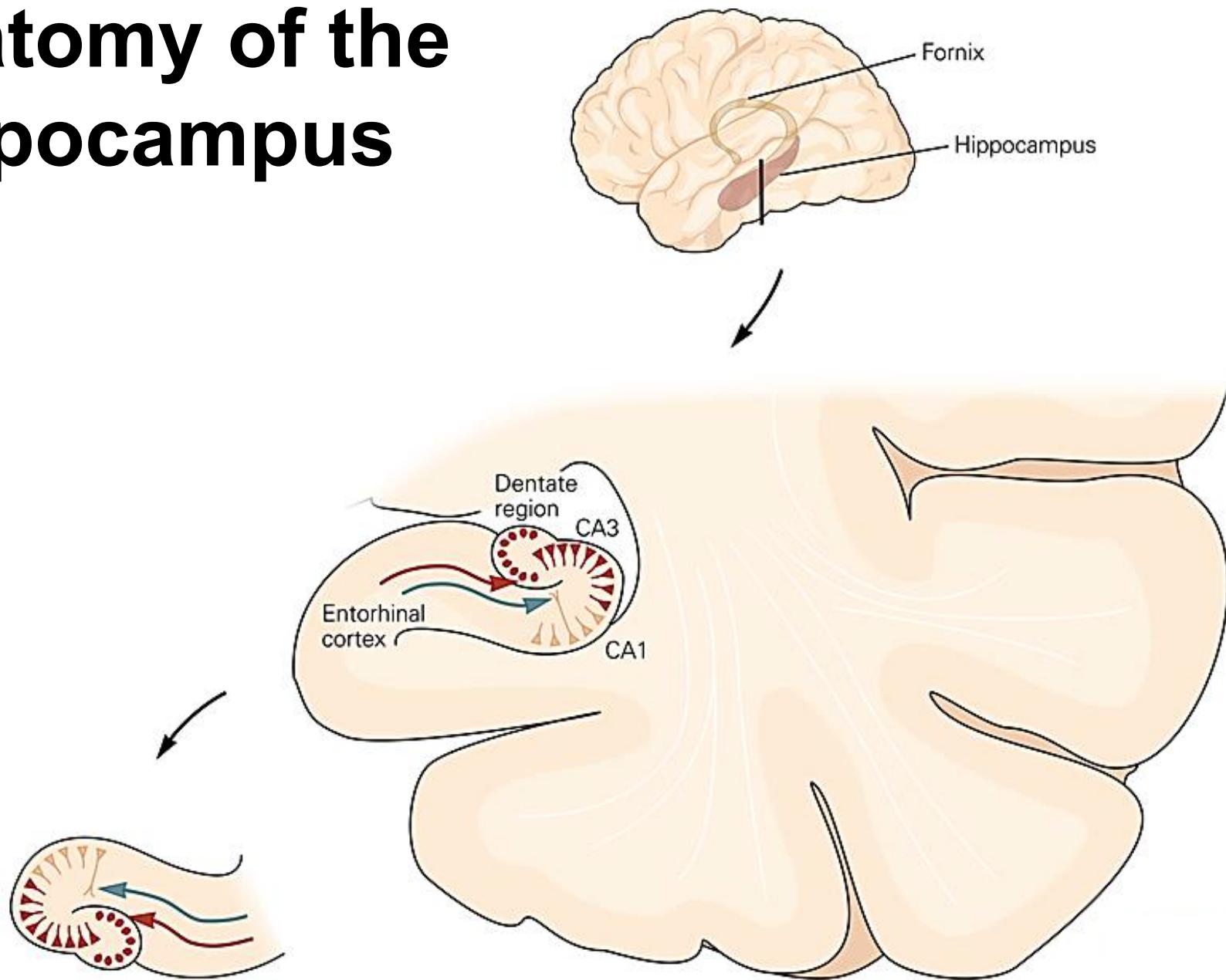


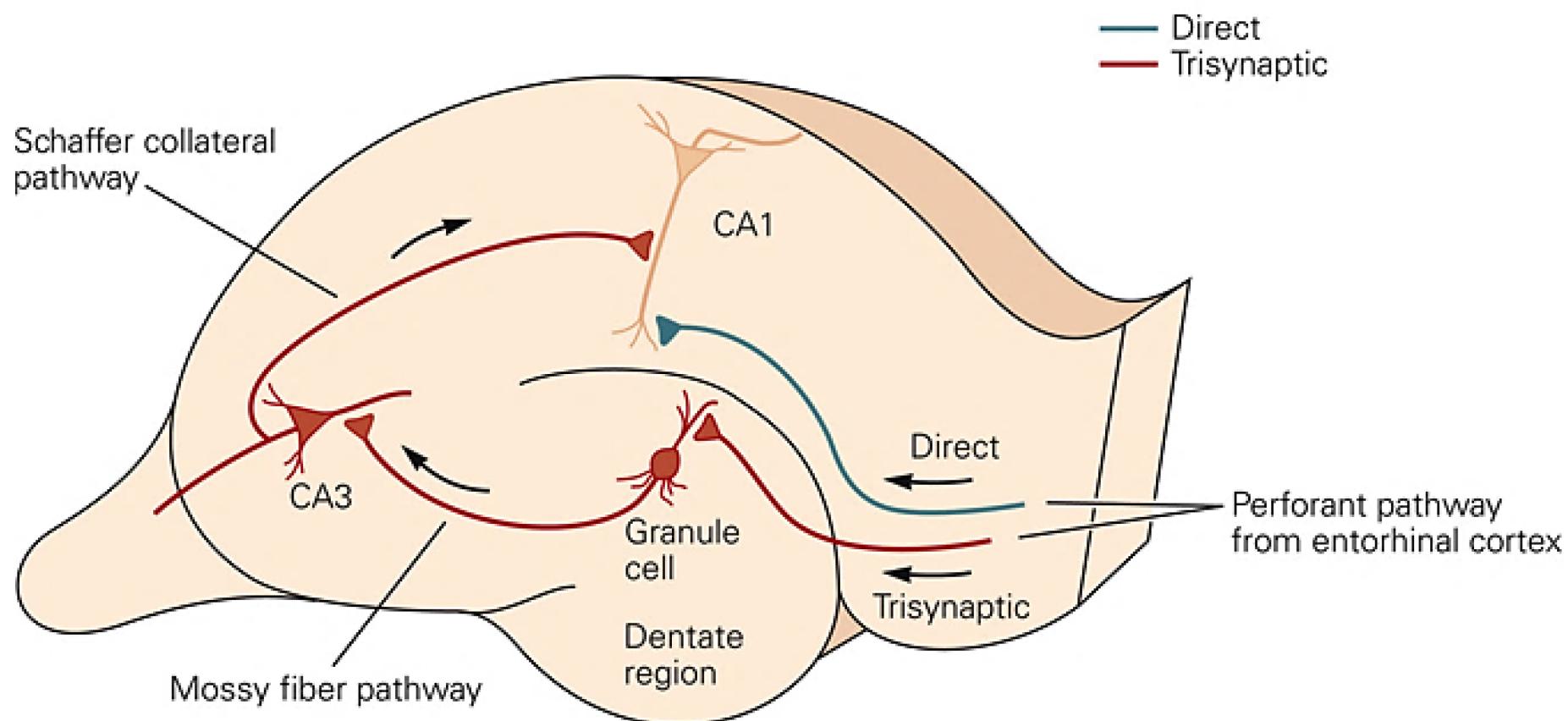
# Chapter 54: Neural Plasticity in the Hippocampus



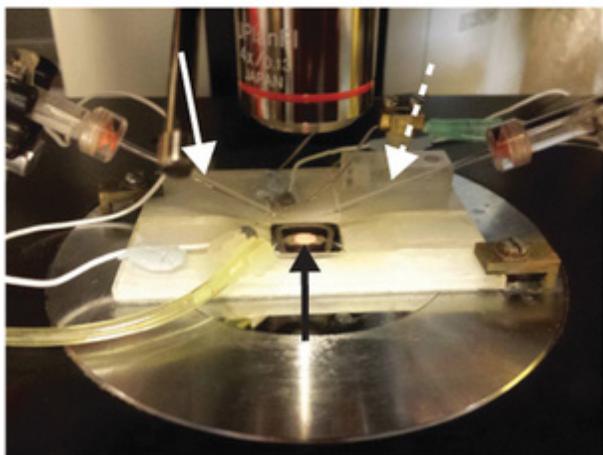
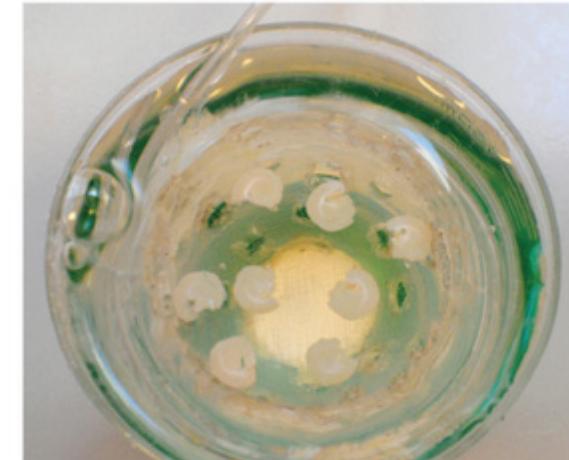
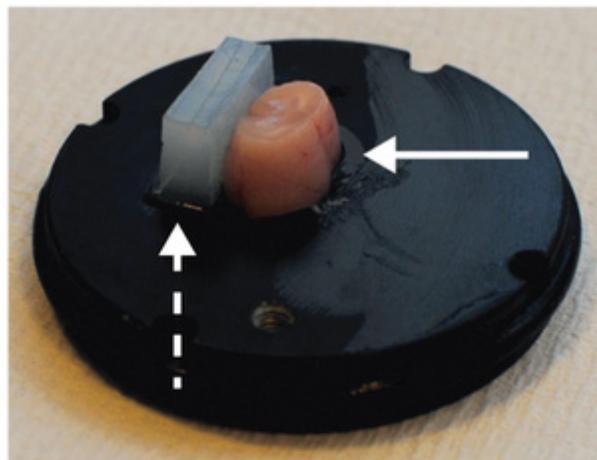
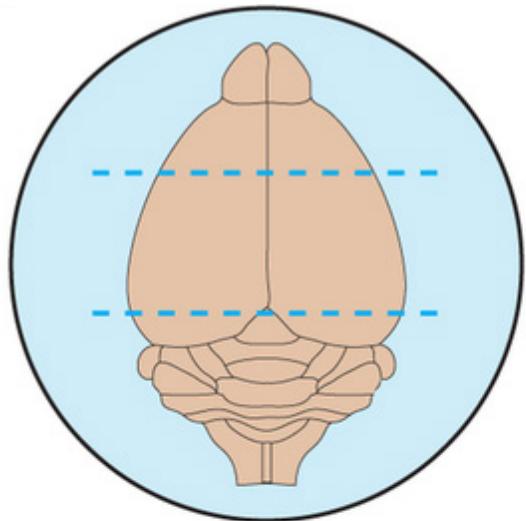
# Anatomy of the Hippocampus



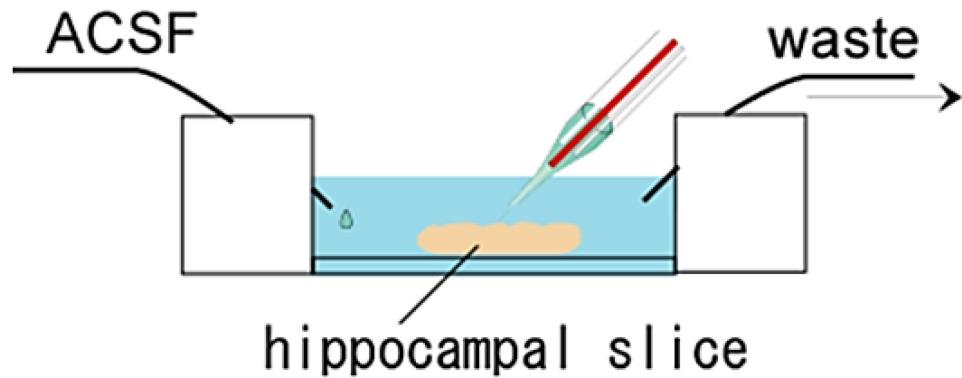
# Circuitry of the Hippocampus



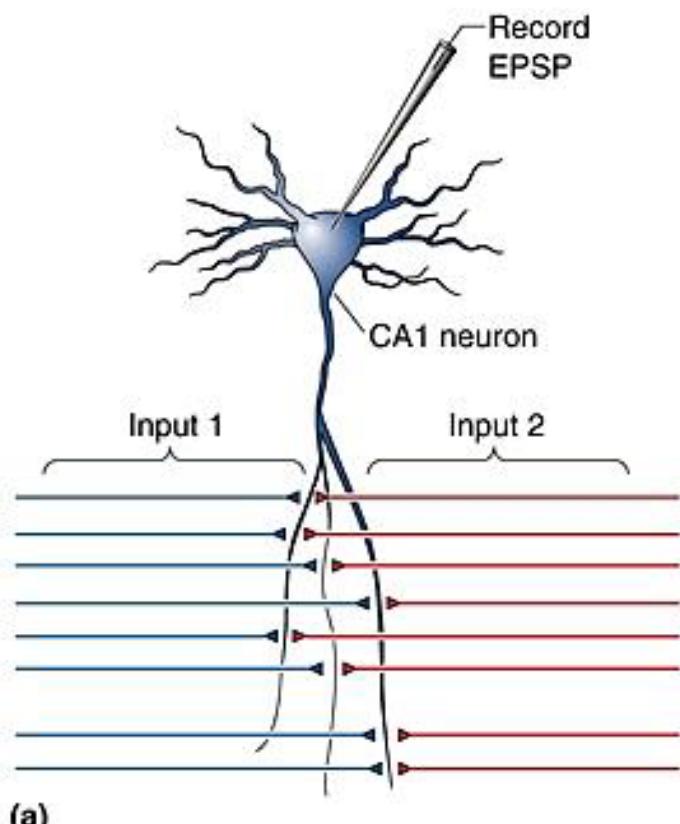
# Hippocampal Slice Preparation



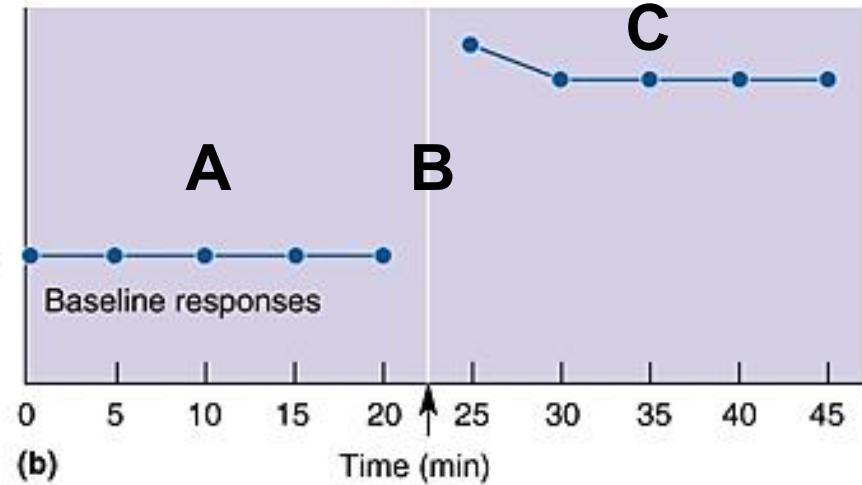
Submerged preparation



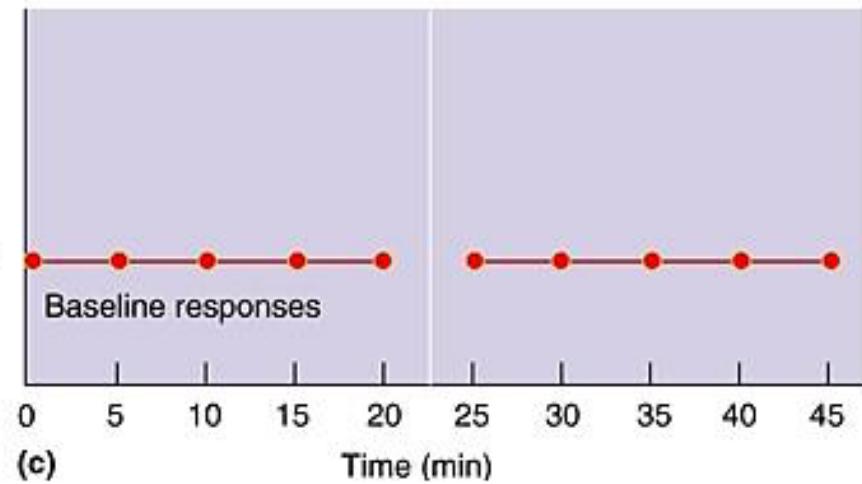
# Long Term Potentiation (LTP)



EPSP magnitude in response to test stimulation of input 1



EPSP magnitude in response to test stimulation of input 2

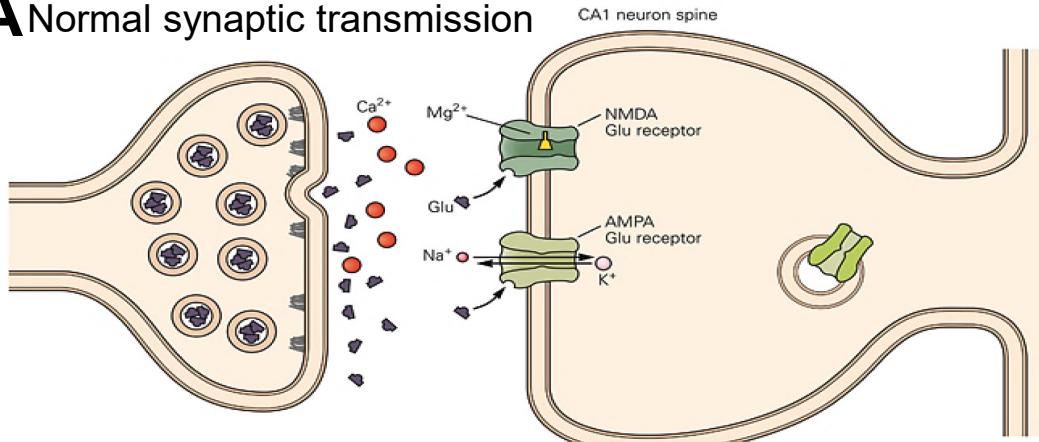


# Mechanism of LTP

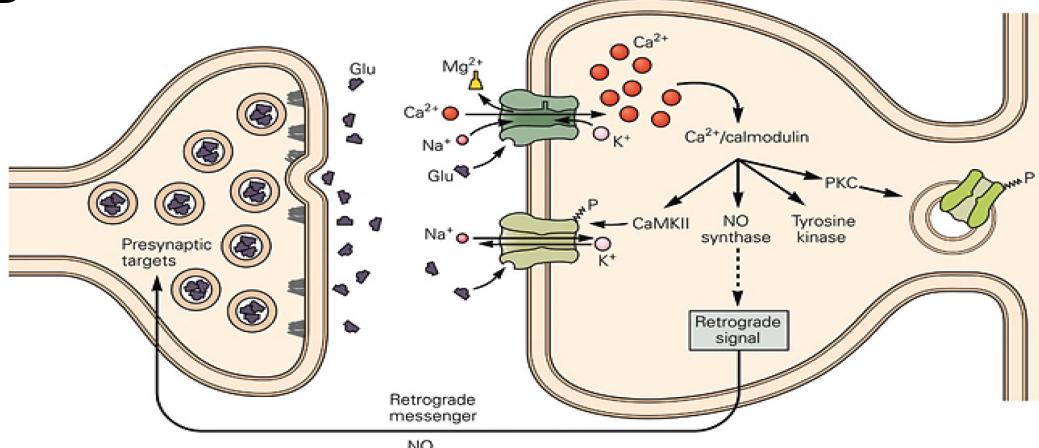
(Schaffer collateral - CA1 synapse)

What would happen if NMDA receptors were blocked during induction of LTP?

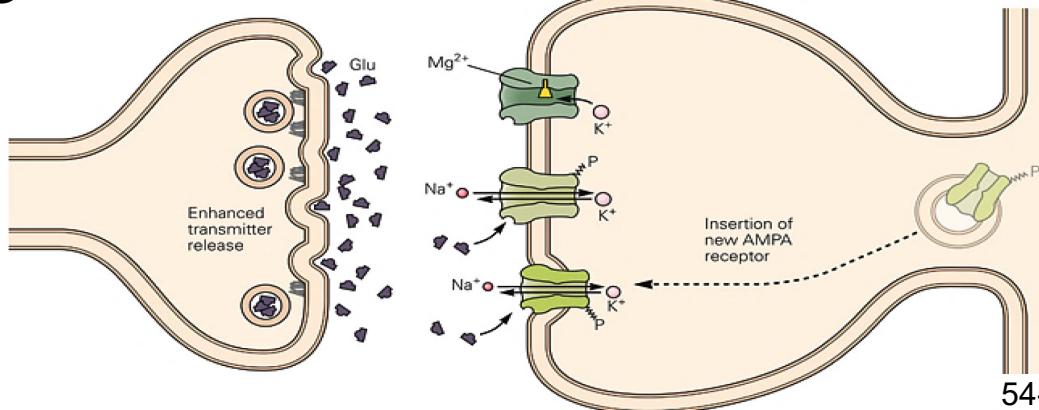
A Normal synaptic transmission



B Induction of LTP



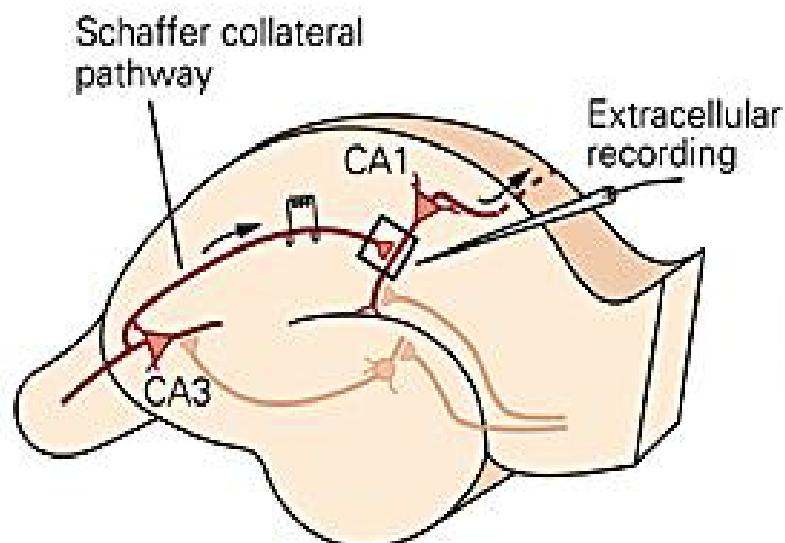
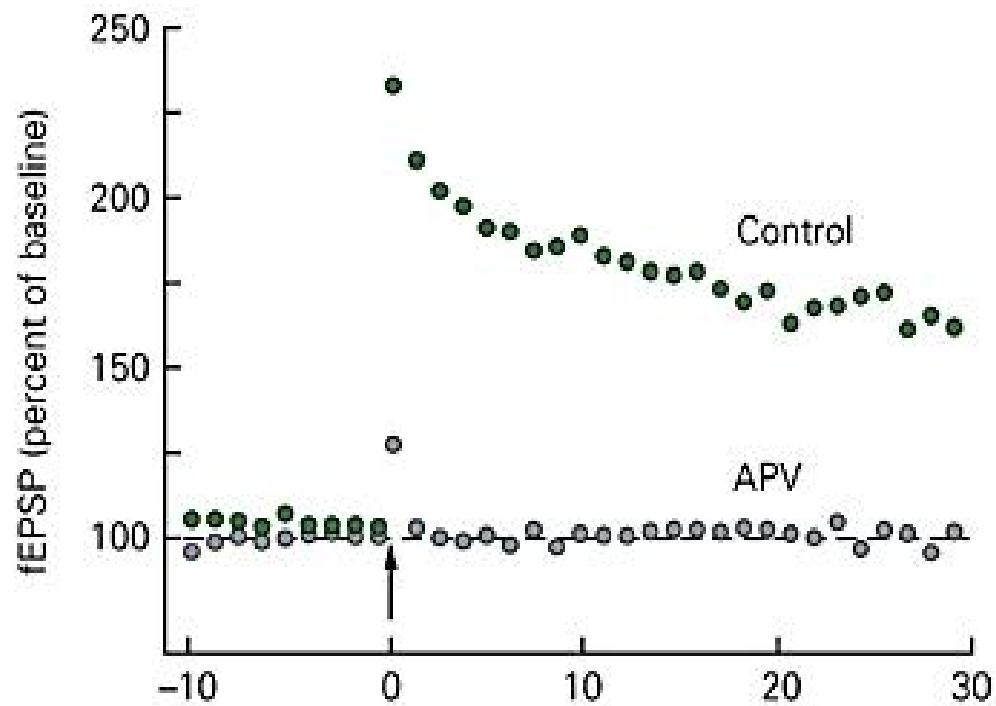
C Expression of LTP



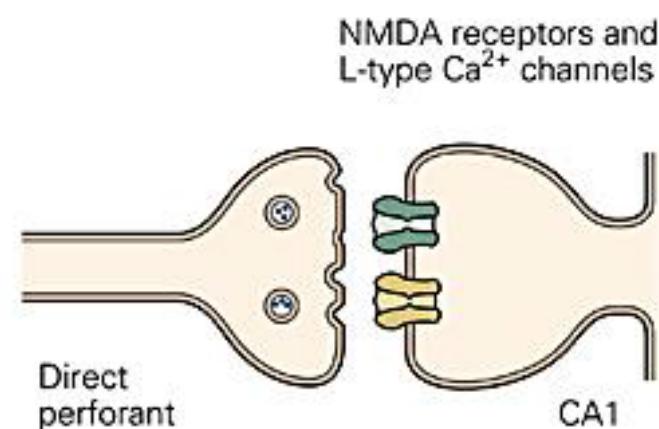
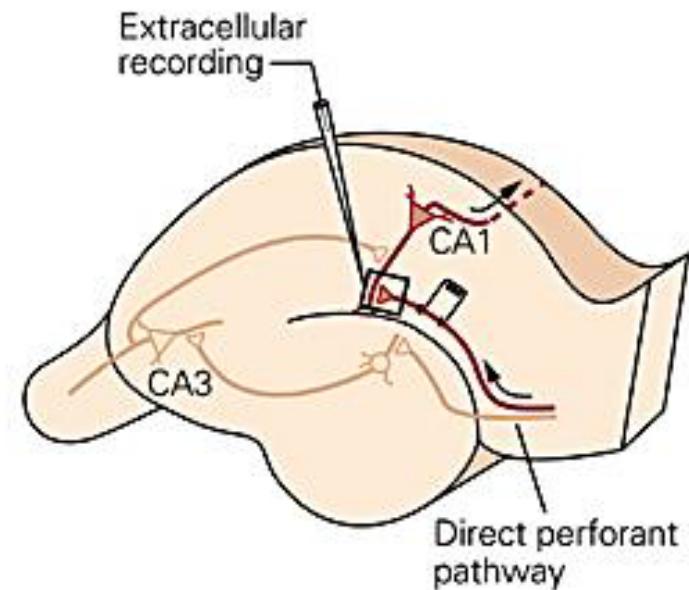
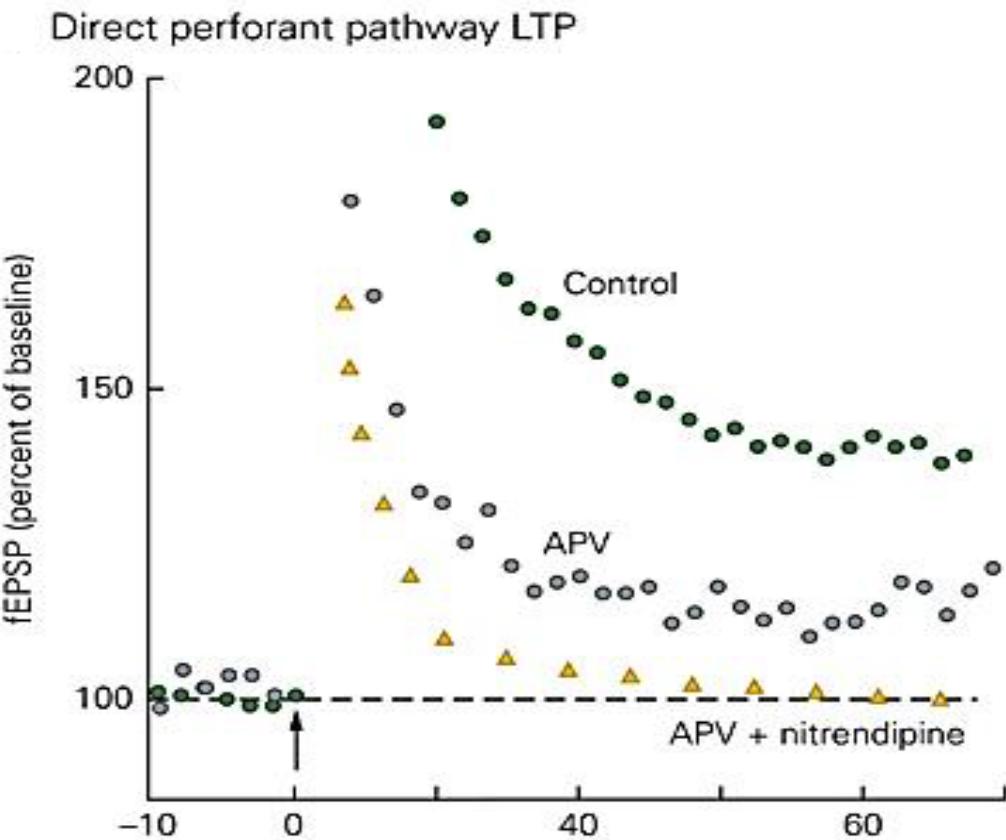
# Mechanism of LTP

(Schaffer collateral - CA1 synapse)

Schaffer collateral pathway LTP

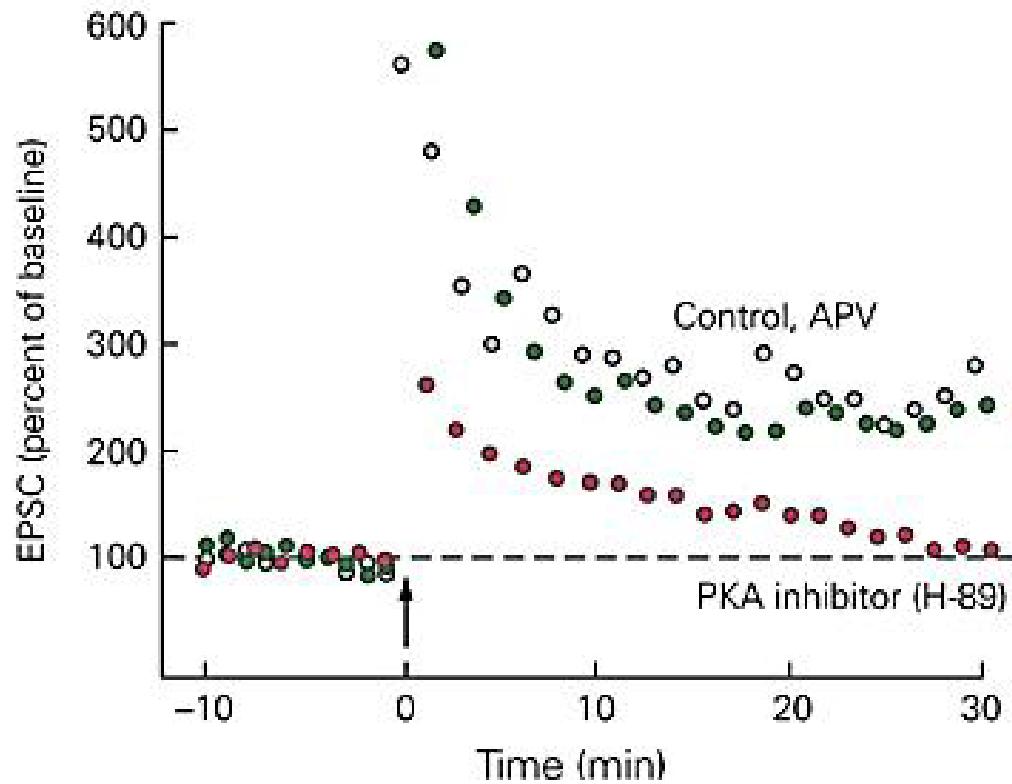


# Alternate Mechanisms of LTP

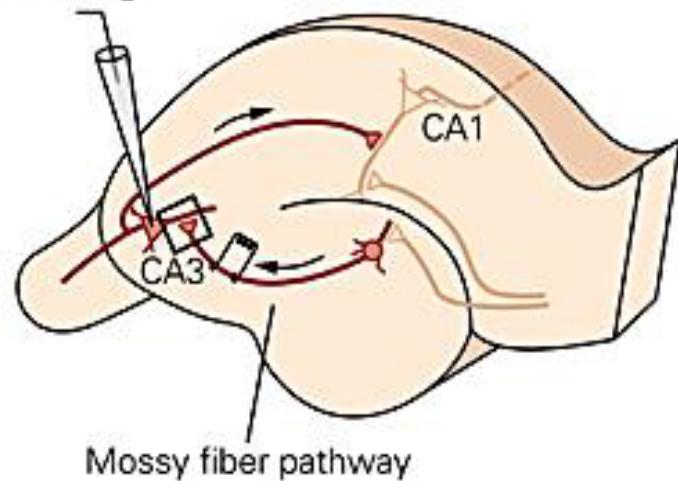


# Alternate Mechanisms of LTP

Mossy fiber pathway LTP

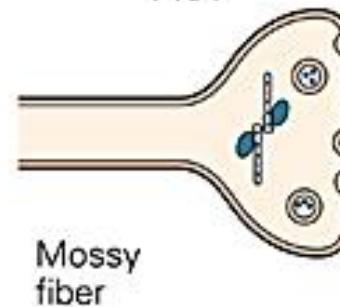


Voltage-clamp recording

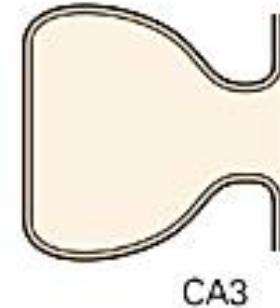


Mossy fiber pathway

Presynaptic PKA

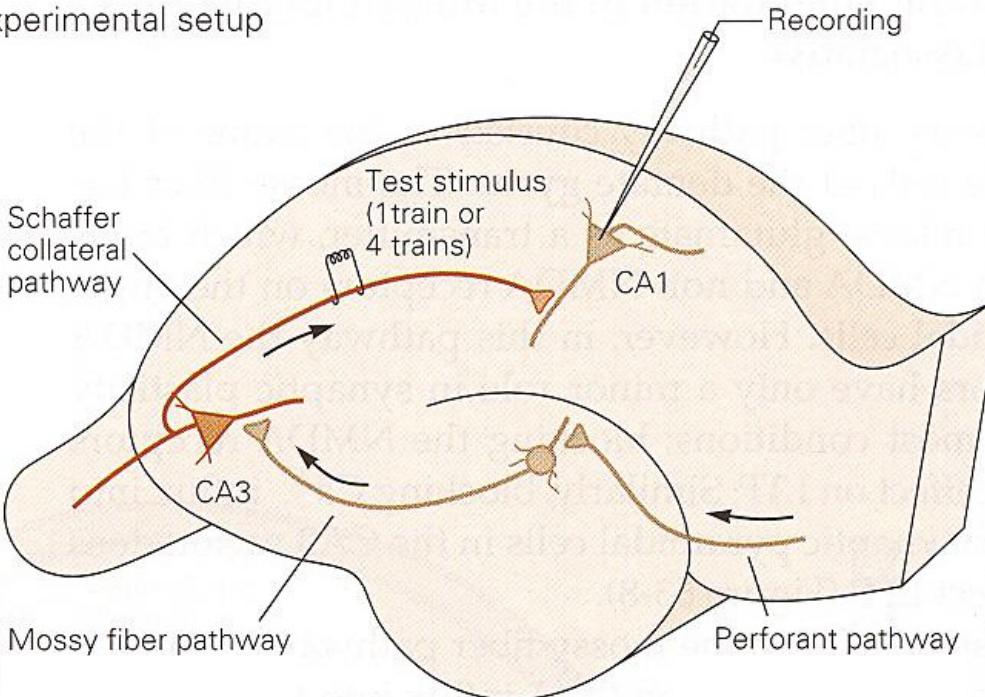


Mossy fiber

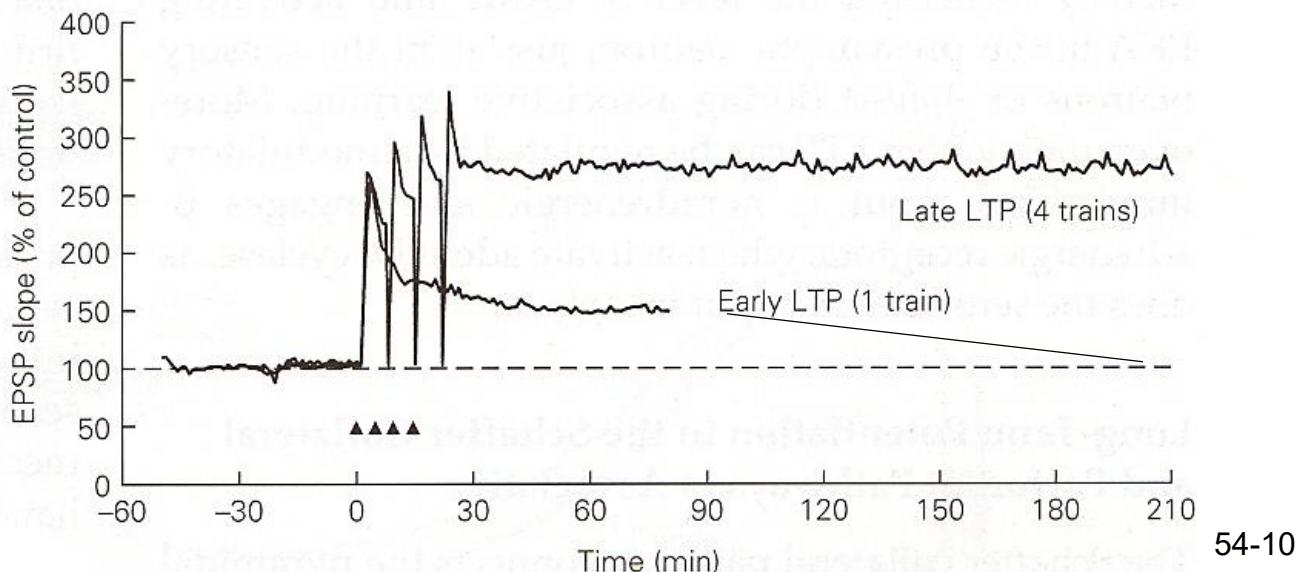


A Experimental setup

# Early vs. Late LTP

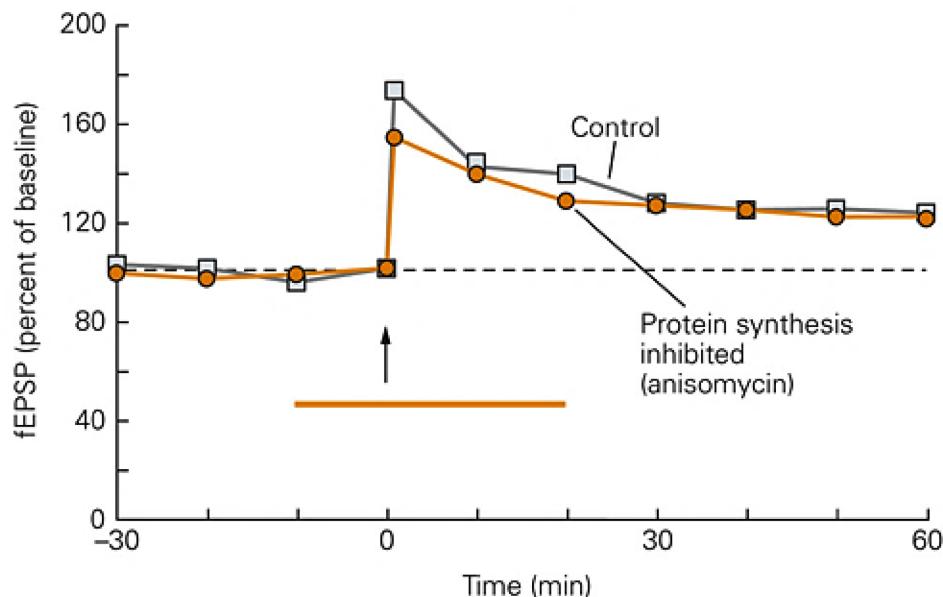


B LTP in the hippocampus CA1 area

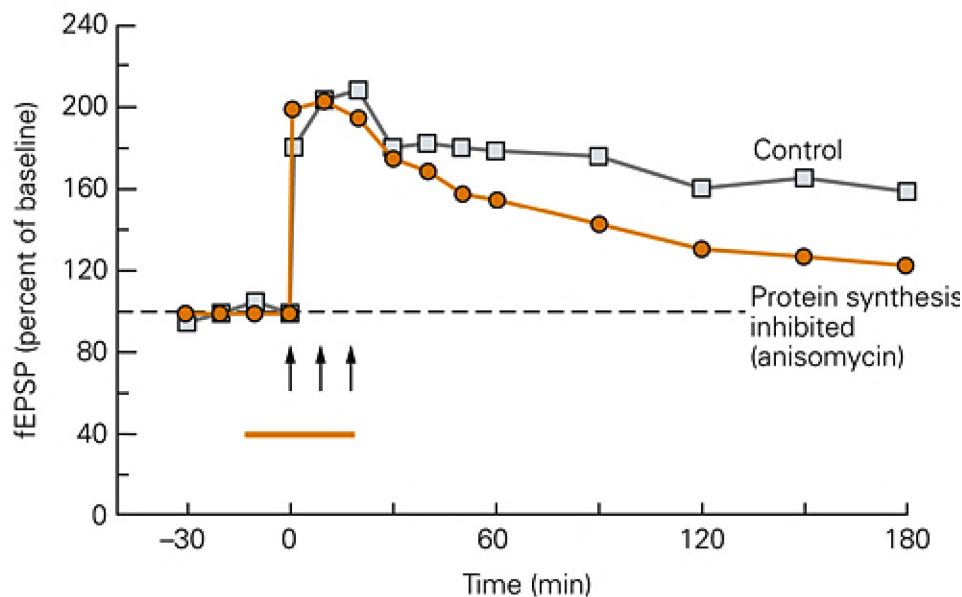


# Early vs. Late LTP

B Early LTP does not require protein synthesis

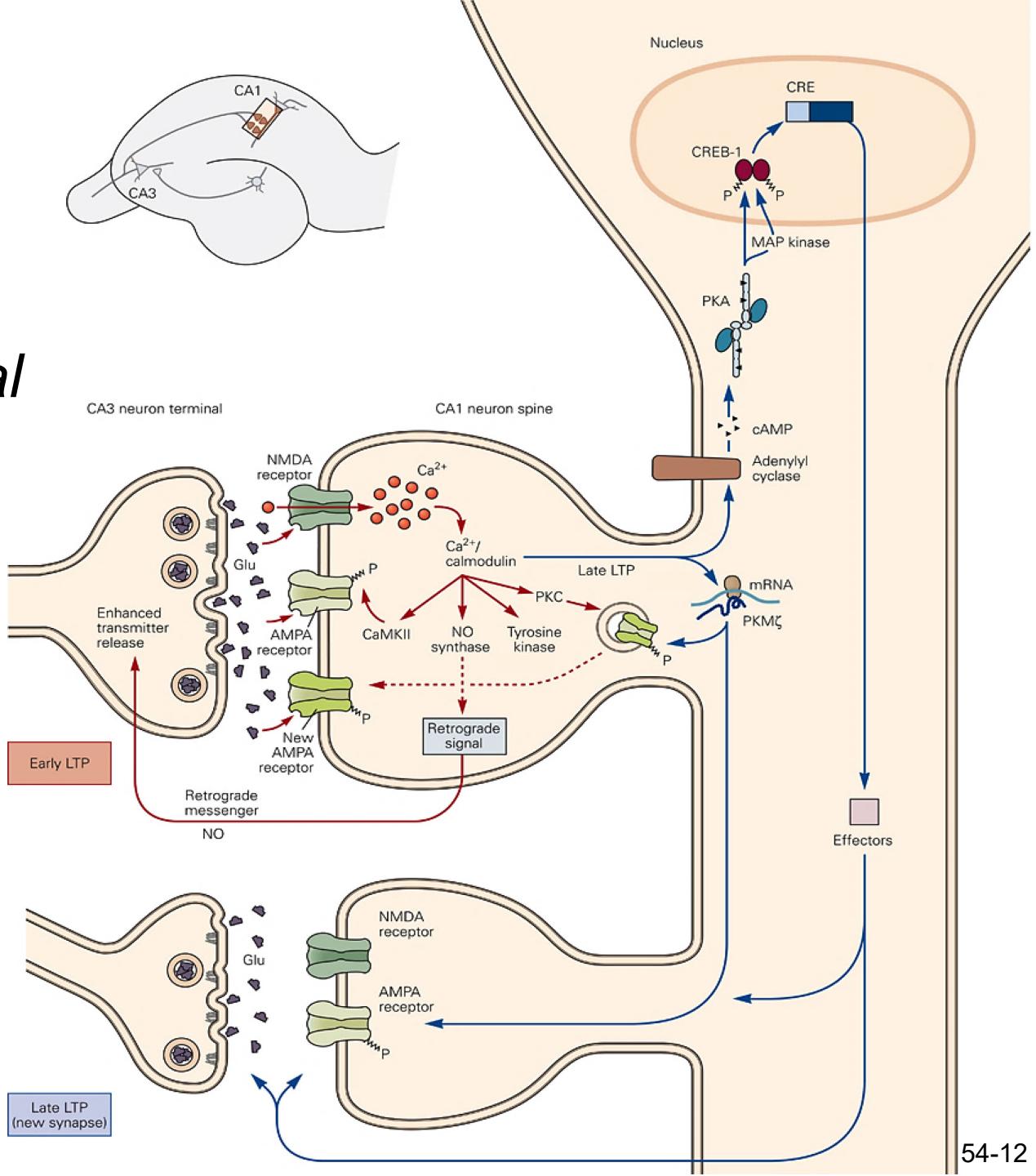


C Late LTP requires protein synthesis



# Mechanisms of Early and Late LTP

(Schaffer collateral -CA1 synapse)

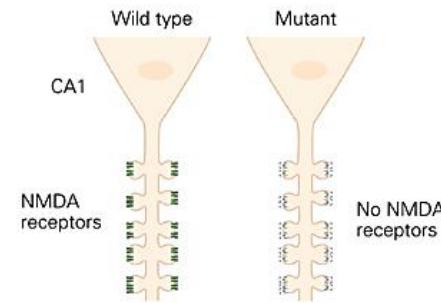
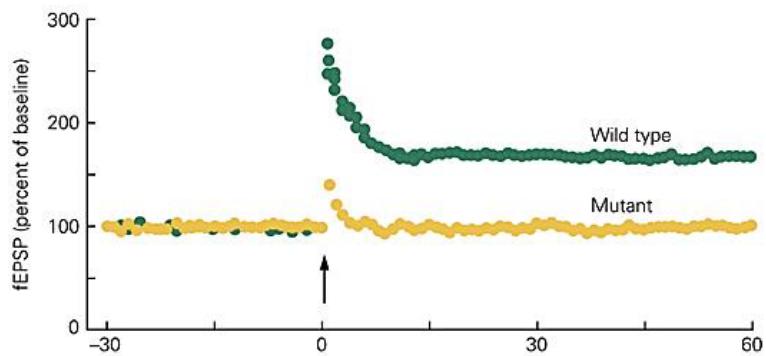


# LTP and Spatial Memory

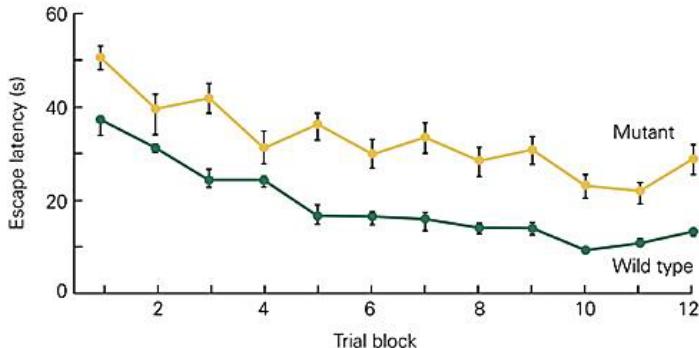
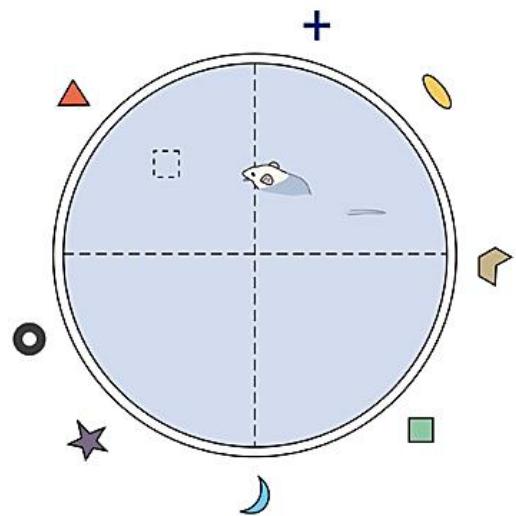
Experiment:

- Knock out NMDA receptors in the CA1 region.
- Test the effects on LTP and on a spatial memory task.

A Long-term potentiation

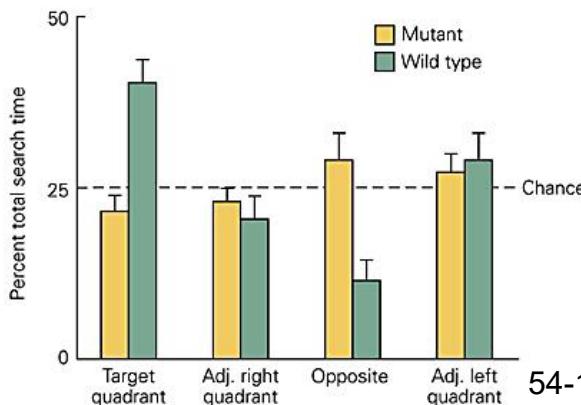
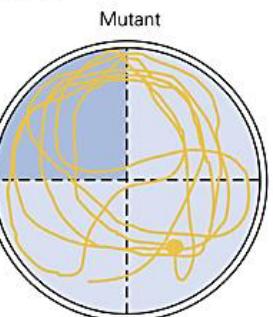
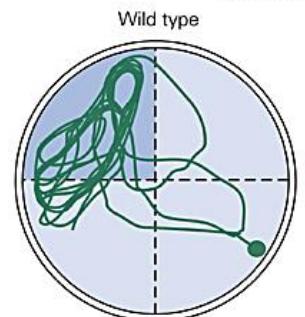


B Morris water maze learning



C Probe trial test of memory

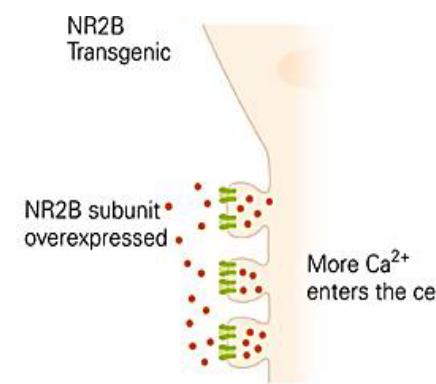
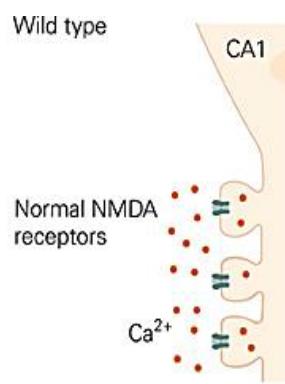
Movement patterns



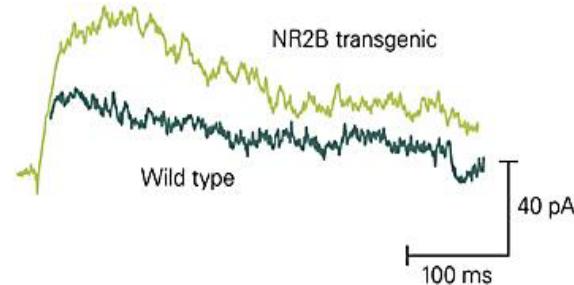
# LTP and Spatial Memory

Experiment:

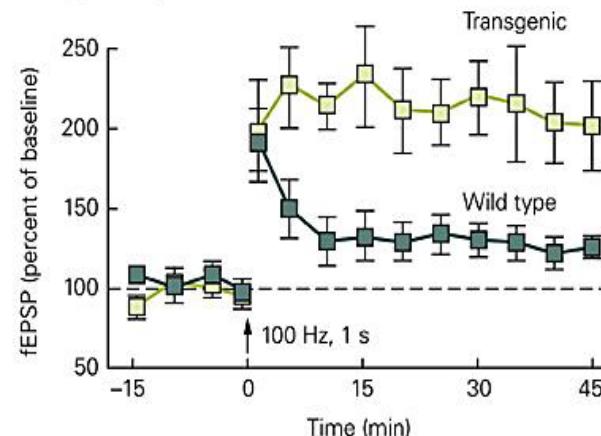
- Overexpress NR2B subunits (NMDA receptor subunits that have high  $\text{Ca}^{2+}$  permeability)
- Test the effects on LTP and on a spatial memory task.



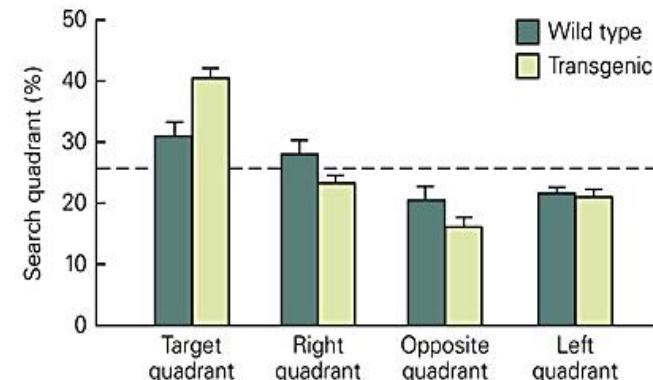
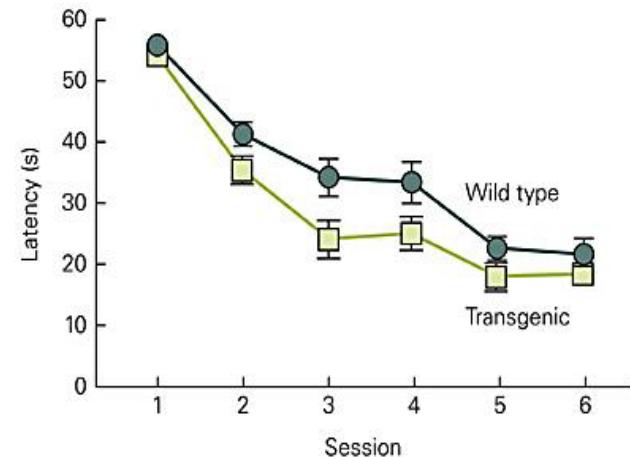
A NMDA-type receptor synaptic current



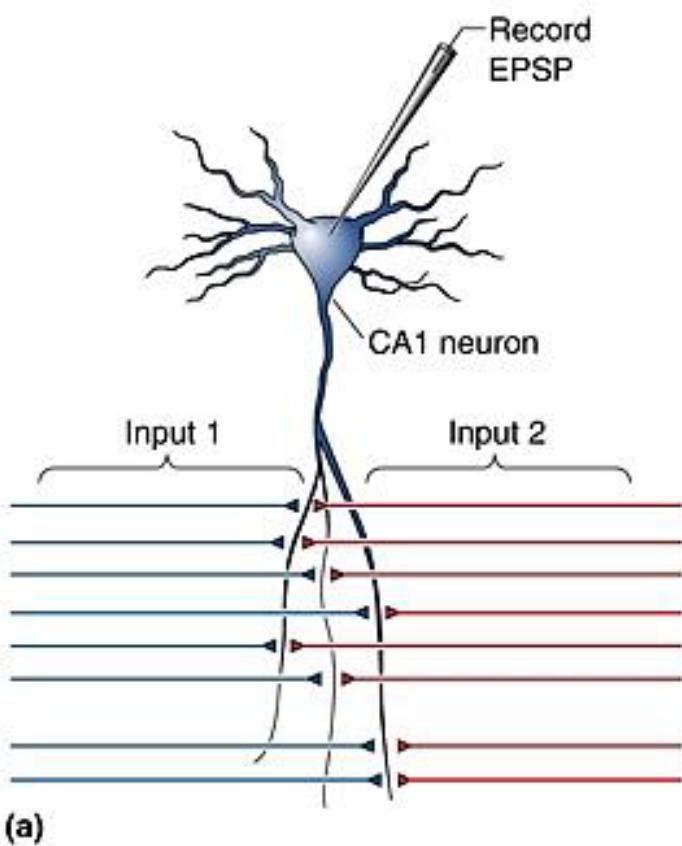
B Long-term potentiation



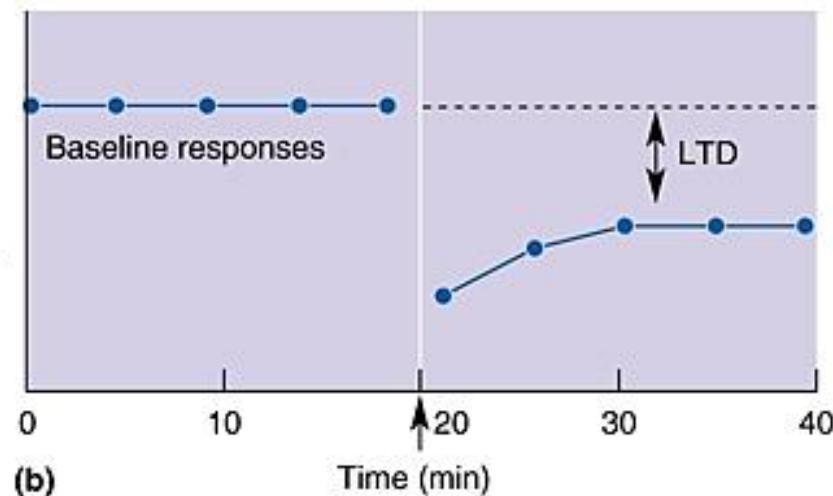
C Morris water maze learning



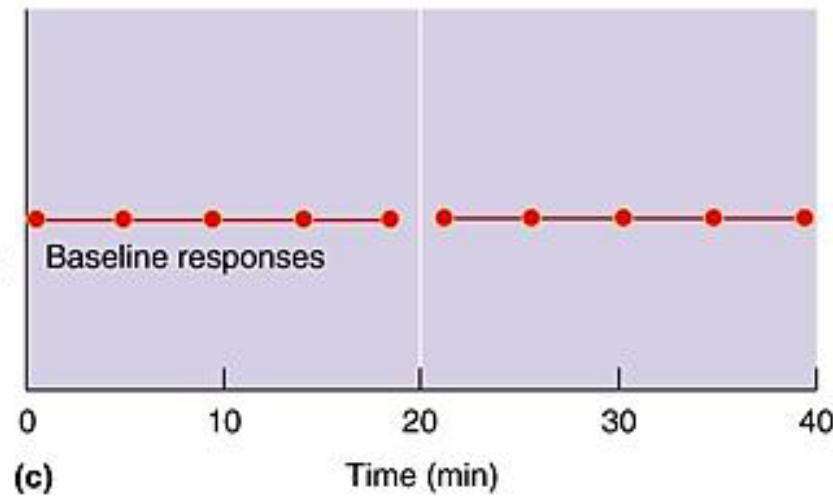
# Long Term Depression (LTD)



EPSP magnitude in response to test stimulation of input 1

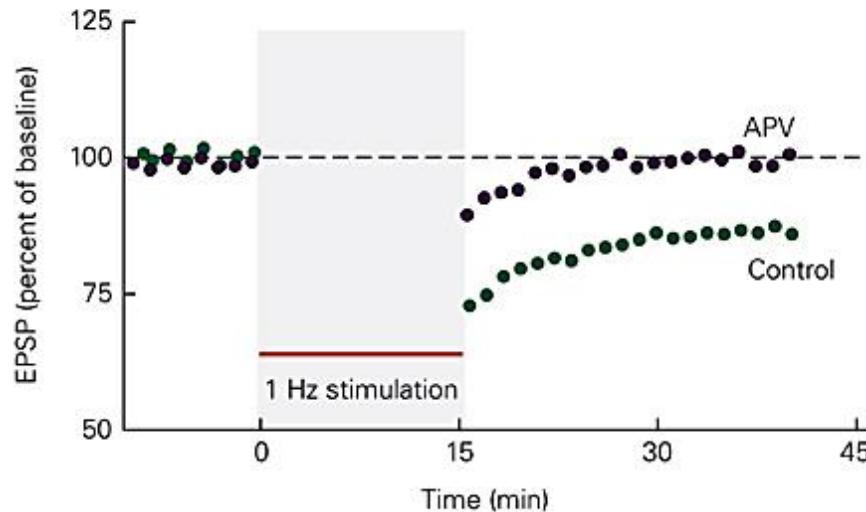


EPSP magnitude in response to test stimulation of input 2

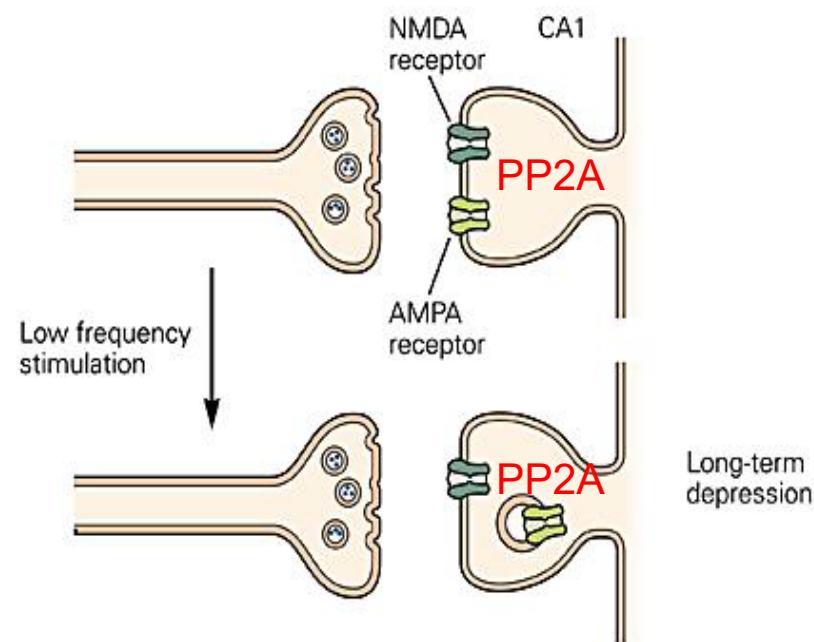
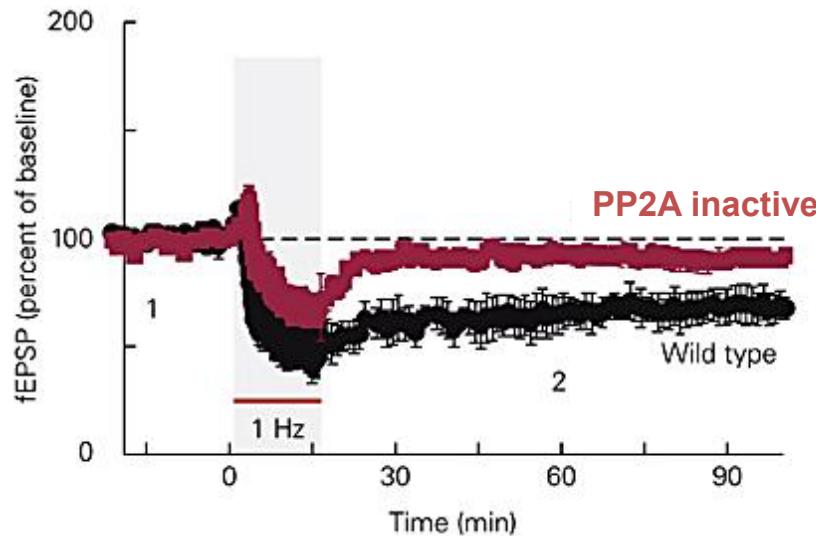


# Mechanisms of Long Term Depression

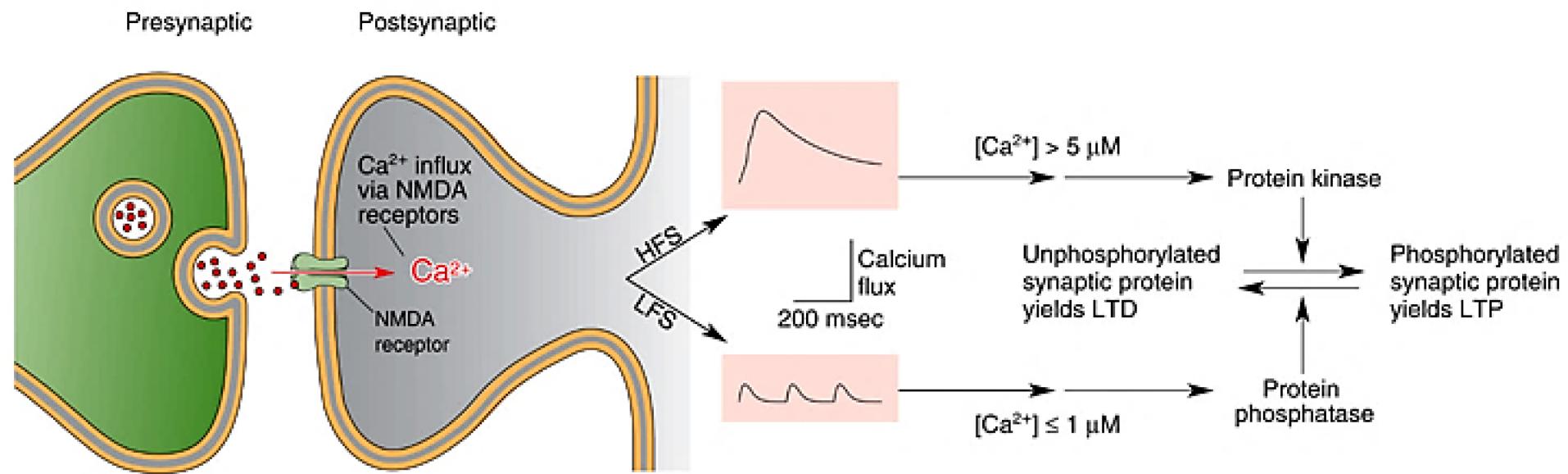
A NMDA receptors are required for long-term depression



B Protein phosphatase 2A is required for LTD



# Mechanisms of LTP and LTD

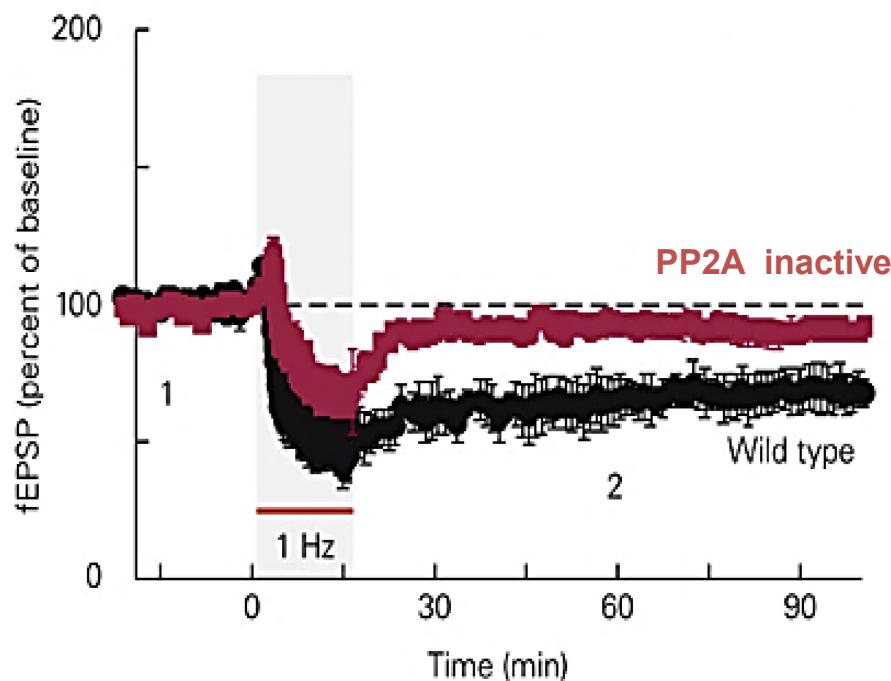


# LTD and Spatial Memory

Experiment:

- Inhibit PP2A
- Test the effects on LTD and on a spatial memory task.

B Protein phosphatase 2A is required for LTD



C LTD contributes to behavioral flexibility

