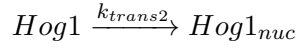
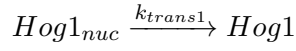
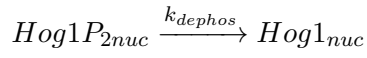
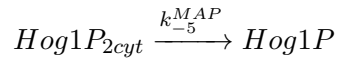
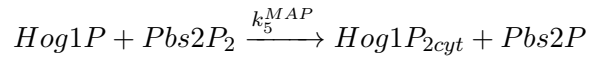
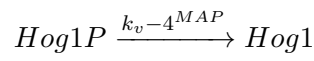
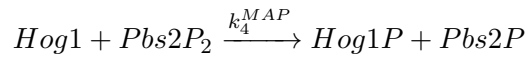
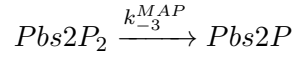
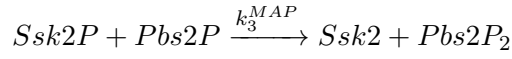
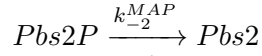
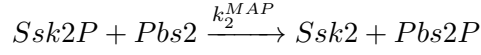
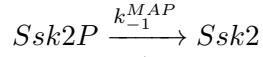
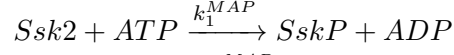


$$\frac{dA}{dt} = -k_1 * A$$

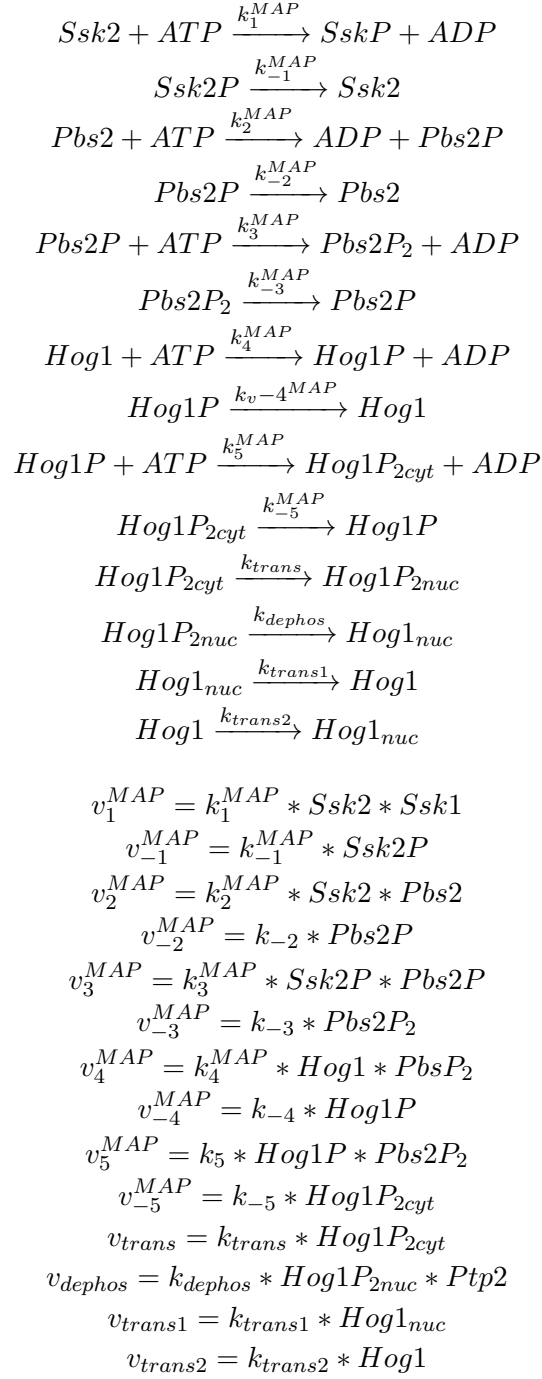
$$\frac{dA}{dt} = -k_{2f} * A + k_{2r} * B$$

$$\frac{dB}{dt} = k_{2f} * A - k_{2r} * B$$

Karin's



Paper's

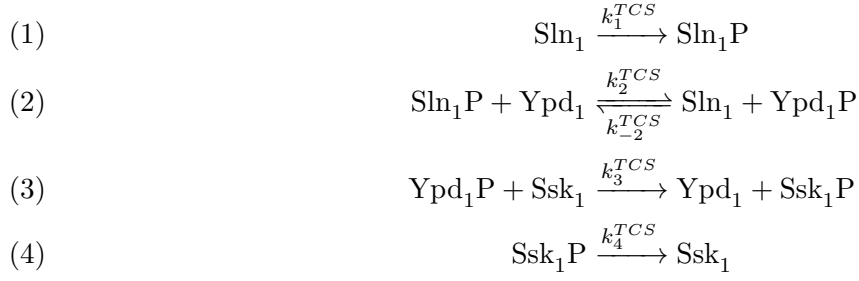


Karin's

$$\begin{aligned}
\frac{dSsk2}{dt} &= -v_1^{MAP} + v_{-1}^{MAP} + v_2^{MAP} + v_3^{MAP} \\
\frac{dSsk2P}{dt} &= v_1^{MAP} - v_{-1}^{MAP} - v_2^{MAP} - v_3^{MAP} \\
\frac{dPbs2}{dt} &= -v_2^{MAP} + v_{-2}^{MAP} \\
\frac{dPbs2P}{dt} &= v_2^{MAP} - v_{-2}^{MAP} - v_3^{MAP} + v_{-3}^{MAP} + v_4^{MAP} \\
\frac{dPbs2P_2}{dt} &= v_3^{MAP} - v_{-3}^{MAP} - v_4^{MAP} - v_5^{MAP} \\
\frac{dHog1}{dt} &= -v_4^{MAP} + v_{-4}^{MAP} + v_{trans1} - v_{trans2} \\
\frac{dHog1P}{dt} &= v_4^{MAP} - v_{-4}^{MAP} - v_5^{MAP} + v_{-5}^{MAP} \\
\frac{dHog1P_{2cyt}}{dt} &= v_5^{MAP} - v_{-5}^{MAP} - v_{trans} \\
\frac{dHog1P_{2nuc}}{dt} &= v_{trans} - v_{dephos} \\
\frac{dHog1_{nuc}}{dt} &= -v_{trans1} + v_{dephos} + v_{trans2}
\end{aligned}$$

Paper

$$\begin{aligned}
\frac{dSsk2}{dt} &= -v_1^{MAP} + v_{-1}^{MAP} \\
\frac{dSsk2P}{dt} &= v_1^{MAP} - v_{-1}^{MAP} \\
\frac{dPbs2}{dt} &= -v_2^{MAP} + v_{-2}^{MAP} \\
\frac{dPbs2P}{dt} &= v_2^{MAP} - v_{-2}^{MAP} - v_3^{MAP} + v_{-3}^{MAP} \\
\frac{dPbs2P_2}{dt} &= v_3^{MAP} - v_{-3}^{MAP} \\
\frac{dHog1}{dt} &= -v_4^{MAP} + v_{-4}^{MAP} + v_{trans1} - v_{trans2} \\
\frac{dHog1P}{dt} &= v_4^{MAP} - v_{-4}^{MAP} - v_5^{MAP} + v_{-5}^{MAP} \\
\frac{dHog1P_{2cyt}}{dt} &= v_5^{MAP} - v_{-5}^{MAP} - v_{trans} \\
\frac{dHog1P_{2nuc}}{dt} &= v_{trans} - v_{dephos} \\
\frac{dHog1_{nuc}}{dt} &= -v_{trans1} + v_{dephos} + v_{trans2}
\end{aligned}$$



$$\begin{aligned}
\frac{dVolume}{dt} &= -v_0^{TCS} \\
\frac{dSln1}{dt} &= -v_1^{TCS} + v_2^{TCS} \\
\frac{dSln1P}{dt} &= v_1^{TCS} - v_2^{TCS} \\
\frac{dYpd1}{dt} &= -v_2^{TCS} + v_3^{TCS} \\
\frac{dYpd1P}{dt} &= v_2^{TCS} - v_3^{TCS} \\
\frac{dSsk1}{dt} &= -v_3^{TCS} + v_4^{TCS} \\
\frac{dSsk1P}{dt} &= v_3^{TCS} - v_4^{TCS} \\
v_0^{TCS} &= k_0^{TCS} * Ssk1 \\
v_1^{TCS} &= k_1^{TCS} * Sln1 \\
v_2^{TCS} &= k_2^{TCS} * Sln1 * Ypd1 - k_{-2}^{TCS} * Sln1 * Ypd1P \\
v_3^{TCS} &= k_3^{TCS} * Ssk1 * Ypd1P \\
v_4^{TCS} &= k_4^{TCS} * Ssk1P
\end{aligned}$$

$$\begin{aligned}
v0 &= k0 * Receptor \\
v1 &= k1 * MAPKKK * Receptor \\
v2 &= k2 * MAPKKKP * Phosphotase \\
v3 &= k3 * MAPKK * MAPKKKP \\
v4 &= k4 * MAPKKP * Phosphotase \\
v5 &= k5 * MAPK * MAPKKP \\
v6 &= k6 * MAPKP * Phosphotase
\end{aligned}$$

$$\begin{aligned}
\frac{dReceptor}{dt} &= -v0 \\
\frac{dMAPKKKP}{dt} &= v1 - v2 \\
\frac{dMAPKKP}{dt} &= v3 - v4 \\
\frac{dMAPKP}{dt} &= v5 - v6 \\
\frac{dMAPKKK}{dt} &= -dMAPKKKP \\
\frac{dMAPKK}{dt} &= -dMAPKKP \\
\frac{dMAPK}{dt} &= -dMAPKP \\
\frac{dPhosphotase}{dt} &= 0
\end{aligned}$$

$$\begin{aligned}
v_0 &= k_0 * Ssk1 \\
v_1^{MAP} &= k_1^{MAP} * Ssk2 * Ssk1 \\
v_{-1}^{MAP} &= k_{-1}^{MAP} * Ssk2P \\
v_2^{MAP} &= k_2^{MAP} * Ssk2 * Pbs2 \\
v_{-2}^{MAP} &= k_{-2} * Pbs2P \\
v_3^{MAP} &= k_3^{MAP} * Ssk2P * Pbs2P \\
v_{-3}^{MAP} &= k_{-3} * Pbs2P_2 \\
v_4^{MAP} &= k_4^{MAP} * Hog1 * PbsP_2 \\
v_{-4}^{MAP} &= k_{-4} * Hog1P \\
v_5^{MAP} &= k_5 * Hog1P * Pbs2P_2 \\
v_{-5}^{MAP} &= k_{-5} * Hog1P_2
\end{aligned}$$

$$\begin{aligned}
\frac{dSsk1}{dt} &= -v_0^{MAP} \\
\frac{dSsk2}{dt} &= -v_1^{MAP} + v_{-1}^{MAP} \\
\frac{dSsk2P}{dt} &= v_1^{MAP} - v_{-1}^{MAP} \\
\frac{dPbs2}{dt} &= -v_2^{MAP} + v_{-2}^{MAP} \\
\frac{dPbs2P}{dt} &= v_2^{MAP} - v_{-2}^{MAP} - v_3^{MAP} + v_{-3}^{MAP} \\
\frac{dPbs2P_2}{dt} &= v_3^{MAP} - v_{-3}^{MAP} \\
\frac{dHog1}{dt} &= -v_4^{MAP} + v_{-4}^{MAP} \\
\frac{dHog1P}{dt} &= v_4^{MAP} - v_{-4}^{MAP} - v_5^{MAP} + v_{-5}^{MAP} \\
\frac{dHog1P_2}{dt} &= v_5^{MAP} - v_{-5}^{MAP}
\end{aligned}$$

$$vts = kts_1 * Hog_1 P_{2nuc}$$

$$vex = kex * mRNA_{nuc}$$

$$vrd = kts * mRNA_{cyt}$$

$$vtl = ktl * mRNA_{cyt}$$

$$vpd = kpd * Protein$$

$$\frac{dmRNA_{nuc}}{dt} = vts - vex$$

$$\frac{dmRNA_{cyt}}{dt} = vex - vrd$$

$$\frac{dProtein}{dt} = vtl - vpd$$

$$f(E, S, ES)$$

$$[H_2](t), [O_2](t), [H_2O](t), [C](t), [CO_2](t)$$

$$y(t) = \begin{pmatrix} [H_2](t) \\ [O_2](t) \\ [H_2O](t) \\ [C](t) \\ [CO_2](t) \end{pmatrix}$$

$$\dot{y} \equiv \frac{dy}{dt} = \begin{pmatrix} \frac{d[H_2]}{dt} \\ \frac{d[O_2]}{dt} \\ \frac{d[H_2O]}{dt} \\ \frac{d[C]}{dt} \\ \frac{d[CO_2]}{dt} \end{pmatrix}$$

$$\dot{y} = \Gamma V$$

$$\dot{y} \equiv \frac{dy}{dt} = \begin{pmatrix} \frac{d[H_2]}{dt} = -k_1 * [H_2]^2 * [O_2] \\ \frac{d[O_2]}{dt} = -k_1 * [H_2]^2 * [O_2] - k_2 * [C] * [O_2] \\ \frac{d[H_2O]}{dt} = 2 * k_1 * [H_2]^2 * [O_2] \\ \frac{d[C]}{dt} = -k_2 * [C] * [O_2] \\ \frac{d[CO_2]}{dt} = k_2 * [C] * [O_2] \end{pmatrix}$$

$$\Gamma = \begin{pmatrix} & H_2 & O_2 & H_2O & C & CO_2 \\ R1 : & -2 & -1 & 2 & 0 & 0 \\ R2 : & 0 & -1 & 0 & -1 & 1 \end{pmatrix}$$

$$\Gamma = \begin{pmatrix} & R1 & R2 \\ H_2 & -2 & 0 \\ O_2 & -1 & -1 \\ H_2O & 2 & 0 \\ C & 0 & -1 \\ CO_2 & 0 & 1 \end{pmatrix}$$

$$V = \begin{pmatrix} k_1 * [H_2]^2 * [O_2] \\ k_2 * [C] * [O_2] \end{pmatrix}$$

$$\dot{y} = \Gamma * V = \begin{pmatrix} & R1 & R2 \\ H_2 & -2 & 0 \\ O_2 & -1 & -1 \\ H_2O & 2 & 0 \\ C & 0 & -1 \\ CO_2 & 0 & 1 \end{pmatrix} * \begin{pmatrix} R1 : & k_1 * [H_2]^2 * [O_2] \\ R2 : & k_2 * [C] * [O_2] \end{pmatrix} = \begin{pmatrix} \frac{d[H_2]}{dt} = -2 * k_1 * [H_2]^2 * [O_2] \\ \frac{d[O_2]}{dt} = -k_1 * [H_2]^2 * [O_2] - k_2 * [C] * [O_2] \\ \frac{d[H_2O]}{dt} = 2 * k_1 * [H_2]^2 * [O_2] \\ \frac{d[C]}{dt} = -k_2 * [C] * [O_2] \\ \frac{d[CO_2]}{dt} = k_2 * [C] * [O_2] \end{pmatrix}$$

$$rate_{R1} = -\frac{1}{2} * \frac{d[H_2]}{dt} = -\frac{d[O_2]}{dt} = +\frac{1}{2} * \frac{d[H_2O]}{dt}$$

$$rate_{R1} = k_1[H_2]^2[O_2]$$

Enzymatic reaction

$$\dot{y} = \Gamma * V = \begin{pmatrix} & R1 & R2 & R3 \\ S & -1 & +1 & 0 \\ E & -1 & +1 & +1 \\ SE & +1 & -1 & -1 \\ P & 0 & 0 & +1 \end{pmatrix} * \begin{pmatrix} R1 : & k_1 * E * S \\ R2 : & k_2 * ES \\ R3 : & k_3 * ES \end{pmatrix} = \begin{pmatrix} \frac{dS}{dt} = -k_1 * E * S + k_2 * ES \\ \frac{dE}{dt} = -k_1 * E * S + (k_2 + k_3) * ES \\ \frac{dES}{dt} = k_1 * E * S - (k_2 + k_3) * ES \\ \frac{dP}{dt} = k_3 * ES \end{pmatrix}$$

Gene expression

$$\dot{y} = \Gamma * V = \begin{pmatrix} & R1 & R2 & R3 & R4 \\ G & 0 & 0 & 0 & 0 \\ M & +1 & 0 & -1 & 0 \\ P & 0 & +1 & 0 & -1 \end{pmatrix} * \begin{pmatrix} R1 : & k_1 * G \\ R2 : & k_2 * M \\ R3 : & k_3 * M \\ R4 : & k_4 * P \end{pmatrix} = \begin{pmatrix} \frac{dG}{dt} = 0 \\ \frac{dM}{dt} = k_1 * G - k_3 * M \\ \frac{dP}{dt} = k_2 * M - k_4 * P \end{pmatrix}$$

Gene regulation

$$\dot{y} = \Gamma * V = \begin{pmatrix} & R1 & R2 & R3 \\ S & -1 & +1 & 0 \\ E & -1 & +1 & +1 \\ SE & +1 & -1 & -1 \\ P & 0 & 0 & +1 \end{pmatrix} * \begin{pmatrix} R1 : & k_1 * E * S \\ R2 : & k_2 * ES \\ R3 : & k_3 * ES \end{pmatrix} = \begin{pmatrix} \frac{dS}{dt} = -k_1 * E * S + k_2 * ES \\ \frac{dE}{dt} = -k_1 * E * S + (k_2 + k_3) * ES \\ \frac{dES}{dt} = k_1 * E * S - (k_2 + k_3) * ES \\ \frac{dP}{dt} = k_3 * ES \end{pmatrix}$$