A mathematical modeling toolbox for ion channels and transporters across cell membranes

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The following supplementary material is from " A mathematical modeling toolbox for ion channels and transporters across cell membranes" manuscript. It contains an overview of all equations related to Ion channels, Pumps, Cotransporters, and Symporters, organized in a table form. The detailed transporters along with the descriptions of their equatuons can be found from here.

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4. Antiporters (Exchangers) model

4.1. Chloride Bicarbonate Antiporter (Cl/HCO3)

Chloride Bicarbonate Antiporter (Cl/HCO3)	Ref
$$\mathbf{J_{Cl,BCE}} = E_t \frac{[g^M_{EHCO_3} g^N_{ECl} HCO^M_3(Cl^N) - g^N_{EHCO_3} g^M_{ECl} HCO^N_3(Cl^M)]}{R_M R_{00} + R_N R_{ee}} \quad (143a)$$ $$\mathbf{J_{HCO3,BCE}} = E_t \frac{[g^M_{EHCO_3} g^N_{ECl}(Cl^M HCO^N_3) - g^N_{EHCO_3} g^M_{ECl}(Cl^N HCO^M_3)}{R_M R_{00} + R_N R_{ee}} \quad (143b)$$ where $[E]_t = [E]_M + [EHCO_3]_M + [ECl]_M + [E]_N + [EHCO_3]_N + [ECl]_N$ $HCO^M_3 = \frac{[HCO_3]_M}{K^M_{HCO_3}}, Cl^M = \frac{[Cl]_M}{K^M_{Cl}} \mid HCO^N_3 = \frac{[HCO_3]_N}{K^N_{HCO_3}}, Cl^N = \frac{[Cl]_N}{K^N_{Cl}}$ $R_M = 1 + HCO^M_3 + Cl^M \mid R_N = 1 + HCO^N_3 + Cl^N$ $R_{MM} = g^M_{EHCO_3} HCO^M_3 + g^M_{ECl}\, Cl^M \mid R_{NN} = g^N_{EHCO_3} HCO^N_3 + g^N_{ECl}\, Cl^N$	[34, 59]
$$J_{BCE} = P_{BCE} \frac{[Cl]_l[HCO3]_c - [Cl]_c[HCO3]_l}{K_{Cl}K_{HCO3}\left((1 + \frac{[Cl]_c}{K_{Cl}} + \frac{[HCO3]_c}{K_{HCO3}})(\frac{[Cl]_l}{K_{Cl}} + \frac{[HCO3]_l}{K_{HCO3}})\right.} \quad (144)$$ $$\left. \frac{}{(1 + \frac{[Cl]_l}{K_{Cl}} + \frac{[HCO3]_l}{K_{HCO3}})(\frac{[Cl]_c}{K_{Cl}} + \frac{[HCO3]_c}{K_{HCO3}})\right)}$$	[34, 38]
Basolateral $$J_{BCE} = n''_{BCE} \frac{k^+_{Cl}k^+_{HCO_3}[Cl]_{M(e)}[HCO3]_{N(i)} - k^-_{Cl}k^-_{HCO_3}[Cl]_{N(i)}[HCO3]_{M(e)}}{k^+_{Cl}[Cl]_{M(e)} + k^+_{HCO_3}[HCO3]_{N(i)} + k^-_{HCO_3}[HCO3]_{M(e)} + k^-_{Cl}[Cl]_{N(i)}} \quad (145)$$	[6, 60]

Table 27: The corresponding equations describing the flux and current transported via chloride bicarbonate antiporter (exchangers) across the cell membrane