Mass Action Reactions

Reaction	Description or Expansion
$\emptyset \to X$	Creation (introduction)
$X \to \emptyset$	Annihilation (removal)
$p_1A_1 + p_2A_2 + \cdots \to q_1B_1 + q_2B_2 + \cdots$	Standard mass action with stoichiometry
$A \rightleftarrows B$	$\begin{cases} A \to B \\ B \to A \end{cases}$
$p_1A_1 + p_2A_2 + \cdots \rightleftarrows q_1B_1 + q_2B_2 + \cdots$	$\begin{cases} p_1A_1 + \cdots \to q_1B_1 + \cdots \\ q_1B_1 + \cdots \to p_1A_q + \cdots \end{cases}$
Representation of $A + X \rightleftarrows A\_X \rightleftarrows B + X$	
$A \overset{X}{\rightleftarrows} B$	$\begin{cases} A + X \to A\_X \\ A\_X \to A + X \\ A\_X \to B + X \\ B + X \to A\_X \end{cases}$
Representation of $A + X \rightleftarrows A\_X \rightleftarrows B\_X \rightleftarrows B + X$	
$A \overset{X}{\rightleftharpoons} B$	$\begin{cases} A + X \to A\_X \\ A\_X \to A + X \\ A\_X \to B\_X \\ B\_X \to A\_X \\ B\_X \to B + X \\ B + X \to B\_X \end{cases}$
Typical Cascades	
$A_1 \to A_2 \to A_3 \cdots$	$\begin{cases} A_1 \to A_2 \\ A_2 \to A_3 \\ \vdots \end{cases}$
$A_1 \rightleftarrows A_2 \rightleftarrows A_3 \cdots$	$\begin{cases} A_1 \rightleftarrows A_2 \\ A_2 \rightleftarrows A_3 \\ \vdots \end{cases}$
$A_1 \rightleftarrows A_2 \overset{X}{\rightleftarrows} A_3 \cdots$	$\begin{cases} A_1 \overset{X}{\rightleftarrows} A_2 \\ A_2 \overset{X}{\rightleftarrows} A_3 \\ \vdots \end{cases}$
$A_1 \rightleftarrows A_2 \overset{\{X_1, X_2 \ldots\}}{\rightleftarrows} A_3 \cdots$	$\begin{cases} A_1 \overset{X_1}{\rightleftarrows} A_2 \\ A_2 \overset{X_2}{\rightleftarrows} A_3 \\ \vdots \end{cases}$

Michaelis-Menten-Henri Style Reactions

Syntax $\{A \Longrightarrow B, MM[K, v]\}$ or $\{A \overset{X}{\Longrightarrow} B, MM[K, v]\}$	
$A \Longrightarrow B$	$[B]' = \dfrac{v[A]}{K + [A]} = -[A]'$
$A \overset{X}{\Longrightarrow} B$	$[B]' = \dfrac{v[A][X]}{K + [A]} = -[A]'$
$A \Longleftrightarrow B$	$[B]' = \dfrac{v_A[A]}{K_A + [A]} - \dfrac{v_B[B]}{K_B + [B]} = -[A]'$
$A \underset{Y}{\overset{X}{\Longleftrightarrow}} B$	$[B]' = \dfrac{v_A[A][X]}{K_A + [A]} - \dfrac{v_B[B][Y]}{K_B + [B]} = -[A]'$
Syntax $\{A \Longrightarrow B, MM[k_1, k_2, k_3]\}$ or $\{A \overset{X}{\Longrightarrow} B, MM[k_1, k_2, k_3]\}$	
$A \Longrightarrow B$	$[B]' = \dfrac{k_1[A]}{\frac{k_2+k_3}{k_1} + [A]} = -[A]'$
$A \overset{X}{\Longrightarrow} B$	$[B]' = \dfrac{k_1[A][X]}{\frac{k_2+k_3}{k_1} + [A]} = -[A]'$
Cascades	
$A_1 \Longrightarrow A_2 \Longrightarrow A_3 \Longrightarrow \cdots$	$\begin{cases} A_1 \Longrightarrow A_2 \\ A_2 \Longrightarrow A_3 \\ \quad\vdots \end{cases}$
$A_1 \Longrightarrow A_2 \overset{X}{\Longrightarrow} A_3 \Longrightarrow \cdots$	$\begin{cases} A_1 \overset{X}{\Longrightarrow} A_2 \\ A_2 \overset{X}{\Longrightarrow} A_3 \\ \quad\vdots \end{cases}$
$A_1 \Longrightarrow A_2 \overset{\{X_1, X_2, \dots\}}{\Longrightarrow} A_3 \Longrightarrow \cdots$	$\begin{cases} A_1 \overset{X_1}{\Longrightarrow} A_2 \\ A_2 \overset{X_2}{\Longrightarrow} A_3 \\ \quad\vdots \end{cases}$

Regulatory Hill Functions

Syntax $\{\mathtt{A} \mapsto \mathtt{B}, \mathtt{hill}[\mathtt{v}, \mathtt{n}, \mathtt{K}, \mathtt{b}, \mathtt{T}]\}$	
$\mathtt{A} \mapsto \mathtt{B}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}(\mathtt{b} + \mathtt{T}[\mathtt{A}])^{\mathtt{n}}}{\mathtt{K}^{\mathtt{n}} + (\mathtt{b} + \mathtt{T}[\mathtt{A}])^{\mathtt{n}}}$ and $[\mathtt{A}]' = 0$
Syntax $\{\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}, \mathtt{hill}[\mathtt{v}, \mathtt{n}, \mathtt{K}, \mathtt{b}, \{\mathtt{T}_1, \mathtt{T}_2, \ldots\}]\}$	
$\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}$ or $\{\mathtt{A}_1, \mathtt{A}_2, \mathtt{A}_3, \ldots\} \mapsto \mathtt{B}$ or $\begin{cases} \mathtt{A}_1 \mapsto \mathtt{B} \\ \mathtt{A}_2 \mapsto \mathtt{B} \\ \mathtt{A}_3 \mapsto \mathtt{B} \\ \quad \vdots \end{cases}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}(\mathtt{b} + \mathtt{T}_1[\mathtt{A}_1] + \mathtt{T}_2[\mathtt{A}_2] + \cdots)^{\mathtt{n}}}{\mathtt{K}^{\mathtt{n}} + (\mathtt{b} + \mathtt{T}_1[\mathtt{A}_1] + \mathtt{T}_2[\mathtt{A}_2] + \cdots)^{\mathtt{n}}}$ $[\mathtt{A}_1]' = [\mathtt{A}_2]' = \cdots = 0$

Catalytic Hill Functions

Syntax $\{\mathtt{A} \overset{\mathtt{X}}{\mapsto} \mathtt{B}, \mathtt{hill}[\mathtt{v}, \mathtt{n}, \mathtt{K}, \mathtt{b}, \mathtt{T}]\}$	
$\mathtt{A} \overset{\mathtt{X}}{\mapsto} \mathtt{B}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}[\mathtt{X}](\mathtt{b} + \mathtt{T}[\mathtt{A}])^{\mathtt{n}}}{\mathtt{K}^{\mathtt{n}} + (\mathtt{b} + \mathtt{T}[\mathtt{A}])^{\mathtt{n}}} = -[\mathtt{A}]'$
Syntax $\{\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}, \mathtt{hill}[\mathtt{v}, \mathtt{n}, \mathtt{K}, \mathtt{b}, \{\mathtt{T}_1, \mathtt{T}_2, \ldots\}]\}$	
$\mathtt{A}_1 + \mathtt{A}_2 + \cdots \overset{\mathtt{X}}{\mapsto} \mathtt{B}$ or $\{\mathtt{A}_1, \mathtt{A}_2, \mathtt{A}_3, \ldots\} \overset{\mathtt{X}}{\mapsto} \mathtt{B}$ or $\begin{cases} \mathtt{A}_1 \overset{\mathtt{X}}{\mapsto} \mathtt{B} \\ \mathtt{A}_2 \overset{\mathtt{X}}{\mapsto} \mathtt{B} \\ \mathtt{A}_3 \overset{\mathtt{X}}{\mapsto} \mathtt{B} \\ \quad \vdots \end{cases}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}[\mathtt{X}](\mathtt{b} + \mathtt{T}_1[\mathtt{A}_1] + \mathtt{T}_2[\mathtt{A}_2] + \cdots)^{\mathtt{n}}}{\mathtt{K}^{\mathtt{n}} + (\mathtt{b} + \mathtt{T}_1[\mathtt{A}_1] + \mathtt{T}_2[\mathtt{A}_2] + \cdots)^{\mathtt{n}}}$ $[\mathtt{A}_1]' = [\mathtt{A}_2]' = \cdots = -[\mathtt{B}]'$

Logistic Rate Functions

<table>
<tr><td colspan="2">Syntax $\{\mathtt{A} \mapsto \mathtt{B}, \mathtt{GRN}[\mathtt{v}, \beta, \mathtt{n}, \mathtt{h}]\}$</td></tr>
<tr><td>$\mathtt{A} \mapsto \mathtt{B}$</td><td>$[\mathtt{B}]' = \dfrac{\mathtt{v}}{1 + e^{-\mathtt{h} - \beta [\mathtt{A}]^{\mathtt{n}}}}$
$[\mathtt{A}]' = 0$</td></tr>
<tr><td colspan="2">Syntax $\{\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}, \mathtt{GRN}[\mathtt{v}, \{\beta_1, \beta_2, \ldots\}, \{\mathtt{n}_1, \mathtt{n}_2, \ldots\}, \mathtt{h}]\}$</td></tr>
<tr><td>$\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}$ or
$\{\mathtt{A}_1, \mathtt{A}_2, \ldots\} \mapsto \mathtt{B}$ or
$\begin{cases} \mathtt{A}_1 \to \mathtt{B} \\ \mathtt{A}_2 \to \mathtt{B} \\ \quad \vdots \end{cases}$</td><td>$[\mathtt{B}]' = \dfrac{\mathtt{v}}{1 + e^{-\mathtt{h} - \beta_1 [\mathtt{A}_1]^{\mathtt{n}_1} - \beta_2 [\mathtt{A}_2]^{\mathtt{n}_2} - \cdots}}$
$[\mathtt{A}_1]' = [\mathtt{A}_2]' = \cdots = 0$</td></tr>
</table>

S-System Rate Functions (Synergistic Systems)

<table>
<tr><td colspan="2">Syntax $\{\mathtt{A} \mapsto \mathtt{B}, \mathtt{SSystem}[\tau, \mathtt{K}_+, \mathtt{K}_-, \mathtt{c}_+, \mathtt{c}_-]\}$</td></tr>
<tr><td>$\mathtt{A} \mapsto \mathtt{B}$</td><td>$[\mathtt{B}]' = \dfrac{1}{\tau} \left(\mathtt{K}_+ [\mathtt{A}]^{\mathtt{c}_+} - \mathtt{K}_- [\mathtt{A}]^{\mathtt{c}_-} \right)$
$[\mathtt{A}]' = 0$</td></tr>
<tr><td colspan="2">Syntax $\{\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}, \mathtt{SSystem}[\tau, \mathtt{K}_+, \mathtt{K}_-, \{\mathtt{p}_1, \mathtt{p}_2, \ldots\}, \{\mathtt{m}_1, \mathtt{m}_2, \ldots\}]\}$</td></tr>
<tr><td>$\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}$ or
$\{\mathtt{A}_1, \mathtt{A}_2, \ldots\} \mapsto \mathtt{B}$ or
$\begin{cases} \mathtt{A}_1 \to \mathtt{B} \\ \mathtt{A}_2 \to \mathtt{B} \\ \quad \vdots \end{cases}$</td><td>$[\mathtt{B}]' = \dfrac{\mathtt{K}_+ [\mathtt{A}_1]^{\mathtt{p}_1} [\mathtt{A}_2]^{\mathtt{p}_2} \cdots - \mathtt{K}_- [\mathtt{A}_1]^{\mathtt{m}_1} [\mathtt{A}_2]^{\mathtt{m}_2} \cdots}{\tau}$
$[\mathtt{A}_1]' = [\mathtt{A}_2]' = \cdots = 0$</td></tr>
</table>

NHCA Rate Function
(Non-Hierarchical Cooperative Activation)

Syntax $\{\mathtt{A} \mapsto \mathtt{B}, \mathtt{NHCA}[\mathtt{v}, \{\alpha, \beta\}, \mathtt{n}, \mathtt{m}, \mathtt{k}]\}$	
$\mathtt{A} \mapsto \mathtt{B}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}(1+\alpha[\mathtt{A}]^{\mathtt{n}})^{\mathtt{m}}}{(1+\alpha[\mathtt{A}]^{\mathtt{n}})^{\mathtt{m}} + \mathtt{k}(1+\beta[\mathtt{A}]^{\mathtt{n}})^{\mathtt{m}}}$ $[\mathtt{A}]' = 0$
Syntax $\{\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}, \mathtt{NHCA}[\mathtt{v}, \{\{\alpha_1, \beta_1\}, \{\alpha_2, \beta_2\}, \dots\}, \{\mathtt{n}_1, \mathtt{n}_2, \dots\}, \mathtt{m}, \mathtt{k}]\}$ Syntax $\{\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}, \mathtt{NHCA}[\mathtt{v}, \{\{\alpha_1, \beta_1\}, \{\alpha_2, \beta_2\}, \dots\}, \mathtt{n}, \mathtt{m}, \mathtt{k}]\}$	
$\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}$ or $\{\mathtt{A}_1, \mathtt{A}_2, \cdots\} \mapsto \mathtt{B}$ or $\begin{cases} \mathtt{A}_1 \mapsto \mathtt{B} \\ \mathtt{A}_2 \mapsto \mathtt{B} \\ \quad \vdots \end{cases}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}\prod_{\mathtt{j}}(1+\alpha_{\mathtt{j}}[\mathtt{A}_{\mathtt{j}}]^{\mathtt{n}_{\mathtt{j}}})^{\mathtt{m}}}{\prod_{\mathtt{j}}(1+\alpha_{\mathtt{j}}[\mathtt{A}_{\mathtt{j}}]^{\mathtt{n}_{\mathtt{j}}})^{\mathtt{m}} + \mathtt{k}\prod_{\mathtt{j}}(1+\beta_{\mathtt{j}}[\mathtt{B}_{\mathtt{j}}]^{\mathtt{n}_{\mathtt{j}}})^{\mathtt{m}}}$ $[\mathtt{A}_1]' = [\mathtt{A}_2]' = \cdots = 0$
Syntax $\{\mathtt{A} \mapsto \mathtt{B}, \mathtt{NHCA}[\mathtt{v}, \mathtt{T}, \mathtt{n}, \mathtt{m}, \mathtt{k}]\}$ Syntax $\{\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}, \mathtt{NHCA}[\mathtt{v}, \{\mathtt{T}_1, \mathtt{T}_2, \dots\}, \{\mathtt{n}_1, \mathtt{n}_2, \dots\}, \mathtt{m}, \mathtt{k}]\}$	
$\mathtt{A} \mapsto \mathtt{B}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}(1+\mathtt{T}\mathcal{U}(\mathtt{T})[\mathtt{A}]^{\mathtt{n}})^{\mathtt{m}}}{(1+\mathtt{T}\mathcal{U}(\mathtt{T})[\mathtt{A}]^{\mathtt{n}})^{\mathtt{m}} + \mathtt{k}(1+\mathtt{T}\mathcal{U}(-\mathtt{T})[\mathtt{A}]^{\mathtt{n}})^{\mathtt{m}}}$ $[\mathtt{A}]' = 0$
$\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}$ or $\{\mathtt{A}_1, \mathtt{A}_2, \dots\} \mapsto \mathtt{B}$ or $\begin{cases} \mathtt{A}_1 \mapsto \mathtt{B} \\ \mathtt{A}_2 \mapsto \mathtt{B} \\ \quad \vdots \end{cases}$	$[\mathtt{B}]' = \dfrac{\mathtt{v}\prod_{\mathtt{j}}(1+\mathtt{T}_{\mathtt{j}}\mathcal{U}(\mathtt{T}_{\mathtt{j}})[\mathtt{A}_{\mathtt{i}}]^{\mathtt{n}_{\mathtt{j}}})^{\mathtt{m}}}{\prod_{\mathtt{j}}(1+\mathtt{T}_{\mathtt{j}}\mathcal{U}(-\mathtt{T}_{\mathtt{j}})[\mathtt{A}_{\mathtt{j}}]^{\mathtt{n}_{\mathtt{j}}})^{\mathtt{m}} + \mathtt{k}\prod_{\mathtt{j}}(1+\mathtt{T}_{\mathtt{j}}\mathcal{U}(-\mathtt{T}_{\mathtt{j}})[\mathtt{A}_{\mathtt{j}}]^{\mathtt{n}_{\mathtt{j}}})^{\mathtt{m}}}$ $[\mathtt{A}_1]' = [\mathtt{A}_2]' = \cdots = 0$

MWC/GWMC Rate Function
(Generalized Monod-Wyman-Changeaux)

Syntax $\{\mathtt{A} \overset{\mathtt{X}}{\Rightarrow} \mathtt{B}, \mathtt{MWC}[\mathtt{k_{cat}}, \mathtt{n}, \mathtt{c}, \ell, \mathtt{K}]\}$	
$\mathtt{A} \overset{\mathtt{X}}{\Rightarrow} \mathtt{B}$	$[\mathtt{B}]' = \mathtt{k_{cat}}[\mathtt{X}]\dfrac{\alpha(1+\alpha)^{\mathtt{n}-1} + \mathtt{c}\ell\alpha(1+\mathtt{c}\alpha)^{\mathtt{n}-1}}{(1+\alpha)^{\mathtt{n}} + \ell\alpha(1+\mathtt{c}\alpha)^{\mathtt{n}}}$ where $\alpha = \dfrac{[A]}{K}$ $[\mathtt{A}]' = -[\mathtt{B}]'$
$\mathtt{S} \underset{\{\mathtt{A},\mathtt{I}\}}{\overset{\mathtt{X}}{\Rightarrow}} \mathtt{P}$	$[\mathtt{B}]' = \mathtt{k_{cat}}[\mathtt{X}]\dfrac{\mathtt{s}(1+\mathtt{s})^{\mathtt{n}-1} + \mathtt{cLs}(1+\mathtt{cs})^{\mathtt{n}-1}}{(1+\mathtt{s})^{\mathtt{n}} + \mathtt{Ls}(1+\mathtt{cs})^{\mathtt{n}}}$ with $L = \left(\dfrac{1+i}{1+a}\right)^n \ell,\ s = \dfrac{[S]}{K},\ i = \dfrac{[I]}{K_I},\ a = \dfrac{[A]}{K_A}$ $[\mathtt{A}]' = -[\mathtt{B}]'$
Syntax $\{\{\mathtt{S_1}, \mathtt{S_2}, \dots\} \underset{\{\{\mathtt{A_1},\mathtt{A_2},\dots\},\{\mathtt{I_1},\mathtt{I_2},\dots\}\}}{\overset{\mathtt{X}}{\Rightarrow}} \{\mathtt{P_1}, \mathtt{P_2}, \dots\}, \mathtt{MWC}[\{\mathtt{k_1}, \mathtt{k_2} \dots\}, \mathtt{n}, \mathtt{c}, \ell, \mathtt{K}]\}$	
$[\mathtt{P_q}]' = \mathtt{k_q}[\mathtt{X}]\dfrac{\prod_{\mathtt{i}}(1+\mathtt{a_i})^{\mathtt{n}}\prod_{\mathtt{j}}(1+\mathtt{s_j})^{\mathtt{n}-1}\prod_{\mathtt{k}}\mathtt{s_k} + \ell\prod_{\mathtt{i}}(\mathtt{cs_i})\prod_{\mathtt{j}}(1+\mathtt{cs_j})^{\mathtt{n}-1}\prod_{\mathtt{k}}(1+\mathtt{i_k})^{\mathtt{n}}}{\prod_{\mathtt{i}}(1+\mathtt{a_i})^{\mathtt{n}}\prod_{\mathtt{j}}(1+\mathtt{s_j})^{\mathtt{n}} + \ell\prod_{\mathtt{i}}(1+\mathtt{cs_i})^{\mathtt{n}-1}\prod_{\mathtt{j}}(1+\mathtt{i_j})^{\mathtt{n}}}$ where $s_j = \dfrac{[S_j]}{K_{S_j}},\ a_j = \dfrac{[A_j]}{K_{A_j}},\ i_j = \dfrac{[I_j]}{K_{I_j}}$	
Syntax $\{\underset{\{\{\mathtt{A_1},\mathtt{A_2},\dots\},\{\mathtt{I_1},\mathtt{I_2},\dots\}\},\{\{\mathtt{C'_{11}},\mathtt{C'_{12}},\dots\}\{\mathtt{C'_{21}},\mathtt{C'_{22}},\dots\},\dots,\{\mathtt{A'_{11}},\mathtt{A'_{12}},\dots\},\dots\}}{\{\mathtt{S_1}, \mathtt{S_2}, \dots\} \overset{\mathtt{X}}{\Rightarrow} \{\mathtt{P_1}, \mathtt{P_2}, \dots\}}, \mathtt{MWC}[\{\mathtt{k_1}, \mathtt{k_2}, \dots\}, \mathtt{n}, \mathtt{c}, \ell, \mathtt{K}]\}$ here $C_{j1}, C_{j2}, \dots$ are competitive inhibitors of S_j, $A'_{i1}, A'_{i2}, \dots$ are competitive activators of A_i	
$[P_q]' = \dfrac{\prod_i(1+a_i+\overline{a_i})^{\mathtt{n}}\prod_j(1+s_j+\overline{s_j})^{\mathtt{n}-1}\prod_m s_m + L\prod_i(\mathtt{c}s_i)\prod_j(1+\mathtt{c}s_j+\mathtt{c}\overline{s_j})^{\mathtt{n}-1} + \prod_m(1+i_m)^{\mathtt{n}}}{\prod_i(1+a_i+\overline{a_i})^{\mathtt{n}}\prod_j(1+s_j)^{\mathtt{n}} + L\prod_j(1+\mathtt{c}s_j+\mathtt{c}\overline{s_j})^{\mathtt{n}-1} + \prod_m(1+i_m)^{\mathtt{n}}}$ where $s_j = \dfrac{[S_j]}{K_{S_j}},\ a_j = \dfrac{[A_j]}{K_{A_j}},\ i_j = \dfrac{[I_j]}{K_{I_j}},\ \overline{s_j} = \sum_q \dfrac{[C_{jq}]}{K_{S_{jq}}},\ \overline{a_j} = \sum_q \dfrac{[A'_{jq}]}{K_{A'_{jq}}}$	

Rational Function Rate Law

$\{\{\{\mathtt{A}_1, \mathtt{A}_2, \dots\}, \{\mathtt{B}_1, \mathtt{B}_2, \dots\}\} \Rightarrow \mathtt{X}$ $\mathtt{rational}[\{\mathtt{a}_0, \dots\}, \{\mathtt{b}_0, \dots\}, \{\mathtt{p}_1, \dots\}, \{\mathtt{q}_1, \dots\}]\}$
$[\mathtt{X}]' = \dfrac{\mathtt{a}_0 + \mathtt{a}_1[\mathtt{A}_1]^{\mathtt{p}_1} + \mathtt{a}_2[\mathtt{A}_2]^{\mathtt{p}_2} + \cdots}{\mathtt{b}_0 + \mathtt{b}_1[\mathtt{B}_1]^{\mathtt{q}_1} + \mathtt{b}_2[\mathtt{B}_2]^{\mathtt{q}_2} + \cdots}$ $[\mathtt{A}_1]' = [\mathtt{A}_2]' = \cdots = [\mathtt{B}_1]' = [\mathtt{B}_2]' = \cdots = 0$

User-Defined Stoichiometric Rate Laws

Syntax $\{\mathtt{p}_1\mathtt{A}_1 + \mathtt{p}_2\mathtt{A}_2 + \cdots \Rightarrow \mathtt{q}_1\mathtt{B}_1 + \mathtt{q}_2\mathtt{B}_2 + \cdots, \mathtt{f}[\mathtt{A}_1[\mathtt{t}], \mathtt{A}_2[\mathtt{t}], \dots, \mathtt{B}_1[\mathtt{t}], \mathtt{B}_2[\mathtt{t}], \dots]\}$
$[\mathtt{X}_\mathtt{i}]' = (\mathtt{q}_\mathtt{i} - \mathtt{p}_\mathtt{i})\mathtt{f}[\mathtt{A}_1[\mathtt{t}], \mathtt{A}_2[\mathtt{t}], \dots, \mathtt{B}_1[\mathtt{t}], \dots]$

User-Defined Regulatory Rate Laws

$\{\mathtt{A} \mapsto \mathtt{B}, \mathtt{name}[\mathtt{r}, \mathtt{T}, \mathtt{n}, \mathtt{h}, \mathtt{f}]\}$	$[\mathtt{B}]' = \mathtt{rf}(\mathtt{h} + \mathtt{T}[\mathtt{A}]^\mathtt{n})$
$\mathtt{A}_1 + \mathtt{A}_2 + \cdots \mapsto \mathtt{B}$ or $\{\mathtt{A}_1, \mathtt{A}_2, \dots\} \mapsto \mathtt{B}$ or $\begin{cases} \mathtt{A}_1 \mapsto \mathtt{B} \\ \mathtt{A}_2 \mapsto \mathtt{B} \\ \quad\vdots \end{cases}$	$[\mathtt{B}]' = \mathtt{rf}(\mathtt{h} + \mathtt{T}_1[\mathtt{A}_1]^{\mathtt{n}_1} + \mathtt{T}_2[\mathtt{A}_2]^{\mathtt{n}_2} + \cdots)$

Flux-Only Reactions

$\{\mathtt{p}_1\mathtt{X}_1 + \mathtt{p}_2\mathtt{X}_2 + \cdots \rightarrow \mathtt{q}_1\mathtt{Y}_2 + \mathtt{q}_2\mathtt{Y}_2 + \cdots,$ `Flux`[*lower bounds* , *variable name*, *upper bounds*, *value*, *objective coefficient*]}

This document was last revised on August 31, 2012.