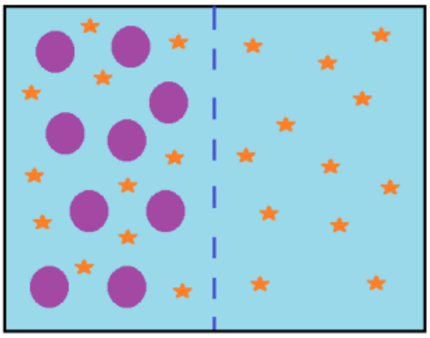
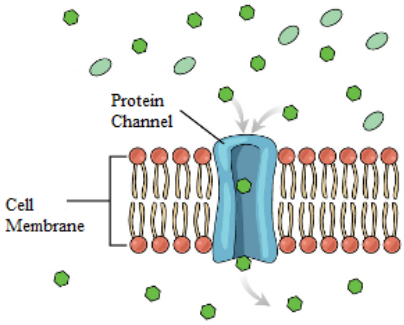
1 flux through plasma membrane

useful for :
time-dependent distribution of substances in two compartiment under the conditions, that the compartiments are seperated by a semipermeable wall
practical application :
predict growth of one compartiment; get access to what can cross the wall (e.g. nutrient, medicine, proteins, ion)
can't do :
get the whole picture of the process in one experiment; is only an approximation

1.1 Graphic of the used system :





1.2 Theoretical understanding

Non-Equilibrium Theormodynamic approach (not valid if: very fast processes; big inhomogeneity):
Fluxes over membranes are irreversible processes. This will lead to a production of entropy in the system, which is calculated by the entropy production density σ.

$$\sigma = \vec{J}_Q \left(\frac{1}{T}\right) - \sum_{i=1}^{k} \vec{J}_{c_i} grad \left(\frac{\eta_i}{T}\right) + \sum_{r=1}^{R} J_r \frac{A_r}{T} \geq 0$$

This equation summeries the production of entropy under the conditions of temperatur difference, concentration difference and chemical reactions.
Fundamentally, σ can only be created by fluxes J with it's forces X. In the area around equilibrium we can further assume that a flux is linearly coupled with it's forces, because at equilibrium all forces and fluxes vanish.

$$\sigma = \sum_i J_i X_i = \sum_i \sum_j L_{ij} X_j X_i$$

«where σ denotes the local entropy production density, T is the temperature, is the heat flow density, is the diffusion density of component i, ηi is the electrochemical potential

of component i, is the rate of reaction i, Ai is the affinity of reaction i, and nf and nr are the numbers of compounds and reactions, respectively.»
The equation for the flux J of ion k is:

$$J_k = \sum_{j=1}^{n} L_{kj}(RT \cdot ln\left(\frac{c_k^{in}}{c_k^{out}}\right) + z_k F\Delta\phi) + L_{kAr}A_{Ar}$$

where L_{kj} is a component of the phenomenological matrix L and has the following conditions:

$$L_{ii} > 0 \; ; \; L_{ij} = L_{ji} \; ; \; Determinant[\{L_{ij}\}] > 0$$

$$L = \{L_{kj}\} = \begin{pmatrix} L_{11} & L_{12} & ... \\ L_{21} & L_{22} & ... \\ ... & ... & ... \end{pmatrix}$$

other theoretical approaches: ...
What skills you need further: algebra understanding, parameter estimating knowledge (for the phenomenological coefficients L_{kj}), knowledge of a programming language for modelling

1.3 Experimental examination techniques

concentration meassurement of ions and nutrients over the time