Donnan Equilibrium/Example

Please note that this example is only for a very simplified understanding of the Donnan equilibrium principle, stripped of all other physiological events at the membrane. This membrane is therefore fully permeable to all ions, except for proteins, which do not pass through at all. Under all circumstances, however, both compartments remain electroneutral (unlike the physiological state).

1) Initial concentration of ions on the membrane

	IC concetracion	EC concetracion
Na+	0	150
K+	150	0
Cl-	0	150
Protein-	150	0

2) Equalization of cation concentrations

An easy-to-understand step where, with full permeability of cations, both amounts would equalize.

	IC concetracion	EC concetracion
Na+	75	75
K+	75	75
Cl-	0	150
Protein-	150	0

Of course, this step takes place at the same time as the following, but they are separated for convenience. The cations will hereafter be referred to collectively as Kation+ because they already move together. (So the concentration of cations on both sides of the membrane is 150.)

3) Chlorine wants to enter the cell following its concentration gradient

However, there still remains a strong concentration gradient of chlorine, which wants to enter the cell and the membrane is permeable to it. However, proteins cannot move, so the result will be that there will be more ions inside the cell than outside . The cations will only move proportionally to balance the electrical gradient , i.e. for the amount of chlorine that moves IC, the amount of IC increasing cations corresponds to half sodium and half potassium.

The Donnan equilibrium then holds for this shift , that **[cation IC] × [chlorine IC] = [cation EC] × [chlorine EC]**.

If x mmol/l of chlorine is moved, then:

$$(150 + x) * (x) = (150 - x) * (150 - x)$$

and after calculating the equation:

	IC concentracion	EC concentracion
Cation+	200	100
Cl-	50	100
Protein-	150	0