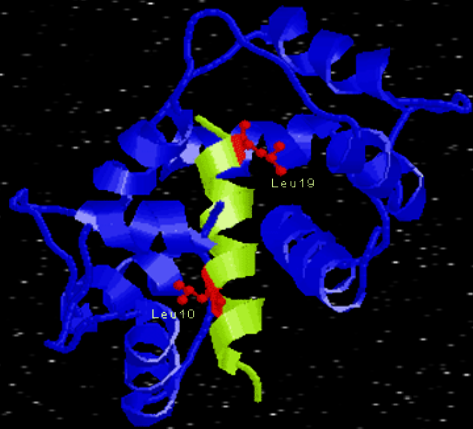
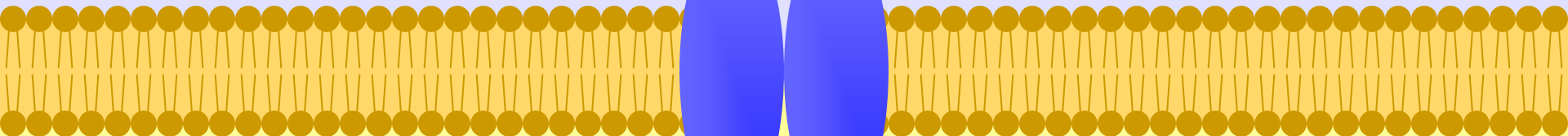
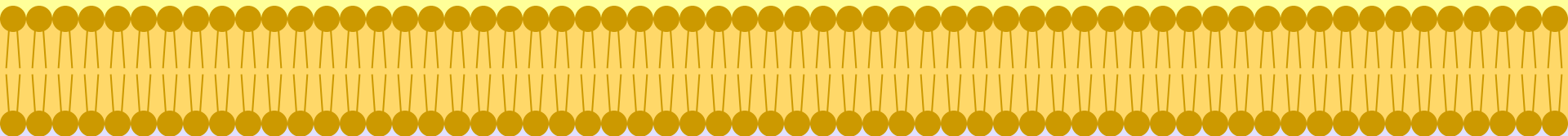
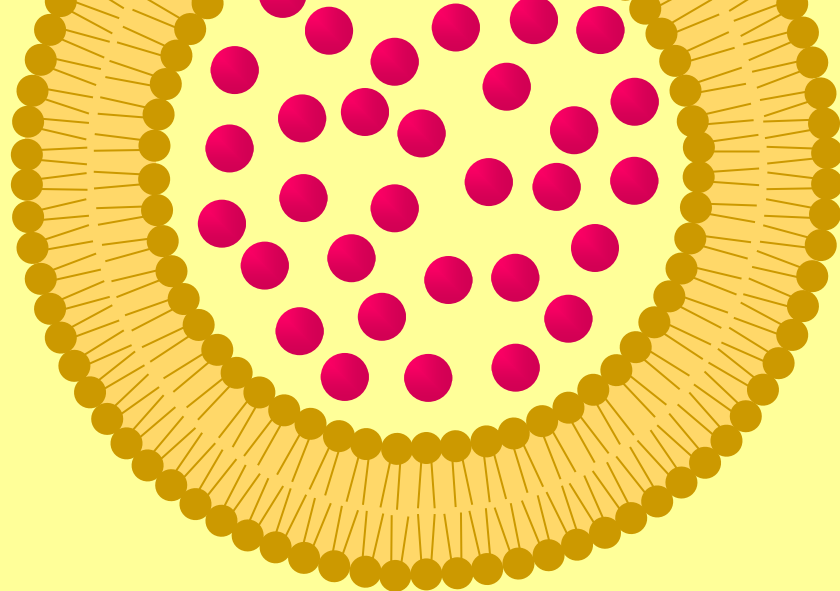


Molecules In Space:

Diffusible Signals in the Synapse

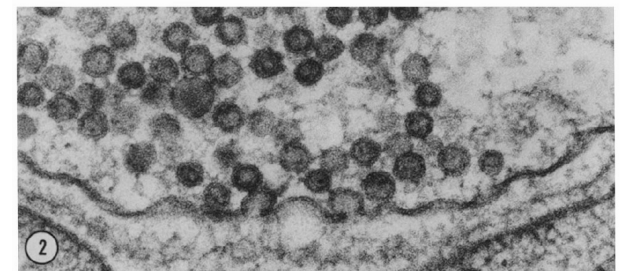
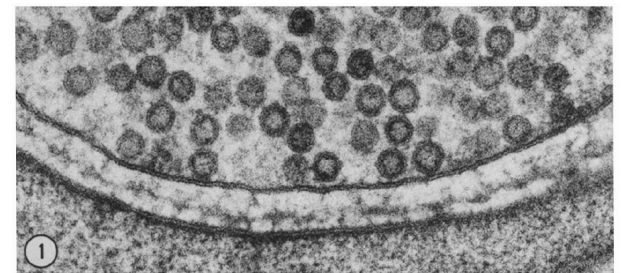
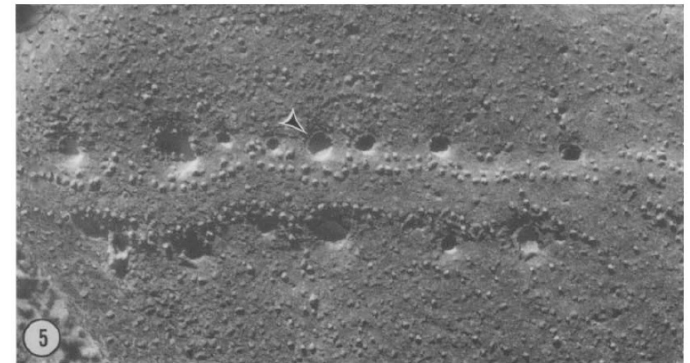
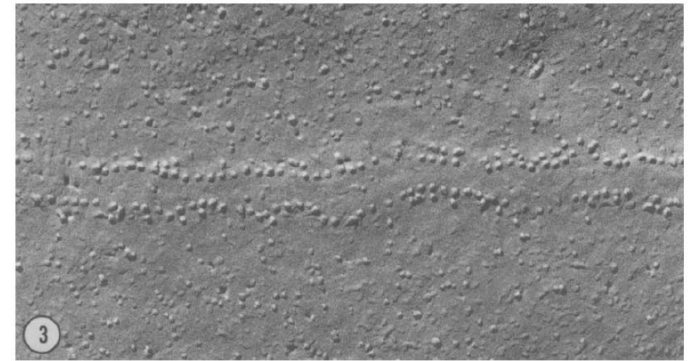
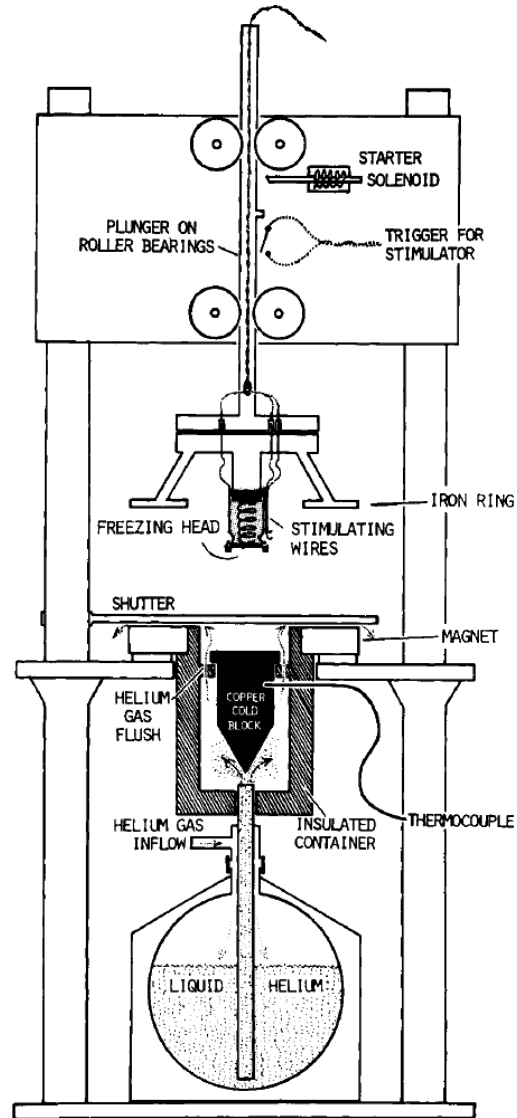


David Santucci
Quantitative Biology Bootcamp 2009



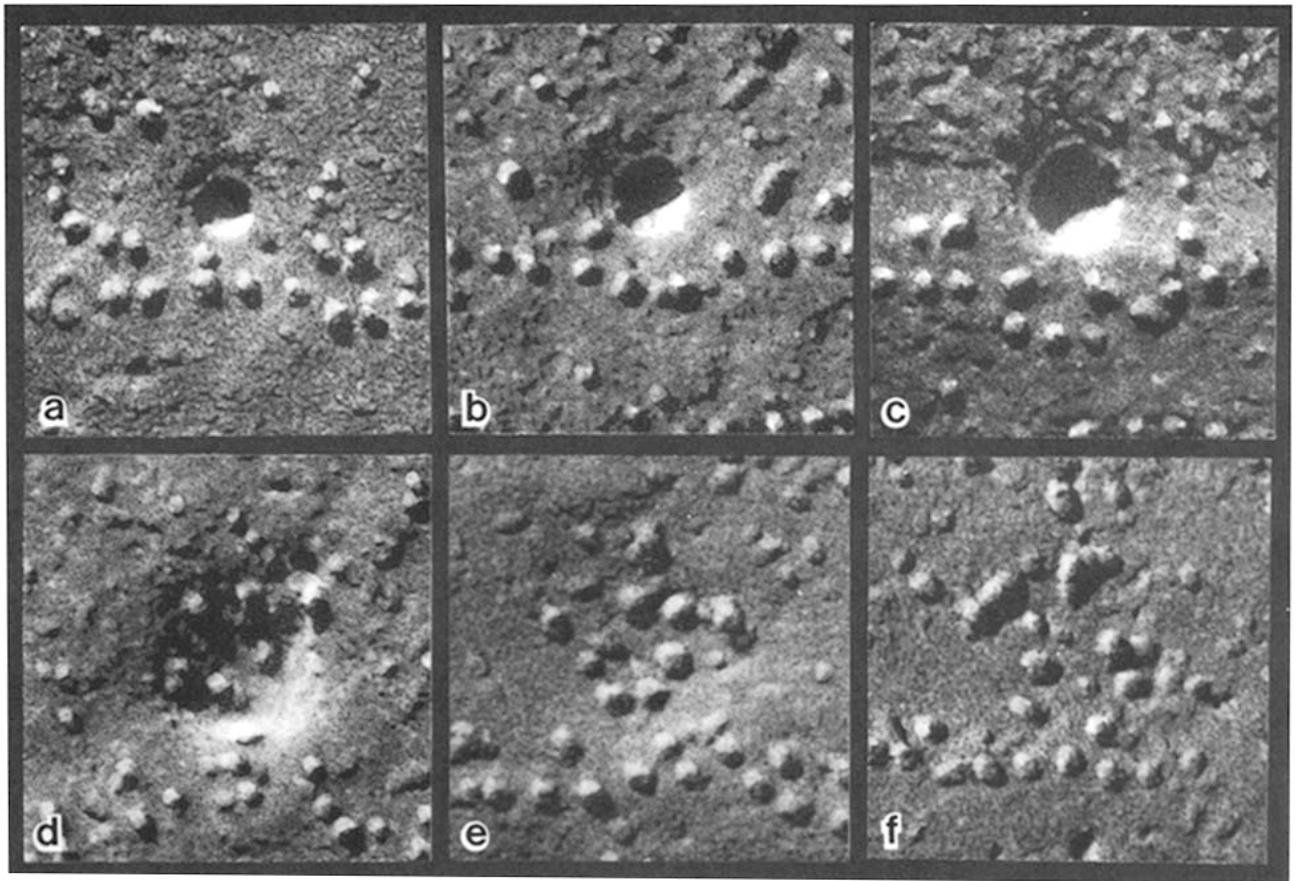


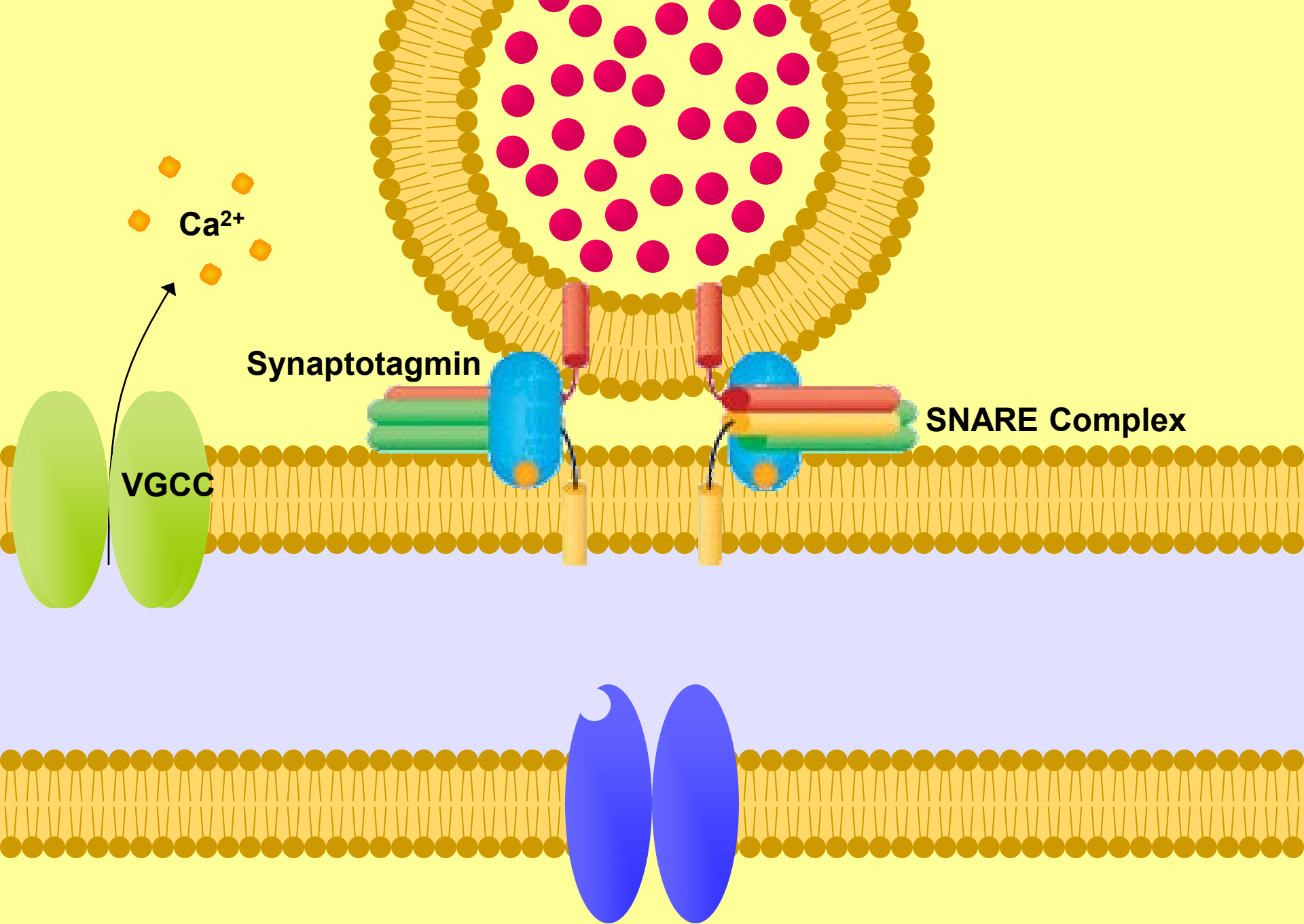
John Heuser

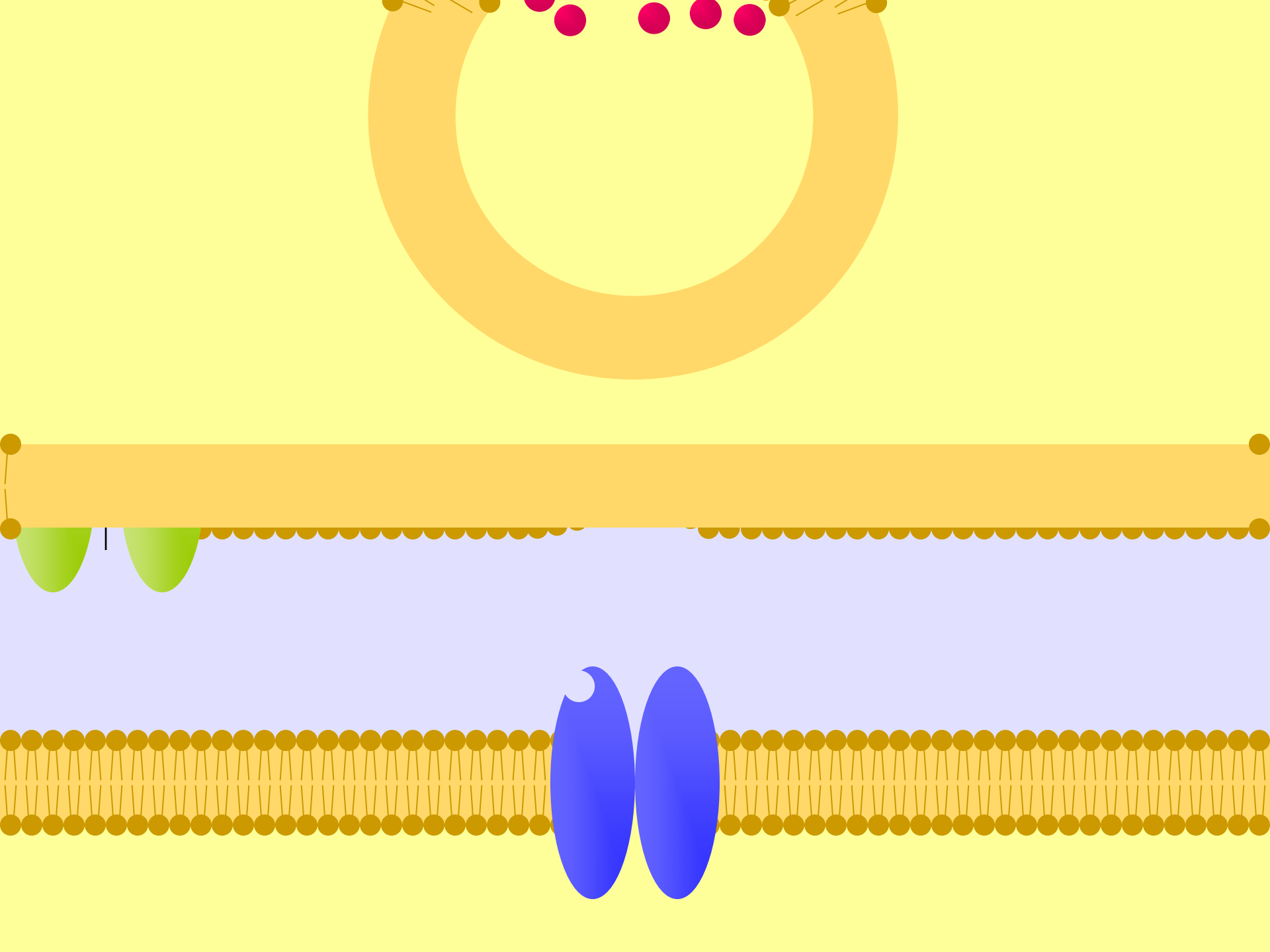


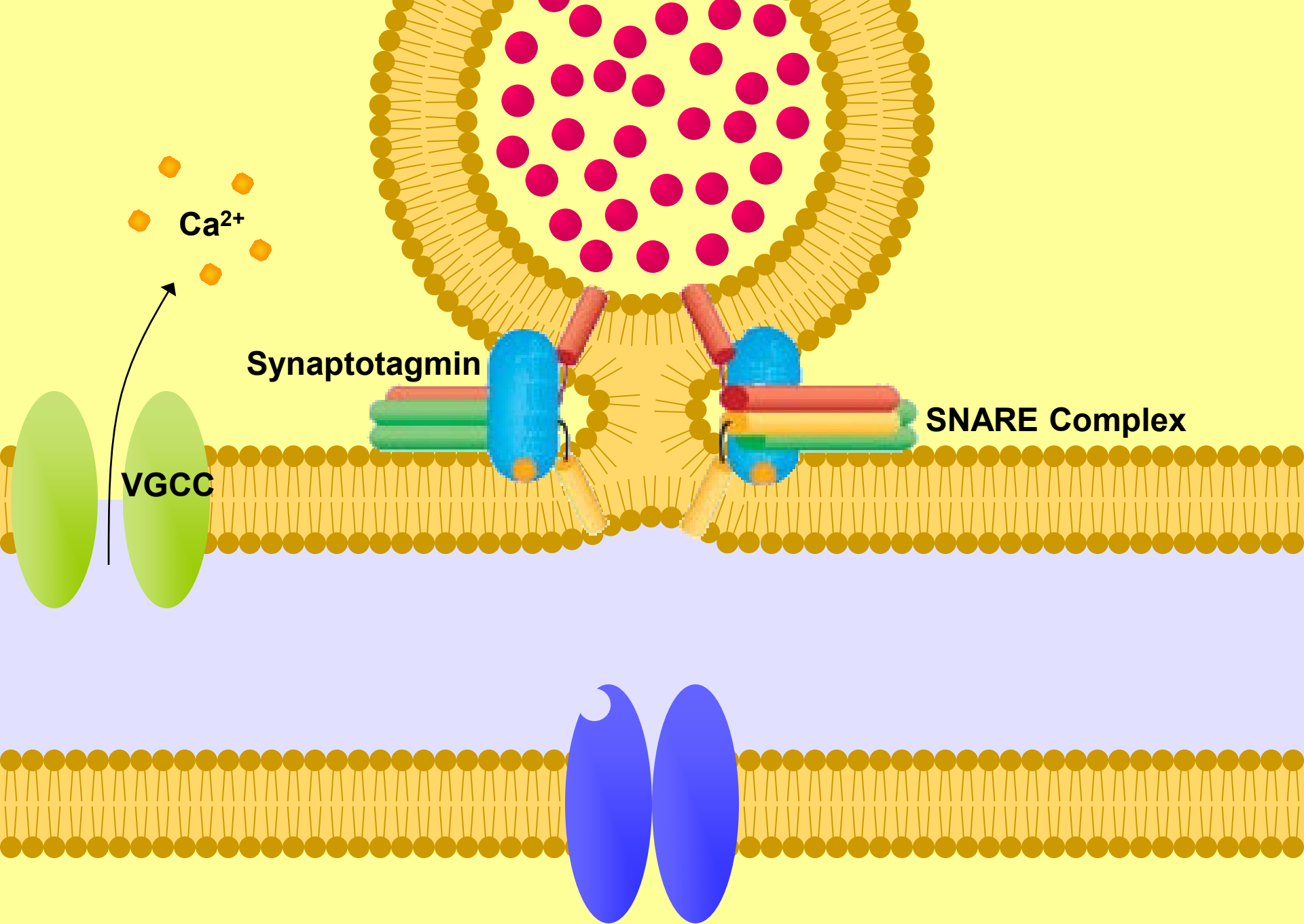


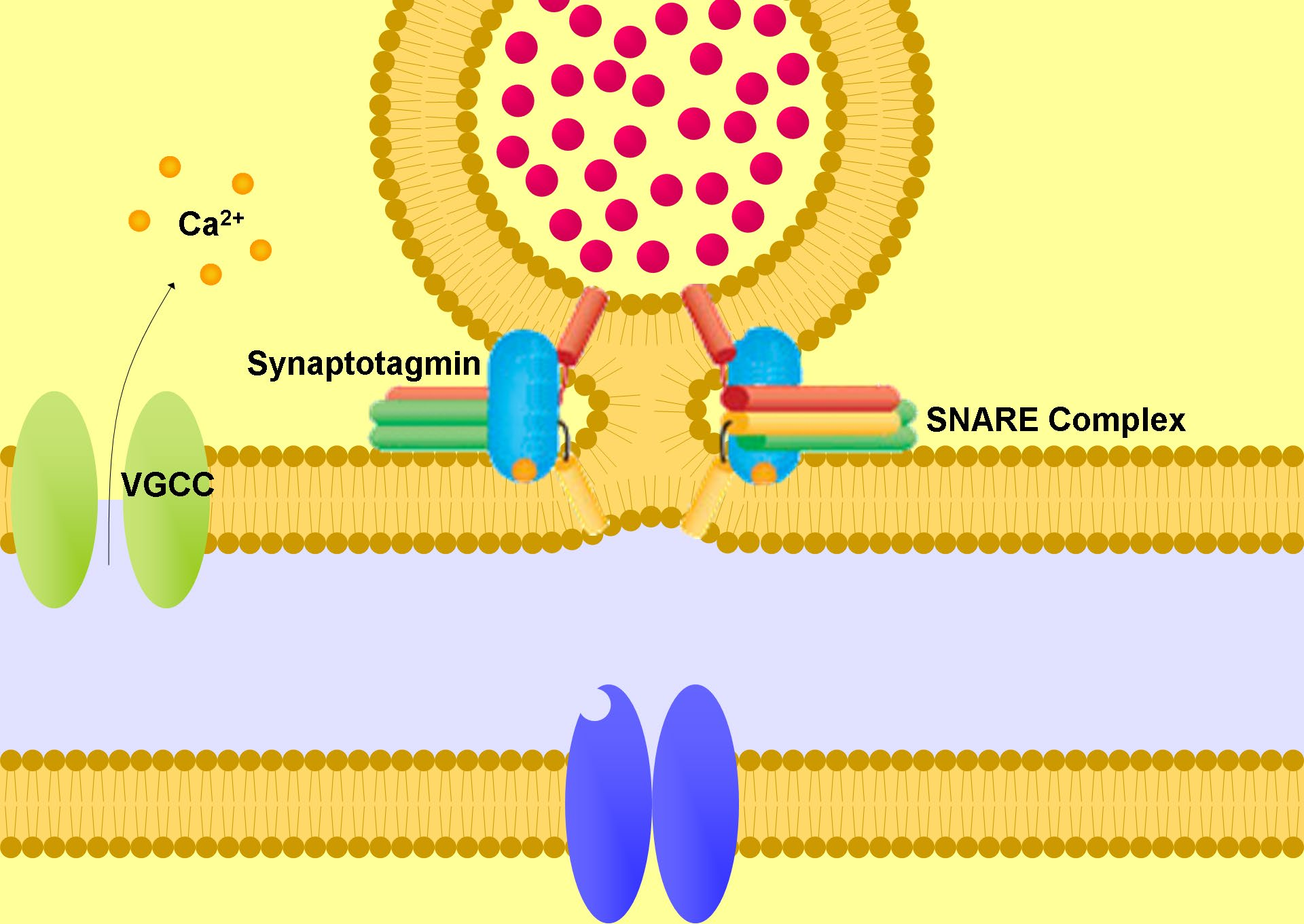
John Heuser

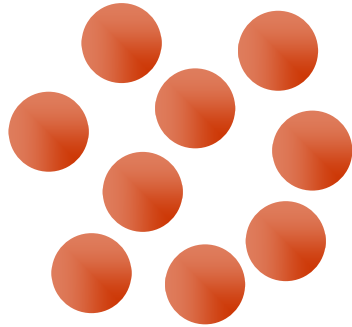




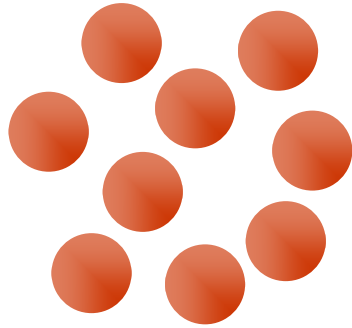






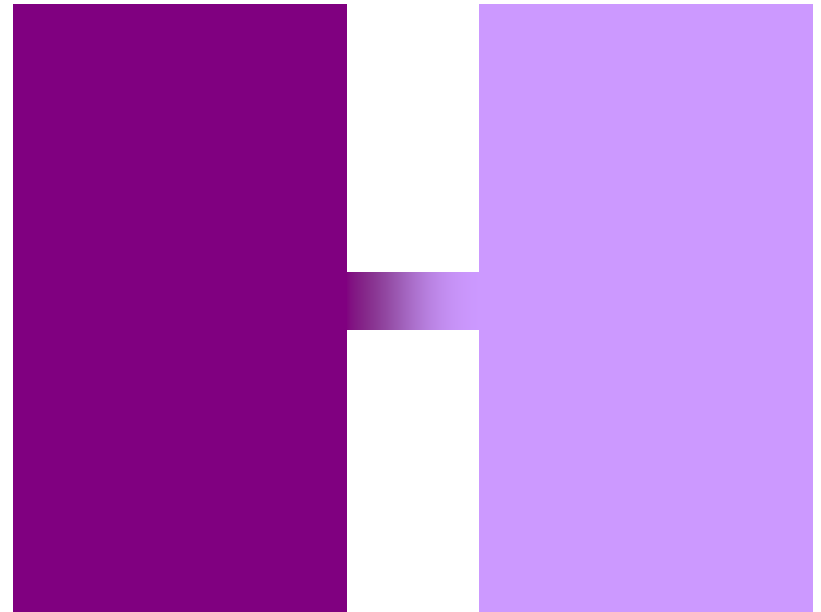


Diffusion



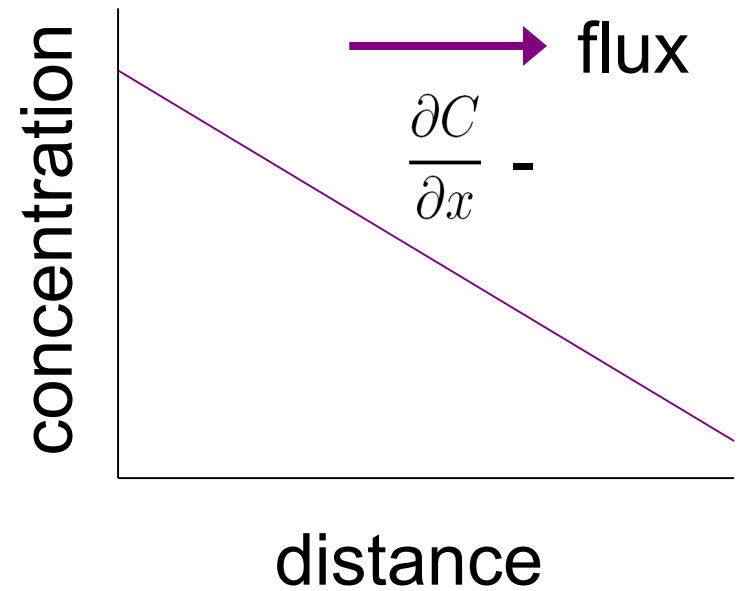
Diffusion

$$F = -D \frac{\partial C}{\partial x}$$



Fick's First Law of Diffusion

$$F = -D \frac{\partial C}{\partial x}$$



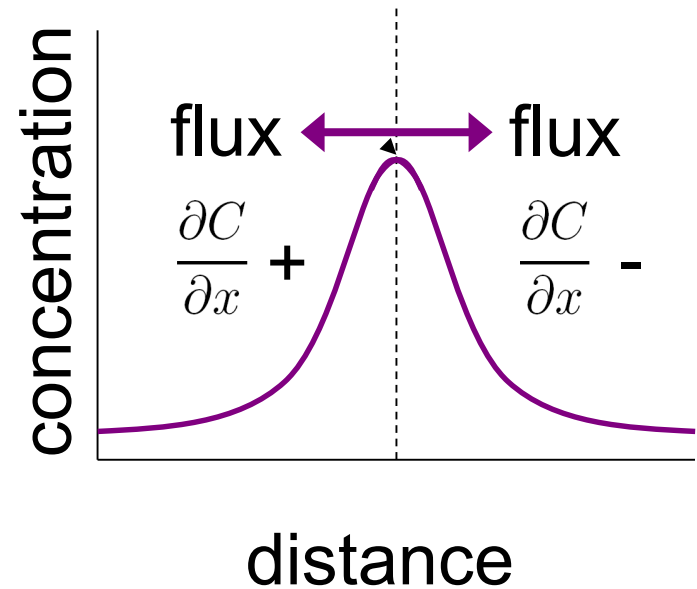
Fick's First Law of Diffusion

$$\frac{\partial C}{\partial t} = D \frac{\partial^2 C}{\partial x^2}$$



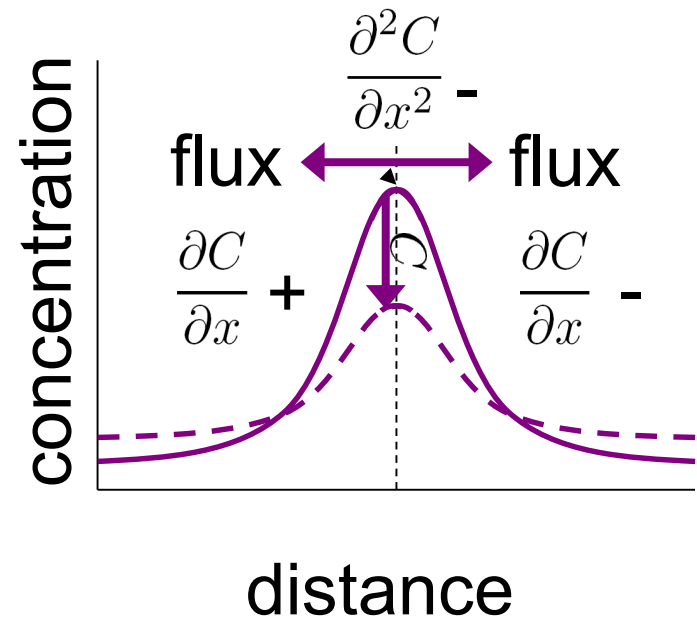
Fick's Second Law of Diffusion

$$\frac{\partial C}{\partial t} = D \frac{\partial^2 C}{\partial x^2}$$

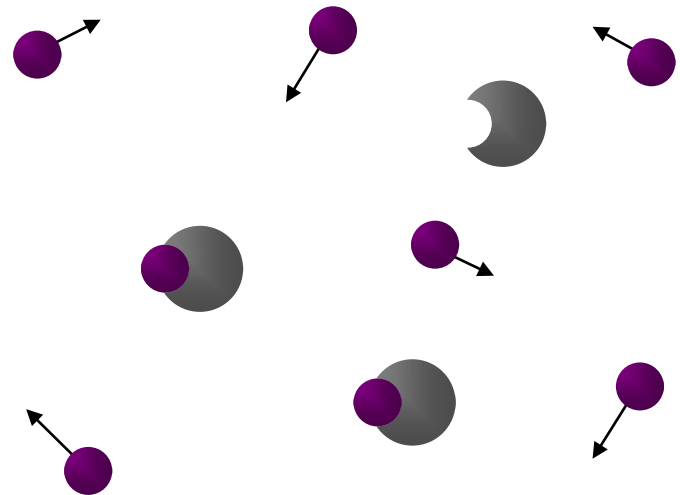
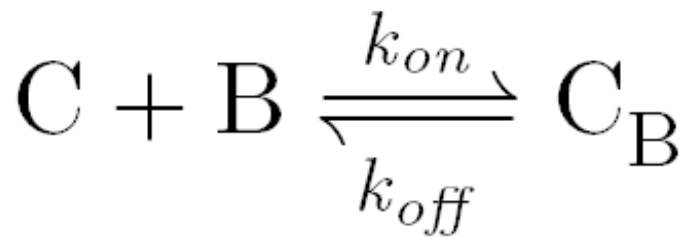


Fick's Second Law of Diffusion

$$\frac{\partial C}{\partial t} = D \frac{\partial^2 C}{\partial x^2}$$



Fick's Second Law of Diffusion

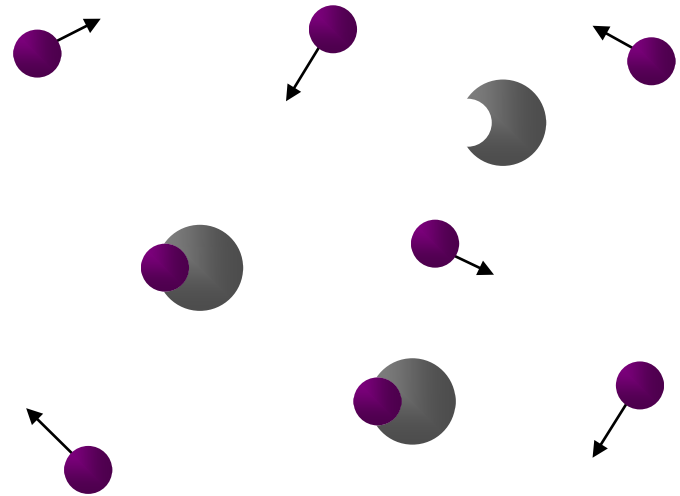


Calcium Buffers

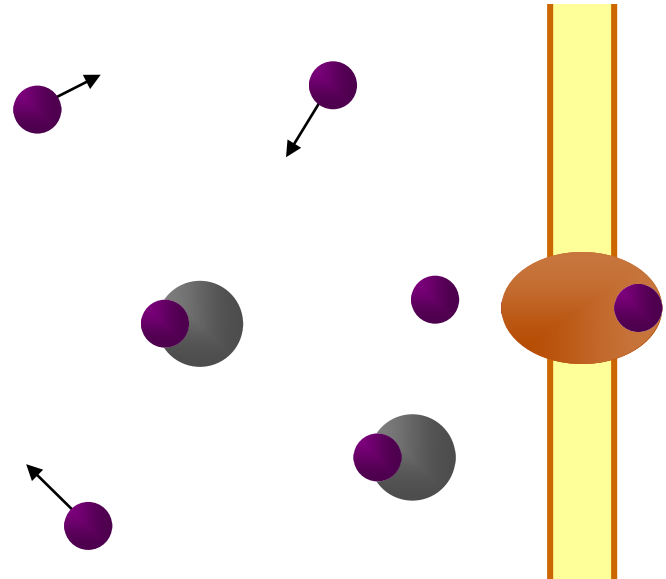
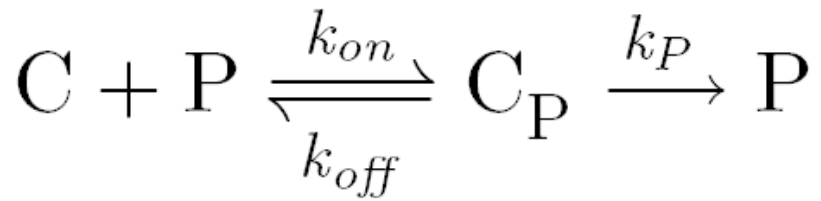
$$\frac{\partial C}{\partial t} = k_{\text{off}} C_B - k_{\text{on}} C B$$

$$\frac{\partial B}{\partial t} = k_{\text{off}} C_B - k_{\text{on}} C B$$

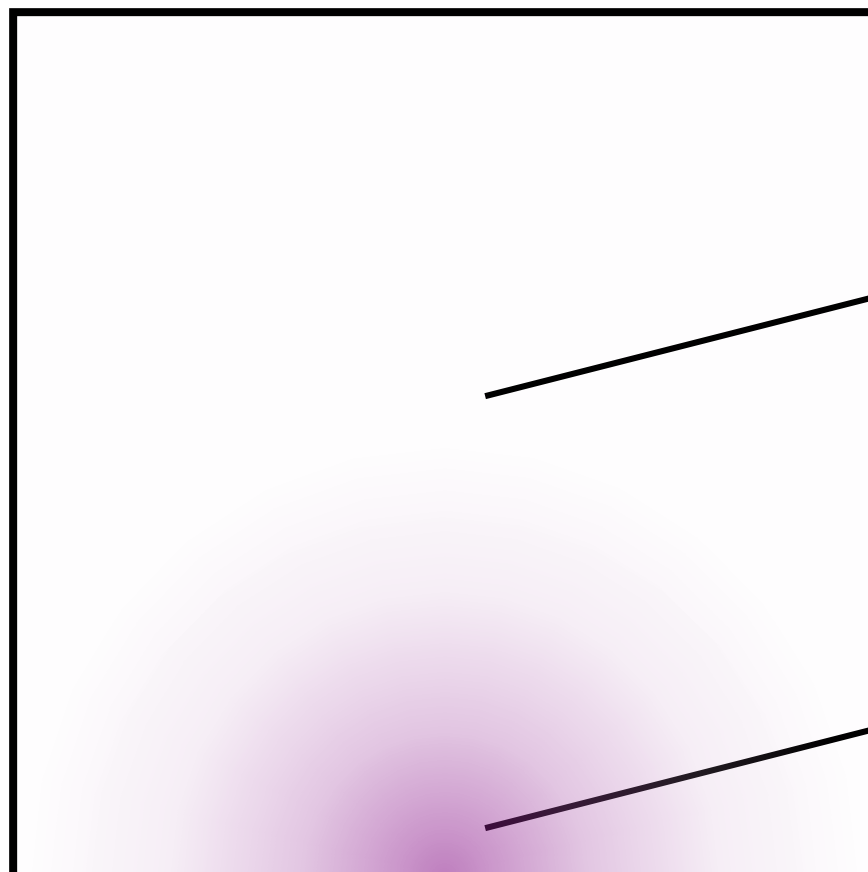
$$\frac{\partial C_B}{\partial t} = k_{\text{on}} C B - k_{\text{off}} C_B$$



Calcium Buffers

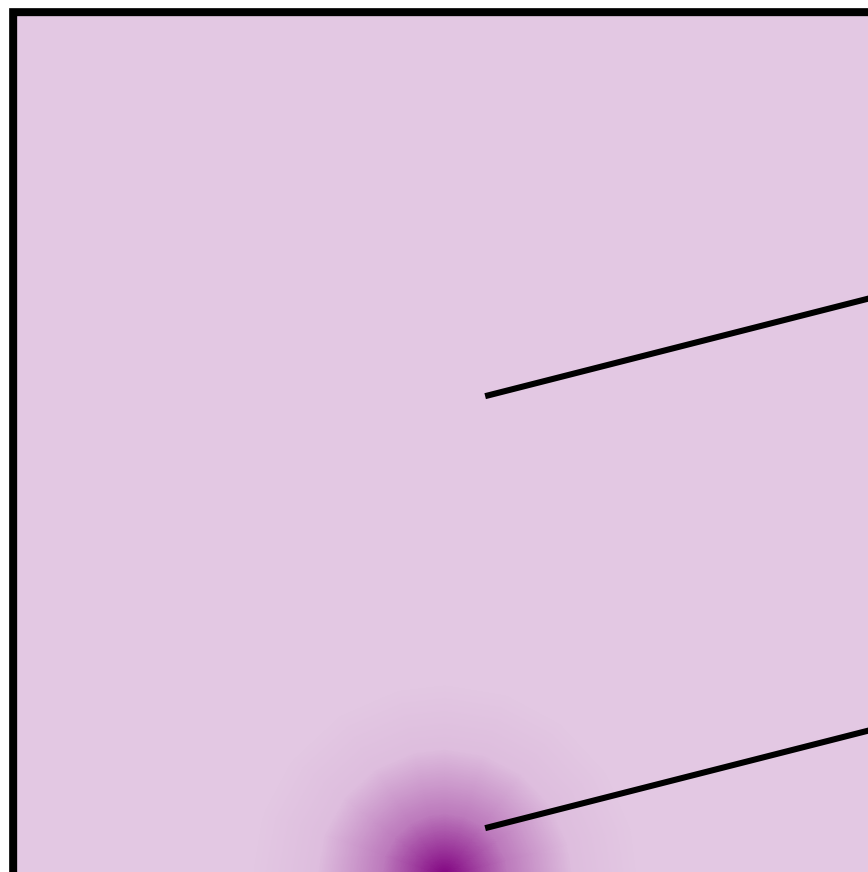


Membrane Calcium Pumps



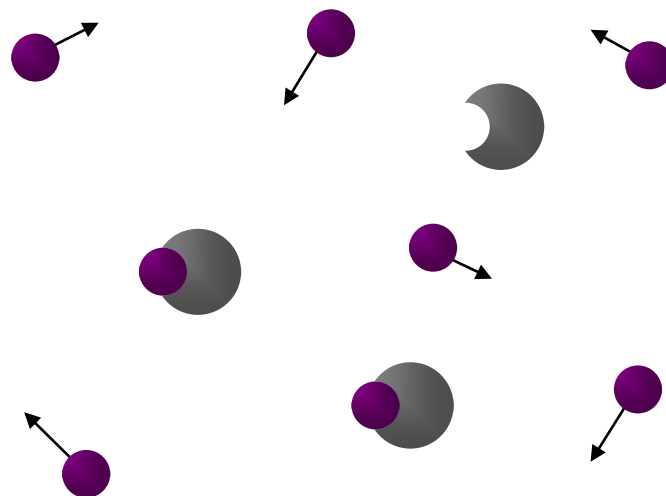
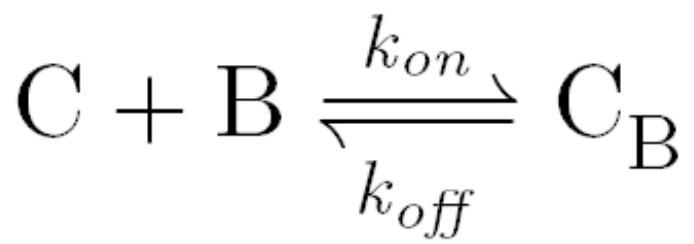
global calcium

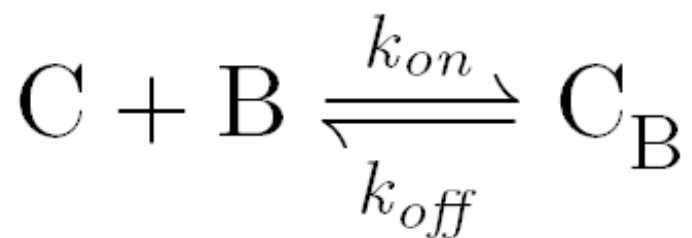
local calcium



global calcium

local calcium



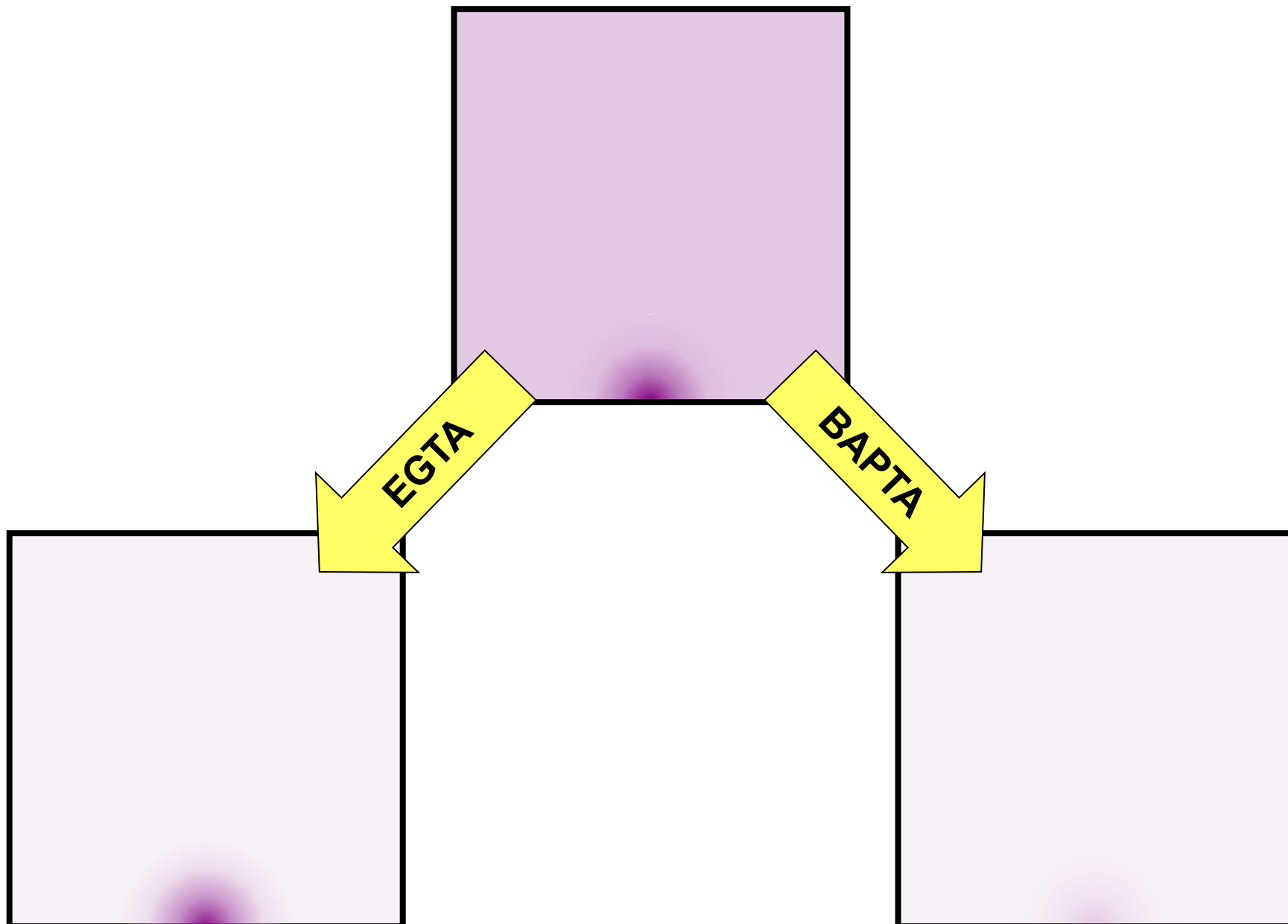


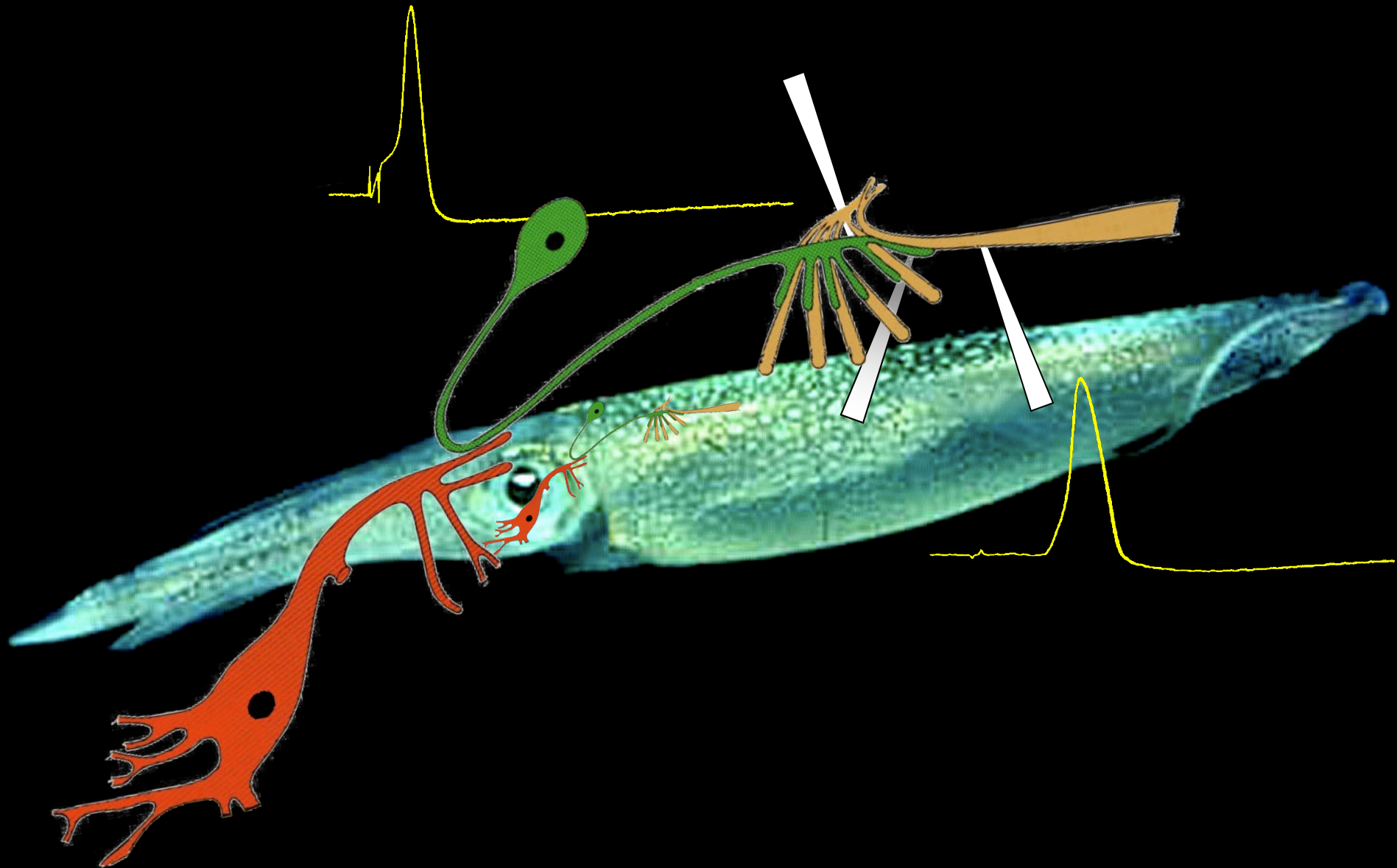
$$EGTA \ k_{on} = 1.5 \times 10^6 \text{ M}^{-1}\text{s}^{-1}$$

$$k_{off} = 0.3 \text{ s}^{-1}$$

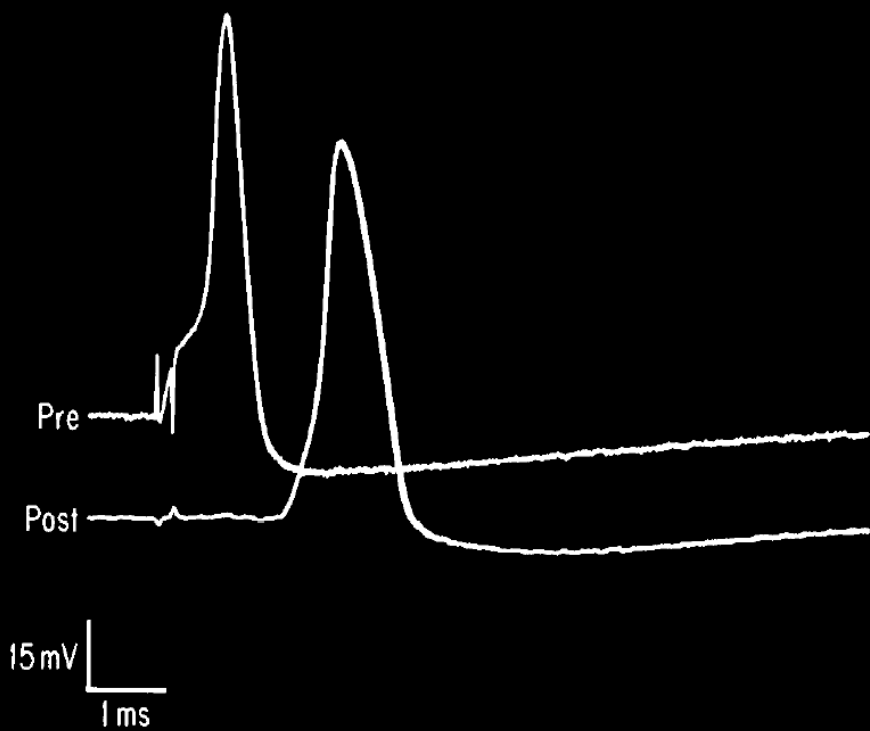
$$BAPTA \ k_{on} = 6 \times 10^8 \text{ M}^{-1}\text{s}^{-1}$$

$$k_{off} = 97 \text{ s}^{-1}$$

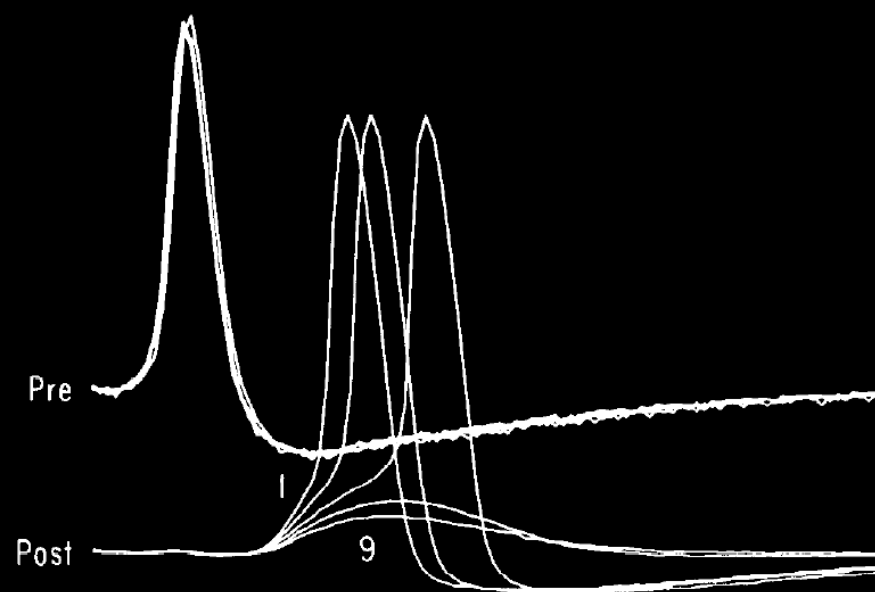




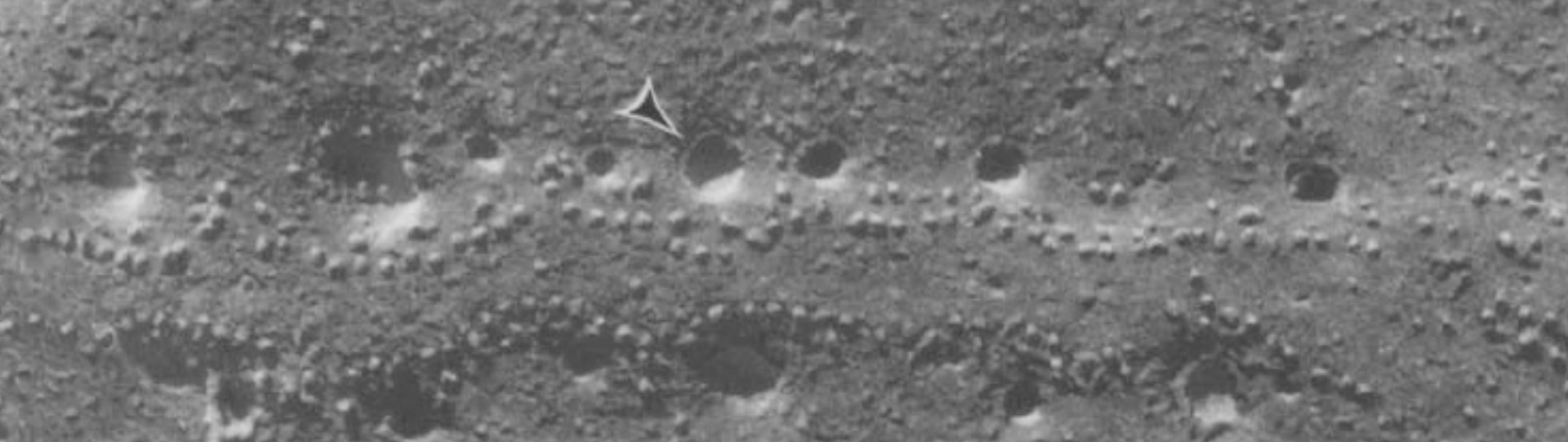
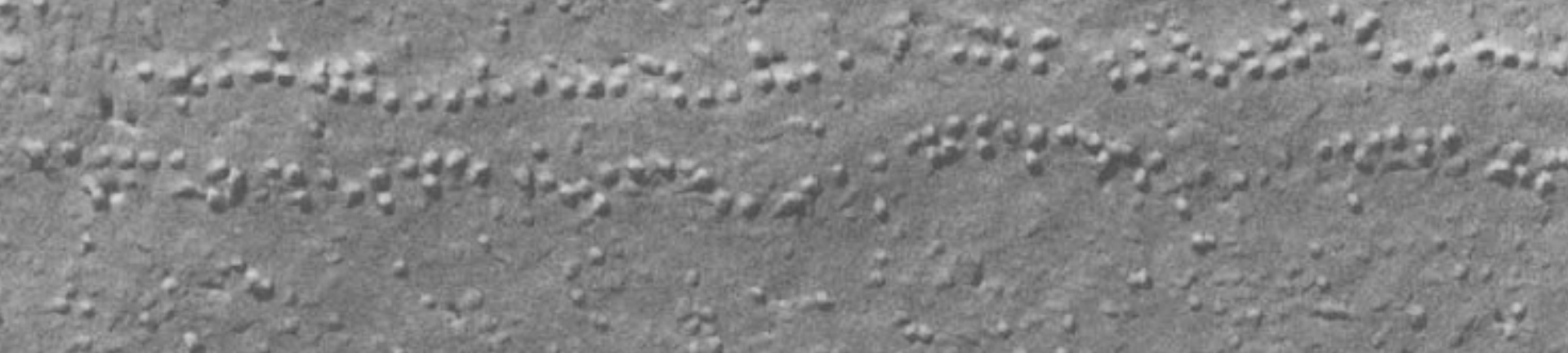
Squid giant synapse

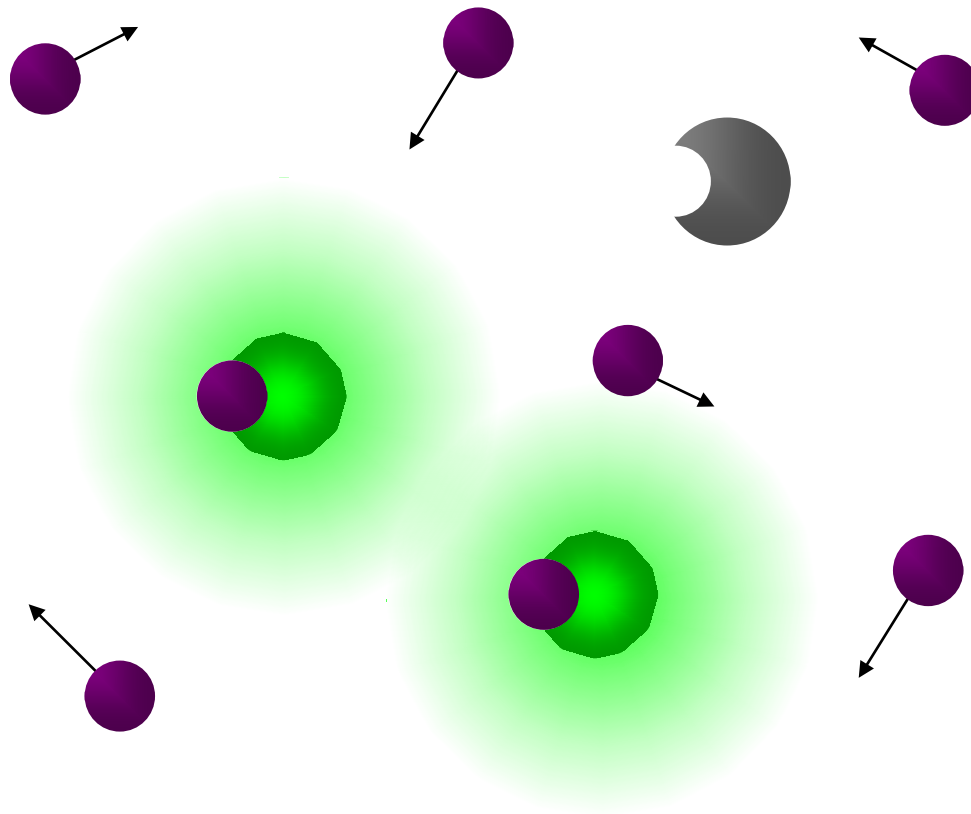


EGTA

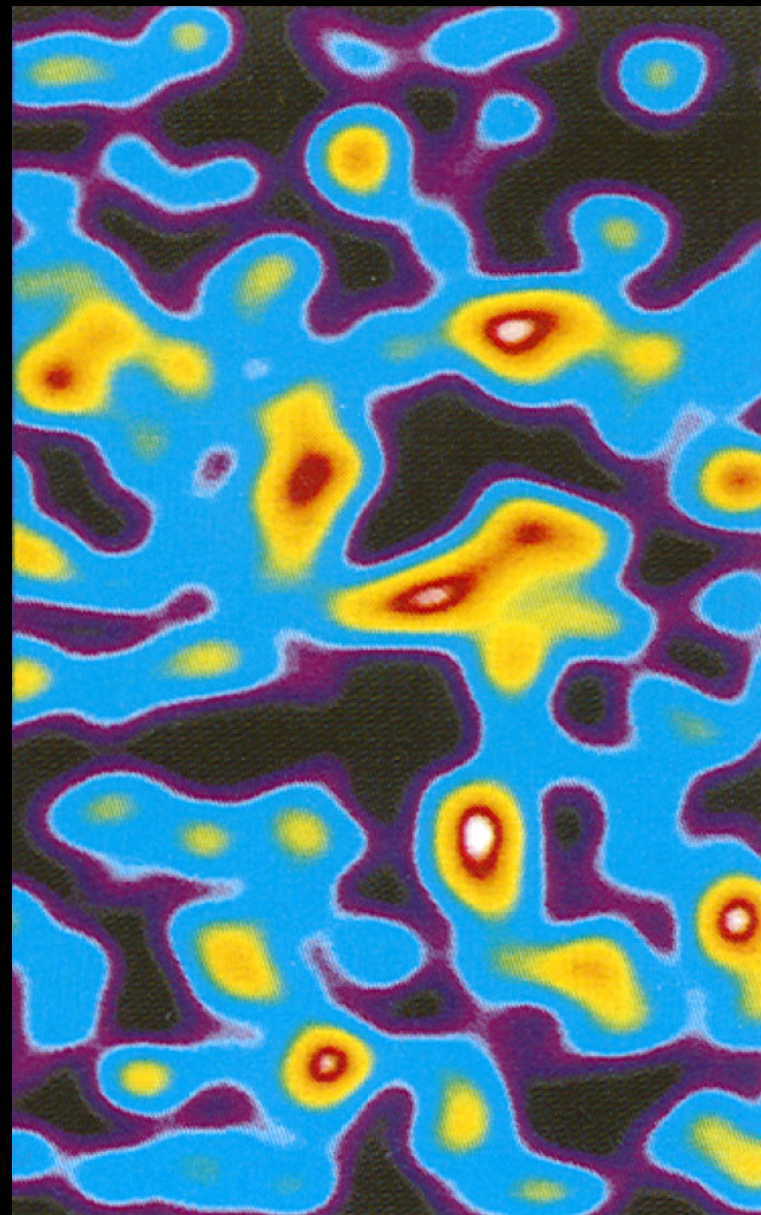
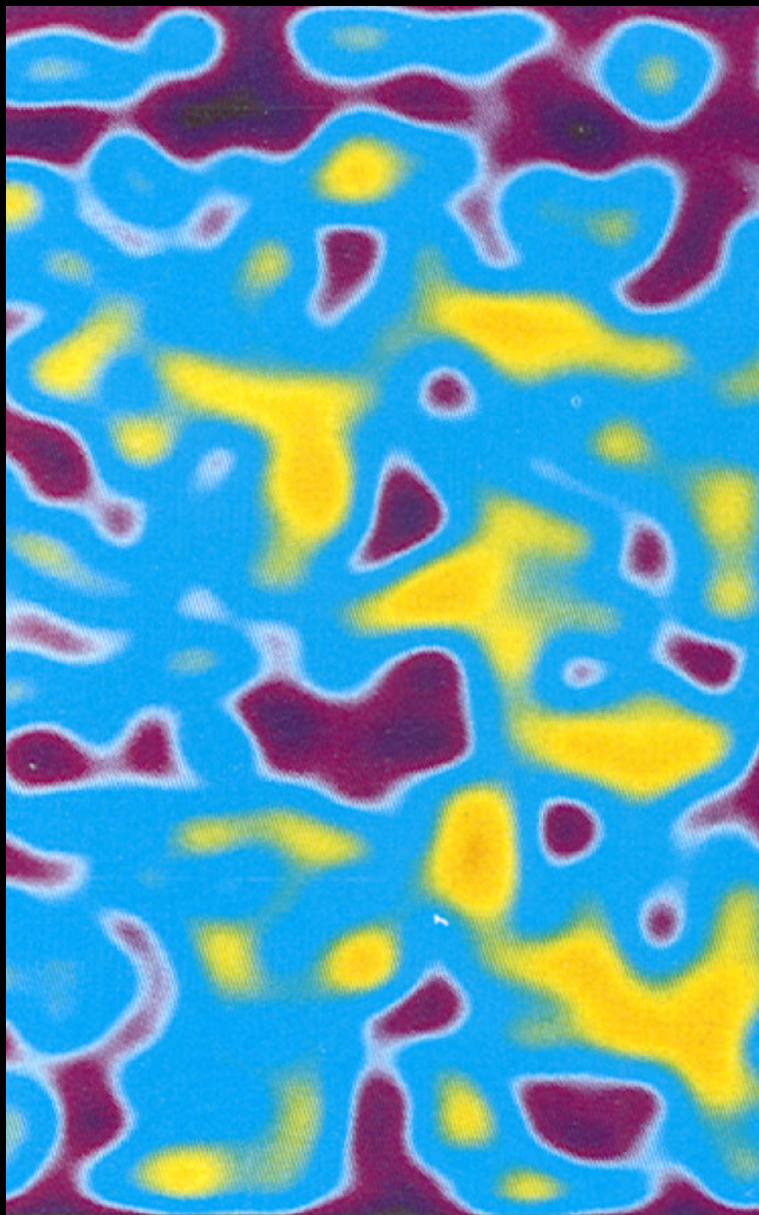


BAPTA



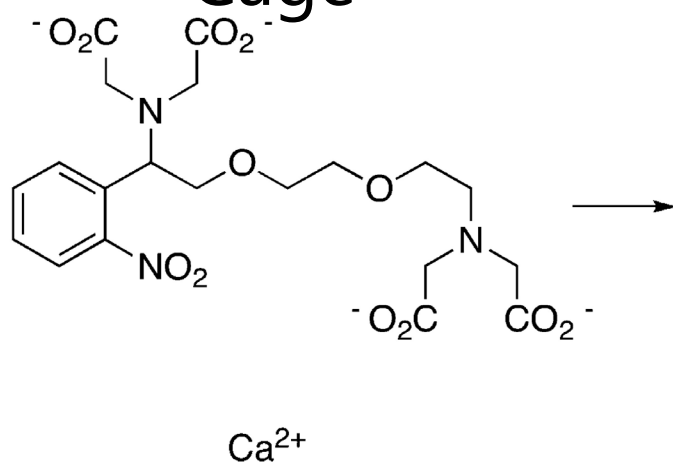


Fluorescent Calcium Dyes

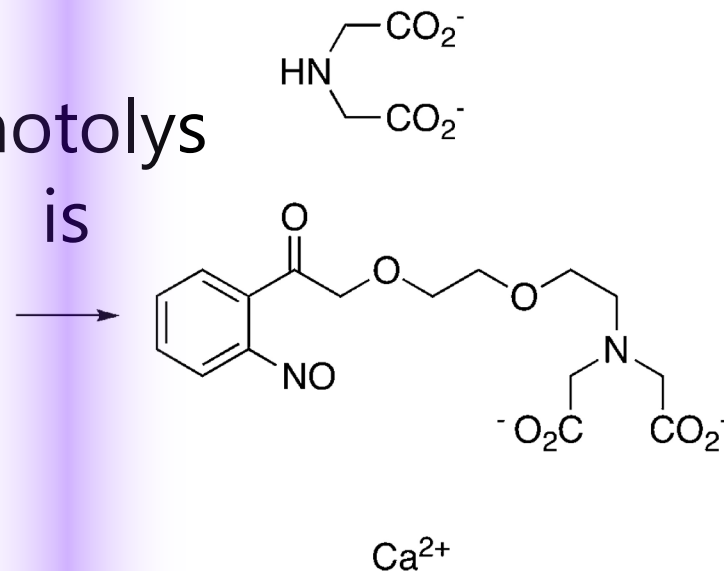
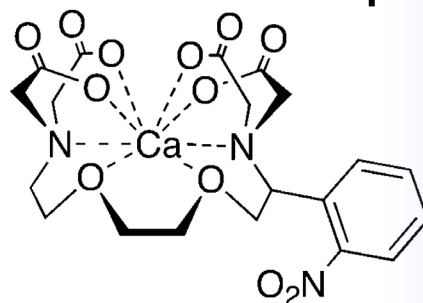


10 μm

Calcium Cage

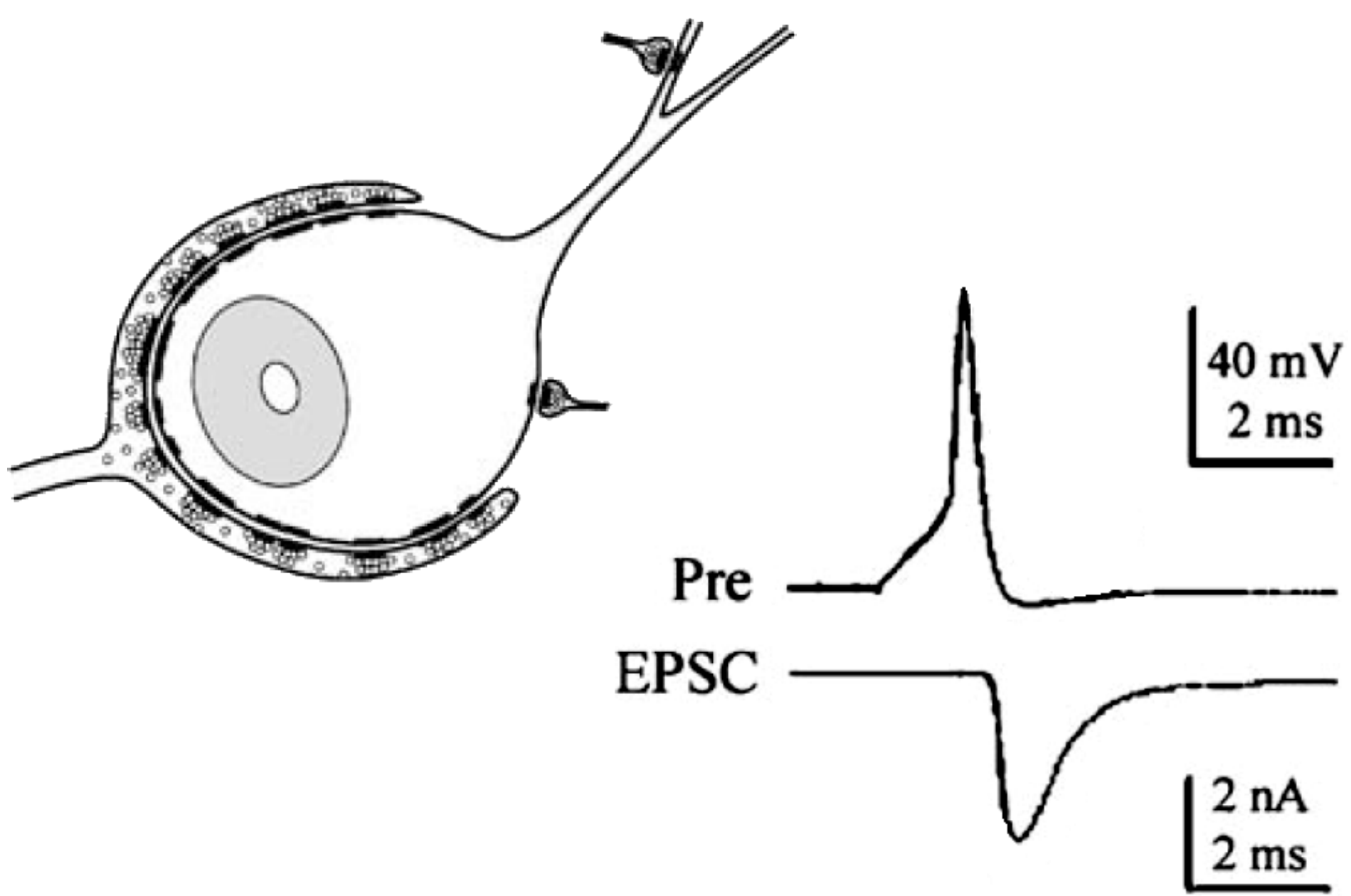


photolysis
is

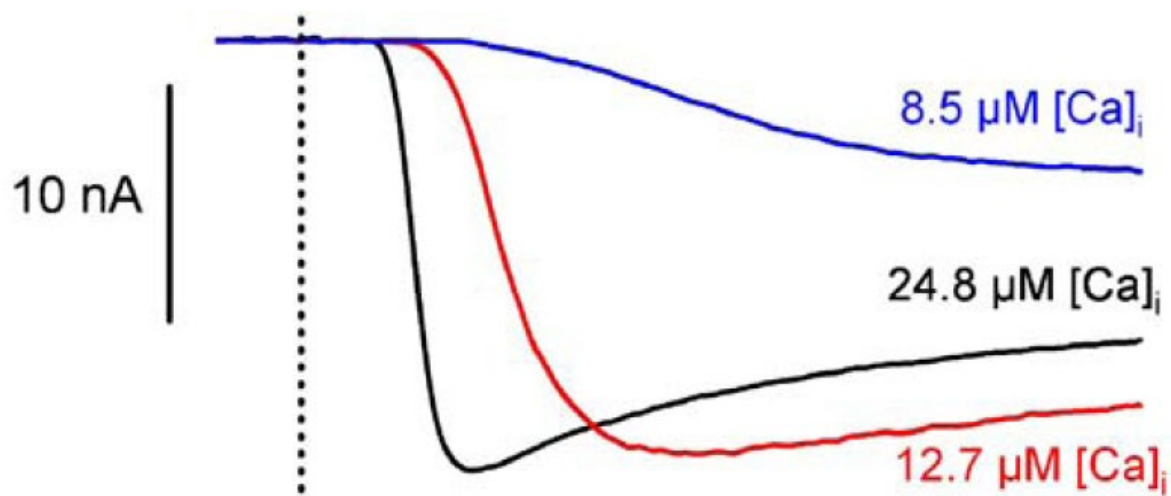
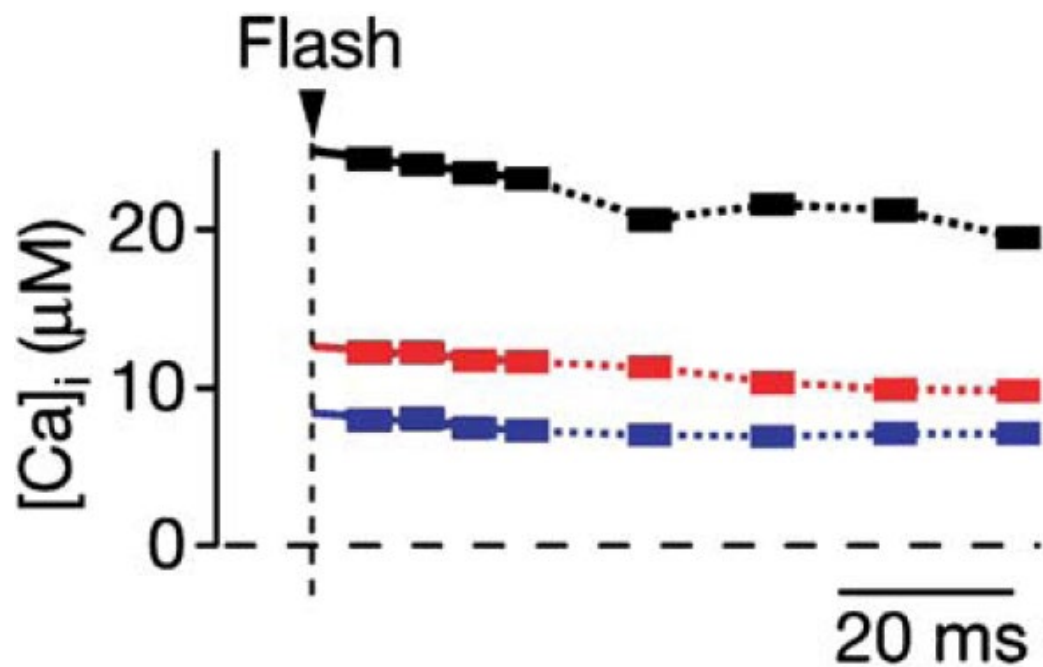
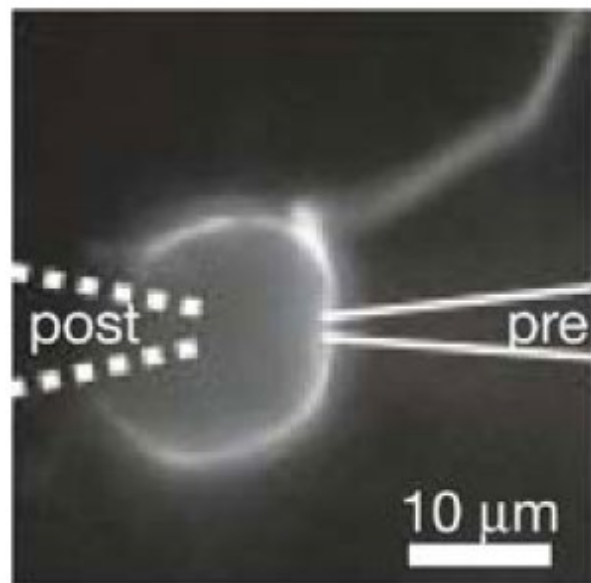


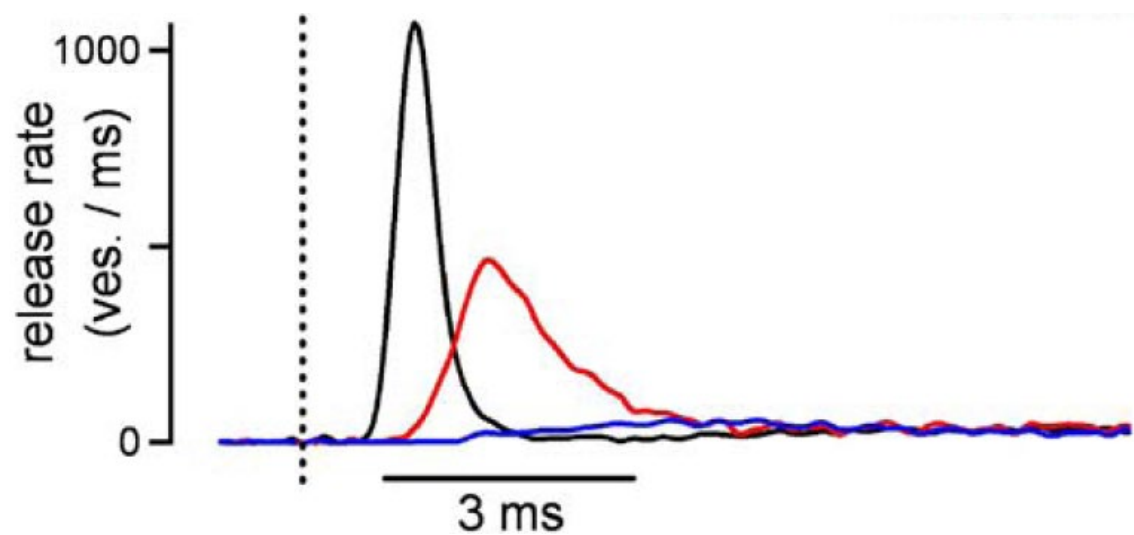
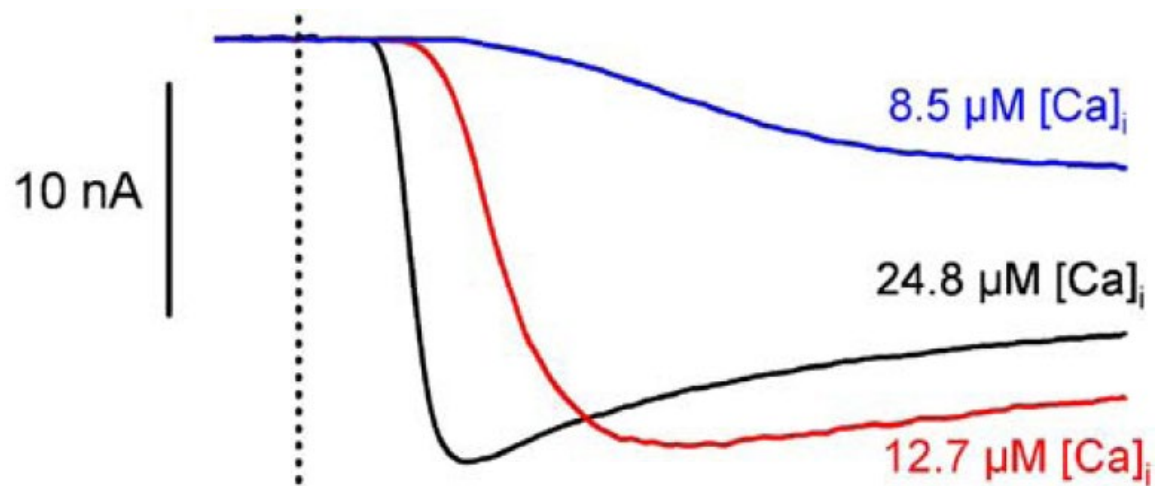
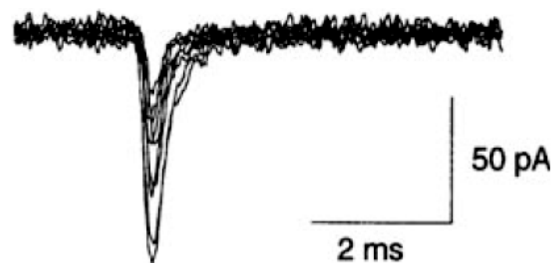
Caged
Calcium

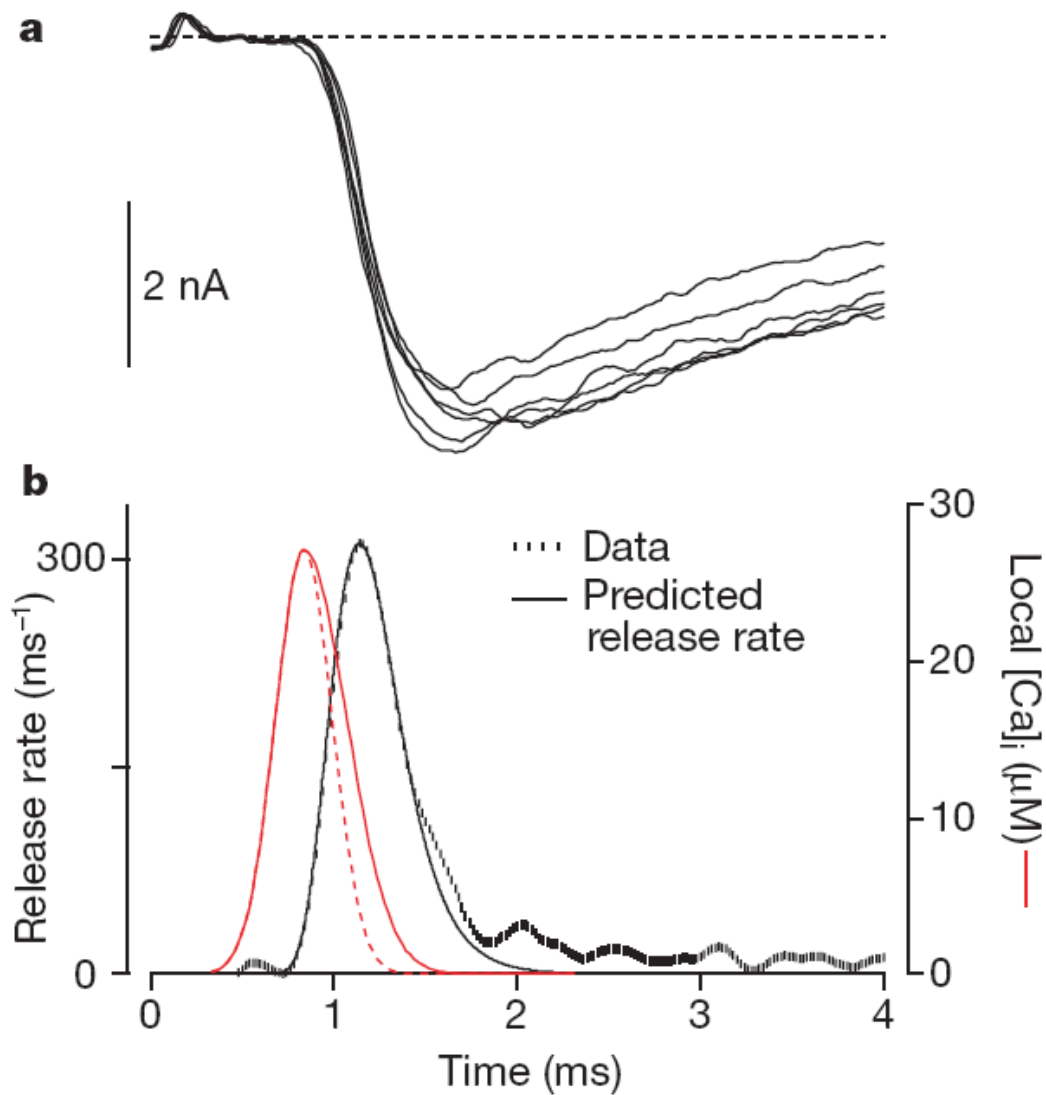
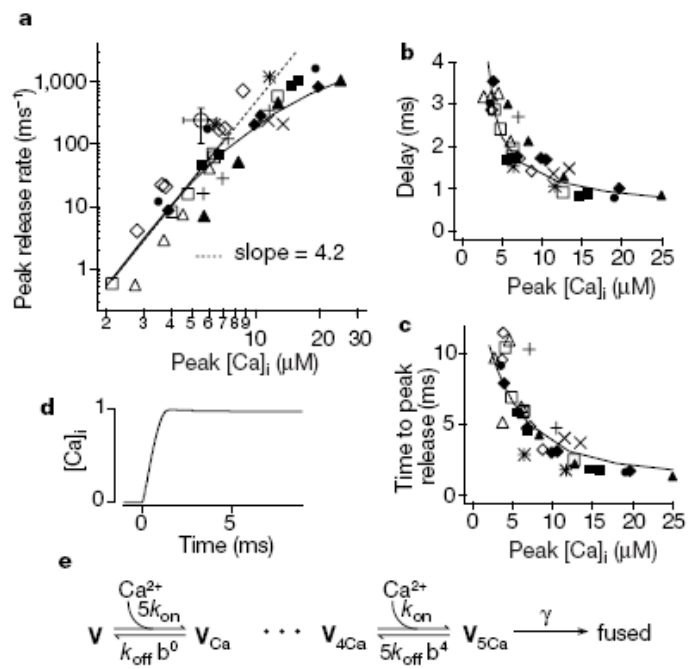
Uncaged
Calcium



The Calyx of Held







Until next time...

