Group 4

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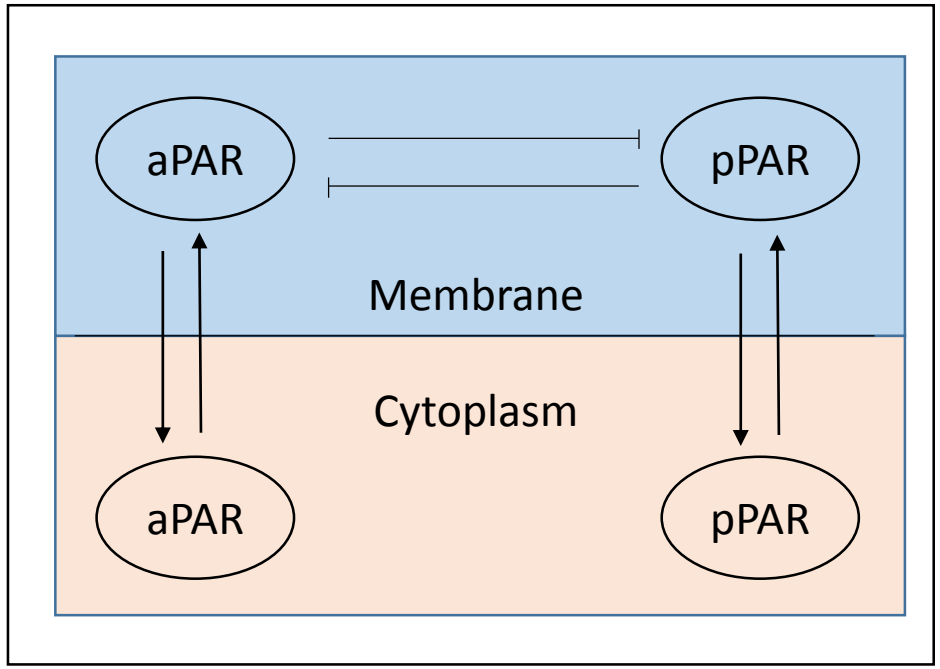
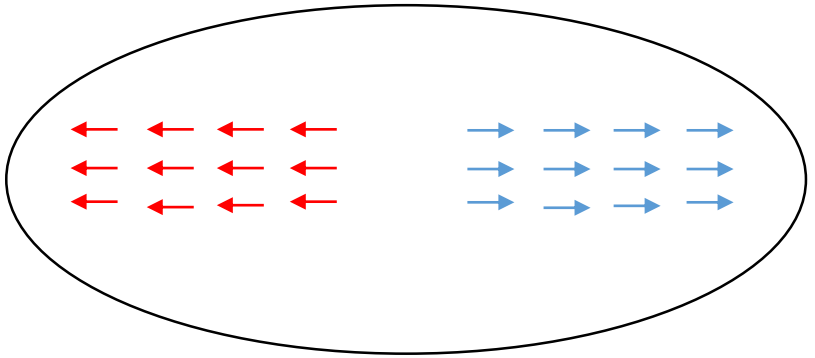
Motivation

a) Chemical reaction system



b) Flow & transport



Reaction system representation

$$A \xrightarrow{k_{offA}} A_{cyto}$$

$$A_{cyto} \xrightarrow{k_{on\,A}} A$$

$$P \xrightarrow{k_{offP}} P_{cyto}$$

$$P_{cyto} \xrightarrow{k_{on\,P}} P$$

$$A + \alpha P \xrightarrow{k_{AP}} A_{cyto} + \alpha P$$

$$P + \beta A \xrightarrow{k_{AP}} P_{cyto} + \beta A$$

Mass conservation

$$N_A = A\Omega_{men} + A_{cyto}\, V_{cyto}$$

Reaction system representation

$$\frac{dA}{dt} = -k_{offA} + k_{OnA}\frac{N_A - A\Omega_{men}}{V_{cyto}} - k_{AP}P^{\alpha}A$$

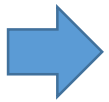
$$\frac{dP}{dt} = -k_{offP} + k_{OnP}\frac{N_P - P\Omega_{men}}{V_{cyto}} - k_{PA}A^{\beta}P$$

Stability analysis

$$J = \begin{pmatrix} \frac{\partial f_P}{\partial P} & \frac{\partial f_P}{\partial A} \\ \frac{\partial f_A}{\partial P} & \frac{\partial f_A}{\partial A} \end{pmatrix} \qquad J = \begin{pmatrix} -k_{offP} - k_{onP}\frac{\Omega_{mem}}{V_{cyto}} - k_{PA}A^{\beta} & -k_{PA}\beta A^{\beta-1}P \\ -k_{AP}\alpha P^{\alpha-1}A & -k_{offA} - k_{onA}\frac{\Omega_{mem}}{V_{cyto}} - k_{AP}P^{\alpha} \end{pmatrix}$$

$tr(J) < 0 \qquad \beta = [1,2,3]$

$det(J) > 0 \qquad \alpha = [1,2,3]$



In which parameter and state region does the system exhibit a bistable

Outlook

- Use the approximation of the kinetic parameters
- Model the mass transport using particle method (Advection and Diffusion)