

# The Nervous System

Action Potentials; Part II  
(What is a thought?)

# Main Statement(s)

- ◆ In the axon membrane, ion channels for  $\text{Na}^+$  and  $\text{K}^+$  are guarded by gates that open in response to depolarization.
- ◆ Diffusion of  $\text{Na}^+$  and  $\text{K}^+$  produces action potentials, which are all-or-none events.

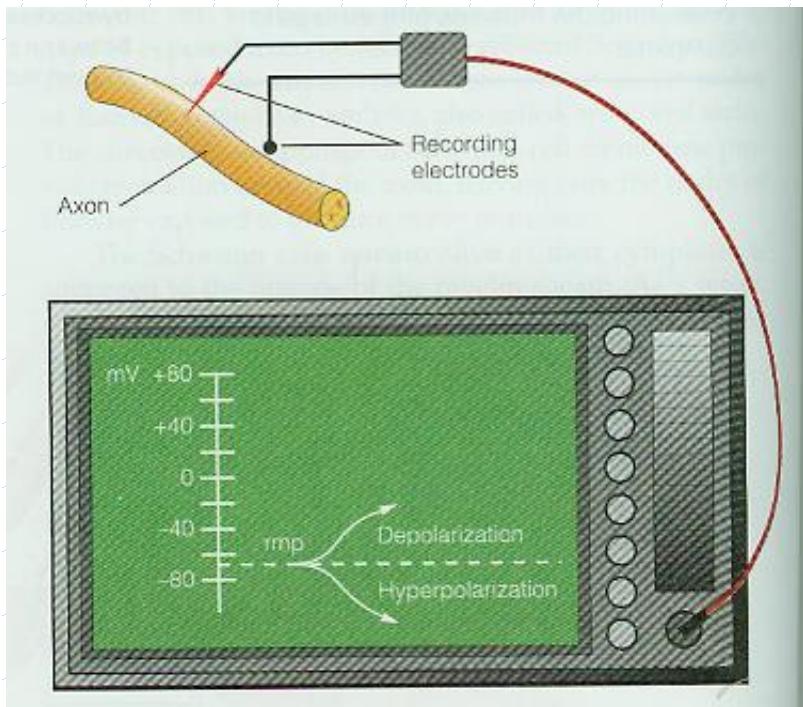
# What is an Action Potential?

- ◆ An electrical event carried out by neurons – a conduction of a nerve impulse – thought!

# Creating Action Potentials

- ◆ All cells of the body have more negative charged ions inside the cell than outside
- ◆ Thus all cells have a resting potential of -65mvolts
- ◆ Only nerve & muscle cells can change this potential when they are stimulated

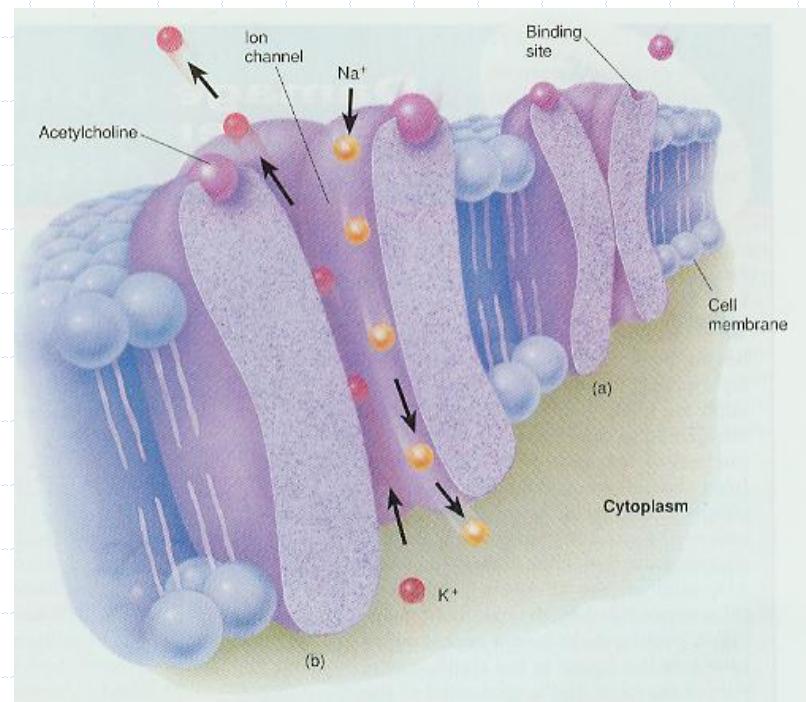
# Electrodes & Squids



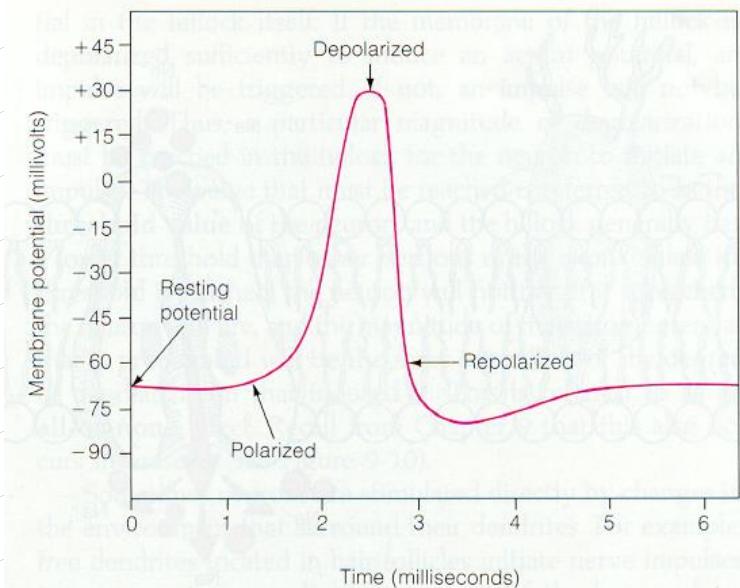
- ◆ Two electrodes; one placed inside, one outside the neuron
- ◆ The line at  $-65$  is the resting potential
- ◆ If the line moves up, the inside of the cell has become less negative – this is called depolarization

# Chemically Regulated Gates

- ◆ What stops or lets in  $\text{Na}^+$ ,  $\text{K}^+$  & other ions through the cell membranes are “gates”
- ◆ At a resting potential of  $-65\text{mV}$  the gates are closed
- ◆ But a stimulus can open the gates - depolarization



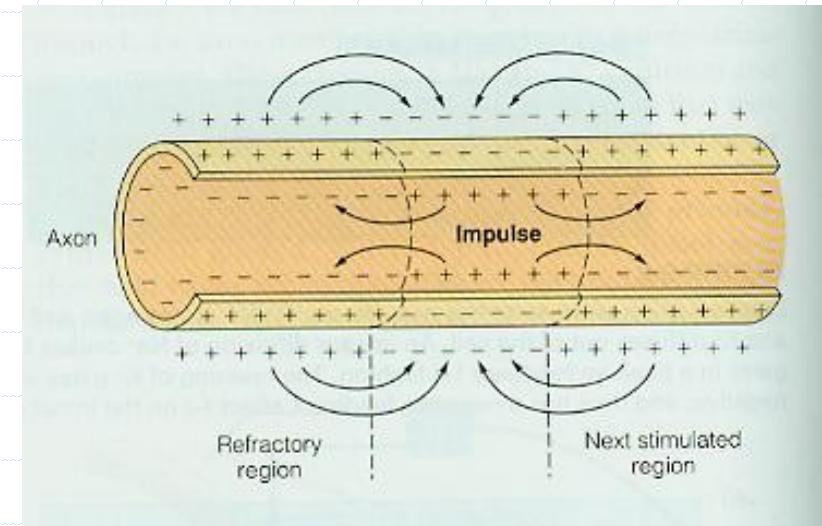
# The Gates...& Action Potentials



- ◆ The  $\text{Na}^+$  gate opens and  $\text{Na}^+$  pours into the cell – the cell now has a positive voltage, it is depolarized (this is the action potential – thought!)
- ◆ Now the  $\text{Na}^+$  gate closes and the  $\text{K}^+$  gate opens and  $\text{K}^+$  pours out of the cell
- ◆ The cell is back to  $-65$  (repolarized)

# The Moving AP

- ◆ As the  $\text{Na}^+$  flows in the membrane right next to the area also gets depolarized
- ◆ Thus the AP sweeps down the cell (axon) with the  $\text{K}^+$  resetting right behind it



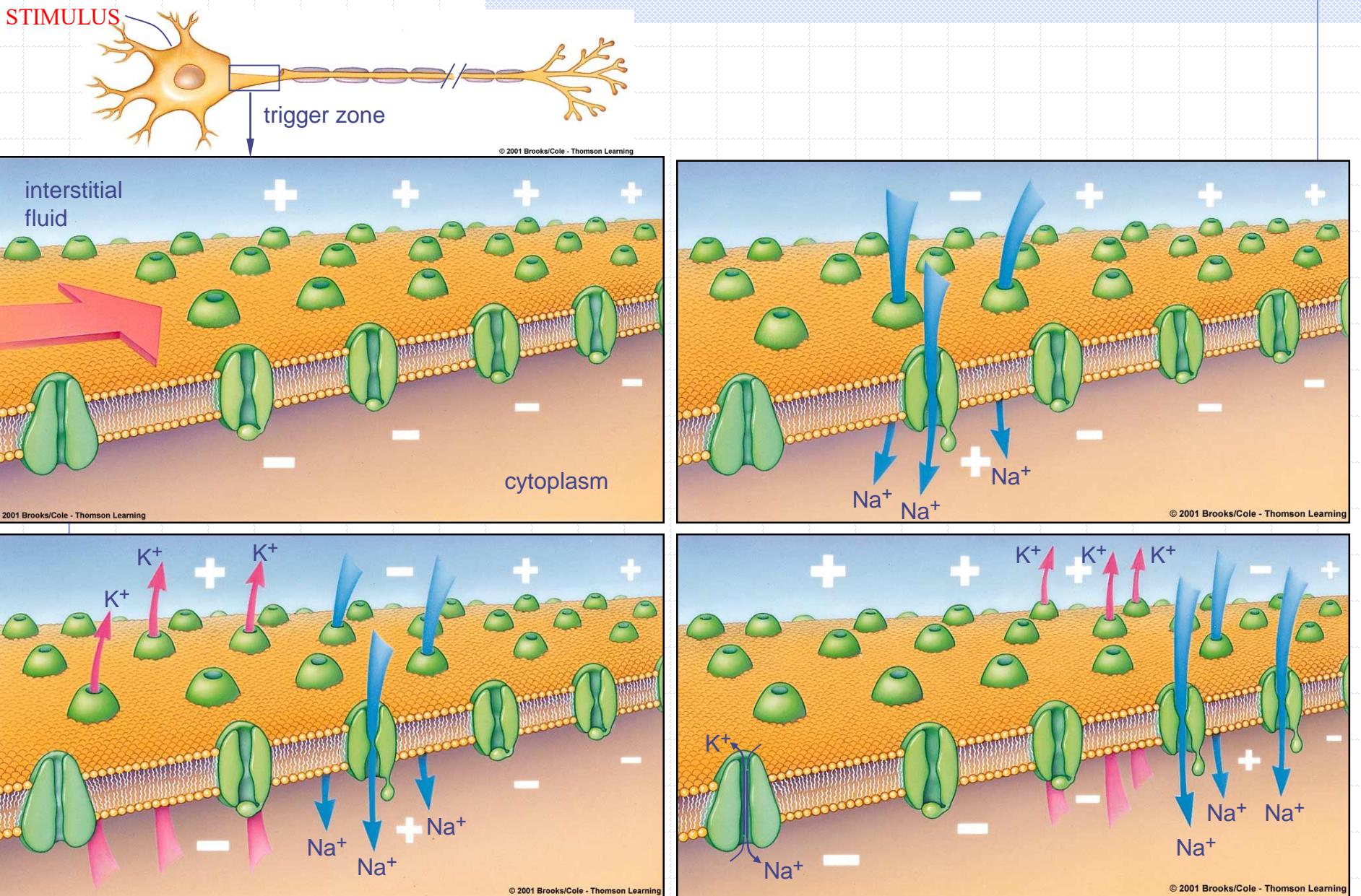


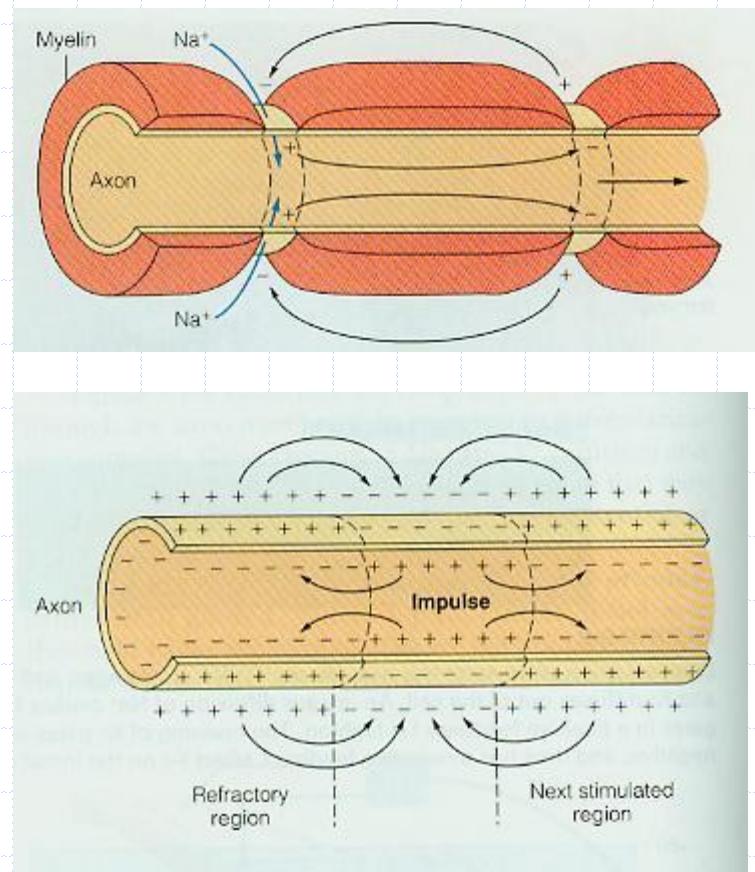
Fig. 34.6, p. 578-9

# All-or-None Principal

- ◆ A neuron either “fires” or not
- ◆ If a stimulus causes depolarization the cell will form a full AP
- ◆ As long as you “feel” the stimulus the cell will produce an AP – the stronger the stimulus the more APs are created but their strength is always the same

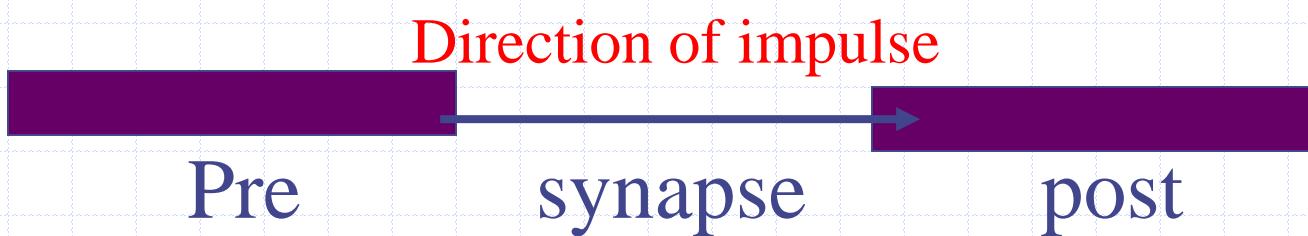
# Saltatory Conduction – Speed!

- If the neuron has a myelin sheath the impulse moves much faster
- The Aps can exceed 100m/s w/o myelin the impulse is never more than 10m/s
- In myelinated cells the impulse “jumps” from node to node called saltatory conduction



# Synaptic Transmission

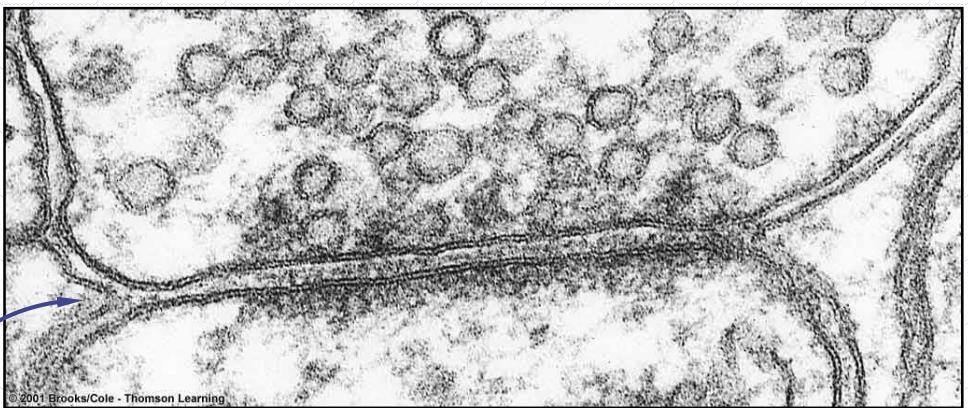
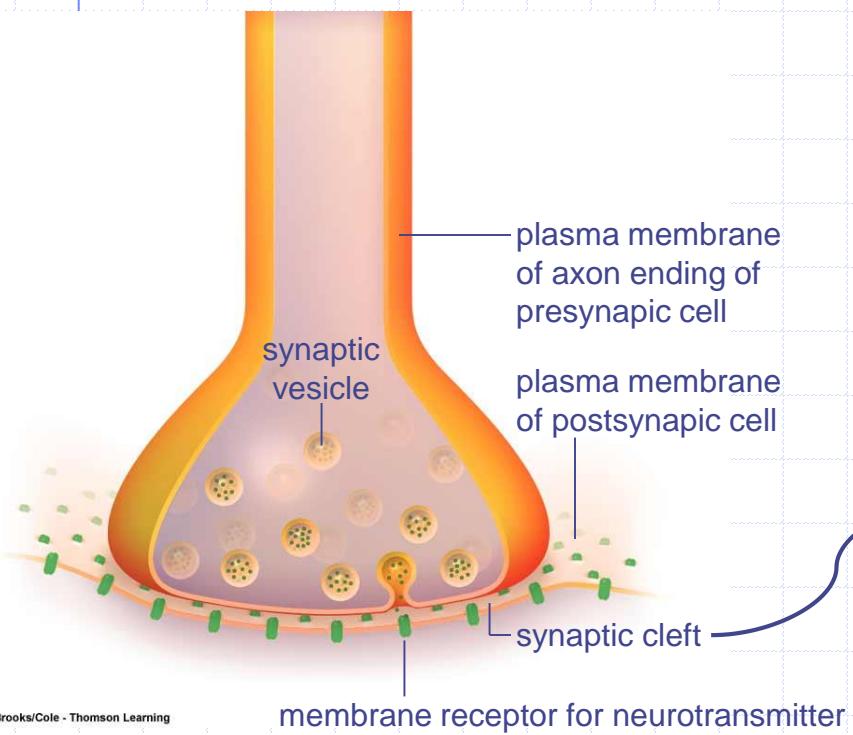
- ◆ Neurons do not touch.
- ◆ The gap between them is called a synapse.
- ◆ The first neuron is called a presynaptic neuron while the 2<sup>nd</sup> neuron is called a postsynaptic neuron.



# Synaptic Transmission (2)

- ◆ When an impulse reaches a synapse a neurotransmitter is released.
- ◆ This transmitter floats across the synapse and initiates an AP on the postsynaptic neuron.
- ◆ After the AP the neurotransmitter is removed by enzymes.

# Synaptic Transmission (3)



# Types of Neurotransmitters

- ◆ Epinephrine (you've heard of it by its common name; adrenaline)
- ◆ Norepinephrine
- ◆ Dopamine: used by the brain
- ◆ Acetylcholine
- ◆ Endorphins
- ◆ Some Amino Acids