

Unit 3: Synaptic Transmission: Principles and excitatory synapses

1) (i) What distinguishes an "excitatory" from an "inhibitory" transmitter? (ii) Name two receptors which can inhibit a neuron. (iii) Explain how their activation leads to the inhibition of a neuron (ion conductance?).

2) What is the "quantal theory" of synaptic transmission? Explain what it is a "miniature EPSP" (at the neuromuscular synapse), and how the observation of such "minis" has given rise to the "quantal" theory of synaptic transmission.

3) (i) What are the respective effects of glutamate and GABA on a typical postsynaptic adult mammalian neuron? (ii) Specifically name the effects of either Glutamate and GABA binding to a downstream neuron (depolarization, or hyperpolarization). (iii) What might happen if a neuron receives equal amounts of both Glutamate and GABA at the same time?

4) One mechanism for learning is thought to be the strengthening of the synaptic connection between neurons that fire together frequently, called long-term potentiation (LTP). Explain how AMPA and NMDA can mediate this learning.

5) Suppose that an excitatory neuron A synapses onto a neuron B, such that when neuron A fires, it is followed by neuron B.

i) Draw a schematic of their connection, indicating the dendrites, synapses, cell body, and axon.

ii) Indicate the following on the drawing : action potential propagation, synaptic release, depolarisation of the spines, propagation of depolarisation current, action potential generation.

iii) draw the membrane potential at a dendritic spine and at the axon hillock of neuron B from the moment that an AP appears in neuron A to the moment an AP appears in neuron B.

iv) Given that firing of neuron A results in firing of neuron B (in this exercise, not in general !), what can we hypothesise on the number of synapses between both ?