Crown 85 Report

Neural Integration and Signaling

Report to the class on the following structures of the eye and briefly state their functions.

5. Understand the following properties of a neuron's response
    a. Summation of excitation and inhibition
    b. Stimulus strength versus firing rate

Here the student will demonstrate the above points using existing animations and teach the class the implications of the phenomena observed in the animations.

Some useful WWW sites:
http://neuroscience.uth.tmc.edu/s1/chapter01.html

STUDENT SHOULD MAKE APPOINTMENT WITH PROF. SWITKES TO DISCUSS REPORT AND OBTAIN POWERPOINT MATERIALS WITH THE FOLLOWING SLIDES:

how a neuron integrates and signals information

5. Understand the following properties of a neuron's response
   a. Summation of excitation and inhibition
   b. Stimulus strength versus firing rate

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overview hhmi | BioInteractive

http://www.hhmi.org/biointeractive/molecular-mechanism-synaptic-function

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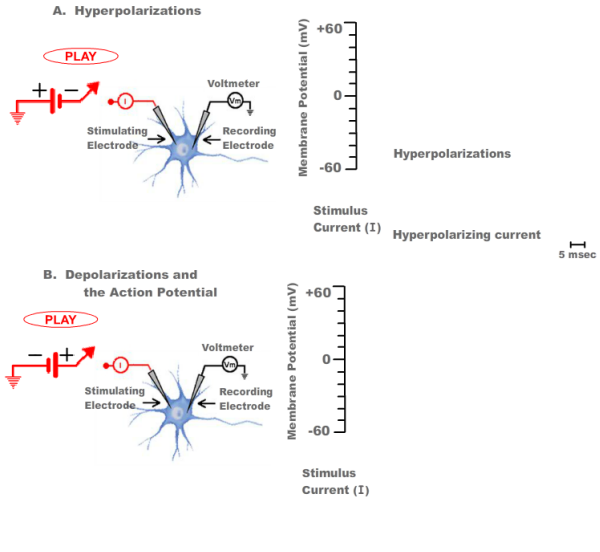
hyperpolarization and depolarization (http://neuroscience.uth.tmc.edu/s1/chapter01.html) figure 1.3



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hyperpolarization and depolarization

'take home' implications:

a. as hyperpolarizing stimulus increases, neuron become more hyperpolarized as "graded" potentials; NO ACTION POTENTIALS

b. as depolarizing stimulus increases subthreshold "graded" depolarization increases until threshold is reached and an action potential is generated

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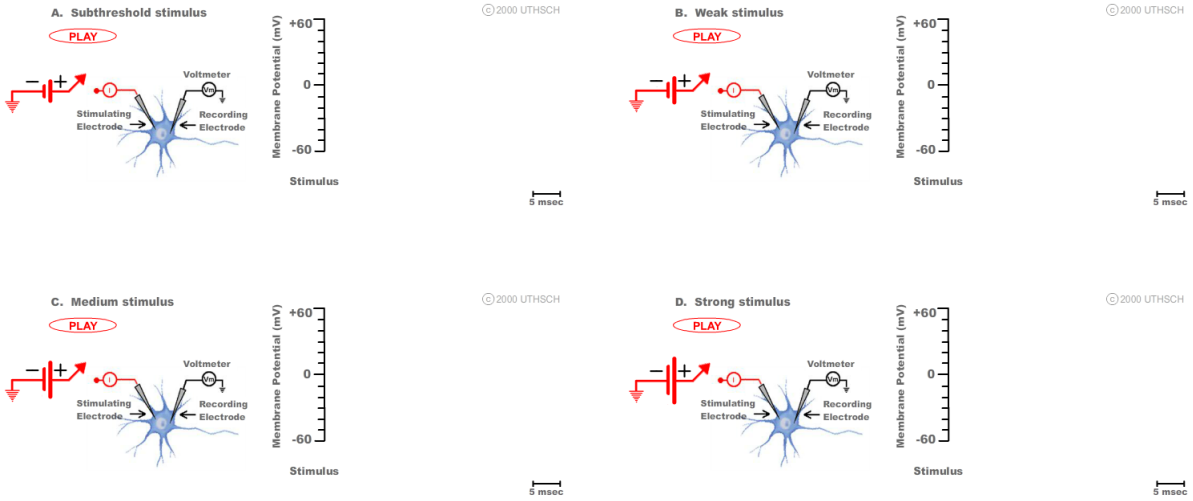
spike properties vs strength of input (http://neuroscience.uth.tmc.edu/s1/chapter01.html) figure 1.4



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spike rate vs intensity of stimulation

what could the 'stimulus' be :

a. inputs from other neurons via dendrites that are summed at axon hillock
b. inputs from 'sensory transduction"
c. input from an artificial electrode (pictured)

what is observed:

a. stimulus too small ⇒ subthreshold depolarization
b. weak stimulus ⇒ one spike
c. medium stimulus ⇒ moderate spike rate
d. strong stimulus ⇒ high spike rate

'take home' implications:

a. very weak stimuli that do not cause neuron to reach threshold will not lead to action potentials
b. amplitude of action potential depolarization is fixed, does not depend on strength of stimulus
c. strength of suprathreshold stimuli coded in firing-rate of neuron
   strong stimulus ⇒ many spikes per second weak stimulus ⇒ few spikes per second

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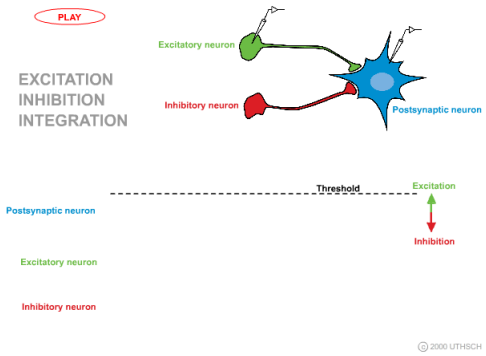
combining excitatory and inhibitory signals http://neuroscience.uth.tmc.edu/s1/introduction.html



http://neuroscience.uth.tmc.edu/s1/introduction.html figure 5

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combining excitatory and inhibitory signals

take home message:

a. action potentials in presynaptic neuron at excitatory synapse will depolarize postsynaptic neuron with resulting postsynaptic spikes (if excitation is above threshold)

b. action potentials in presynaptic neuron at inhibitory synapse will hyperpolarize postsynaptic neuron

c. if excitation and inhibition arrive sufficiently simultaneously, they will cancel in postsynaptic neuron

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