Systems Biology Tutorial 5: The kinetic model and JWS Online

JWS Online home page: jjj.bio.vu.nl / jjj.biochem.sun.ac.za

Chemical equilibrium (closed system)

1. Select the **lin1** model in the Model Database and open it in the Simulator by clicking on the green arrow.
   (a) Simulate the timecourse until the system reaches equilibrium and note the concentrations for $x2$ and $x3$.
   (b) Estimate the equilibrium constant for the reaction using your results. Does it match the relevant parameter value in the reversible MM kinetics?
   (c) Are there dependent metabolites in this model? Write down the conservation equation.
2. Select the **lin3_eq** model in the Model Database and open it in the Simulator by clicking on the green arrow.
   (a) Set the initial concentrations of $s1$, $x2$, $x3$ and $p1$ to 1, 0, 0 and 0 respectively. Set the equilibrium constants $Keq1$, $Keq2$ and $Keq3$ to 1, 2 and 3 respectively.
   (b) Determine the concentrations at equilibrium for the individual metabolites.
   (c) Show how the Keq values of the individual steps can be used to calculate the equilibrium constant of the pathway as a whole.
   (d) Determine the values of the rates at equilibrium. Is this what you would expect?

Steady state (open system)

Select the **lin3** model in the Model Database and open it in the Simulator by clicking on the green arrow.

1. Set the equilibrium constants $Keq1$, $Keq2$ and $Keq3$ to 1, 2 and 3 respectively and set $s1$ and $p1$ to 2 and 1 respectively. $s1$ and $p1$ should remain fixed now as we are simulating an open system.
2. Simulate the system from initial conditions to steady state (find a suitable end time). Plot the simulation for both the species and the rates.
3. Show that the mass-action ratio of the pathway equals the product of the mass action ratios of the individual steps.
4. Determine the value of the flux. How does this compare to the rates of the closed system?

Published model of glycolysis in *Plasmodium falciparum*.

Select the **penkler1** model in the Model Database and proceed to the Simulator.

1. Are there any dependent metabolites in this model? Write down the conservation equations for these metabolites.
2. How many independent fluxes are there?
3. Which reactions have the most control on the production of lactate?
4. Which reactions have the most control on the parasite glucose?