

QUIZ 05

Instructions: Download the quiz from Blackboard (in Quiz Questions Folder), print a copy and use the paper copy to work through the various questions and problems. Mark the correct answers on it. When you are ready to **submit** your answers, you will see the quiz posted under Quiz Answer Sheets.

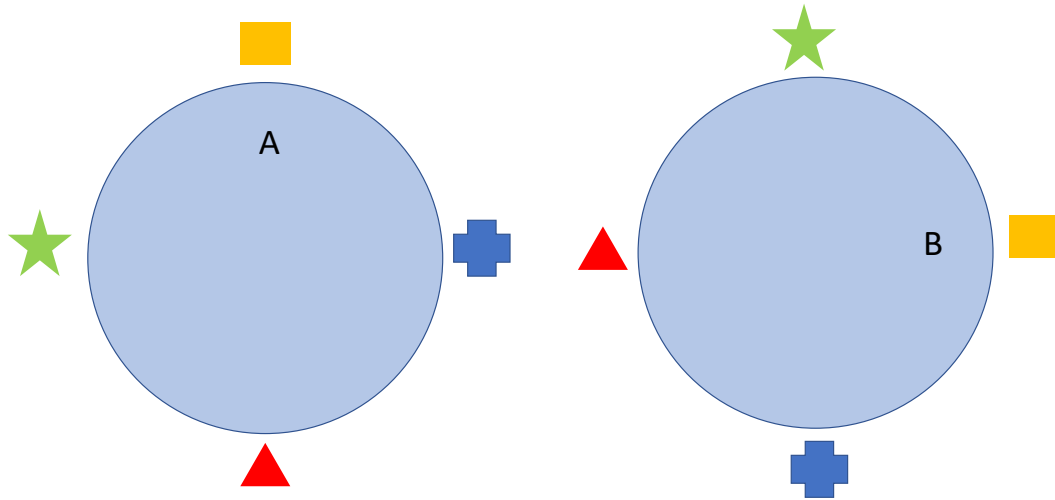
Click the quiz name to launch the quiz. Enter your answers to each of the corresponding numbered questions onto the **blank answer sheet** (the questions will not be repeated, simply a blank page for your answers). The quiz may be saved if you do not finish entering your answers in one sitting. When you are finished with the quiz, make sure to **submit** your answers and they will be recorded.

For each question, select the one **best answer** from among those given (multiple choice). Each question is worth one (1) point.

1. Synapses within the hippocampus exhibit both long-term potentiation (LTP) and long-term depression (LTD). Which of the following is **most** likely for LTD to occur?
 - a) LTD is likely if the postsynaptic membrane contains GABA receptors.
 - ☒ b) LTD is likely to occur then the presynaptic cell is stimulated at low frequencies.
 - c) LTD is more likely to occur when the postsynaptic cell is stimulated at high frequencies.
 - d) LTD is likely to occur when the postsynaptic cell is depolarized.
 - e) LTD requires the entry of a large amount of Ca^{2+} into the postsynaptic cell.
2. The factor that decides if a particular experimental stimulation paradigm at a specific synapse induces LTP or LTD is:
 - a) the type of electrode used for stimulation.
 - ☒ b) the amount of calcium that enters the cell.
 - c) the type of neurotransmitter used at that synapse.
 - d) the stimulation paradigm used.
 - e) none of the above.

$[\text{Ca}^{2+}] \text{ LTP} \approx 1 \mu\text{M}$
 $[\text{Ca}^{2+}] \text{ LTD} \approx 400 \text{ nM}$
3. In order for long-term potentiation (LTP) to occur at a synapse during an experiment done in a hippocampal brain slice, what is very likely true regarding the conditioning stimulus?
 - ☒ a) The stimulation works best with short trains at high frequencies.
 - ☒ b) The conditioning stimulus must be such that it induces increased protein synthesis in the postsynaptic neuron.
 - ☒ c) The stimulation works best with short trains at low frequencies.
 - ☒ d) Both A and B.
 - e) None of the above are likely true.

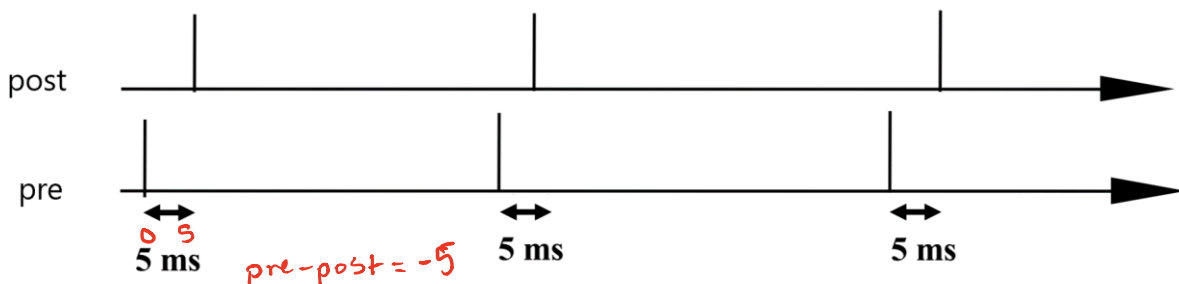
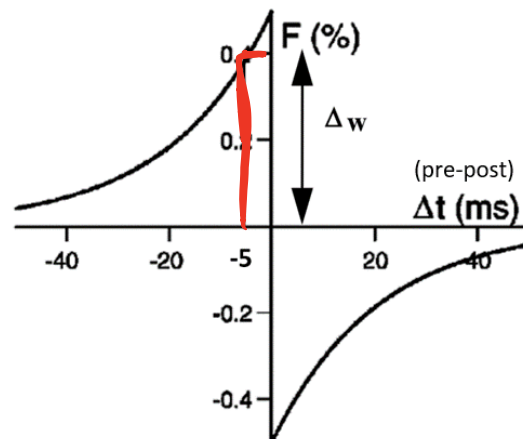
4. You are trying to evoke LTP by high-intensity stimulation of an excitatory input to a neuron. By accident, you are actually stimulating both an excitatory and an inhibitory input to the neuron at the same time. What will this potentially do to the induction of LTP? Assume both inputs are onto the soma of the post-synaptic neuron.
- a) It will accelerate the development of LTP
 - ☒ b) It will reduce/prevent LTP induction.
 - c) It will have no effect: LTP is a property of glutamatergic synapses, not inhibitory ones.
 - d) It will make the LTP much stronger (greater amplification of the post-synaptic EPSP).
 - ☒ e) The post-synaptic cell will melt down under all this stimulation.
5. Hippocampal LTP was first reported by Bliss and Lomo in 1973. The type of receptor that is critical for the induction of hippocampal LTP, by virtue of its admitting calcium into a dendritic spine, is called:
- a) An AMPA receptor.
 - ☒ b) An NMDA receptor.
 - c) A glycine receptor.
 - d) A cholinergic G protein-coupled receptor (GPCR).
 - e) A noradrenergic GPCR.
6. Rabbits will blink in response to an air puff to the eye. Classical experiments in rabbits suggest that you can get an animal to blink in response to a tone if it is predictive of an air puff. Which of the following is FALSE regarding this conditioning, according to what you learned in lecture?
- a) The air puff is the unconditioned stimulus
 - b) The tone is the conditioned stimulus.
 - c) The eye blink is the unconditioned response.
 - d) The eye blink is the conditioned response.
 - ☒ e) Eye blink conditioning involves appetitive conditioning
7. A rabbit is being conditioned to associate a tone with a foot shock. In this example, LTP between which neurons most likely is involved in learning the association:
- a) Lateral amygdala and somatosensory cortex
 - b) Auditory thalamus and somatosensory cortex
 - ☒ c) Auditory thalamus and lateral amygdala
 - d) Somatosensory and auditory cortices
 - e) None of the above
8. You place a rat in an arena with landmarks around the space while recording from a place cell. You find the cell fires when the rat is in location A. You then move the landmarks around the arena and observe that the cell now fires when the rat is in location B. Which of the following can you deduce from this experiment?



- ☒ a) Place cell fields rotate when visual landmark cues are rotated
☐ b) Place cell fields become less finely tuned with time
☐ c) Place cells only work in water mazes, not in dry land arenas
☐ d) Place cells fields are independent of the location of landmarks
☐ e) This is not actually a place cell

9. Based on the synaptic weight change versus Δt in the figure displayed at right and the post and presynaptic action potential sequence depicted below, you would expect a (choose the most likely one):

- ☒ a) 0.4% increase in synaptic weight
☒ b) 0.4% decrease in synaptic weight
☒ c) 1.2% increase in synaptic weight
☒ d) 1.2% decrease in synaptic weight
☒ e) No change



3 pre-post firings 5 ms apart

10. Which of the following statements regarding the mechanism for LTP is TRUE?

- ✓ a) Associativity can help establish LTP.
- ✓ b) Ca^{2+} entry induces metabolic changes.
- ✓ c) Depolarization is needed from AMPA receptors.
- ✓ d) Coincidence detection occurs at NMDA receptors.
- ⑤ e) All of the above.

11. **Thought question (ungraded):** Describe the molecular and cellular basis for early and late stages of LTP.

12. **Thought question (ungraded):** A new street drug nicknamed “devil dust” prevents users from generating new memories while high. It has been hypothesized that devil dust interferes with long-term potentiation in the hippocampus, but scientists have shown that AMPA and NMDA inward currents are unaffected by devil dust. Propose a possible mechanism of action for devil dust that would interfere with LTP.

⑪ Early: Activation of NMDA receptor $\rightarrow \text{Ca}^{2+}$ influx
 \rightarrow more receptors get recruited to membrane

Late: Phosphorylation of CREB \rightarrow transcription of genes
involved in synaptogenesis

⑫ Prevents Ca^{2+} from binding to CAMKII
preventing strengthening of synapse