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The Johns Hopkins University

Corrigendum to Handout #1

On page 6, Eq. 23 should instead read,

$$V_m = \frac{g_{\mathrm{K}}}{g_{\mathrm{K}}+g_{\mathrm{Na}}+g_{\mathrm{L}}}\frac{RT}{F}\ln\frac{[\mathrm{K}]_e}{[\mathrm{K}]_i} + \frac{g_{\mathrm{Na}}}{g_{\mathrm{K}}+g_{\mathrm{Na}}+g_{\mathrm{L}}}\frac{RT}{F}\ln\frac{[\mathrm{Na}]_e}{[\mathrm{Na}]_i} + \frac{g_{\mathrm{L}}}{g_{\mathrm{K}}+g_{\mathrm{Na}}+g_{\mathrm{L}}}E_L \quad (23)$$

In the Hodgkin-Huxley 1952 paper in which the conductances of the squid giant axon membrane were studied,[1] the leak current was attributed to chloride ions and other leakage currents, and g_L and E_L were determined experimentally from voltage clamp records. E_L was not related to any ionic concentrations.

Addendum to Handout #2

Question from class member: On p. 6, is i_m a current density? It is referred to as axial density of the current source. To me, i_m seems to be the radial density or transverse density, rather than the density along the length of the fiber. I think it's just a case of confusing/overlapping nomenclature.

Answer: No, i_m is not a current density. It is a current source that generates Φ_e (Eq. 8) and is a line density of membrane current (p. 4). To clarify this point, in membrane biophysics the membrane current (I_m, units of amp) is often normalized to membrane surface area, or amp/cm^2. Let's call that membrane current density J_m. Then we can relate J_m to I_m according to,

$$J_m = \frac{I_m}{(2\pi a)\Delta x} \quad (1)$$

where a is the fiber radius and Δx is the width of the membrane patch (or incremental length along the fiber axis). If we were to integrate J_m around the circumference of the fiber we would be left with a current per unit length; i.e.,

$$\int_{\mathbf{0}}^{\mathbf{2\pi}} J_m(a d\theta) = \frac{I_m}{\Delta x} = i_m \quad (2)$$

Thus, i_m has units of amp/cm (current per unit length), which is a line density (as opposed to area density) of current. The units for i_m also check out in Eq. 8 in the handout.

[1] Hodgkin AL and Huxley AF. The components of membrane conductance in the giant axon of *Loligo*. J Physiol 116:473-496, 1952.