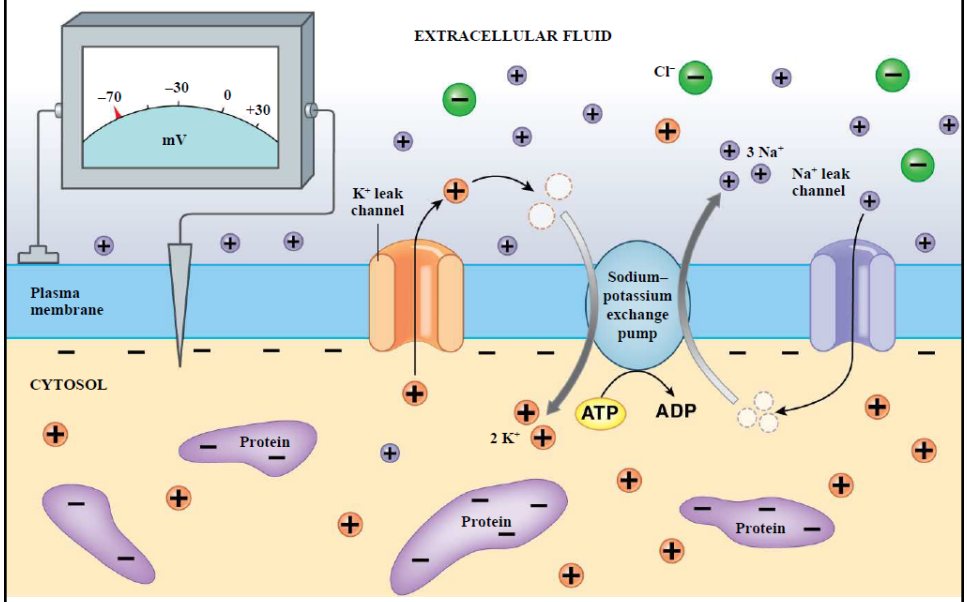
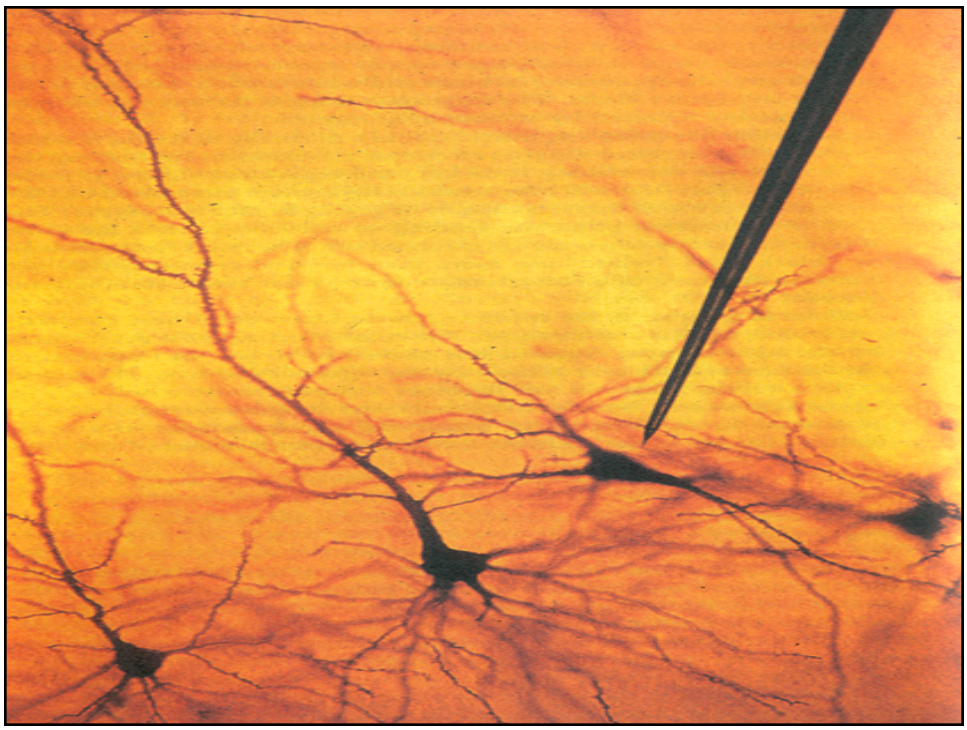
Neurons send fast long-distance signals

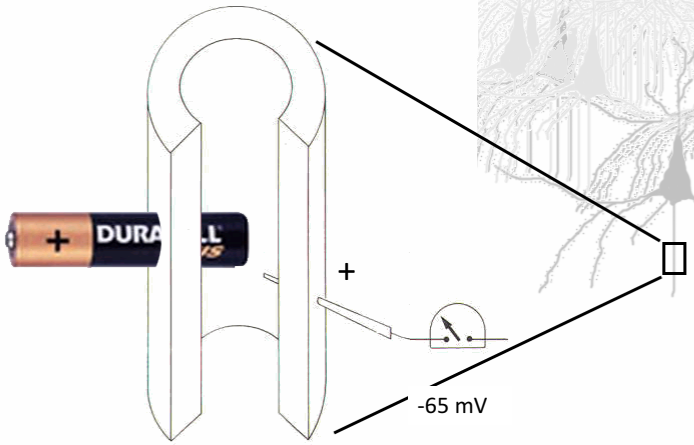


Membrane potential: charge imbalance





The electrical properties of neurons are what enables them to regulate every aspect of behavior.



Membrane potential aka membrane voltage is the difference between the electric potential outside vs inside the cell: **Vm = Vin – Vout**

Adding plus charge (positive **current**) inside the cell makes the inside less negative compared to the outside

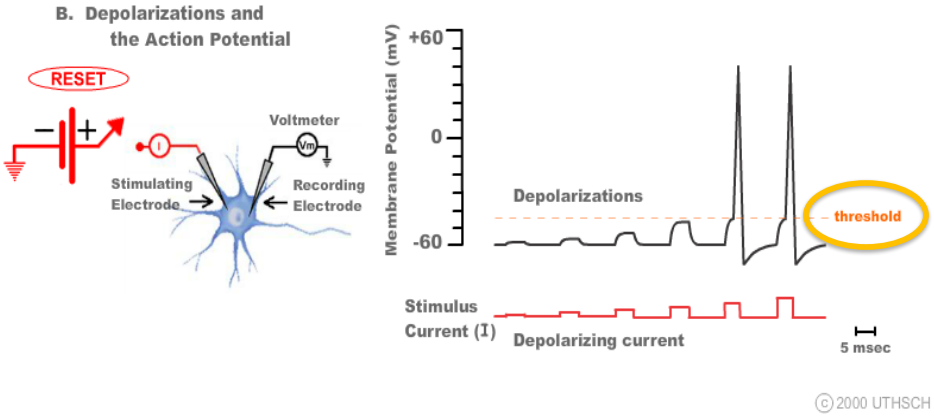
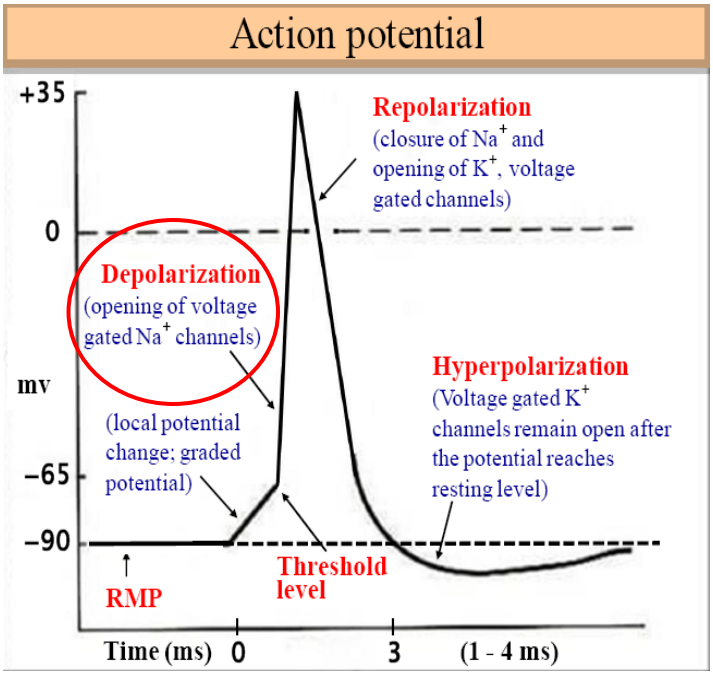


Figure 3



http://howmed.net/physiology/action-potential/

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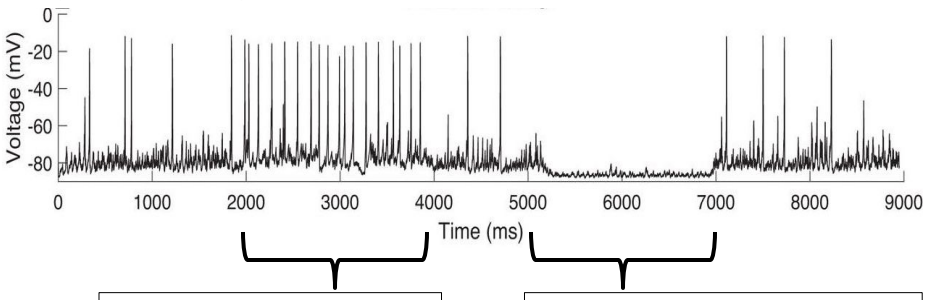
Spikes!

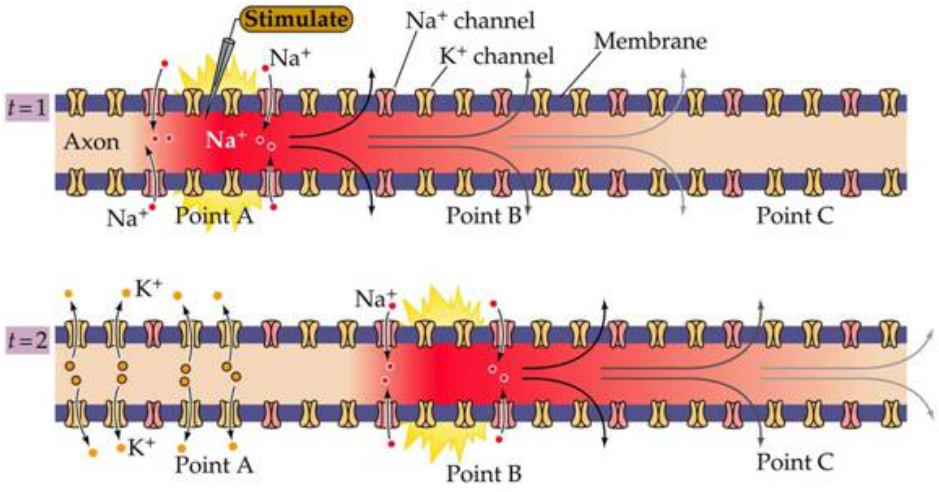
Firing rate = (number of spikes)/(time)



Excitation: higher firing rate

Inhibition: lower firing rate and membrane is hyperpolarized

Propagation



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http://www.rci.rutgers.edu/~uzwiak/AnatPhys/APFallLect18.html

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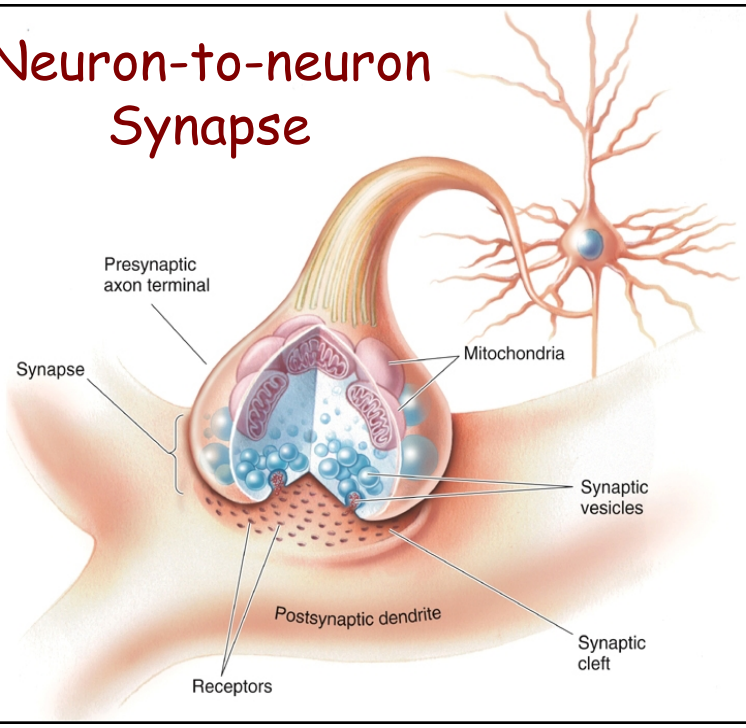
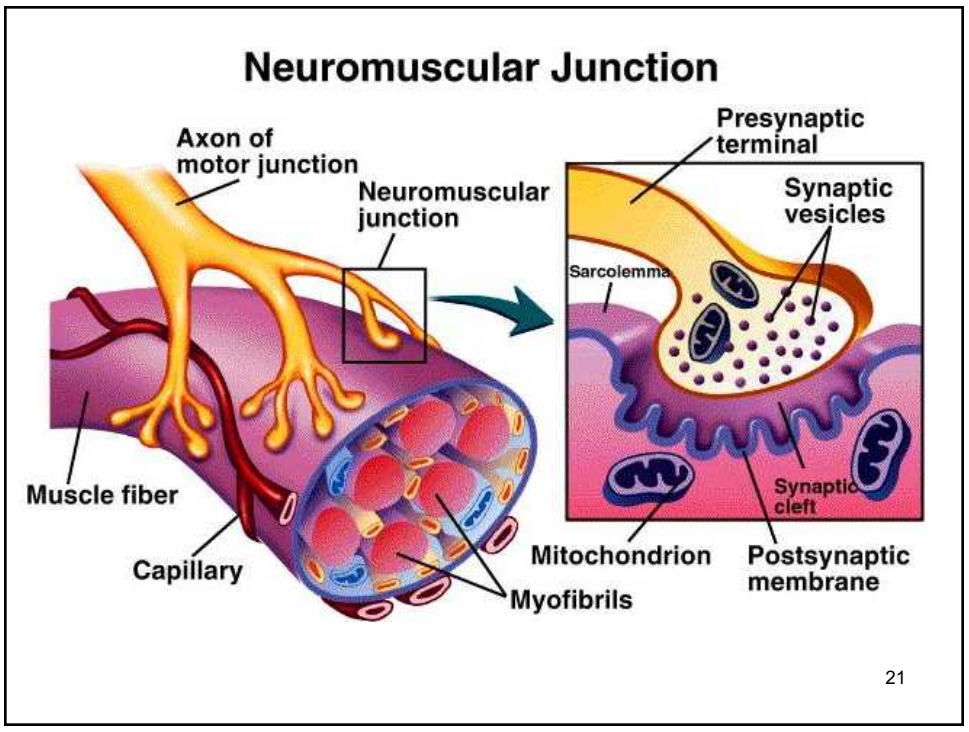
Neuron-to-neuron Synapse




Neuromuscular Junction
Axon of motor junction
Neuromuscular junction
Presynaptic terminal
Synaptic vesicles
Sarcolemma
Muscle fiber
Capillary
Myofibrils
Mitochondrion
Synaptic cleft
Postsynaptic membrane
21

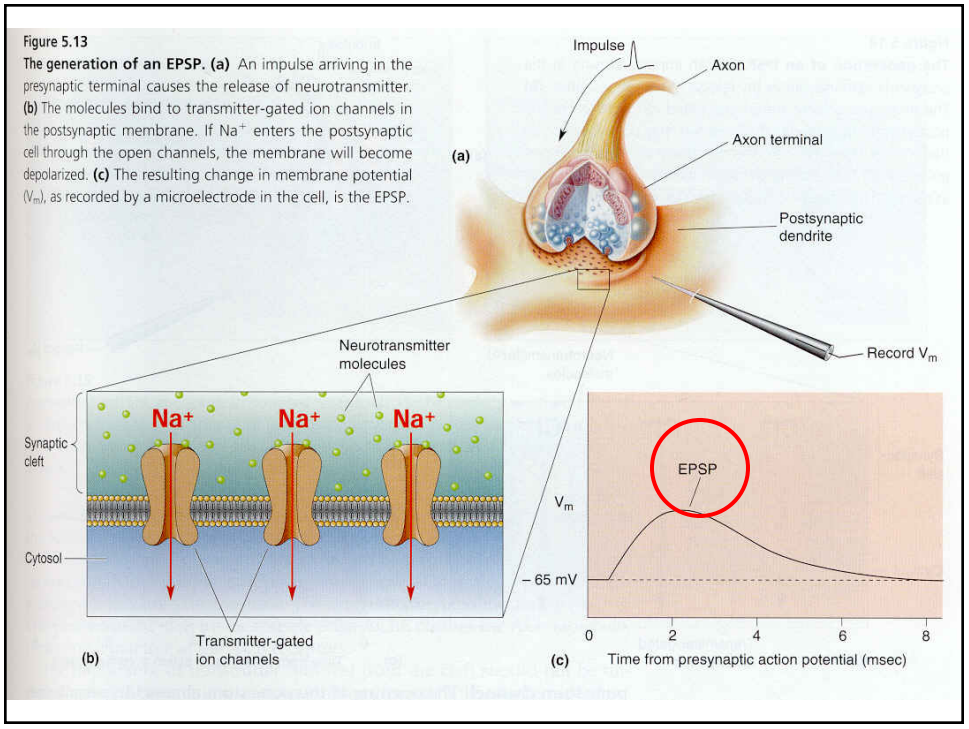


Figure 5.13
The generation of an EPSP. (a) An impulse arriving in the presynaptic terminal causes the release of neurotransmitter. (b) The molecules bind to transmitter-gated ion channels in the postsynaptic membrane. If Na+ enters the postsynaptic cell through the open channels, the membrane will become depolarized. (c) The resulting change in membrane potential (V_m), as recorded by a microelectrode in the cell, is the EPSP.
Impulse
Axon
(a)
Axon terminal
Postsynaptic dendrite
Record V_m
Neurotransmitter molecules
Na+
Na+
Na+
Synaptic cleft
Cytosol
Transmitter-gated ion channels
(b)
EPSP
V_m
– 65 mV
0
2
4
6
8
(c)
Time from presynaptic action potential (msec)