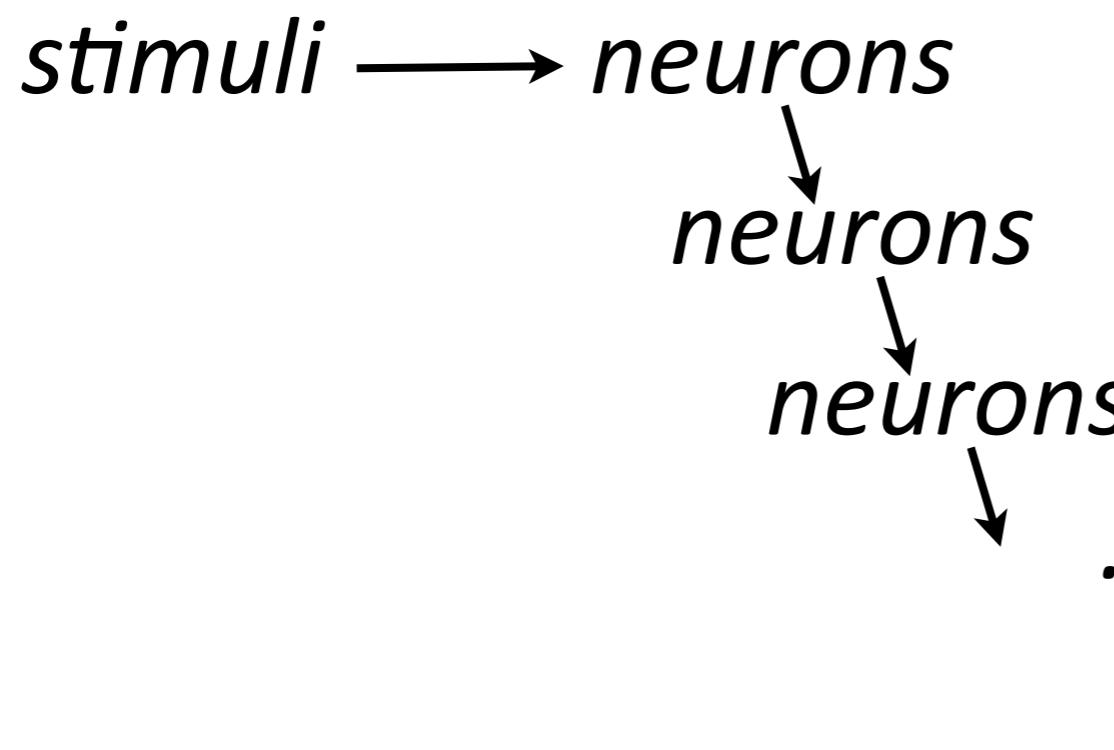


# *Neuroscience Workshop*

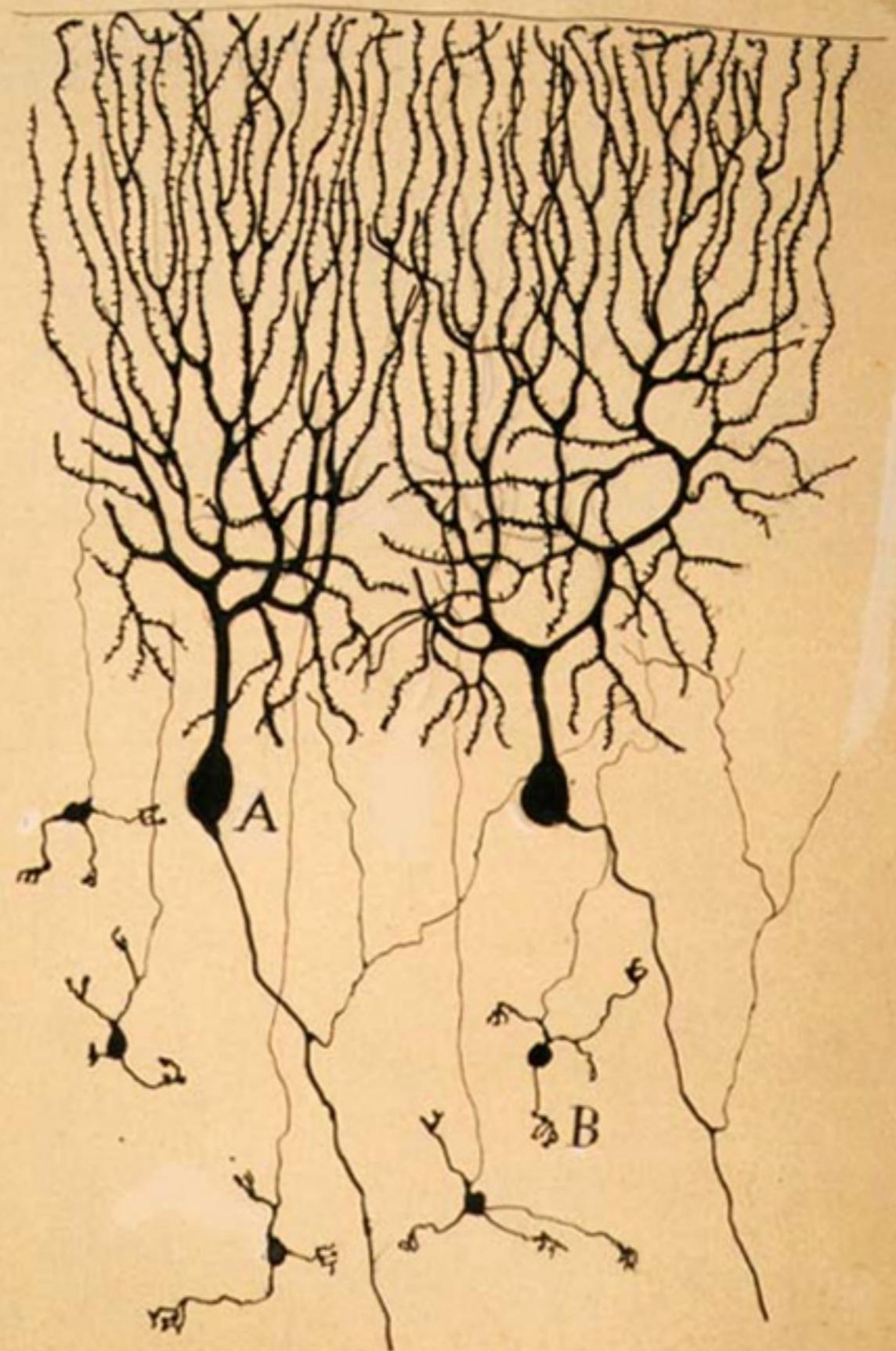
*Stephanie Palmer*

*Marie Greaney*

*...special thanks to the Freedman Lab*

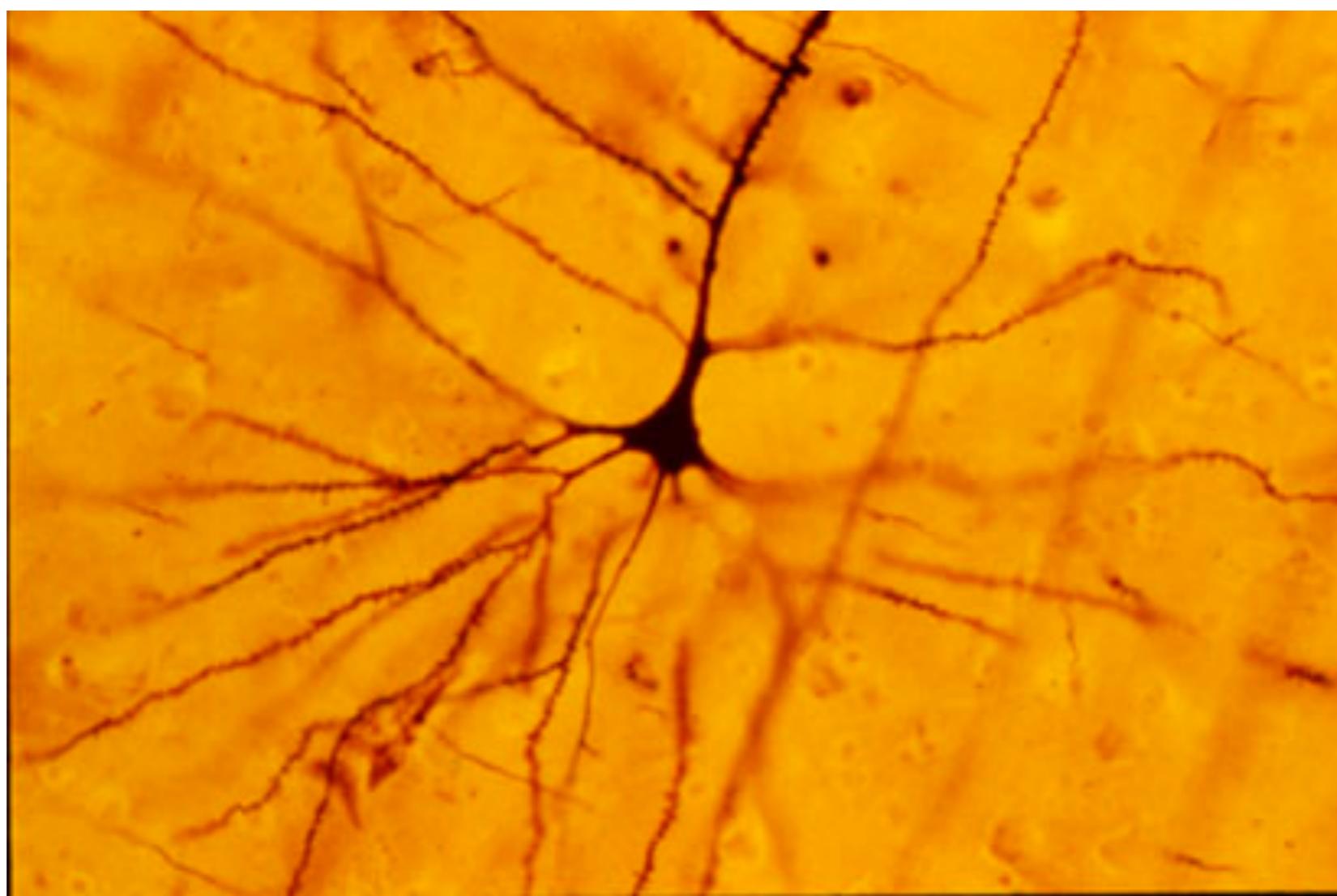


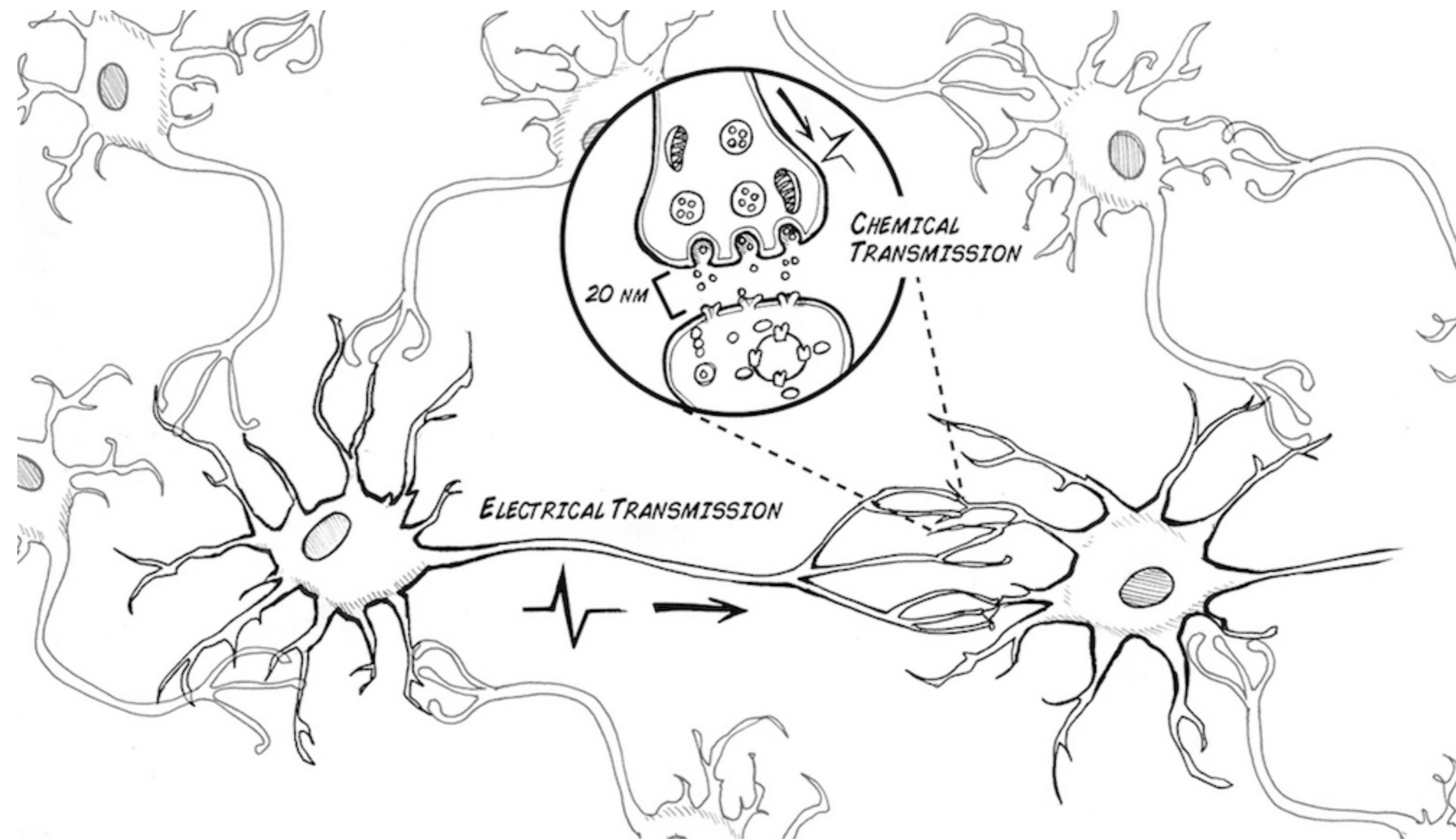




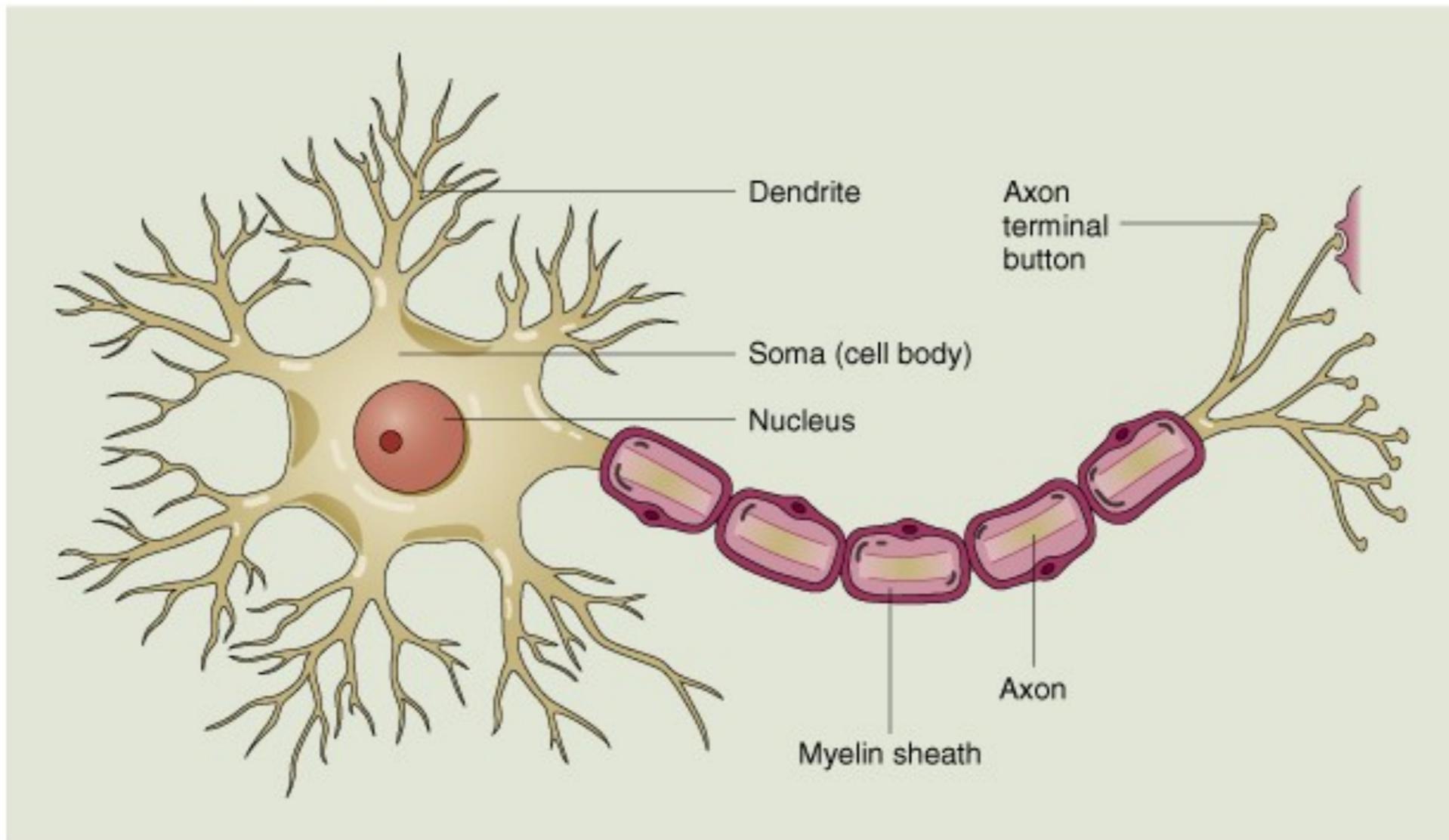
MUSEO CAJAL  
1952  
MADRID

Gantere  
en ferio  
o cerca

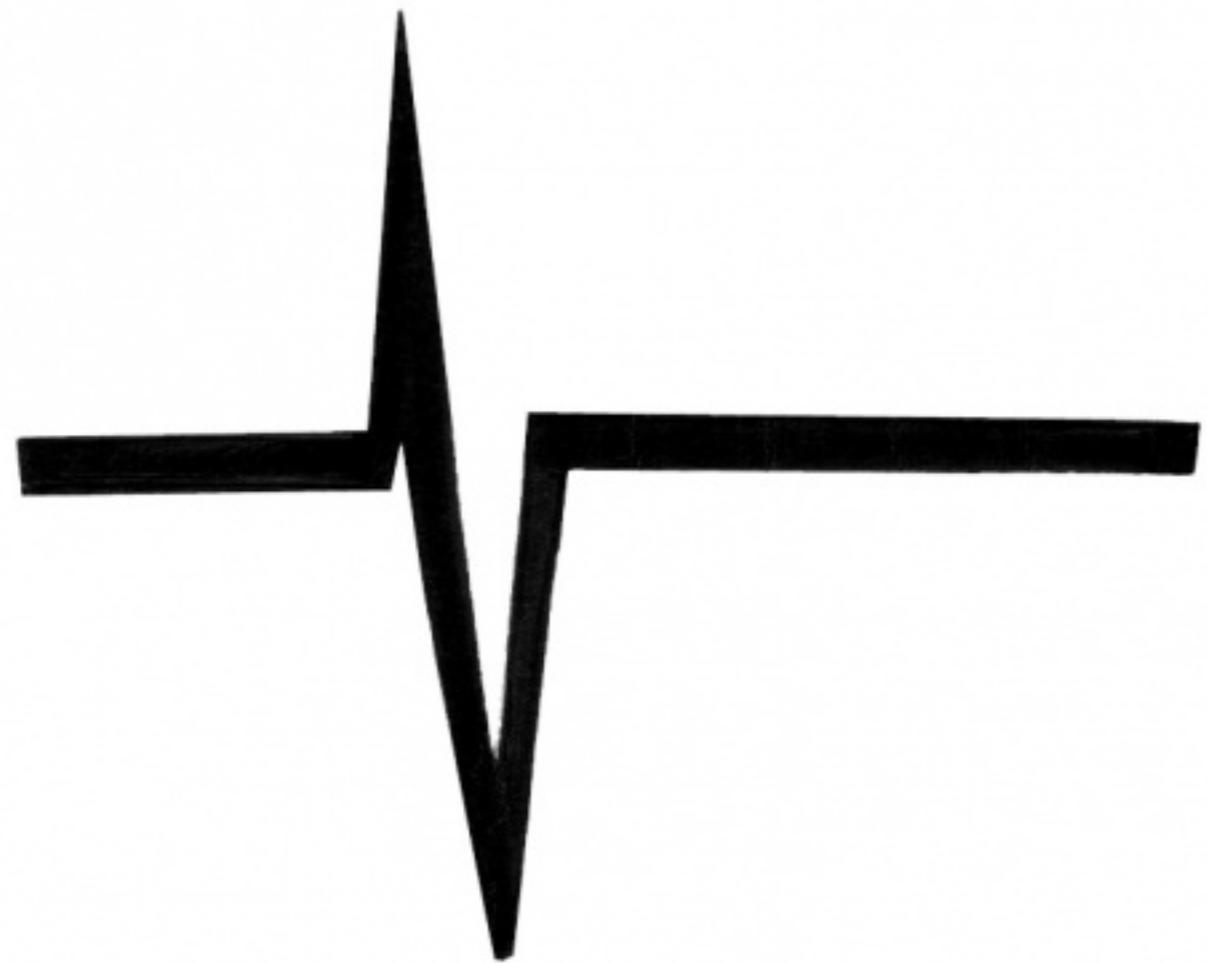




# *Anatomy of a neuron:*

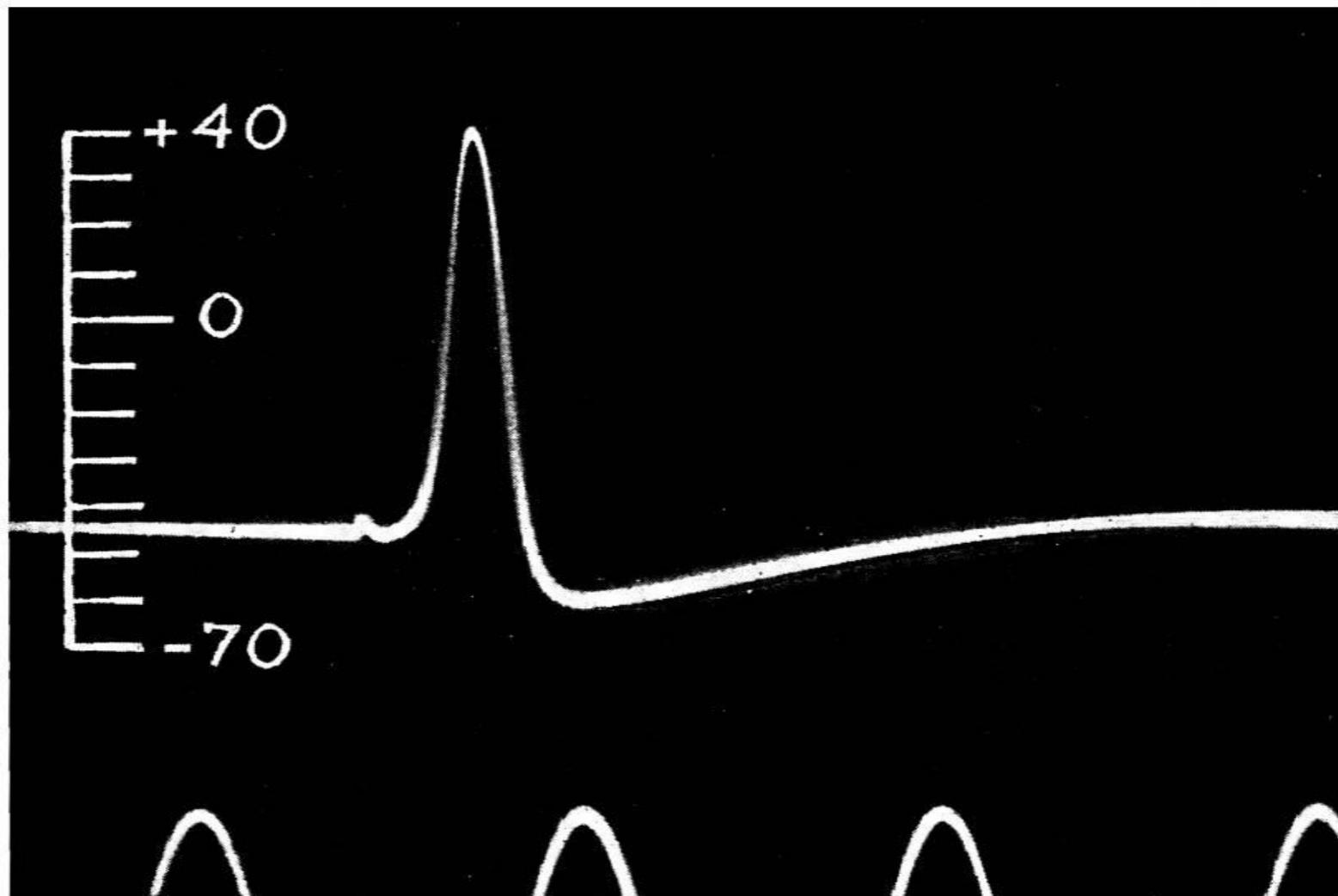


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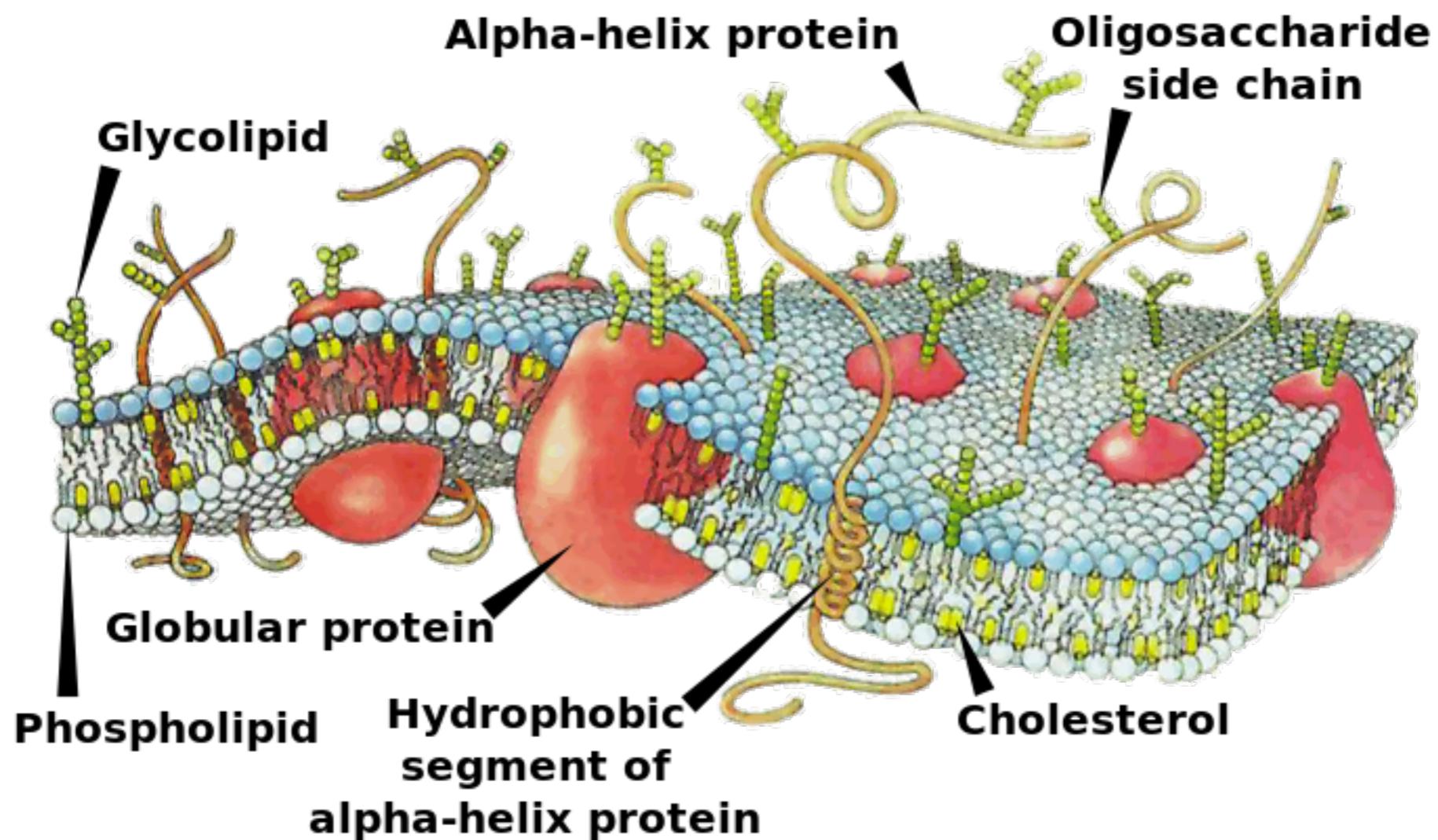


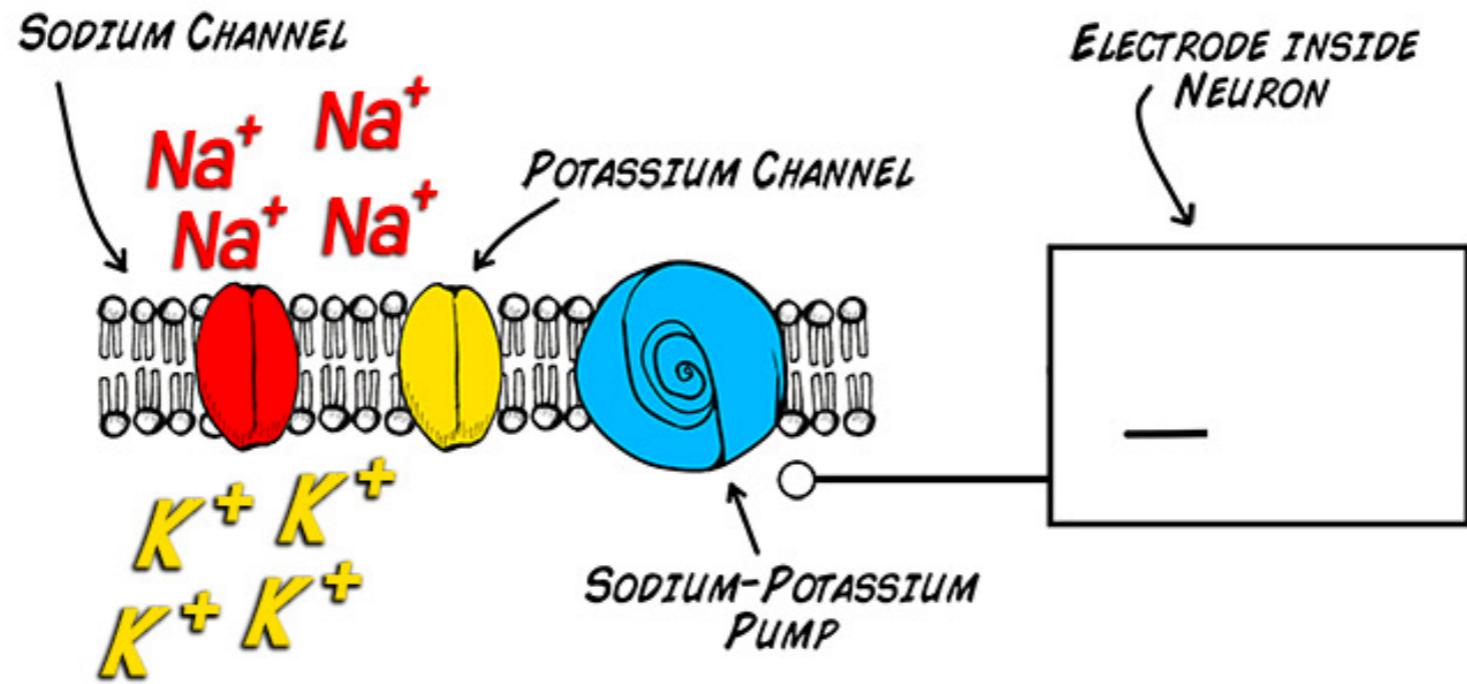
***SPIKE!***

*Electrical response from a neuron:*

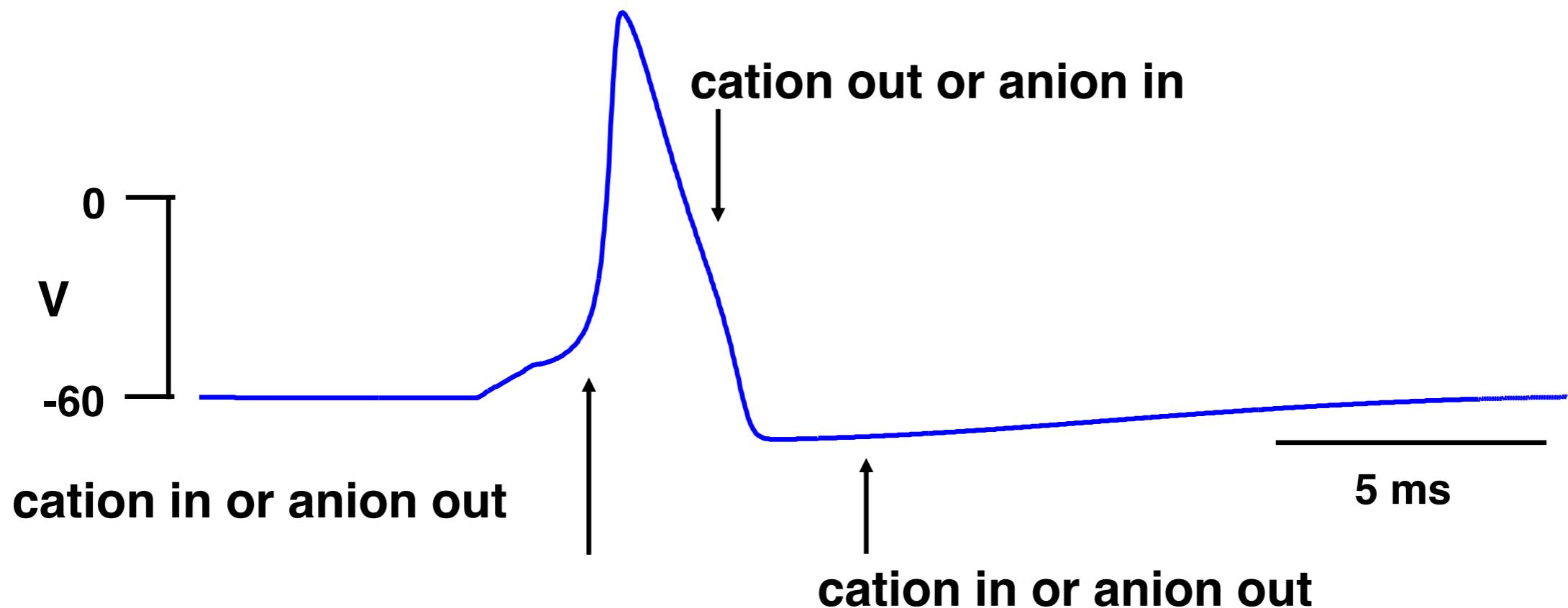


# *Some basics:*

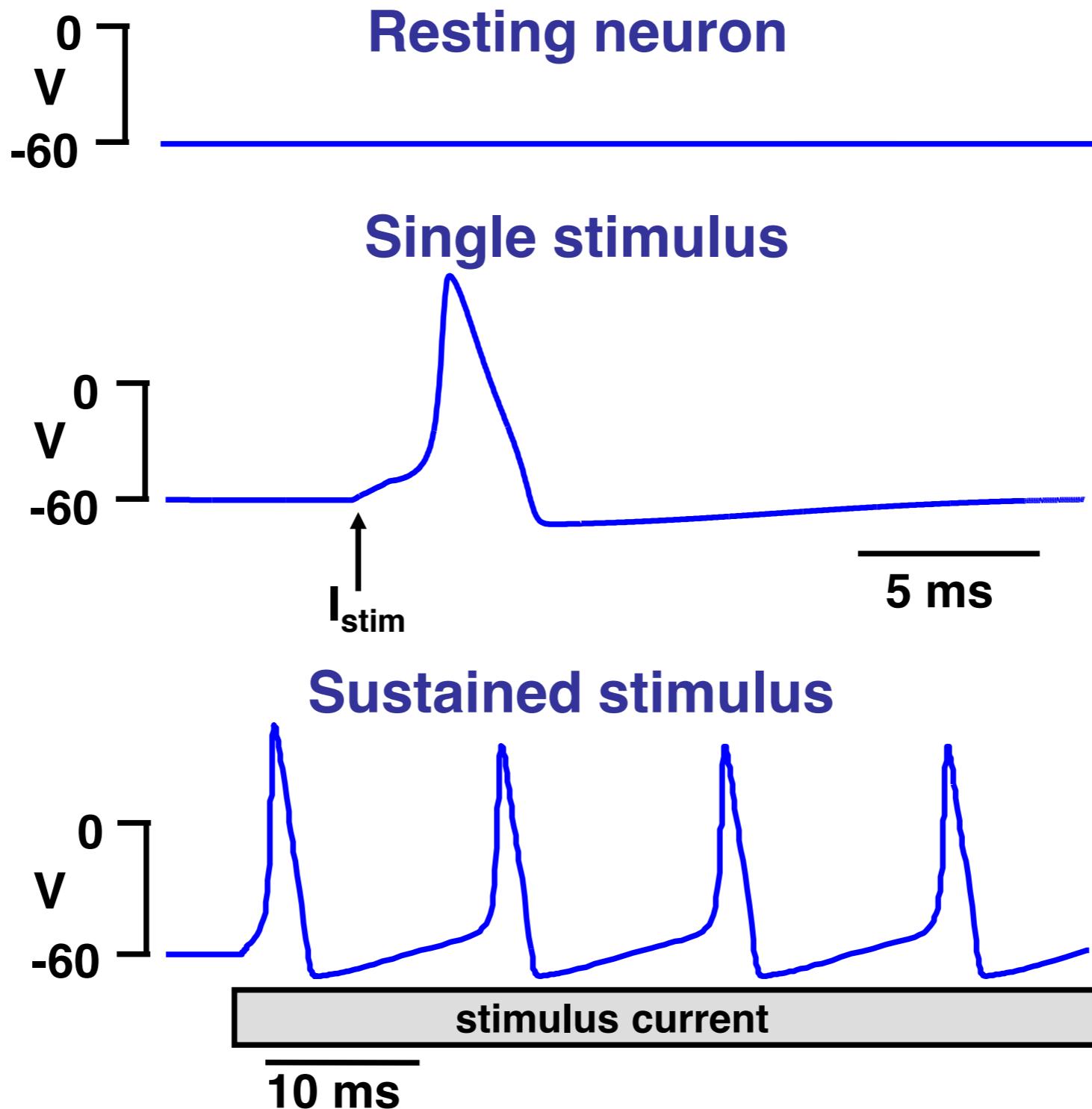




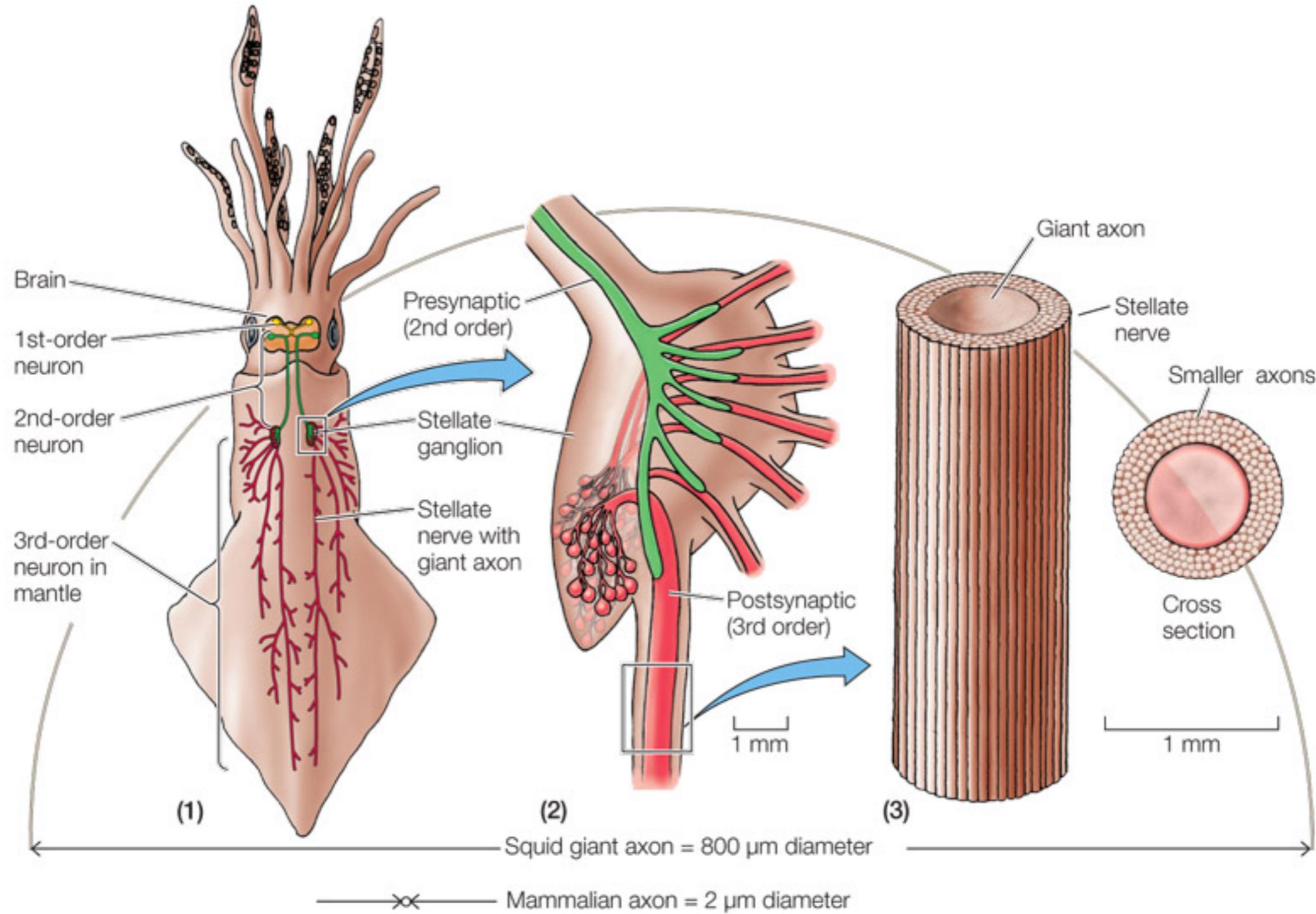
*We seek a quantitative description of this behavior:*



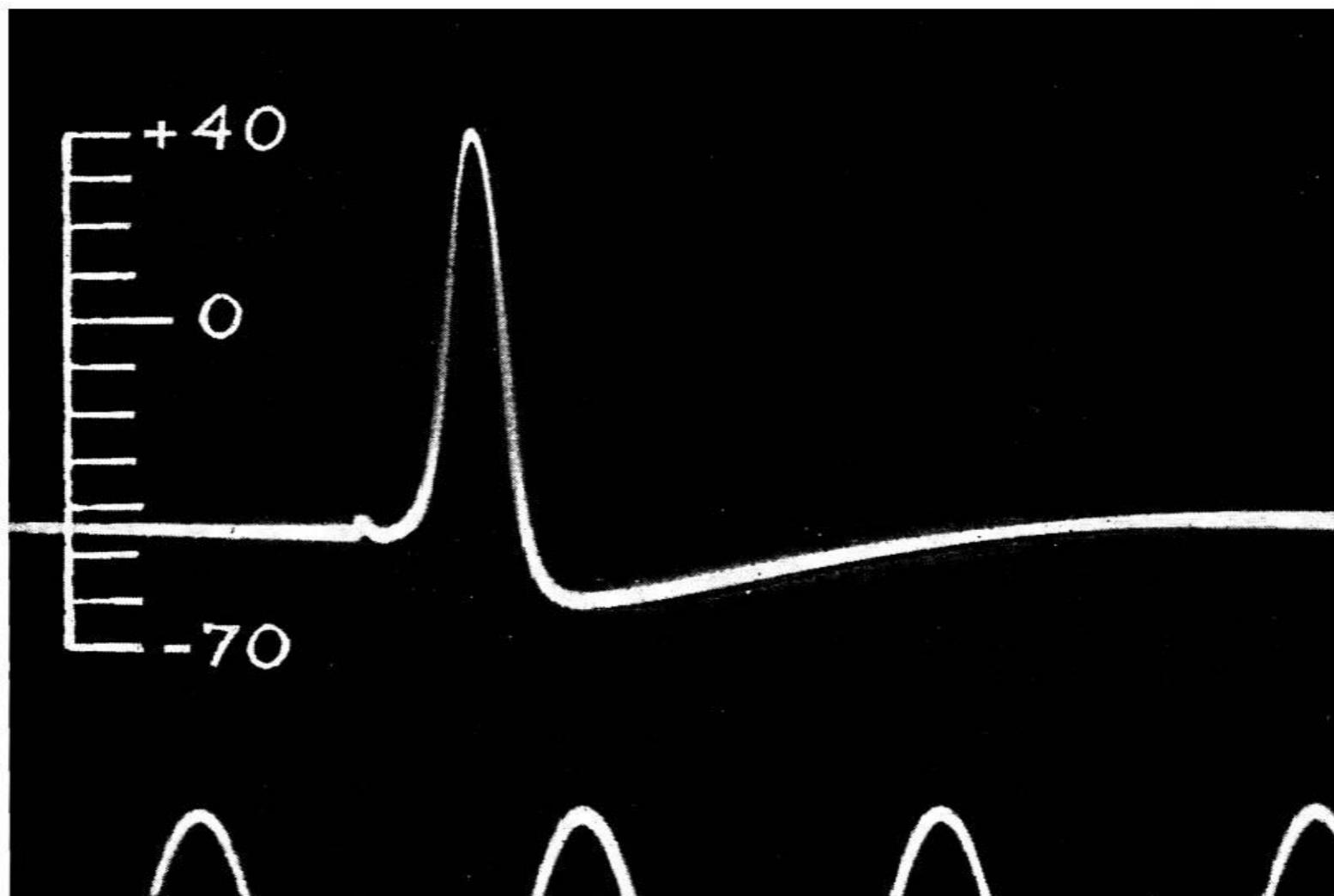
# *Properties of spiking:*



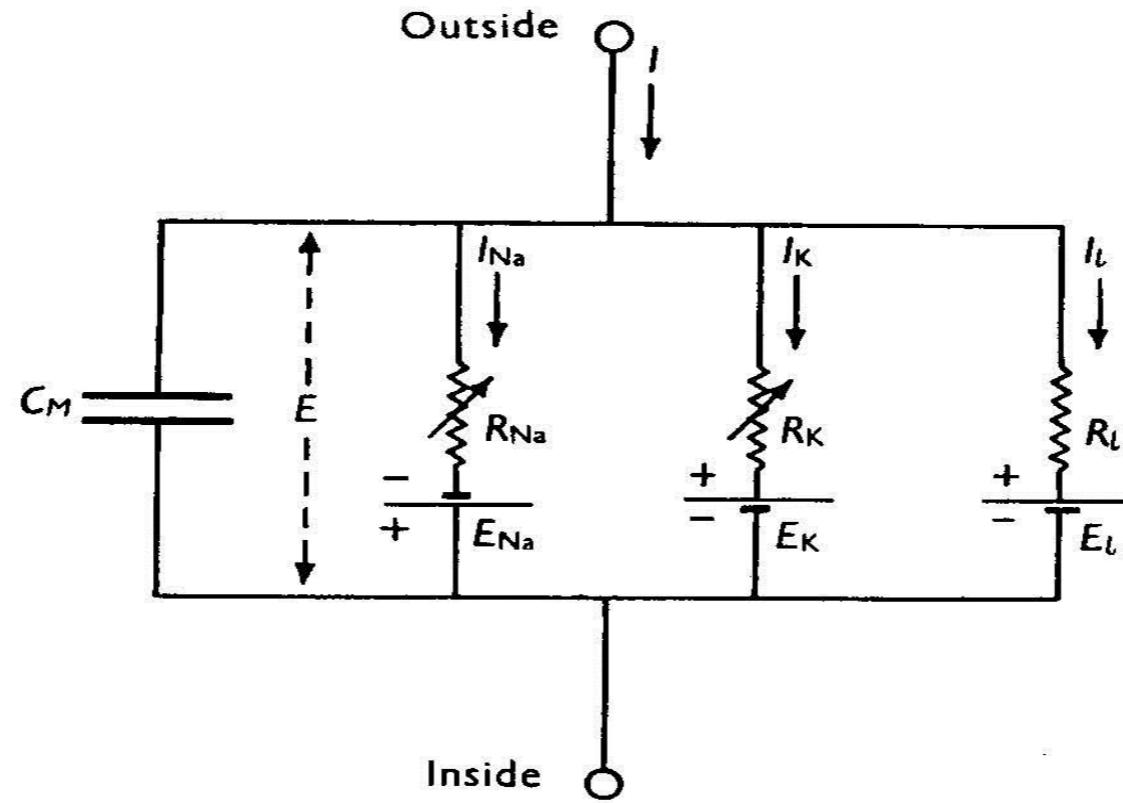
# Squid giant axon:



# *The 1939 letter to Nature:*



# The final model:



**Hodgkin & Huxley (1952), J. Physiol. 117:400.**

$$C_m \frac{dV}{dt} = -g_L(V - V_L) - \bar{g}_{Na} m^3 h (V - V_{Na}) - \bar{g}_K n^4 (V - V_K)$$

$$\frac{dm}{dt} = \alpha_m(V)(1-m) - \beta_m(V)m$$

$$\alpha_m = 0.1(V_m + 35.0)/(1 - e^{-(V_m + 35.0)/10.0})$$

$$\beta_m = 4.0 e^{-(V_m + 60.0)/18.0}$$

$$\frac{dh}{dt} = \alpha_h(V)(1-h) - \beta_h(V)h$$

$$\alpha_h = 0.07 e^{-(V_m + 60.0)/20.0}$$

$$\frac{dn}{dt} = \alpha_n(V)(1-n) - \beta_n(V)n$$

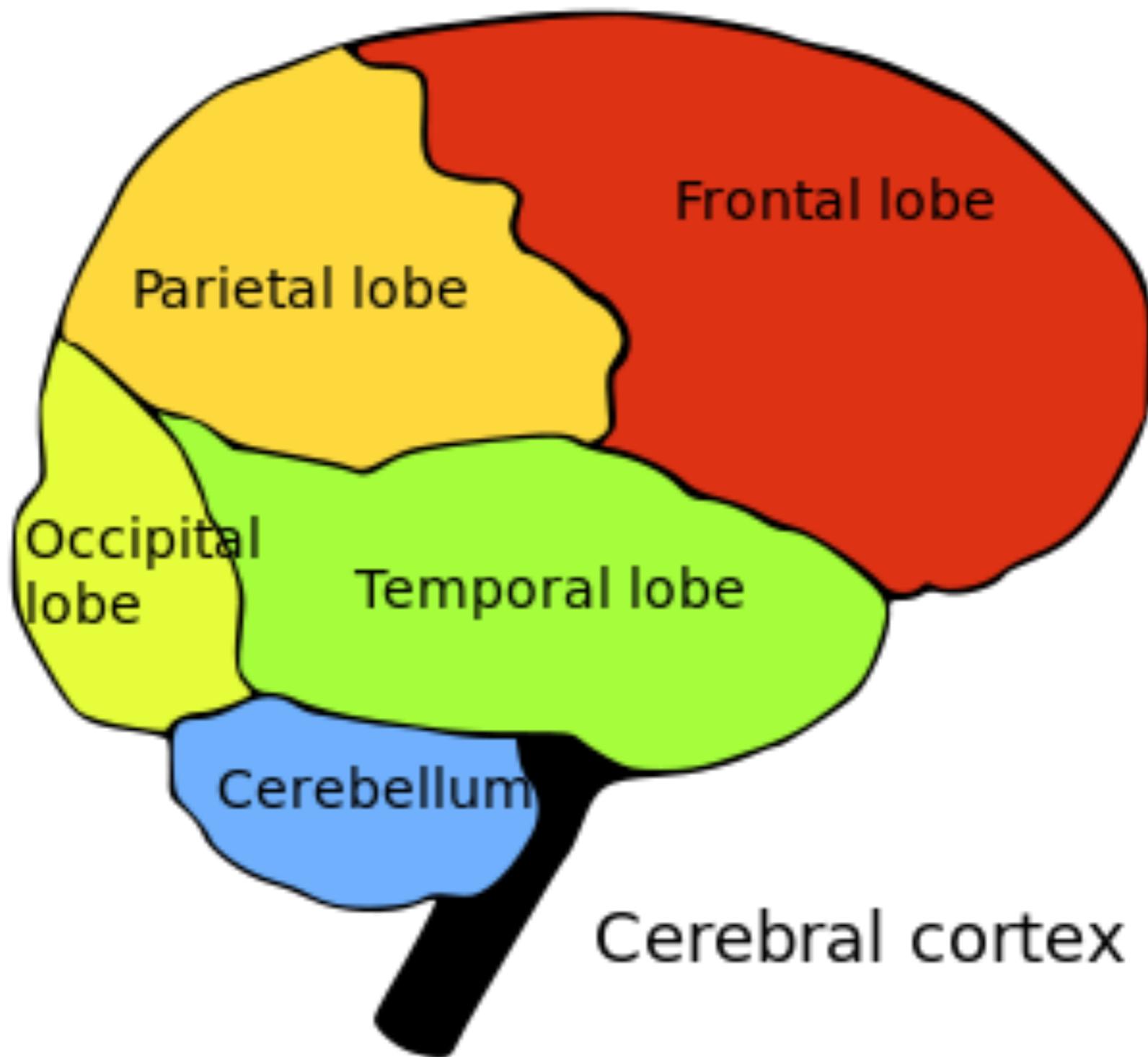
$$\beta_h = 1/(1 + e^{-(V_m + 30.0)/10.0})$$

$$\alpha_n = 0.01(V_m + 50.0)/(1 - e^{-(V_m + 50.0)/10.0})$$

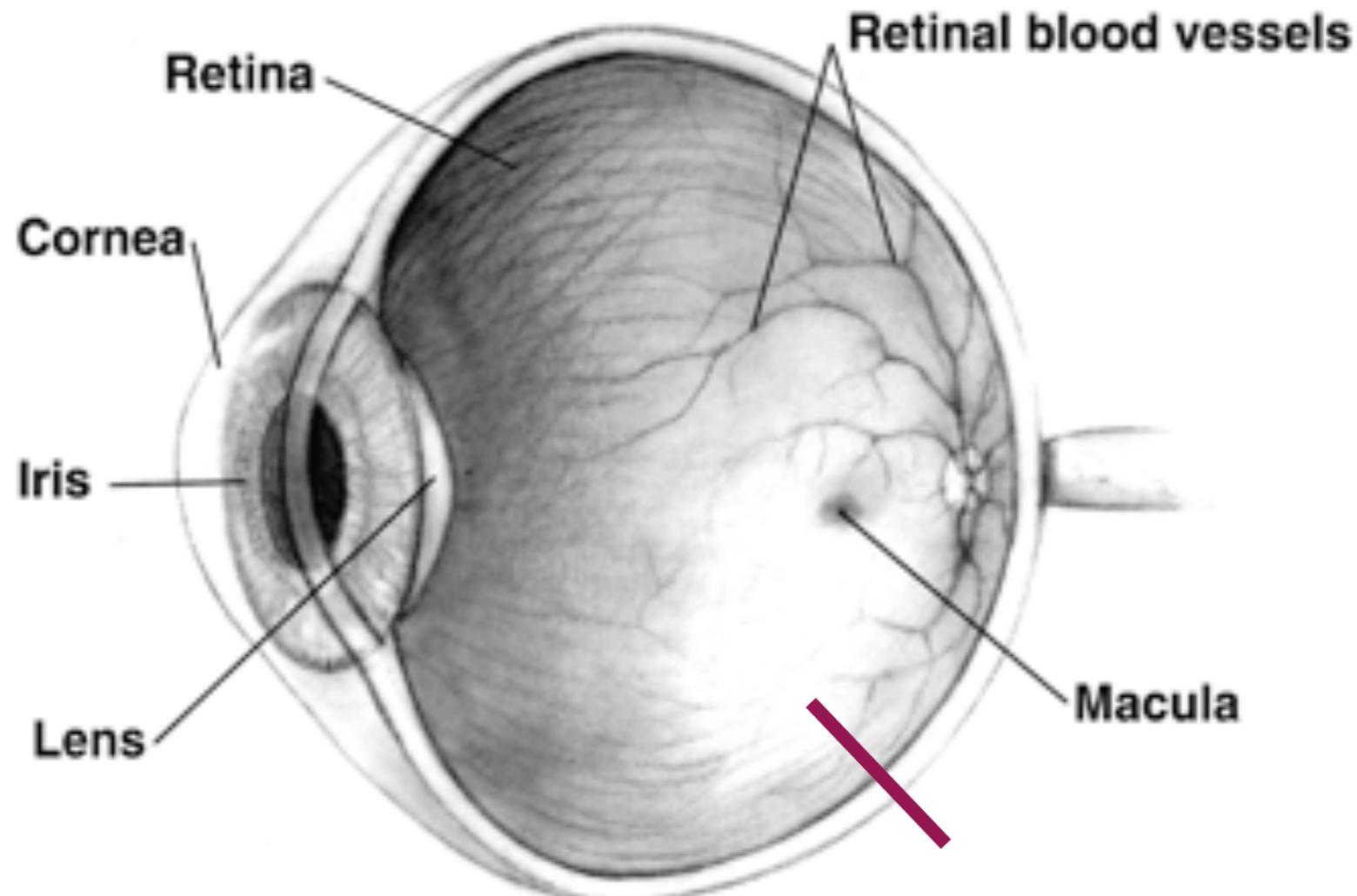
$$\beta_n = 0.125 e^{-(V_m + 60.0)/80.0}$$



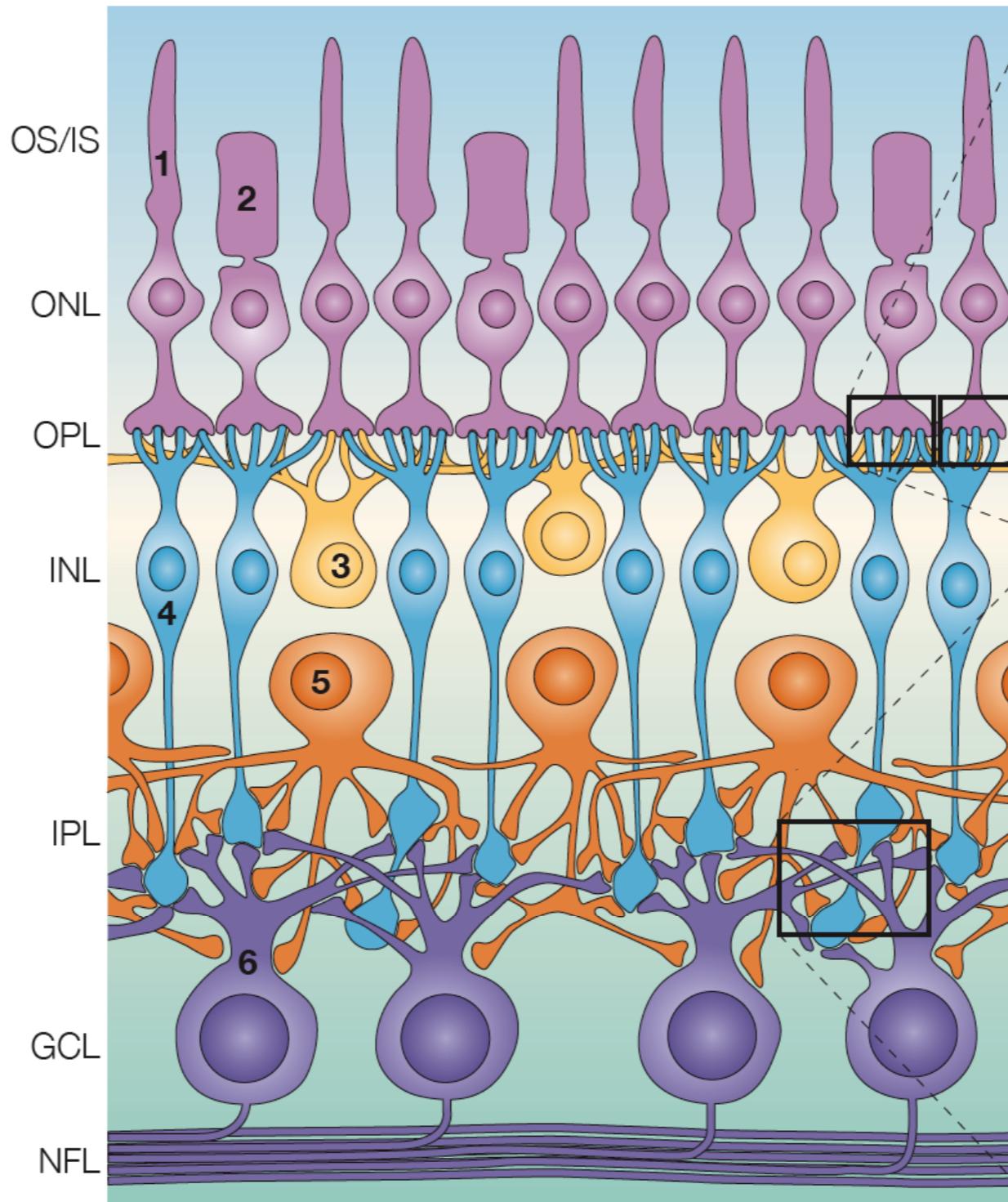




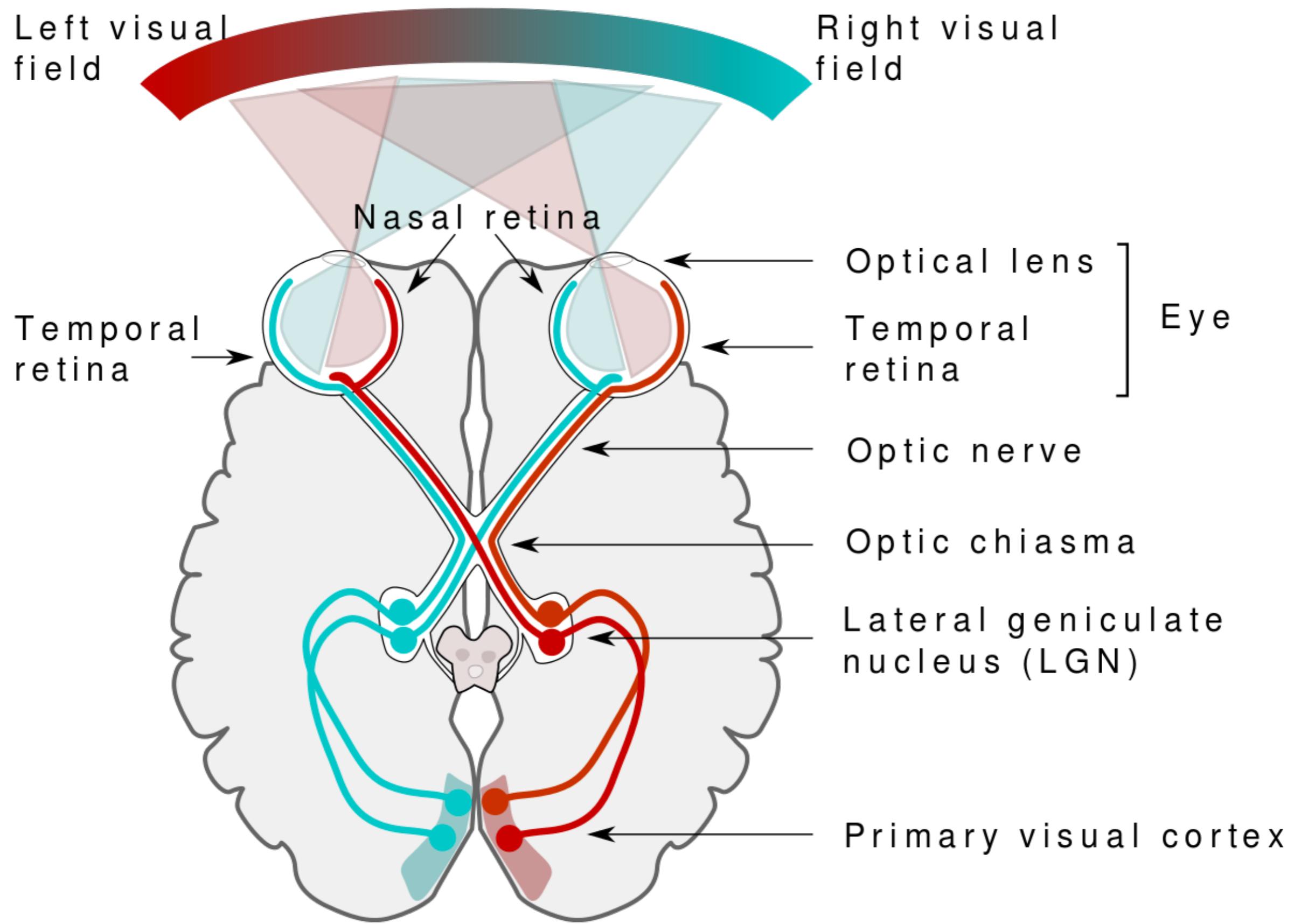
# *Basic eye anatomy:*



# *The retina is a complex piece of tissue:*



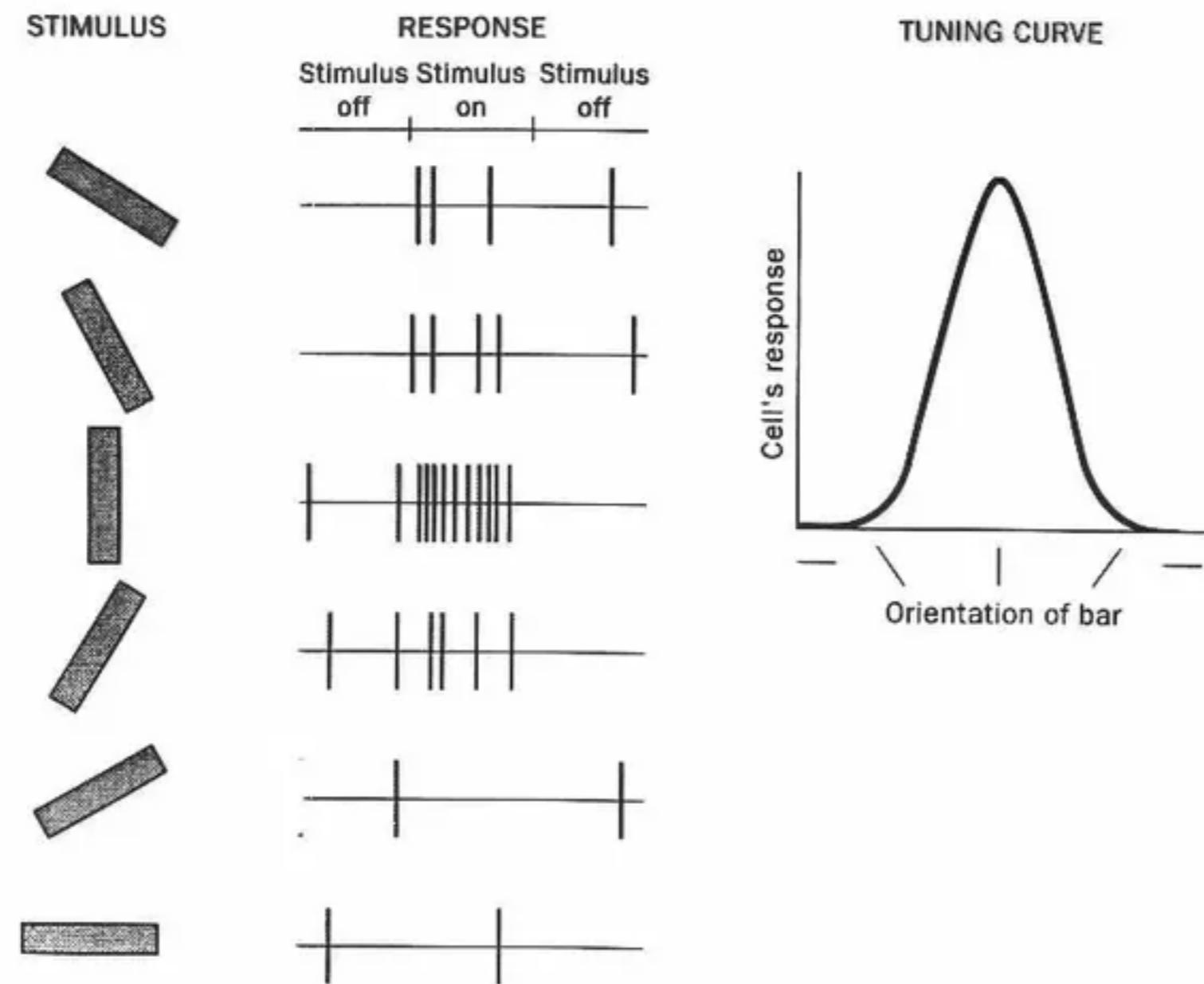
H Wassle, *Nature Reviews Neurosci* (2004)



*The basic learning problem: what about the stimulus do neurons respond to?*



# *V1 neurons are tuned to orientation!*



**FIGURE 4.8** Response of a single cortical cell to bars presented at various orientations.

**PARIETAL**  
*Spatial processing (action)*

