

## 4.5 Dendritic spines

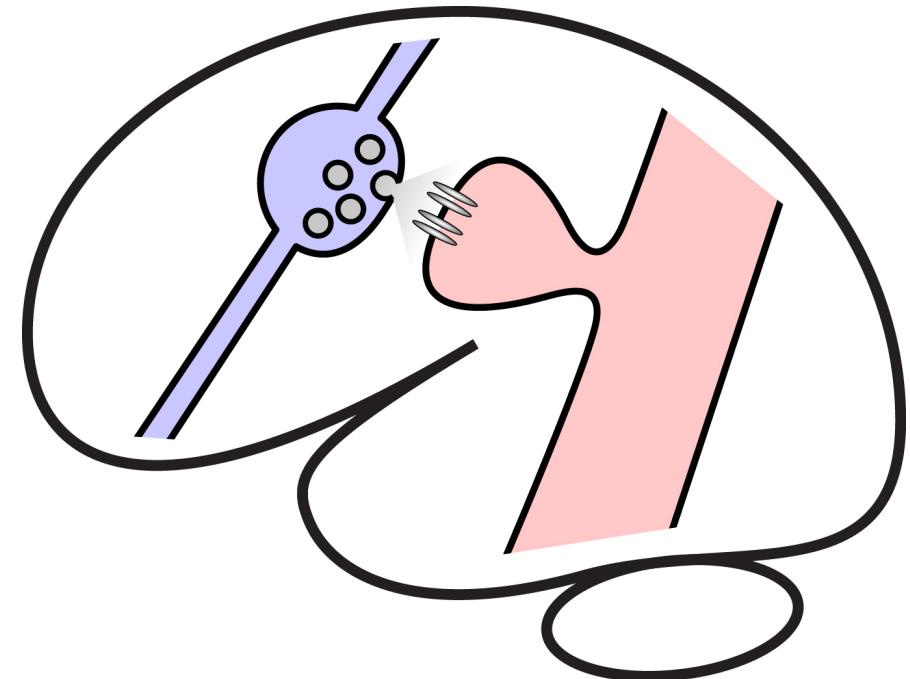
**Cellular Mechanisms of Brain Function**

Prof. Carl Petersen

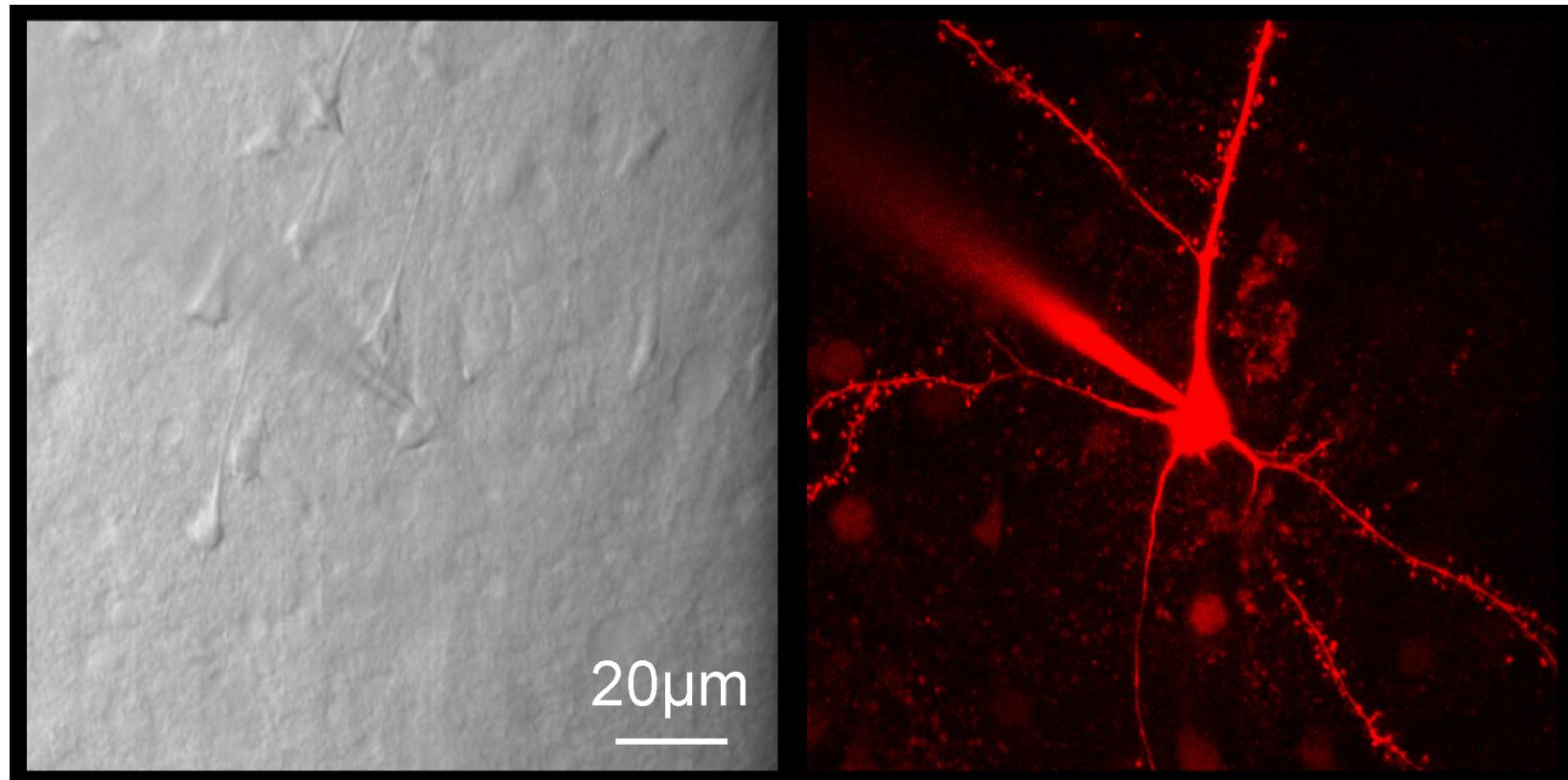
# Dendritic spines



# Excitatory synapses on dendritic spines



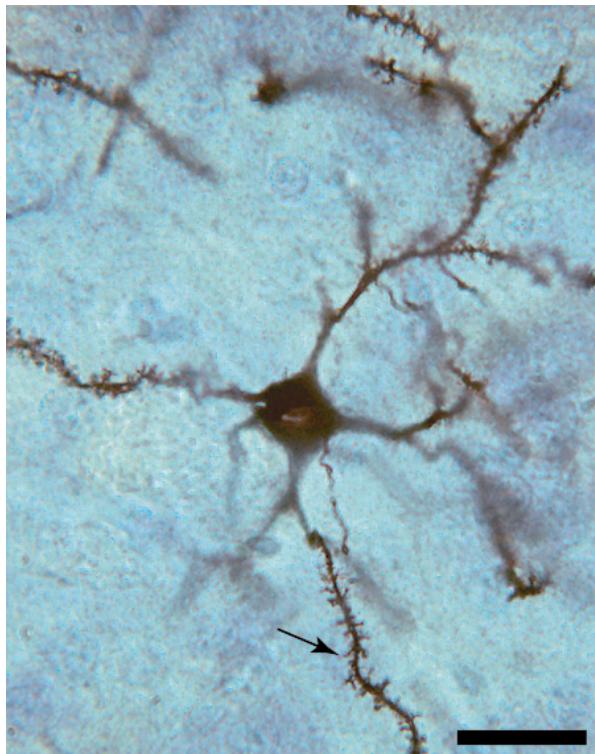
# Dendrites are often decorated with spines



Aronoff & Petersen, 2007

Cellular Mechanisms of Brain Function

# Structure of dendritic spines



Graham Knott



Cellular Mechanisms of Brain Function

# Structure of dendritic spines



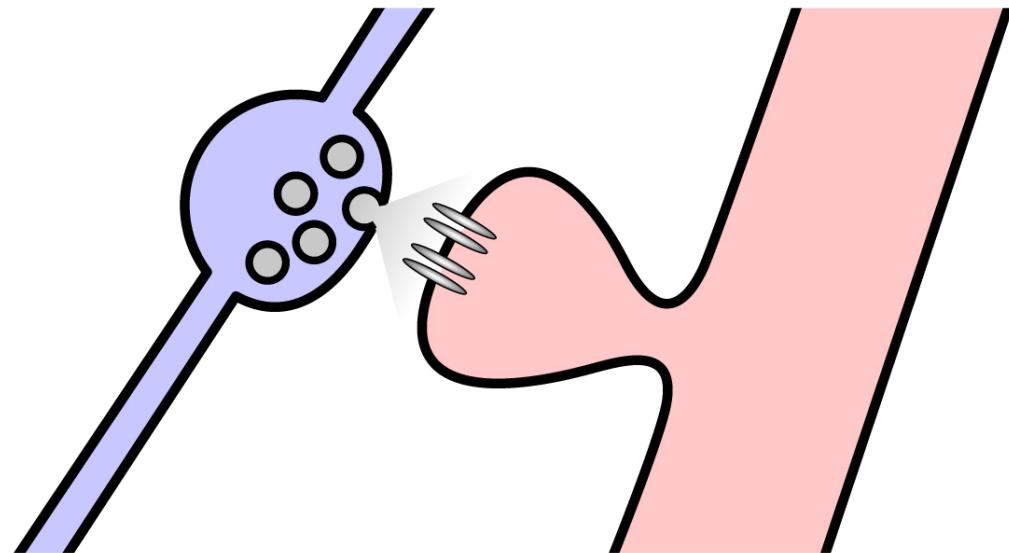
Post-synaptic density (PSD)

Spine apparatus (ER)

Graham Knott

Cellular Mechanisms of Brain Function

# Localised biochemical reactions in spines

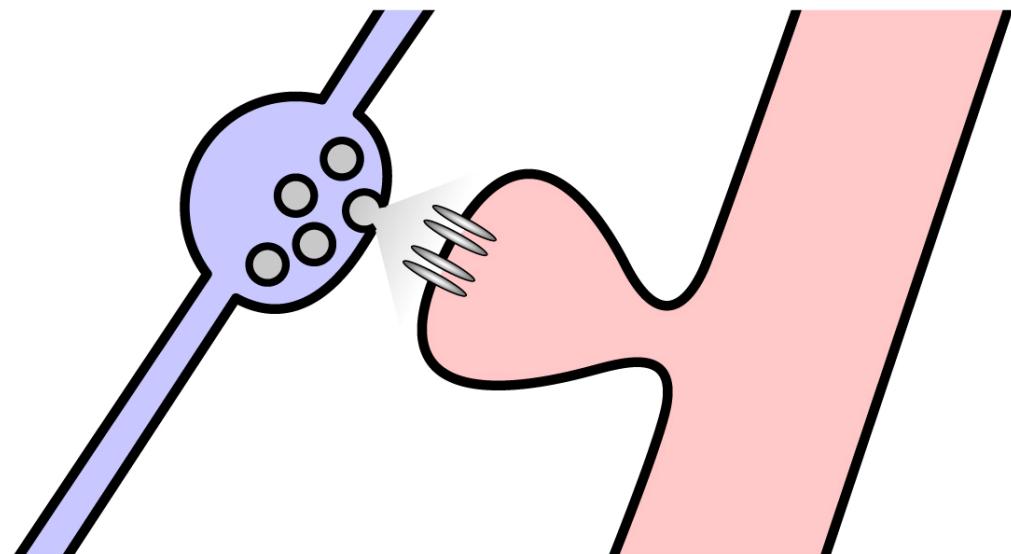


Calcium signals can be confined to a single spine.

Spine neck limits diffusion.

Localised signalling is likely to be important for synapse specific plasticity.

# Electrical resistance of spine necks

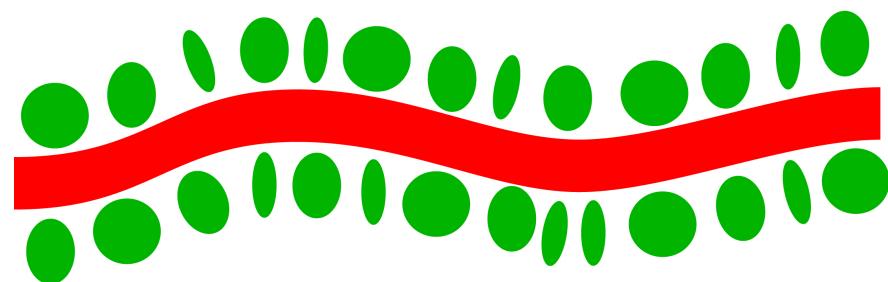


In some spines, the neck might offer high electrical resistance ( $\sim 1 \text{ G}\Omega$ ).

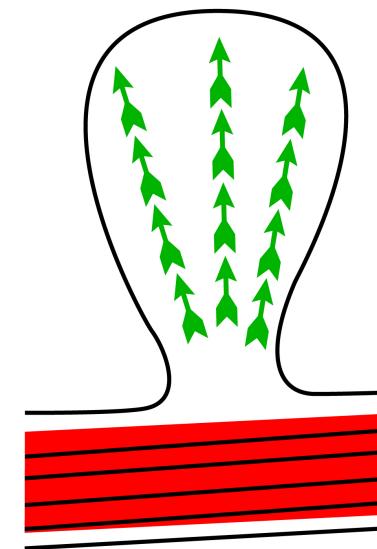
Spine  $V_m$  might differ from  $V_m$  of parent dendrite.

Regulation:  
Spine neck diameter ?  
GABAergic synapse ?

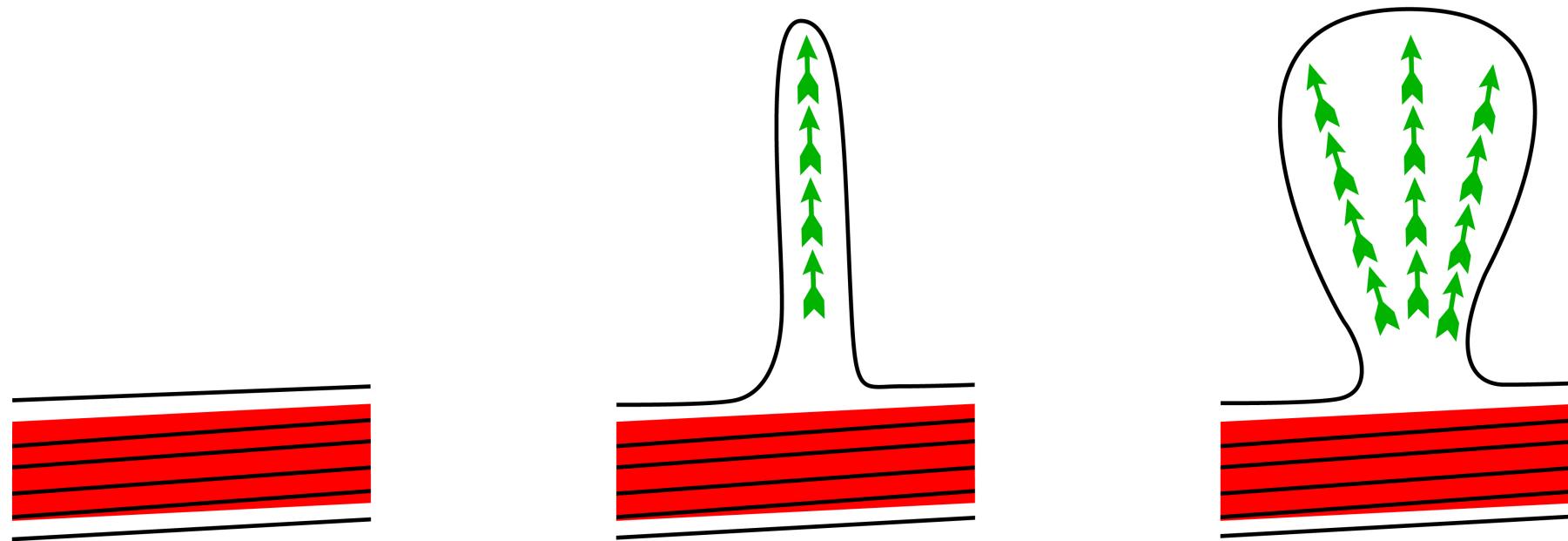
# Actin filaments in spines



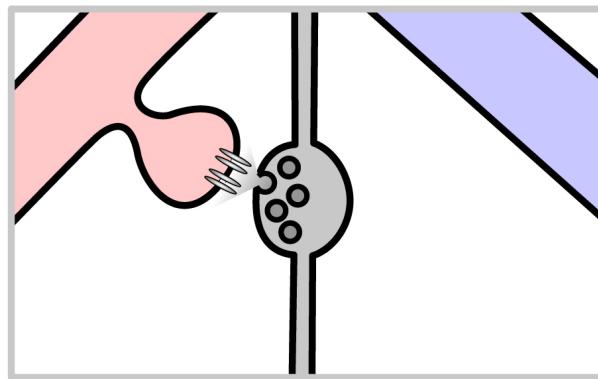
Actin - dendritic spines  
MAP2 - microtubules



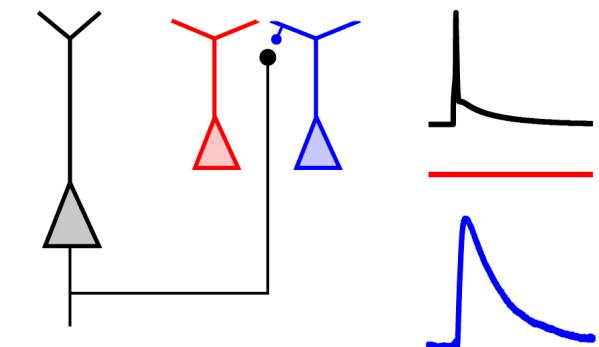
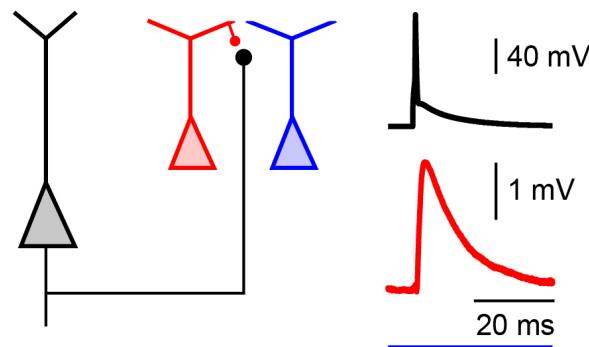
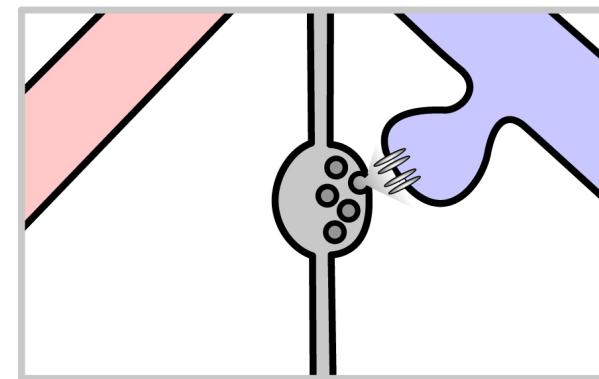
# Spine motility



# Dendritic spines for rewiring neuronal networks



Learning



# Dendritic spines



- Dendrites are often decorated with a high density of spines, which are postsynaptic specialisations of excitatory glutamatergic synapses.
- Spines are localised compartments for biochemical signalling, allowing synapse specific plasticity.
- Spine growth and disappearance may be important for rewiring neuronal networks during learning.