SBML Model Report

Model name: "Arnold2011_Zhu2007_CalvinCycle_Starch-_Sucrose_Photorespiration"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following three authors: Vijayalakshmi Chelliah[1], Anne Arnold[2] and Zoran Nikoloski[3] at October 24th 2011 at 11:17 a. m. and last time modified at April eighth 2016 at 5:14 p. m. Table 1 shows an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

Element	Quantity	Element	Quantity
compartment types	0	compartments	2
species types	0	species	58
events	0	constraints	0
reactions	36	function definitions	22
global parameters	10	unit definitions	2
rules	23	initial assignments	0

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Model Notes

This model is from the article:
A quantitative comparison of CalvinBenson cycle models
Anne Arnold, Zoran Nikoloski Trends in Plant Science2011 Oct 14. 22001849,
Abstract:
The Calvin-Benson cycle (CBC) provides the precursors for biomass synthesis necessary for plant growth. The dynamic behavior and yield of the CBC depend on the environmental conditions and regulation of the cellular state. Accurate quantitative models hold the promise of identifying the key determinants of the tightly regulated CBC function and their effects on the responses in future climates. We provide an integrative analysis of the largest compendium of existing models for photosynthetic processes. Based on the proposed ranking, our framework facilitates the discovery of best-performing models with regard to metabolomics data and of candidates for metabolic engineering.

Note: Model of the Calvin cycle and the related end-product pathways to starch and sucrose synthesis and photorespiration by Zhu et al. (2007, DOI:10.1104/pp.107.103713) and the personally provided implementation. The parameter values are partly taken from Pettersson and Ryde-Pettersson (1988, DOI:10.1111/j.1432-1033.1988.tb14242.x). The initial metabolite values are chosen from the data set of Zhu et al. (2007, DOI:10.1104/pp.107.103713). A detailed description of all modifications is given in the model described by Arnold and Nikoloski (2011, PMID:22001849.

2 Unit Definitions

This is an overview of five unit definitions of which three are predefined by SBML and not mentioned in the model.

2.1 Unit `volume`

Definition l

2.2 Unit `substance`

Definition mmol

2.3 Unit `area`

Notes Square metre is the predefined SBML unit for `area` since SBML Level 2 Version 1.

Definition m^2

2.4 Unit `length`

Notes Metre is the predefined SBML unit for `length` since SBML Level 2 Version 1.

Definition m

2.5 Unit `time`

Notes Second is the predefined SBML unit for `time`.

Definition s

3 Compartments

This model contains two compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
`chloroplast`	chloroplast		3	1	litre	☑	
`cytosol`	cytosol		3	1	litre	☑	

3.1 Compartment `chloroplast`

This is a three dimensional compartment with a constant size of one litre.

Name chloroplast

3.2 Compartment `cytosol`

This is a three dimensional compartment with a constant size of one litre.

Name cytosol

4 Species

This model contains 58 species. The boundary condition of 30 of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 9 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
PGA	PGA	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
DPGA	DPGA	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GAP	GAP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
DHAP	DHAP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
TP	TP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
FBP	FBP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
F6P	F6P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
G6P	G6P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
G1P	G1P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
HeP	HeP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
E4P	E4P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
SBP	SBP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
S7P	S7P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
X5P	X5P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
R5P	R5P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
Ru5P	Ru5P	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
PeP	PeP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
RuBP	RuBP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
ATP	ATP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
ADP	ADP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
NADPH	NADPH	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Pi	Pi	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
PGCA	PGCA	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GCA	GCA	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GCEA	GCEA	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
CO2	CO2	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
O2	O2	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
NADP	NADP	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
HPRc	HPRc	chloroplast	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GCAc	GCAc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GOAc	GOAc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GLYc	GLYc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
SERc	SERc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GCEAc	GCEAc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
PGAc	PGAc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
GAPc	GAPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
DHAPc	DHAPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
TPc	TPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
FBPc	FBPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
F6Pc	F6Pc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
G6Pc	G6Pc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
G1Pc	G1Pc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
HePc	HePc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
F26BPc	F26BPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
UDPGc	UDPGc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
SucPc	SucPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
Succ	Succ	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☐
UTPc	UTPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
UDPc	UDPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
NAD	NAD	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
NADH	NADH	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GLUc	GLUc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
KGc	KGc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
Pic	Pic	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
PiTc	PiTc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
ATPc	ATPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
ADPc	ADPc	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑
PiPic	PiPic	cytosol	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☐	☑

5 Parameters

This model contains ten global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
cA	cA	0000009	1.500		☑
cP	cP	0000009	15.000		☑
cAc	cAc	0000009	1.000		☑
cPc	cPc	0000009	15.000		☑
cNc	cNc	0000009	0.870		☑
cUc	cUc	0000009	1.500		☑
E	E	0000009	1.457		☑
Wc_min	Wc*min	0000009	0.767		☐
Wo_min	Wo*min	0000009	0.280		☐
K52a	K52a	0000009	0.003		☐

6 Function definitions

This is an overview of 22 function definitions.

6.1 Function definition function_9

Name MMlike s2p2 + reg 3*c-s1,1*m-s2

Arguments Vm, s1, s2, p1, p2, q, Ks1, r1, Kr1, r2, Kr2, r3, Kr3, r4, Kr41, Ks2, Kr42

Mathematical Expression

$$\frac{\mathrm{Vm}\cdot\left(\mathrm{s1}\cdot\mathrm{s2}-\frac{\mathrm{p1}\cdot\mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1}+\mathrm{Ks1}\cdot\left(1+\frac{\mathrm{r1}}{\mathrm{Kr1}}+\frac{\mathrm{r2}}{\mathrm{Kr2}}+\frac{\mathrm{r3}}{\mathrm{Kr3}}\right)\right)\cdot\left(\mathrm{s2}\cdot\left(1+\frac{\mathrm{r4}}{\mathrm{Kr41}}\right)+\mathrm{Ks2}\cdot\left(1+\frac{\mathrm{r4}}{\mathrm{Kr42}}\right)\right)} \quad (1)$$

6.2 Function definition function_18

Name Competitive inhibition (irr)

Arguments substrate, Inhibitor, Km, V, Ki

Mathematical Expression

$$\frac{\mathrm{V}\cdot\mathrm{substrate}}{\mathrm{Km}+\mathrm{substrate}+\frac{\mathrm{Km}\cdot\mathrm{Inhibitor}}{\mathrm{Ki}}} \quad (2)$$

6.3 Function definition function_17

Name Henri-Michaelis-Menten (irreversible)

Arguments substrate, Km, V

Mathematical Expression

$$\frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{3}$$

6.4 Function definition function_5

Name MMlike s1p2 + reg 2*c

Arguments Vm, s1, p1, p2, q, Ks1, r1, Kr1, r2, Kr2

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)} \tag{4}$$

6.5 Function definition function_14

Name MMlike s2p2 + reg 1*c-s1,4*c-s2

Arguments Vm, s1, s2, p1, p2, q, Ks1, r1, Kr1, Ks2, r2, Kr2, r3, Kr3, r4, Kr4, r5, Kr5

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right) \cdot \left(1 + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right) \cdot \left(1 + \frac{\mathrm{r4}}{\mathrm{Kr4}}\right) \cdot \left(1 + \frac{\mathrm{r5}}{\mathrm{Kr5}}\right)\right)} \tag{5}$$

6.6 Function definition function_21

Name MMlike s2p2 -s2 + reg 1*c

Arguments Vm, s1, s2, p1, p2, q, Ks1, r1, Kr1

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{6}$$

6.7 Function definition function_15

Name MMlike s2p2 + reg 2*c-s1,1*c-s2

Arguments Vm, s1, s2, p1, p2, q, Ks1, r1, Kr1, r2, Kr2, Ks2, r3, Kr3

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right) \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)\right) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right)\right)} \tag{7}$$

6.8 Function definition function_4

Name MM s2p1 - reg

Arguments s1, s2, p1, q, Ks1, Ks2, Kp1, Vm

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \mathrm{Ks2} \cdot \left(\left(1 + \frac{\mathrm{s1}}{\mathrm{Ks1}}\right) \cdot \left(1 + \frac{\mathrm{s2}}{\mathrm{Ks2}}\right) + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right)} \tag{8}$$

6.9 Function definition function_8

Name MMlike s1p2 + reg 1*c

Arguments Vm, s1, p1, p2, q, Ks1, r1, Kr1

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{9}$$

6.10 Function definition function_12

Name MM s1p2 - reg

Arguments s1, p1, p2, q, Ks1, Kp1, Kp2, Vm

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \left(\frac{\mathrm{s1}}{\mathrm{Ks1}} + \left(1 + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right) \cdot \left(1 + \frac{\mathrm{p2}}{\mathrm{Kp2}}\right)\right)} \tag{10}$$

6.11 Function definition function_13

Name MM s2p2 - reg

Arguments s1, s2, p1, p2, q, Ks1, Ks2, Kp1, Kp2, Vm

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \mathrm{Ks2} \cdot \left(\left(1 + \frac{\mathrm{s1}}{\mathrm{Ks1}}\right) \cdot \left(1 + \frac{\mathrm{s2}}{\mathrm{Ks2}}\right) + \left(1 + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right) \cdot \left(1 + \frac{\mathrm{p2}}{\mathrm{Kp2}}\right) - 1\right)} \tag{11}$$

6.12 Function definition function_2

Name MM s2 + reg 1*c

Arguments Vm, s1, s2, Ks1, Ks2, r1, Kr1

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{s1} \cdot \mathrm{s2}}{(\mathrm{s1} + \mathrm{Ks1}) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right)} \tag{12}$$

6.13 Function definition function_10

Name starch synthase - Pettersson

Arguments Vm, S1, S2, K1, K2, R1, KR1, R2, KA1, A1, KA2, A2, KA3, A3

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{S1} \cdot \mathrm{S2}}{(\mathrm{S1} + \mathrm{K1}) \cdot \left(1 + \frac{\mathrm{R1}}{\mathrm{KR1}}\right) \cdot \left(\mathrm{S2} + \mathrm{K2} \cdot \left(1 + \frac{\mathrm{K2} \cdot \mathrm{R2}}{\mathrm{KA1} \cdot \mathrm{A1} + \mathrm{KA2} \cdot \mathrm{A2} + \mathrm{KA3} \cdot \mathrm{A3}}\right)\right)} \tag{13}$$

6.14 Function definition function_19

Name MM s1 + reg 2*s

Arguments Vm, s1, Ks1, r1, Kr1, r2, Kr2

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{s1}}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right) \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)} \tag{14}$$

6.15 Function definition function_20

Name MMlike s2p2 + reg 1*c

Arguments Vm, s1, s2, p1, p2, q, Ks1, r1, Kr1, Ks2

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{15}$$

6.16 Function definition function_1

Name MM s1 + reg 5*c

Arguments Vm, S, K, R1, KR1, R2, KR2, R3, KR3, R4, KR4, R5, KR5

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{S}}{\mathrm{S} + \mathrm{K} \cdot \left(1 + \frac{\mathrm{R1}}{\mathrm{KR1}} + \frac{\mathrm{R2}}{\mathrm{KR2}} + \frac{\mathrm{R3}}{\mathrm{KR3}} + \frac{\mathrm{R4}}{\mathrm{KR4}} + \frac{\mathrm{R5}}{\mathrm{KR5}}\right)} \tag{16}$$

6.17 Function definition function_3

Name MM s2 - reg

Arguments Vm, s1, s2, K1, K2

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{s1} \cdot \mathrm{s2}}{(\mathrm{s1} + \mathrm{K1}) \cdot (\mathrm{s2} + \mathrm{K2})} \tag{17}$$

6.18 Function definition function_22

Name MMlike s1 - reg

Arguments Vm, s1, Ks1, r1, Kr1

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{s1}}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{18}$$

6.19 Function definition function_16

Name MM s1 + reg 2*n

Arguments Vm, s1, r1, Kr1, r2, Kr2, Ks1

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{s1}}{(\mathrm{s1} + \mathrm{Ks1}) \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right) \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)} \tag{19}$$

6.20 Function definition function_6

Name MMlike s2p2 + reg 2*c

Arguments Vm, s1, s2, p1, p2, Ks1, Ks2, r1, Kr1, r2, Kr2, q

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{20}$$

6.21 Function definition function_7

Name MMlike s2p1 - reg

Arguments Vm, s1, s2, p1, q, Ks1, Ks2

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1}}{\mathrm{q}}\right)}{(\mathrm{s1} + \mathrm{Ks1}) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{21}$$

6.22 Function definition function_11

Name MM s1 + reg A,3*c

Arguments Vm, S, KA, A, K, R1, KR1, R2, KR2, R3, KR3

Mathematical Expression

$$\frac{\mathrm{Vm} \cdot \mathrm{S}}{\mathrm{S} \cdot \left(1 + \frac{\mathrm{KA}}{\mathrm{A}}\right) + \mathrm{K} \cdot \left(1 + \left(1 + \frac{\mathrm{KA}}{\mathrm{A}}\right) \cdot \left(\frac{\mathrm{R1}}{\mathrm{KR1}} + \frac{\mathrm{R2}}{\mathrm{KR2}} + \frac{\mathrm{R3}}{\mathrm{KR3}}\right)\right)} \tag{22}$$

7 Rules

This is an overview of 23 rules.

7.1 Rule K52a

Rule K52a is an assignment rule for parameter K52a:

$$\mathrm{K52a} = 0.0025 \cdot \left(1 + \frac{[\mathrm{F26BPc}]}{7.0000000000000001E-5}\right) \tag{23}$$

7.2 Rule R5P

Rule R5P is an assignment rule for species R5P:

$$\mathrm{R5P} = \frac{\frac{[\mathrm{PeP}]}{0.4}}{1 + \frac{1}{0.4} + \frac{1}{0.67}} \tag{24}$$

7.3 Rule G6P

Rule G6P is an assignment rule for species G6P:

$$\mathrm{G6P} = \frac{[\mathrm{HeP}]}{1 + \frac{1}{2.3} + 0.058} \tag{25}$$

7.4 Rule DHAP

Rule DHAP is an assignment rule for species DHAP:

$$\mathrm{DHAP} = \frac{[\mathrm{TP}]}{1 + 0.05} \tag{26}$$

7.5 Rule GAP

Rule GAP is an assignment rule for species GAP:

$$\mathrm{GAP} = \frac{0.05 \cdot [\mathrm{TP}]}{1 + 0.05} \tag{27}$$

7.6 Rule G1P

Rule G1P is an assignment rule for species G1P:

$$\mathrm{G1P} = \frac{[\mathrm{HeP}] \cdot 0.058}{1 + \frac{1}{2.3} + 0.058} \tag{28}$$

7.7 Rule X5P

Rule X5P is an assignment rule for species X5P:

$$\mathrm{X5P} = \frac{\frac{[\mathrm{PeP}]}{0.67}}{1 + \frac{1}{0.4} + \frac{1}{0.67}} \tag{29}$$

7.8 Rule Pi

Rule Pi is an assignment rule for species Pi:

$$\begin{aligned} \mathrm{Pi} = {} & \mathrm{cP} - 2 \cdot ([\mathrm{RuBP}] + [\mathrm{DPGA}] + [\mathrm{FBP}] + [\mathrm{SBP}]) \\ & - ([\mathrm{PGA}] + [\mathrm{TP}] + [\mathrm{HeP}] + [\mathrm{E4P}] + [\mathrm{S7P}] + [\mathrm{PeP}] + [\mathrm{ATP}] + [\mathrm{PGCA}]) \end{aligned} \tag{30}$$

7.9 Rule Ru5P

Rule Ru5P is an assignment rule for species Ru5P:

$$\mathrm{Ru5P} = \frac{[\mathrm{PeP}]}{1 + \frac{1}{0.4} + \frac{1}{0.67}} \tag{31}$$

7.10 Rule F6P

Rule F6P is an assignment rule for species F6P:

$$\mathrm{F6P} = \frac{\frac{[\mathrm{HeP}]}{2.3}}{1 + \frac{1}{2.3} + 0.058} \tag{32}$$

7.11 Rule ADP

Rule ADP is an assignment rule for species ADP:

$$\mathrm{ADP} = \mathrm{cA} - [\mathrm{ATP}] \tag{33}$$

7.12 Rule G6Pc

Rule G6Pc is an assignment rule for species G6Pc:

$$\mathrm{G6Pc} = \frac{[\mathrm{HePc}]}{1 + \frac{1}{2.3} + 0.0584} \tag{34}$$

7.13 Rule GAPc

Rule GAPc is an assignment rule for species GAPc:

$$\mathrm{GAPc} = \frac{0.05 \cdot [\mathrm{TPc}]}{1 + 0.05} \tag{35}$$

7.14 Rule PiTc

Rule PiTc is an assignment rule for species PiTc:

$$\begin{aligned} \mathrm{PiTc} = {} & \mathrm{cPc} - 2 \cdot ([\mathrm{FBPc}] + [\mathrm{F26BPc}]) \\ & - ([\mathrm{PGAc}] + [\mathrm{TPc}] + [\mathrm{HePc}] + [\mathrm{SucPc}] + [\mathrm{ATPc}] + [\mathrm{UTPc}]) \end{aligned} \tag{36}$$

7.15 Rule F6Pc

Rule F6Pc is an assignment rule for species F6Pc:

$$\mathrm{F6Pc} = \frac{\frac{[\mathrm{HePc}]}{2.3}}{1 + \frac{1}{2.3} + 0.0584} \tag{37}$$

7.16 Rule Pic

Rule Pic is an assignment rule for species Pic:

$$\mathrm{Pic} = \frac{12000000}{2} \cdot \left(\sqrt{2} - 1\right) \tag{38}$$

7.17 Rule PiPic

Rule PiPic is an assignment rule for species PiPic:

$$\mathrm{PiPic} = [\mathrm{PiTc}] - [\mathrm{Pic}] \tag{39}$$

Derived unit $\mathrm{mmol} \cdot \mathrm{l}^{-1}$

7.18 Rule Wc_min

Rule Wc_min is an assignment rule for parameter Wc_min:

$$\mathrm{Wc\_min} = \frac{2.913930914 \cdot [\mathrm{CO2}]}{[\mathrm{CO2}] + 0.0115 \cdot \left(1 + \frac{[\mathrm{O2}]}{0.222}\right)} \cdot \frac{1 + \frac{[\mathrm{RuBP}]}{\mathrm{E}} - \left|1 - \frac{[\mathrm{RuBP}]}{\mathrm{E}}\right|}{2} \tag{40}$$

7.19 Rule G1Pc

Rule G1Pc is an assignment rule for species G1Pc:

$$\mathrm{G1Pc} = \frac{[\mathrm{HePc}] \cdot 0.0584}{1 + \frac{1}{2.3} + 0.0584} \tag{41}$$

7.20 Rule DHAPc

Rule DHAPc is an assignment rule for species DHAPc:

$$\mathrm{DHAPc} = \frac{[\mathrm{TPc}]}{1 + 0.05} \tag{42}$$

7.21 Rule UDPc

Rule UDPc is an assignment rule for species UDPc:

$$\mathrm{UDPc} = \mathrm{cUc} - [\mathrm{UTPc}] - [\mathrm{UDPGc}] \tag{43}$$

7.22 Rule `Wo_min`

Rule `Wo_min` is an assignment rule for parameter `Wo_min`:

$$\text{Wo\_min} = \frac{0.24 \cdot 2.913930914 \cdot [\text{O2}]}{[\text{O2}] + 0.222 \cdot \left(1 + \frac{[\text{CO2}]}{0.0115}\right)} \cdot \frac{1 + \frac{[\text{RuBP}]}{\text{E}} - \left|1 - \frac{[\text{RuBP}]}{\text{E}}\right|}{2} \tag{44}$$

7.23 Rule `ADPc`

Rule `ADPc` is an assignment rule for species `ADPc`:

$$\text{ADPc} = \text{cAc} - [\text{ATPc}] \tag{45}$$

8 Reactions

This model contains 36 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	RuBisCO_CO2	RuBisCO - CO2	$\mathrm{RuBP} \xrightarrow{\mathrm{PGA,\ FBP,\ SBP,\ Pi,\ NADPH}} 2\,\mathrm{PGA}$	
2	PGA_K	PGA kinase	$\mathrm{PGA} + \mathrm{ATP} \xrightarrow{\mathrm{ADP}} \mathrm{DPGA} + \mathrm{ADP}$	
3	GAP_DH	GAP dehydrogenase	$\mathrm{DPGA} + \mathrm{NADPH} \xrightarrow{\mathrm{GAP}} \mathrm{TP} + \mathrm{NADP}$	
4	FBP_A	FBP aldolase	$2\,\mathrm{TP} \xrightleftharpoons{\mathrm{GAP,\ DHAP}} \mathrm{FBP}$	
5	FBPase	FBPase	$\mathrm{FBP} \xrightleftharpoons{\mathrm{F6P,\ Pi}} \mathrm{HeP} + \mathrm{Pi}$	
6	F6P_TK	F6P transketolase	$\mathrm{HeP} + \mathrm{TP} \xrightleftharpoons{\mathrm{F6P,\ GAP,\ X5P,\ E4P}} \mathrm{E4P} + \mathrm{PeP}$	
7	SBP_A	SBP aldolase	$\mathrm{TP} + \mathrm{E4P} \xrightleftharpoons{\mathrm{DHAP}} \mathrm{SBP}$	
8	SBPase	SBPase	$\mathrm{SBP} \xrightleftharpoons{\mathrm{Pi}} \mathrm{S7P} + \mathrm{Pi}$	
9	S7P_TK	S7P transketolase	$\mathrm{TP} + \mathrm{S7P} \xrightleftharpoons{\mathrm{GAP,\ X5P,\ R5P}} 2\,\mathrm{PeP}$	
10	Ru5P_K	Ru5P kinase	$\mathrm{PeP} + \mathrm{ATP} \xrightleftharpoons{\mathrm{Ru5P,\ PGA,\ RuBP,\ Pi,\ ADP}} \mathrm{RuBP} + \mathrm{ADP}$	
11	ATP_S	ATP synthetase	$\mathrm{ADP} + \mathrm{Pi} \rightleftharpoons \mathrm{ATP}$	
12	AGPase	AGPase	$\mathrm{HeP} + \mathrm{ATP} \xrightarrow{\mathrm{G1P,\ ADP,\ Pi,\ PGA,\ F6P,\ FBP}} \emptyset$	
13	TPT_PGA	TPT - PGA	$\mathrm{PGA} \xrightarrow{\mathrm{Pic,\ Pi,\ GAP,\ DHAP}} \mathrm{PGAc}$	
14	TPT_GAP	TPT - GAP	$\mathrm{TP} \xrightarrow{\mathrm{GAP,\ GAPc,\ Pic,\ Pi,\ PGA,\ DHAP}} \mathrm{TPc}$	
15	TPT_DHAP	TPT - DHAP	$\mathrm{TP} \xrightarrow{\mathrm{DHAP,\ DHAPc,\ Pic,\ Pi,\ PGA,\ GAP}} \mathrm{TPc}$	

№	Id	Name	Reaction Equation	SBO
16	FBPc_A	FBPc aldolase	$2\,\mathrm{TPc} \overset{\mathrm{GAPc,\ DHAPc}}{\rightleftharpoons} \mathrm{FBPc}$	
17	FBPcase	FBPcase	$\mathrm{FBPc} \overset{\mathrm{F6Pc}}{\rightleftharpoons} \mathrm{HePc} + \mathrm{Pic}$	
18	UGPase	UGPase	$\mathrm{HePc} + \mathrm{UTPc} \overset{\mathrm{G1Pc}}{\rightleftharpoons} \mathrm{UDPGc} + \mathrm{PiPic}$	
19	SucPc_S	SucPc synthase	$\mathrm{HePc} + \mathrm{UDPGc} \overset{\mathrm{F6Pc,\ FBPc,\ UDPc,\ SucPc,\ Succ,\ Pic}}{\rightleftharpoons} \mathrm{SucPc} + \mathrm{UDPc}$	
20	SucPc_P	SucPc phosphatase	$\mathrm{SucPc} \overset{\mathrm{Succ}}{\rightleftharpoons} \mathrm{Succ} + \mathrm{Pic}$	
21	F6Pc_K	F6Pc kinase	$\mathrm{HePc} + \mathrm{ATPc} \overset{\mathrm{F6Pc,\ F26BPc,\ DHAPc,\ ADPc}}{\rightleftharpoons} \mathrm{F26BPc} + \mathrm{ADPc}$	
22	F26BPc_P	F26BPc phosphatase	$\mathrm{F26BPc} \overset{\mathrm{Pic,\ F6Pc}}{\longrightarrow} \mathrm{HePc} + \mathrm{Pic}$	
23	Succ_Deg	Succ degradation	$\mathrm{Succ} \longrightarrow \emptyset$	
24	PGAc_Deg	PGAc degradation	$\mathrm{PGAc} \longrightarrow \emptyset$	
25	GPT_GCEAc	GPT - GCEAc	$\mathrm{GCEAc} \overset{\mathrm{GCAc}}{\longrightarrow} \mathrm{GCEA}$	
26	GPT_GCEA	GPT - GCEA	$\mathrm{GCEA} \overset{\mathrm{GCA}}{\longrightarrow} \mathrm{GCEAc}$	
27	GPT_GCA	GPT - GCA	$\mathrm{GCA} \overset{\mathrm{GCEA}}{\longrightarrow} \mathrm{GCAc}$	
28	GPT_GCAc	GPT - GCAc	$\mathrm{GCAc} \overset{\mathrm{GCEAc}}{\longrightarrow} \mathrm{GCA}$	
29	RuBisCO_O2	RuBisC0 - O2	$\mathrm{RuBP} \overset{\mathrm{PGA,\ FBP,\ SBP,\ Pi,\ NADPH}}{\longrightarrow} \mathrm{PGA} + \mathrm{PGCA}$	
30	PGCA_P	PGCA phosphatase	$\mathrm{PGCA} \overset{\mathrm{GCA,\ Pi}}{\longrightarrow} \mathrm{GCA}$	
31	GCEA_K	GCEA kinase	$\mathrm{ATP} + \mathrm{GCEA} \overset{\mathrm{PGA}}{\rightleftharpoons} \mathrm{PGA} + \mathrm{ADP}$	
32	GCAc_Ox	GCAc oxidase	$\mathrm{GCAc} \longrightarrow \mathrm{GOAc}$	
33	SERcGOAc_AT	SERc:GOAc aminotransferase	$\mathrm{SERc} + \mathrm{GOAc} \overset{\mathrm{GLYc}}{\rightleftharpoons} \mathrm{HPRc} + \mathrm{GLYc}$	
34	GCEA_DH	GCEA dehydrogenase	$\mathrm{HPRc} + \mathrm{NADH} \overset{\mathrm{HPRc}}{\rightleftharpoons} \mathrm{GCEAc} + \mathrm{NAD}$	

№	Id	Name	Reaction Equation	SBO
35	GLUcGOAc_AT	GLUc:GOAc aminotransferase	$\mathrm{GLUc} + \mathrm{GOAc} \overset{\mathrm{GLYc}}{\rightleftharpoons} \mathrm{KGc} + \mathrm{GLYc}$	
36	GLYc_DC	GLYc decarboxylase	$2\,\mathrm{GLYc} \overset{\mathrm{SERc}}{\longrightarrow} \mathrm{SERc}$	

8.1 Reaction RuBisCO_CO2

This is an irreversible reaction of one reactant forming one product influenced by five modifiers.

Name RuBisCO - CO2

Reaction equation

$$\mathrm{RuBP} \xrightarrow{\mathrm{PGA,\ FBP,\ SBP,\ Pi,\ NADPH}} 2\,\mathrm{PGA} \tag{46}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
RuBP	RuBP	

Modifiers

Table 7: Properties of each modifier.

Id	Name	SBO
PGA	PGA	
FBP	FBP	
SBP	SBP	
Pi	Pi	
NADPH	NADPH	

Product

Table 8: Properties of each product.

Id	Name	SBO
PGA	PGA	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_1}\,(\mathrm{Wc\_min}, [\mathrm{RuBP}], \mathrm{K}, [\mathrm{PGA}], \mathrm{KR1}, [\mathrm{FBP}], \mathrm{KR2}, [\mathrm{SBP}], \mathrm{KR3}, [\mathrm{Pi}], \mathrm{KR4}, [\mathrm{NADPH}], \mathrm{KR5}) \tag{47}$$

$$\text{function\_1}(\text{Vm},\text{S},\text{K},\text{R1},\text{KR1},\text{R2},\text{KR2},\text{R3},\text{KR3},\text{R4},\text{KR4},\text{R5},\text{KR5}) = \frac{\text{Vm}\cdot\text{S}}{\text{S}+\text{K}\cdot\left(1+\frac{\text{R1}}{\text{KR1}}+\frac{\text{R2}}{\text{KR2}}+\frac{\text{R3}}{\text{KR3}}+\frac{\text{R4}}{\text{KR4}}+\frac{\text{R5}}{\text{KR5}}\right)} \tag{48}$$

$$\text{function\_1}(\text{Vm},\text{S},\text{K},\text{R1},\text{KR1},\text{R2},\text{KR2},\text{R3},\text{KR3},\text{R4},\text{KR4},\text{R5},\text{KR5}) = \frac{\text{Vm}\cdot\text{S}}{\text{S}+\text{K}\cdot\left(1+\frac{\text{R1}}{\text{KR1}}+\frac{\text{R2}}{\text{KR2}}+\frac{\text{R3}}{\text{KR3}}+\frac{\text{R4}}{\text{KR4}}+\frac{\text{R5}}{\text{KR5}}\right)} \tag{49}$$

Table 9: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
K	K	0000009	0.020		☑
KR1	KR1	0000009	0.840		☑
KR2	KR2	0000009	0.040		☑
KR3	KR3	0000009	0.075		☑
KR4	KR4	0000009	0.900		☑
KR5	KR5	0000009	0.070		☑

8.2 Reaction PGA_K

This is an irreversible reaction of two reactants forming two products influenced by one modifier.

Name PGA kinase

Reaction equation

$$\text{PGA} + \text{ATP} \xrightarrow{\text{ADP}} \text{DPGA} + \text{ADP} \tag{50}$$

Reactants

Table 10: Properties of each reactant.

Id	Name	SBO
PGA	PGA	
ATP	ATP	

Modifier

Table 11: Properties of each modifier.

Id	Name	SBO
ADP	ADP	

Products

Table 12: Properties of each product.

Id	Name	SBO
DPGA	DPGA	
ADP	ADP	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_2}\,(\mathrm{Vm}, [\mathrm{PGA}], [\mathrm{ATP}], \mathrm{Ks1}, \mathrm{Ks2}, [\mathrm{ADP}], \mathrm{Kr1}) \tag{51}$$

$$\mathrm{function\_2}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{r1}, \mathrm{Kr1}) = \frac{\mathrm{Vm} \cdot \mathrm{s1} \cdot \mathrm{s2}}{(\mathrm{s1} + \mathrm{Ks1}) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right)} \tag{52}$$

$$\mathrm{function\_2}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{r1}, \mathrm{Kr1}) = \frac{\mathrm{Vm} \cdot \mathrm{s1} \cdot \mathrm{s2}}{(\mathrm{s1} + \mathrm{Ks1}) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right)} \tag{53}$$

Table 13: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	30.141		☑
Ks1	Ks1	0000009	0.240		☑
Ks2	Ks2	0000009	0.390		☑
Kr1	Kr1	0000009	0.230		☑

8.3 Reaction GAP_DH

This is an irreversible reaction of two reactants forming two products influenced by one modifier.

Name GAP dehydrogenase

Reaction equation

$$\mathrm{DPGA} + \mathrm{NADPH} \xrightarrow{\mathrm{GAP}} \mathrm{TP} + \mathrm{NADP} \tag{54}$$

Reactants

Table 14: Properties of each reactant.

Id	Name	SBO
DPGA	DPGA	
NADPH	NADPH	

Modifier

Table 15: Properties of each modifier.

Id	Name	SBO
GAP	GAP	

Products

Table 16: Properties of each product.

Id	Name	SBO
TP	TP	
NADP	NADP	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{vol}\left(\mathrm{chloroplast}\right) \cdot \mathrm{function\_3}\left(\mathrm{Vm}, [\mathrm{DPGA}], [\mathrm{NADPH}], \mathrm{K1}, \mathrm{K2}\right) \tag{55}$$

$$\mathrm{function\_3}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{K1}, \mathrm{K2}\right) = \frac{\mathrm{Vm} \cdot \mathrm{s1} \cdot \mathrm{s2}}{(\mathrm{s1} + \mathrm{K1}) \cdot (\mathrm{s2} + \mathrm{K2})} \tag{56}$$

$$\mathrm{function\_3}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{K1}, \mathrm{K2}\right) = \frac{\mathrm{Vm} \cdot \mathrm{s1} \cdot \mathrm{s2}}{(\mathrm{s1} + \mathrm{K1}) \cdot (\mathrm{s2} + \mathrm{K2})} \tag{57}$$

Table 17: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	4.039		☑
K1	K1	0000009	0.004		☑
K2	K2	0000009	0.100		☑

8.4 Reaction FBP_A

This is a reversible reaction of one reactant forming one product influenced by two modifiers.

Name FBP aldolase

Reaction equation

$$2\,\mathrm{TP} \rightleftharpoons[\text{GAP, DHAP}] \mathrm{FBP} \tag{58}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
TP	TP	

Modifiers

Table 19: Properties of each modifier.

Id	Name	SBO
GAP	GAP	
DHAP	DHAP	

Product

Table 20: Properties of each product.

Id	Name	SBO
FBP	FBP	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{vol}\,(\text{chloroplast}) \cdot \text{function\_4}\,([\text{GAP}], [\text{DHAP}], [\text{FBP}], \text{q}, \text{Ks1}, \text{Ks2}, \text{Kp1}, \text{Vm}) \quad (59)$$

$$\text{function\_4}\,(\text{s1}, \text{s2}, \text{p1}, \text{q}, \text{Ks1}, \text{Ks2}, \text{Kp1}, \text{Vm}) = \frac{\text{Vm} \cdot \left(\text{s1} \cdot \text{s2} - \frac{\text{p1}}{\text{q}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(\left(1 + \frac{\text{s1}}{\text{Ks1}}\right) \cdot \left(1 + \frac{\text{s2}}{\text{Ks2}}\right) + \frac{\text{p1}}{\text{Kp1}}\right)} \quad (60)$$

$$\text{function\_4}\,(\text{s1}, \text{s2}, \text{p1}, \text{q}, \text{Ks1}, \text{Ks2}, \text{Kp1}, \text{Vm}) = \frac{\text{Vm} \cdot \left(\text{s1} \cdot \text{s2} - \frac{\text{p1}}{\text{q}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(\left(1 + \frac{\text{s1}}{\text{Ks1}}\right) \cdot \left(1 + \frac{\text{s2}}{\text{Ks2}}\right) + \frac{\text{p1}}{\text{Kp1}}\right)} \quad (61)$$

Table 21: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
q	q	0000009	7.100		☑
Ks1	Ks1	0000009	0.300		☑
Ks2	Ks2	0000009	0.400		☑
Kp1	Kp1	0000009	0.020		☑
Vm	Vm	0000009	1.219		☑

8.5 Reaction FBPase

This is a reversible reaction of one reactant forming two products influenced by two modifiers.

Name FBPase

Reaction equation

$$\text{FBP} \overset{\text{F6P, Pi}}{\rightleftharpoons} \text{HeP} + \text{Pi} \quad (62)$$

Reactant

Table 22: Properties of each reactant.

Id	Name	SBO
FBP	FBP	

Modifiers

Table 23: Properties of each modifier.

Id	Name	SBO
F6P	F6P	
Pi	Pi	

Products

Table 24: Properties of each product.

Id	Name	SBO
HeP	HeP	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_5}\,(\mathrm{Vm}, [\mathrm{FBP}], [\mathrm{F6P}], [\mathrm{Pi}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{F6P}], \mathrm{Kr1}, [\mathrm{Pi}], \mathrm{Kr2}) \quad (63)$$

$$\mathrm{function\_5}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)} \quad (64)$$

$$\mathrm{function\_5}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)} \quad (65)$$

Table 25: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	0.726		☑
q	q	0000009	666000.000		☑
Ks1	Ks1	0000009	0.033		☑
Kr1	Kr1	0000009	0.700		☑
Kr2	Kr2	0000009	12.000		☑

8.6 Reaction F6P_TK

This is a reversible reaction of two reactants forming two products influenced by four modifiers.

Name F6P transketolase

Reaction equation

$$\mathrm{HeP} + \mathrm{TP} \xrightleftharpoons{\text{F6P, GAP, X5P, E4P}} \mathrm{E4P} + \mathrm{PeP} \tag{66}$$

Reactants

Table 26: Properties of each reactant.

Id	Name	SBO
HeP	HeP	
TP	TP	

Modifiers

Table 27: Properties of each modifier.

Id	Name	SBO
F6P	F6P	
GAP	GAP	
X5P	X5P	
E4P	E4P	

Products

Table 28: Properties of each product.

Id	Name	SBO
E4P	E4P	
PeP	PeP	

Kinetic Law

Derived unit contains undeclared units

$$\begin{aligned} v_6 = {} & \mathrm{vol}\,(\mathrm{chloroplast}) \\ & \cdot \mathrm{function\_6}\,(\mathrm{Vm}, [\mathrm{F6P}], [\mathrm{GAP}], [\mathrm{X5P}], [\mathrm{E4P}], \mathrm{Ks1}, \mathrm{Ks2}, [\mathrm{X5P}], \mathrm{Kr1}, [\mathrm{E4P}], \mathrm{Kr2}, \mathrm{q}) \end{aligned} \tag{67}$$

$$\begin{aligned}&\text{function\_6}(\text{Vm},\text{s1},\text{s2},\text{p1},\text{p2},\text{Ks1},\text{Ks2},\text{r1},\text{Kr1},\text{r2},\text{Kr2},\text{q})\\&= \frac{\text{Vm}\cdot\left(\text{s1}\cdot\text{s2}-\frac{\text{p1}\cdot\text{p2}}{\text{q}}\right)}{\left(\text{s1}+\text{Ks1}\cdot\left(1+\frac{\text{r1}}{\text{Kr1}}+\frac{\text{r2}}{\text{Kr2}}\right)\right)\cdot(\text{s2}+\text{Ks2})}\end{aligned} \tag{68}$$

$$\begin{aligned}&\text{function\_6}(\text{Vm},\text{s1},\text{s2},\text{p1},\text{p2},\text{Ks1},\text{Ks2},\text{r1},\text{Kr1},\text{r2},\text{Kr2},\text{q})\\&= \frac{\text{Vm}\cdot\left(\text{s1}\cdot\text{s2}-\frac{\text{p1}\cdot\text{p2}}{\text{q}}\right)}{\left(\text{s1}+\text{Ks1}\cdot\left(1+\frac{\text{r1}}{\text{Kr1}}+\frac{\text{r2}}{\text{Kr2}}\right)\right)\cdot(\text{s2}+\text{Ks2})}\end{aligned} \tag{69}$$

Table 29: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	3.122		☑
Ks1	Ks1	0000009	0.100		☑
Ks2	Ks2	0000009	0.100		☑
Kr1	Kr1	0000009	0.100		☑
Kr2	Kr2	0000009	0.100		☑
q	q	0000009	10.000		☑

8.7 Reaction SBP_A

This is a reversible reaction of two reactants forming one product influenced by one modifier.

Name SBP aldolase

Reaction equation

$$\text{TP} + \text{E4P} \overset{\text{DHAP}}{\rightleftharpoons} \text{SBP} \tag{70}$$

Reactants

Table 30: Properties of each reactant.

Id	Name	SBO
TP	TP	
E4P	E4P	

Modifier

Table 31: Properties of each modifier.

Id	Name	SBO
DHAP	DHAP	

Product

Table 32: Properties of each product.

Id	Name	SBO
SBP	SBP	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_7}\,(\mathrm{Vm}, [\mathrm{DHAP}], [\mathrm{E4P}], [\mathrm{SBP}], \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}) \tag{71}$$

$$\mathrm{function\_7}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1}}{\mathrm{q}}\right)}{(\mathrm{s1} + \mathrm{Ks1}) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{72}$$

$$\mathrm{function\_7}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1}}{\mathrm{q}}\right)}{(\mathrm{s1} + \mathrm{Ks1}) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{73}$$

Table 33: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	1.219		☑
q	q	0000009	1.017		☑
Ks1	Ks1	0000009	0.400		☑
Ks2	Ks2	0000009	0.200		☑

8.8 Reaction SBPase

This is a reversible reaction of one reactant forming two products influenced by one modifier.

Name SBPase

Reaction equation

$$\mathrm{SBP} \overset{\mathrm{Pi}}{\rightleftharpoons} \mathrm{S7P} + \mathrm{Pi} \tag{74}$$

Reactant

Table 34: Properties of each reactant.

Id	Name	SBO
SBP	SBP	

Modifier

Table 35: Properties of each modifier.

Id	Name	SBO
Pi	Pi	

Products

Table 36: Properties of each product.

Id	Name	SBO
S7P	S7P	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \mathrm{vol}\left(\mathrm{chloroplast}\right) \cdot \mathrm{function\_8}\left(\mathrm{Vm}, [\mathrm{SBP}], [\mathrm{S7P}], [\mathrm{Pi}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{Pi}], \mathrm{Kr1}\right) \tag{75}$$

$$\mathrm{function\_8}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}\right) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{76}$$

$$\mathrm{function\_8}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}\right) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{77}$$

Table 37: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	0.324		☑
q	q	0000009	666000.000		☑
Ks1	Ks1	0000009	0.050		☑
Kr1	Kr1	0000009	12.000		☑

8.9 Reaction S7P_TK

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

Name S7P transketolase

Reaction equation

$$\mathrm{TP} + \mathrm{S7P} \xrightleftharpoons{\mathrm{GAP,\ X5P,\ R5P}} 2\,\mathrm{PeP} \tag{78}$$

Reactants

Table 38: Properties of each reactant.

Id	Name	SBO
TP	TP	
S7P	S7P	

Modifiers

Table 39: Properties of each modifier.

Id	Name	SBO
GAP	GAP	
X5P	X5P	
R5P	R5P	

Product

Table 40: Properties of each product.

Id	Name	SBO
PeP	PeP	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_6}\,(\mathrm{Vm}, [\mathrm{GAP}], [\mathrm{S7P}], [\mathrm{X5P}], [\mathrm{R5P}], \mathrm{Ks1}, \mathrm{Ks2}, [\mathrm{X5P}], \mathrm{Kr1}, [\mathrm{R5P}], \mathrm{Kr2}, \mathrm{q}) \tag{79}$$

$$\mathrm{function\_6}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{q}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{80}$$

$$\mathrm{function\_6}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{q}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{81}$$

Table 41: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	3.122		☑
Ks1	Ks1	0000009	0.072		☑
Ks2	Ks2	0000009	0.460		☑
Kr1	Kr1	0000009	0.100		☑
Kr2	Kr2	0000009	1.500		☑
q	q	0000009	1.176		☑

8.10 Reaction Ru5P_K

This is a reversible reaction of two reactants forming two products influenced by five modifiers.

Name Ru5P kinase

Reaction equation

$$\mathrm{PeP} + \mathrm{ATP} \xrightleftharpoons{\text{Ru5P, PGA, RuBP, Pi, ADP}} \mathrm{RuBP} + \mathrm{ADP} \tag{82}$$

Reactants

Table 42: Properties of each reactant.

Id	Name	SBO
PeP	PeP	
ATP	ATP	

Modifiers

Table 43: Properties of each modifier.

Id	Name	SBO
Ru5P	Ru5P	
PGA	PGA	
RuBP	RuBP	
Pi	Pi	
ADP	ADP	

Products

Table 44: Properties of each product.

Id	Name	SBO
RuBP	RuBP	
ADP	ADP	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \mathrm{vol}\left(\mathrm{chloroplast}\right) \cdot \mathrm{function\_9}\left(\mathrm{Vm}, [\mathrm{Ru5P}], [\mathrm{ATP}], [\mathrm{RuBP}], [\mathrm{ADP}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{PGA}], \mathrm{Kr1}, [\mathrm{RuBP}], \mathrm{Kr2}, [\mathrm{Pi}], \mathrm{Kr3}, [\mathrm{ADP}], \mathrm{Kr41}, \mathrm{Ks2}, \mathrm{Kr42}\right) \tag{83}$$

$$\mathrm{function\_9}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{r3}, \mathrm{Kr3}, \mathrm{r4}, \mathrm{Kr41}, \mathrm{Ks2}, \mathrm{Kr42}\right) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}} + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right)\right) \cdot \left(\mathrm{s2} \cdot \left(1 + \frac{\mathrm{r4}}{\mathrm{Kr41}}\right) + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r4}}{\mathrm{Kr42}}\right)\right)} \tag{84}$$

$$\mathrm{function\_9}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{r3}, \mathrm{Kr3}, \mathrm{r4}, \mathrm{Kr41}, \mathrm{Ks2}, \mathrm{Kr42}\right) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}} + \frac{\mathrm{r2}}{\mathrm{Kr2}} + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right)\right) \cdot \left(\mathrm{s2} \cdot \left(1 + \frac{\mathrm{r4}}{\mathrm{Kr41}}\right) + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r4}}{\mathrm{Kr42}}\right)\right)} \tag{85}$$

Table 45: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	10.835		☑
q	q	0000009	6846.000		☑
Ks1	Ks1	0000009	0.050		☑
Kr1	Kr1	0000009	2.000		☑
Kr2	Kr2	0000009	0.700		☑
Kr3	Kr3	0000009	4.000		☑
Kr41	Kr41	0000009	2.500		☑
Ks2	Ks2	0000009	0.059		☑
Kr42	Kr42	0000009	0.400		☑

8.11 Reaction ATP_S

This is a reversible reaction of two reactants forming one product.

Name ATP synthetase

Reaction equation

$$\mathrm{ADP} + \mathrm{Pi} \rightleftharpoons \mathrm{ATP} \tag{86}$$

Reactants

Table 46: Properties of each reactant.

Id	Name	SBO
ADP	ADP	
Pi	Pi	

Product

Table 47: Properties of each product.

Id	Name	SBO
ATP	ATP	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_4}\,([\mathrm{ADP}], [\mathrm{Pi}], [\mathrm{ATP}], \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{Kp1}, \mathrm{Vm}) \tag{87}$$

$$\text{function\_4}(s1, s2, p1, q, Ks1, Ks2, Kp1, Vm) = \frac{Vm \cdot \left(s1 \cdot s2 - \frac{p1}{q}\right)}{Ks1 \cdot Ks2 \cdot \left(\left(1 + \frac{s1}{Ks1}\right) \cdot \left(1 + \frac{s2}{Ks2}\right) + \frac{p1}{Kp1}\right)} \tag{88}$$

$$\text{function\_4}(s1, s2, p1, q, Ks1, Ks2, Kp1, Vm) = \frac{Vm \cdot \left(s1 \cdot s2 - \frac{p1}{q}\right)}{Ks1 \cdot Ks2 \cdot \left(\left(1 + \frac{s1}{Ks1}\right) \cdot \left(1 + \frac{s2}{Ks2}\right) + \frac{p1}{Kp1}\right)} \tag{89}$$

Table 48: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
q	q	0000009	5.734		☑
Ks1	Ks1	0000009	0.014		☑
Ks2	Ks2	0000009	0.300		☑
Kp1	Kp1	0000009	0.300		☑
Vm	Vm	0000009	15.000		☑

8.12 Reaction AGPase

This is an irreversible reaction of two reactants forming no product influenced by six modifiers.

Name AGPase

Reaction equation

$$\text{HeP} + \text{ATP} \xrightarrow{\text{G1P, ADP, Pi, PGA, F6P, FBP}} \emptyset \tag{90}$$

Reactants

Table 49: Properties of each reactant.

Id	Name	SBO
HeP	HeP	
ATP	ATP	

Modifiers

Table 50: Properties of each modifier.

Id	Name	SBO
G1P	G1P	
ADP	ADP	
Pi	Pi	
PGA	PGA	
F6P	F6P	
FBP	FBP	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_10}\,(\mathrm{Vm}, [\mathrm{G1P}], [\mathrm{ATP}], \mathrm{K1}, \mathrm{K2}, [\mathrm{ADP}], \mathrm{KR1}, [\mathrm{Pi}], \mathrm{KA1}, [\mathrm{PGA}], \mathrm{KA2}, [\mathrm{F6P}], \mathrm{KA3}, [\mathrm{FBP}]) \tag{91}$$

$$\mathrm{function\_10}\,(\mathrm{Vm}, \mathrm{S1}, \mathrm{S2}, \mathrm{K1}, \mathrm{K2}, \mathrm{R1}, \mathrm{KR1}, \mathrm{R2}, \mathrm{KA1}, \mathrm{A1}, \mathrm{KA2}, \mathrm{A2}, \mathrm{KA3}, \mathrm{A3}) = \frac{\mathrm{Vm} \cdot \mathrm{S1} \cdot \mathrm{S2}}{(\mathrm{S1} + \mathrm{K1}) \cdot \left(1 + \frac{\mathrm{R1}}{\mathrm{KR1}}\right) \cdot \left(\mathrm{S2} + \mathrm{K2} \cdot \left(1 + \frac{\mathrm{K2 \cdot R2}}{\mathrm{KA1 \cdot A1 + KA2 \cdot A2 + KA3 \cdot A3}}\right)\right)} \tag{92}$$

$$\mathrm{function\_10}\,(\mathrm{Vm}, \mathrm{S1}, \mathrm{S2}, \mathrm{K1}, \mathrm{K2}, \mathrm{R1}, \mathrm{KR1}, \mathrm{R2}, \mathrm{KA1}, \mathrm{A1}, \mathrm{KA2}, \mathrm{A2}, \mathrm{KA3}, \mathrm{A3}) = \frac{\mathrm{Vm} \cdot \mathrm{S1} \cdot \mathrm{S2}}{(\mathrm{S1} + \mathrm{K1}) \cdot \left(1 + \frac{\mathrm{R1}}{\mathrm{KR1}}\right) \cdot \left(\mathrm{S2} + \mathrm{K2} \cdot \left(1 + \frac{\mathrm{K2 \cdot R2}}{\mathrm{KA1 \cdot A1 + KA2 \cdot A2 + KA3 \cdot A3}}\right)\right)} \tag{93}$$

Table 51: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	0.267		☑
K1	K1	0000009	0.080		☑
K2	K2	0000009	0.080		☑
KR1	KR1	0000009	10.000		☑
KA1	KA1	0000009	0.100		☑
KA2	KA2	0000009	0.020		☑
KA3	KA3	0000009	0.020		☑

8.13 Reaction TPT_PGA

This is an irreversible reaction of one reactant forming one product influenced by four modifiers.

Name TPT - PGA

Reaction equation

$$\mathrm{PGA} \xrightarrow{\mathrm{Pic,\ Pi,\ GAP,\ DHAP}} \mathrm{PGAc} \tag{94}$$

Reactant

Table 52: Properties of each reactant.

Id	Name	SBO
PGA	PGA	

Modifiers

Table 53: Properties of each modifier.

Id	Name	SBO
Pic	Pic	
Pi	Pi	
GAP	GAP	
DHAP	DHAP	

Product

Table 54: Properties of each product.

Id	Name	SBO
PGAc	PGAc	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \mathrm{function\_11}\left(\mathrm{Vm}, [\mathrm{PGA}], \mathrm{KA}, [\mathrm{Pic}], \mathrm{K}, [\mathrm{Pi}], \mathrm{KR1}, [\mathrm{GAP}], \mathrm{KR2}, [\mathrm{DHAP}], \mathrm{KR3}\right) \tag{95}$$

$$\begin{aligned} &\mathrm{function\_11}\left(\mathrm{Vm}, \mathrm{S}, \mathrm{KA}, \mathrm{A}, \mathrm{K}, \mathrm{R1}, \mathrm{KR1}, \mathrm{R2}, \mathrm{KR2}, \mathrm{R3}, \mathrm{KR3}\right) \\ &= \frac{\mathrm{Vm} \cdot \mathrm{S}}{\mathrm{S} \cdot \left(1 + \frac{\mathrm{KA}}{\mathrm{A}}\right) + \mathrm{K} \cdot \left(1 + \left(1 + \frac{\mathrm{KA}}{\mathrm{A}}\right) \cdot \left(\frac{\mathrm{R1}}{\mathrm{KR1}} + \frac{\mathrm{R2}}{\mathrm{KR2}} + \frac{\mathrm{R3}}{\mathrm{KR3}}\right)\right)} \end{aligned} \tag{96}$$

Table 55: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	1.243		☑
KA	KA	0000009	0.740		☑
K	K	0000009	0.250		☑
KR1	KR1	0000009	0.630		☑
KR2	KR2	0000009	0.075		☑
KR3	KR3	0000009	0.077		☑

8.14 Reaction TPT_GAP

This is an irreversible reaction of one reactant forming one product influenced by six modifiers.

Name TPT - GAP

Reaction equation

$$\mathrm{TP} \xrightarrow{\mathrm{GAP,\ GAPc,\ Pic,\ Pi,\ PGA,\ DHAP}} \mathrm{TPc} \tag{97}$$

Reactant

Table 56: Properties of each reactant.

Id	Name	SBO
TP	TP	

Modifiers

Table 57: Properties of each modifier.

Id	Name	SBO
GAP	GAP	
GAPc	GAPc	
Pic	Pic	
Pi	Pi	
PGA	PGA	
DHAP	DHAP	

Product

Table 58: Properties of each product.

Id	Name	SBO
TPc	TPc	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \text{function\_11}\,(\text{Vm}, [\text{GAP}], \text{KA}, [\text{Pic}], \text{K}, [\text{Pi}], \text{KR1}, [\text{PGA}], \text{KR2}, [\text{DHAP}], \text{KR3}) \quad (98)$$

$$\begin{aligned} &\text{function\_11}\,(\text{Vm}, \text{S}, \text{KA}, \text{A}, \text{K}, \text{R1}, \text{KR1}, \text{R2}, \text{KR2}, \text{R3}, \text{KR3}) \\ &= \frac{\text{Vm} \cdot \text{S}}{\text{S} \cdot \left(1 + \frac{\text{KA}}{\text{A}}\right) + \text{K} \cdot \left(1 + \left(1 + \frac{\text{KA}}{\text{A}}\right) \cdot \left(\frac{\text{R1}}{\text{KR1}} + \frac{\text{R2}}{\text{KR2}} + \frac{\text{R3}}{\text{KR3}}\right)\right)} \end{aligned} \quad (99)$$

Table 59: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	1.243		☑
KA	KA	0000009	0.740		☑
K	K	0000009	0.075		☑
KR1	KR1	0000009	0.630		☑
KR2	KR2	0000009	0.250		☑
KR3	KR3	0000009	0.077		☑

8.15 Reaction TPT_DHAP

This is an irreversible reaction of one reactant forming one product influenced by six modifiers.

Name TPT - DHAP

Reaction equation

$$\text{TP} \xrightarrow{\text{DHAP, DHAPc, Pic, Pi, PGA, GAP}} \text{TPc} \quad (100)$$

Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
TP	TP	

Id	Name	SBO

Modifiers

Table 61: Properties of each modifier.

Id	Name	SBO
DHAP	DHAP	
DHAPc	DHAPc	
Pic	Pic	
Pi	Pi	
PGA	PGA	
GAP	GAP	

Product

Table 62: Properties of each product.

Id	Name	SBO
TPc	TPc	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \text{function\_11}\left(\text{Vm}, [\text{DHAP}], \text{KA}, [\text{Pic}], \text{K}, [\text{Pi}], \text{KR1}, [\text{PGA}], \text{KR2}, [\text{GAP}], \text{KR3}\right) \quad (101)$$

$$\begin{aligned} &\text{function\_11}\left(\text{Vm}, \text{S}, \text{KA}, \text{A}, \text{K}, \text{R1}, \text{KR1}, \text{R2}, \text{KR2}, \text{R3}, \text{KR3}\right) \\ &= \frac{\text{Vm} \cdot \text{S}}{\text{S} \cdot \left(1 + \frac{\text{KA}}{\text{A}}\right) + \text{K} \cdot \left(1 + \left(1 + \frac{\text{KA}}{\text{A}}\right) \cdot \left(\frac{\text{R1}}{\text{KR1}} + \frac{\text{R2}}{\text{KR2}} + \frac{\text{R3}}{\text{KR3}}\right)\right)} \end{aligned} \quad (102)$$

Table 63: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	1.243		☑
KA	KA	0000009	0.740		☑
K	K	0000009	0.077		☑
KR1	KR1	0000009	0.630		☑
KR2	KR2	0000009	0.250		☑
KR3	KR3	0000009	0.075		☑

8.16 Reaction FBPc_A

This is a reversible reaction of one reactant forming one product influenced by two modifiers.

Name FBPc aldolase

Reaction equation

$$2\,\mathrm{TPc} \overset{\mathrm{GAPc,\ DHAPc}}{\rightleftharpoons} \mathrm{FBPc} \tag{103}$$

Reactant

Table 64: Properties of each reactant.

Id	Name	SBO
TPc	TPc	

Modifiers

Table 65: Properties of each modifier.

Id	Name	SBO
GAPc	GAPc	
DHAPc	DHAPc	

Product

Table 66: Properties of each product.

Id	Name	SBO
FBPc	FBPc	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{function\_4}\,([\mathrm{GAPc}], [\mathrm{DHAPc}], [\mathrm{FBPc}], \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{Kp1}, \mathrm{Vm}) \tag{104}$$

$$\mathrm{function\_4}\,(\mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{Kp1}, \mathrm{Vm}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \mathrm{Ks2} \cdot \left(\left(1 + \frac{\mathrm{s1}}{\mathrm{Ks1}}\right) \cdot \left(1 + \frac{\mathrm{s2}}{\mathrm{Ks2}}\right) + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right)} \tag{105}$$

$$\text{function\_4}(s1, s2, p1, q, Ks1, Ks2, Kp1, Vm) = \frac{Vm \cdot \left(s1 \cdot s2 - \frac{p1}{q}\right)}{Ks1 \cdot Ks2 \cdot \left(\left(1 + \frac{s1}{Ks1}\right) \cdot \left(1 + \frac{s2}{Ks2}\right) + \frac{p1}{Kp1}\right)} \tag{106}$$

Table 67: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
q	q	0000009	12.000		☑
Ks1	Ks1	0000009	0.300		☑
Ks2	Ks2	0000009	0.400		☑
Kp1	Kp1	0000009	0.020		☑
Vm	Vm	0000009	0.107		☑

8.17 Reaction FBPcase

This is a reversible reaction of one reactant forming two products influenced by one modifier.

Name FBPcase

Reaction equation

$$\text{FBPc} \overset{\text{F6Pc}}{\rightleftharpoons} \text{HePc} + \text{Pic} \tag{107}$$

Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
FBPc	FBPc	

Modifier

Table 69: Properties of each modifier.

Id	Name	SBO
F6Pc	F6Pc	

Products

Table 70: Properties of each product.

Id	Name	SBO
HePc	HePc	
Pic	Pic	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{function\_12}\,([\mathrm{FBPc}], [\mathrm{F6Pc}], [\mathrm{Pic}], \mathrm{q}, \mathrm{K52a}, \mathrm{Kp1}, \mathrm{Kp2}, \mathrm{Vm}) \quad (108)$$

$$\mathrm{function\_12}\,(\mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{Kp1}, \mathrm{Kp2}, \mathrm{Vm}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \left(\frac{\mathrm{s1}}{\mathrm{Ks1}} + \left(1 + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right) \cdot \left(1 + \frac{\mathrm{p2}}{\mathrm{Kp2}}\right)\right)} \quad (109)$$

$$\mathrm{function\_12}\,(\mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{Kp1}, \mathrm{Kp2}, \mathrm{Vm}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \left(\frac{\mathrm{s1}}{\mathrm{Ks1}} + \left(1 + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right) \cdot \left(1 + \frac{\mathrm{p2}}{\mathrm{Kp2}}\right)\right)} \quad (110)$$

Table 71: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
q	q	0000009	6663.000		☑
Kp1	Kp1	0000009	0.700		☑
Kp2	Kp2	0000009	12.000		☑
Vm	Vm	0000009	0.064		☑

8.18 Reaction UGPase

This is a reversible reaction of two reactants forming two products influenced by one modifier.

Name UGPase

Reaction equation

$$\mathrm{HePc} + \mathrm{UTPc} \overset{\mathrm{G1Pc}}{\rightleftharpoons} \mathrm{UDPGc} + \mathrm{PiPic} \quad (111)$$

Reactants

Table 72: Properties of each reactant.

Id	Name	SBO
HePc	HePc	
UTPc	UTPc	

Modifier

Table 73: Properties of each modifier.

Id	Name	SBO
G1Pc	G1Pc	

Products

Table 74: Properties of each product.

Id	Name	SBO
UDPGc	UDPGc	
PiPic	PiPic	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{function\_13}\,([\mathrm{G1Pc}], [\mathrm{UTPc}], [\mathrm{UDPGc}], [\mathrm{PiPic}], \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{Kp1}, \mathrm{Kp2}, \mathrm{Vm}) \tag{112}$$

$$\mathrm{function\_13}\,(\mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{Kp1}, \mathrm{Kp2}, \mathrm{Vm}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \mathrm{Ks2} \cdot \left(\left(1 + \frac{\mathrm{s1}}{\mathrm{Ks1}}\right) \cdot \left(1 + \frac{\mathrm{s2}}{\mathrm{Ks2}}\right) + \left(1 + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right) \cdot \left(1 + \frac{\mathrm{p2}}{\mathrm{Kp2}}\right) - 1\right)} \tag{113}$$

$$\mathrm{function\_13}\,(\mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{Ks2}, \mathrm{Kp1}, \mathrm{Kp2}, \mathrm{Vm}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{Ks1} \cdot \mathrm{Ks2} \cdot \left(\left(1 + \frac{\mathrm{s1}}{\mathrm{Ks1}}\right) \cdot \left(1 + \frac{\mathrm{s2}}{\mathrm{Ks2}}\right) + \left(1 + \frac{\mathrm{p1}}{\mathrm{Kp1}}\right) \cdot \left(1 + \frac{\mathrm{p2}}{\mathrm{Kp2}}\right) - 1\right)} \tag{114}$$

Table 75: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
q	q	0000009	0.310		☑
Ks1	Ks1	0000009	0.140		☑
Ks2	Ks2	0000009	0.100		☑
Kp1	Kp1	0000009	0.120		☑
Kp2	Kp2	0000009	0.110		☑
Vm	Vm	0000009	0.115		☑

8.19 Reaction SucPc_S

This is a reversible reaction of two reactants forming two products influenced by six modifiers.

Name SucPc synthase

Reaction equation

$$\mathrm{HePc} + \mathrm{UDPGc} \xrightleftharpoons{\mathrm{F6Pc,\ FBPc,\ UDPc,\ SucPc,\ Succ,\ Pic}} \mathrm{SucPc} + \mathrm{UDPc} \qquad (115)$$

Reactants

Table 76: Properties of each reactant.

Id	Name	SBO
HePc	HePc	
UDPGc	UDPGc	

Modifiers

Table 77: Properties of each modifier.

Id	Name	SBO
F6Pc	F6Pc	
FBPc	FBPc	
UDPc	UDPc	
SucPc	SucPc	
Succ	Succ	
Pic	Pic	

Products

Table 78: Properties of each product.

Id	Name	SBO
SucPc	SucPc	
UDPc	UDPc	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{function\_14}\,(\mathrm{Vm}, [\mathrm{F6Pc}], [\mathrm{UDPGc}], [\mathrm{SucPc}], [\mathrm{UDPc}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{FBPc}], \mathrm{Kr1}, \mathrm{Ks2}, [\mathrm{UDPc}], \mathrm{Kr2}, [\mathrm{SucPc}], \mathrm{Kr3}, [\mathrm{Succ}], \mathrm{Kr4}, [\mathrm{Pic}], \mathrm{Kr5}) \tag{116}$$

$$\mathrm{function\_14}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{Ks2}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{r3}, \mathrm{Kr3}, \mathrm{r4}, \mathrm{Kr4}, \mathrm{r5}, \mathrm{Kr5}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right) \cdot \left(1 + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right) \cdot \left(1 + \frac{\mathrm{r4}}{\mathrm{Kr4}}\right) \cdot \left(1 + \frac{\mathrm{r5}}{\mathrm{Kr5}}\right)\right)} \tag{117}$$

$$\mathrm{function\_14}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{Ks2}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{r3}, \mathrm{Kr3}, \mathrm{r4}, \mathrm{Kr4}, \mathrm{r5}, \mathrm{Kr5}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right) \cdot \left(1 + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right) \cdot \left(1 + \frac{\mathrm{r4}}{\mathrm{Kr4}}\right) \cdot \left(1 + \frac{\mathrm{r5}}{\mathrm{Kr5}}\right)\right)} \tag{118}$$

Table 79: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	0.056		☑
q	q	0000009	10.000		☑
Ks1	Ks1	0000009	0.800		☑
Kr1	Kr1	0000009	0.800		☑
Ks2	Ks2	0000009	2.400		☑
Kr2	Kr2	0000009	0.700		☑
Kr3	Kr3	0000009	0.400		☑
Kr4	Kr4	0000009	50.000		☑
Kr5	Kr5	0000009	11.000		☑

8.20 Reaction SucPc_P

This is a reversible reaction of one reactant forming two products influenced by one modifier.

Name SucPc phosphatase

Reaction equation

$$\mathrm{SucPc} \overset{\mathrm{Succ}}{\rightleftharpoons} \mathrm{Succ} + \mathrm{Pic} \tag{119}$$

Reactant

Table 80: Properties of each reactant.

Id	Name	SBO
SucPc	SucPc	

Modifier

Table 81: Properties of each modifier.

Id	Name	SBO
Succ	Succ	

Products

Table 82: Properties of each product.

Id	Name	SBO
Succ	Succ	
Pic	Pic	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \mathrm{vol}\left(\mathrm{cytosol}\right) \cdot \mathrm{function\_8}\left(\mathrm{Vm}, [\mathrm{SucPc}], [\mathrm{Succ}], [\mathrm{Pic}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{Succ}], \mathrm{Kr1}\right) \tag{120}$$

$$\mathrm{function\_8}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}\right) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{121}$$

$$\mathrm{function\_8}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}\right) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{122}$$

Table 83: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	0.555		☑
q	q	0000009	780.000		☑
Ks1	Ks1	0000009	0.350		☑
Kr1	Kr1	0000009	80.000		☑

8.21 Reaction F6Pc_K

This is a reversible reaction of two reactants forming two products influenced by four modifiers.

Name F6Pc kinase

Reaction equation

$$\mathrm{HePc} + \mathrm{ATPc} \xrightleftharpoons{\text{F6Pc, F26BPc, DHAPc, ADPc}} \mathrm{F26BPc} + \mathrm{ADPc} \tag{123}$$

Reactants

Table 84: Properties of each reactant.

Id	Name	SBO
HePc	HePc	
ATPc	ATPc	

Modifiers

Table 85: Properties of each modifier.

Id	Name	SBO
F6Pc	F6Pc	
F26BPc	F26BPc	
DHAPc	DHAPc	
ADPc	ADPc	

Products

Table 86: Properties of each product.

Id	Name	SBO
F26BPc	F26BPc	
ADPc	ADPc	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{function\_15}\,(\mathrm{Vm}, [\mathrm{F6Pc}], [\mathrm{ATPc}], [\mathrm{F26BPc}], [\mathrm{ADPc}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{F26BPc}], \mathrm{Kr1}, [\mathrm{DHAPc}], \mathrm{Kr2}, \mathrm{Ks2}, [\mathrm{ADPc}], \mathrm{Kr3}) \tag{124}$$

$$\mathrm{function\_15}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{Ks2}, \mathrm{r3}, \mathrm{Kr3}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right) \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)\right) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right)\right)} \tag{125}$$

$$\mathrm{function\_15}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}, \mathrm{Ks2}, \mathrm{r3}, \mathrm{Kr3}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right) \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)\right) \cdot \left(\mathrm{s2} + \mathrm{Ks2} \cdot \left(1 + \frac{\mathrm{r3}}{\mathrm{Kr3}}\right)\right)} \tag{126}$$

Table 87: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	0.101		☑
q	q	0000009	590.000		☑
Ks1	Ks1	0000009	0.500		☑
Kr1	Kr1	0000009	0.021		☑
Kr2	Kr2	0000009	0.700		☑
Ks2	Ks2	0000009	0.500		☑
Kr3	Kr3	0000009	0.160		☑

8.22 Reaction F26BPc_P

This is an irreversible reaction of one reactant forming two products influenced by two modifiers.

Name F26BPc phosphatase

Reaction equation

$$\text{F26BPc} \xrightarrow{\text{Pic, F6Pc}} \text{HePc} + \text{Pic} \tag{127}$$

Reactant

Table 88: Properties of each reactant.

Id	Name	SBO
F26BPc	F26BPc	

Modifiers

Table 89: Properties of each modifier.

Id	Name	SBO
Pic	Pic	
F6Pc	F6Pc	

Products

Table 90: Properties of each product.

Id	Name	SBO
HePc	HePc	
Pic	Pic	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \text{vol}\left(\text{cytosol}\right) \cdot \text{function\_16}\left(\text{Vm}, [\text{F26BPc}], [\text{Pic}], \text{Kr1}, [\text{F6Pc}], \text{Kr2}, \text{Ks1}\right) \tag{128}$$

$$\text{function\_16}\left(\text{Vm}, \text{s1}, \text{r1}, \text{Kr1}, \text{r2}, \text{Kr2}, \text{Ks1}\right) = \frac{\text{Vm} \cdot \text{s1}}{\left(\text{s1} + \text{Ks1}\right) \cdot \left(1 + \frac{\text{r1}}{\text{Kr1}}\right) \cdot \left(1 + \frac{\text{r2}}{\text{Kr2}}\right)} \tag{129}$$

$$\text{function\_16}\left(\text{Vm}, \text{s1}, \text{r1}, \text{Kr1}, \text{r2}, \text{Kr2}, \text{Ks1}\right) = \frac{\text{Vm} \cdot \text{s1}}{\left(\text{s1} + \text{Ks1}\right) \cdot \left(1 + \frac{\text{r1}}{\text{Kr1}}\right) \cdot \left(1 + \frac{\text{r2}}{\text{Kr2}}\right)} \tag{130}$$

Table 91: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	0.017		☑
Kr1	Kr1	0000009	0.500		☑
Kr2	Kr2	0000009	0.100		☑
Ks1	Ks1	0000009	0.032		☑

8.23 Reaction Succ_Deg

This is an irreversible reaction of one reactant forming no product.

Name Succ degradation

Reaction equation

$$\text{Succ} \longrightarrow \emptyset \tag{131}$$

Reactant

Table 92: Properties of each reactant.

Id	Name	SBO
Succ	Succ	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \text{vol}\,(\text{cytosol}) \cdot \text{function\_17}\,([\text{Succ}], \text{Km}, \text{V}) \tag{132}$$

$$\text{function\_17}\,(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{133}$$

$$\text{function\_17}\,(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{134}$$

Table 93: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	5.0		☑
V	V	0000009	2.0		☑

8.24 Reaction PGAc_Deg

This is an irreversible reaction of one reactant forming no product.

Name PGAc degradation

Reaction equation

$$\text{PGAc} \longrightarrow \emptyset \tag{135}$$

Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
PGAc	PGAc	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \text{vol}\left(\text{cytosol}\right) \cdot \text{function\_17}\left(\left[\text{PGAc}\right], \text{Km}, \text{V}\right) \tag{136}$$

$$\text{function\_17}\left(\text{substrate}, \text{Km}, \text{V}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{137}$$

$$\text{function\_17}\left(\text{substrate}, \text{Km}, \text{V}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{138}$$

Table 95: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	1.0		☑
V	V	0000009	0.5		☑

8.25 Reaction GPT_GCEAc

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name GPT - GCEAc

Reaction equation

$$\text{GCEAc} \xrightarrow{\text{GCAc}} \text{GCEA} \tag{139}$$

Reactant

Table 96: Properties of each reactant.

Id	Name	SBO
GCEAc	GCEAc	

Modifier

Table 97: Properties of each modifier.

Id	Name	SBO
GCAc	GCAc	

Product

Table 98: Properties of each product.

Id	Name	SBO
GCEA	GCEA	

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \text{function\_18}\left([\text{GCEAc}], [\text{GCAc}], \text{Km}, \text{V}, \text{Ki}\right) \tag{140}$$

$$\text{function\_18}\left(\text{substrate}, \text{Inhibitor}, \text{Km}, \text{V}, \text{Ki}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate} + \frac{\text{Km} \cdot \text{Inhibitor}}{\text{Ki}}} \tag{141}$$

Table 99: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	0.39		☑
V	V	0000009	5.00		☑
Ki	Ki	0000009	0.28		☑

8.26 Reaction GPT_GCEA

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name GPT - GCEA

Reaction equation

$$\text{GCEA} \xrightarrow{\text{GCA}} \text{GCEAc} \tag{142}$$

Reactant

Table 100: Properties of each reactant.

Id	Name	SBO
GCEA	GCEA	

Modifier

Table 101: Properties of each modifier.

Id	Name	SBO
GCA	GCA	

Product

Table 102: Properties of each product.

Id	Name	SBO
GCEAc	GCEAc	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \text{function\_18}\left([\text{GCEA}], [\text{GCA}], \text{Km}, \text{V}, \text{Ki}\right) \tag{143}$$

$$\text{function\_18}\left(\text{substrate}, \text{Inhibitor}, \text{Km}, \text{V}, \text{Ki}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate} + \frac{\text{Km} \cdot \text{Inhibitor}}{\text{Ki}}} \tag{144}$$

Table 103: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	0.39		☑
V	V	0000009	5.00		☑
Ki	Ki	0000009	0.28		☑

8.27 Reaction GPT_GCA

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name GPT - GCA

Reaction equation

$$\mathrm{GCA} \xrightarrow{\mathrm{GCEA}} \mathrm{GCAc} \tag{145}$$

Reactant

Table 104: Properties of each reactant.

Id	Name	SBO
GCA	GCA	

Modifier

Table 105: Properties of each modifier.

Id	Name	SBO
GCEA	GCEA	

Product

Table 106: Properties of each product.

Id	Name	SBO
GCAc	GCAc	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{function\_18}\left([\text{GCA}], [\text{GCEA}], \text{Km}, \text{V}, \text{Ki}\right) \tag{146}$$

$$\text{function\_18}\left(\text{substrate}, \text{Inhibitor}, \text{Km}, \text{V}, \text{Ki}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate} + \frac{\text{Km} \cdot \text{Inhibitor}}{\text{Ki}}} \tag{147}$$

Table 107: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	0.20		☑
V	V	0000009	6.00		☑
Ki	Ki	0000009	0.22		☑

8.28 Reaction GPT_GCAc

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name GPT - GCAc

Reaction equation

$$\text{GCAc} \xrightarrow{\text{GCEAc}} \text{GCA} \tag{148}$$

Reactant

Table 108: Properties of each reactant.

Id	Name	SBO
GCAc	GCAc	

Modifier

Table 109: Properties of each modifier.

Id	Name	SBO
GCEAc	GCEAc	

Product

Table 110: Properties of each product.

Id	Name	SBO
GCA	GCA	

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \text{function\_18}\left([\text{GCAc}], [\text{GCEAc}], \text{Km}, \text{V}, \text{Ki}\right) \tag{149}$$

$$\text{function\_18}\left(\text{substrate}, \text{Inhibitor}, \text{Km}, \text{V}, \text{Ki}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate} + \frac{\text{Km} \cdot \text{Inhibitor}}{\text{Ki}}} \tag{150}$$

Table 111: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	0.20		☑
V	V	0000009	6.00		☑
Ki	Ki	0000009	0.22		☑

8.29 Reaction RuBisCO_O2

This is an irreversible reaction of one reactant forming two products influenced by five modifiers.

Name RuBisC0 - O2

Reaction equation

$$\text{RuBP} \xrightarrow{\text{PGA, FBP, SBP, Pi, NADPH}} \text{PGA} + \text{PGCA} \tag{151}$$

Reactant

Table 112: Properties of each reactant.

Id	Name	SBO
RuBP	RuBP	

Modifiers

Table 113: Properties of each modifier.

Id	Name	SBO
PGA	PGA	
FBP	FBP	
SBP	SBP	
Pi	Pi	
NADPH	NADPH	

Products

Table 114: Properties of each product.

Id	Name	SBO
PGA	PGA	
PGCA	PGCA	

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = \mathrm{vol}\left(\mathrm{chloroplast}\right) \cdot \mathrm{function\_1}\left(\mathrm{Wo\_min}, [\mathrm{RuBP}], \mathrm{K}, [\mathrm{PGA}], \mathrm{KR1}, [\mathrm{FBP}], \mathrm{KR2}, [\mathrm{SBP}], \mathrm{KR3}, [\mathrm{Pi}], \mathrm{KR4}, [\mathrm{NADPH}], \mathrm{KR5}\right) \tag{152}$$

$$\mathrm{function\_1}\left(\mathrm{Vm}, \mathrm{S}, \mathrm{K}, \mathrm{R1}, \mathrm{KR1}, \mathrm{R2}, \mathrm{KR2}, \mathrm{R3}, \mathrm{KR3}, \mathrm{R4}, \mathrm{KR4}, \mathrm{R5}, \mathrm{KR5}\right) = \frac{\mathrm{Vm} \cdot \mathrm{S}}{\mathrm{S} + \mathrm{K} \cdot \left(1 + \frac{\mathrm{R1}}{\mathrm{KR1}} + \frac{\mathrm{R2}}{\mathrm{KR2}} + \frac{\mathrm{R3}}{\mathrm{KR3}} + \frac{\mathrm{R4}}{\mathrm{KR4}} + \frac{\mathrm{R5}}{\mathrm{KR5}}\right)} \tag{153}$$

$$\mathrm{function\_1}\left(\mathrm{Vm}, \mathrm{S}, \mathrm{K}, \mathrm{R1}, \mathrm{KR1}, \mathrm{R2}, \mathrm{KR2}, \mathrm{R3}, \mathrm{KR3}, \mathrm{R4}, \mathrm{KR4}, \mathrm{R5}, \mathrm{KR5}\right) = \frac{\mathrm{Vm} \cdot \mathrm{S}}{\mathrm{S} + \mathrm{K} \cdot \left(1 + \frac{\mathrm{R1}}{\mathrm{KR1}} + \frac{\mathrm{R2}}{\mathrm{KR2}} + \frac{\mathrm{R3}}{\mathrm{KR3}} + \frac{\mathrm{R4}}{\mathrm{KR4}} + \frac{\mathrm{R5}}{\mathrm{KR5}}\right)} \tag{154}$$

Table 115: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
K	K	0000009	0.020		☑
KR1	KR1	0000009	0.840		☑
KR2	KR2	0000009	0.040		☑
KR3	KR3	0000009	0.075		☑
KR4	KR4	0000009	0.900		☑
KR5	KR5	0000009	0.070		☑

8.30 Reaction PGCA_P

This is an irreversible reaction of one reactant forming one product influenced by two modifiers.

Name PGCA phosphatase

Reaction equation

$$\mathrm{PGCA} \xrightarrow{\mathrm{GCA,\ Pi}} \mathrm{GCA} \tag{155}$$

Reactant

Table 116: Properties of each reactant.

Id	Name	SBO
PGCA	PGCA	

Modifiers

Table 117: Properties of each modifier.

Id	Name	SBO
GCA	GCA	
Pi	Pi	

Product

Table 118: Properties of each product.

Id	Name	SBO
GCA	GCA	

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = \mathrm{vol}\left(\mathrm{chloroplast}\right) \cdot \mathrm{function\_19}\left(\mathrm{Vm}, [\mathrm{PGCA}], \mathrm{Ks1}, [\mathrm{GCA}], \mathrm{Kr1}, [\mathrm{Pi}], \mathrm{Kr2}\right) \tag{156}$$

$$\mathrm{function\_19}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}\right) = \frac{\mathrm{Vm} \cdot \mathrm{s1}}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right) \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)} \tag{157}$$

$$\mathrm{function\_19}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{r2}, \mathrm{Kr2}\right) = \frac{\mathrm{Vm} \cdot \mathrm{s1}}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right) \cdot \left(1 + \frac{\mathrm{r2}}{\mathrm{Kr2}}\right)} \tag{158}$$

Table 119: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	52.420		☑
Ks1	Ks1	0000009	0.026		☑
Kr1	Kr1	0000009	94.000		☑
Kr2	Kr2	0000009	2.550		☑

8.31 Reaction GCEA_K

This is a reversible reaction of two reactants forming two products influenced by one modifier.

Name GCEA kinase

Reaction equation

$$\mathrm{ATP} + \mathrm{GCEA} \overset{\mathrm{PGA}}{\rightleftharpoons} \mathrm{PGA} + \mathrm{ADP} \tag{159}$$

Reactants

Table 120: Properties of each reactant.

Id	Name	SBO
ATP	ATP	
GCEA	GCEA	

Modifier

Table 121: Properties of each modifier.

Id	Name	SBO
PGA	PGA	

Products

Table 122: Properties of each product.

Id	Name	SBO
PGA	PGA	
ADP	ADP	

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = \mathrm{vol}\,(\mathrm{chloroplast}) \cdot \mathrm{function\_20}\,(\mathrm{Vm}, [\mathrm{ATP}], [\mathrm{GCEA}], [\mathrm{PGA}], [\mathrm{ADP}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{PGA}], \mathrm{Kr1}, \mathrm{Ks2}) \tag{160}$$

$$\mathrm{function\_20}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{Ks2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{161}$$

$$\mathrm{function\_20}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{Ks2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{162}$$

Table 123: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	5.716		☑
q	q	0000009	300.000		☑
Ks1	Ks1	0000009	0.210		☑
Kr1	Kr1	0000009	0.360		☑
Ks2	Ks2	0000009	0.250		☑

8.32 Reaction GCAc_Ox

This is an irreversible reaction of one reactant forming one product.

Name GCAc oxidase

Reaction equation

$$\mathrm{GCAc} \longrightarrow \mathrm{GOAc} \tag{163}$$

Reactant

Table 124: Properties of each reactant.

Id	Name	SBO
GCAc	GCAc	

Id	Name	SBO

Product

Table 125: Properties of each product.

Id	Name	SBO
GOAc	GOAc	

Kinetic Law

Derived unit contains undeclared units

$$v_{32} = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{function\_17}\,([\mathrm{GCAc}], \mathrm{Km}, \mathrm{V}) \tag{164}$$

$$\mathrm{function\_17}\,(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{165}$$

$$\mathrm{function\_17}\,(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{166}$$

Table 126: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	0.100		☑
V	V	0000009	1.456		☑

8.33 Reaction SERcGOAc_AT

This is a reversible reaction of two reactants forming two products influenced by one modifier.

Name SERc:GOAc aminotransferase

Reaction equation

$$\mathrm{SERc} + \mathrm{GOAc} \overset{\mathrm{GLYc}}{\rightleftharpoons} \mathrm{HPRc} + \mathrm{GLYc} \tag{167}$$

Reactants

Table 127: Properties of each reactant.

Id	Name	SBO
SERc	SERc	
GOAc	GOAc	

Modifier

Table 128: Properties of each modifier.

Id	Name	SBO
GLYc	GLYc	

Products

Table 129: Properties of each product.

Id	Name	SBO
HPRc	HPRc	
GLYc	GLYc	

Kinetic Law

Derived unit contains undeclared units

$$v_{33} = \text{function\_20}\left(\text{Vm}, [\text{SERc}], [\text{GOAc}], [\text{HPRc}], [\text{GLYc}], \text{q}, \text{Ks1}, [\text{GLYc}], \text{Kr1}, \text{Ks2}\right) \quad (168)$$

$$\text{function\_20}\left(\text{Vm}, \text{s1}, \text{s2}, \text{p1}, \text{p2}, \text{q}, \text{Ks1}, \text{r1}, \text{Kr1}, \text{Ks2}\right) = \frac{\text{Vm} \cdot \left(\text{s1} \cdot \text{s2} - \frac{\text{p1} \cdot \text{p2}}{\text{q}}\right)}{\left(\text{s1} + \text{Ks1} \cdot \left(1 + \frac{\text{r1}}{\text{Kr1}}\right)\right) \cdot (\text{s2} + \text{Ks2})} \quad (169)$$

Table 130: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	3.306		☑
q	q	0000009	0.240		☑
Ks1	Ks1	0000009	2.700		☑
Kr1	Kr1	0000009	33.000		☑
Ks2	Ks2	0000009	0.150		☑

8.34 Reaction GCEA_DH

This is a reversible reaction of two reactants forming two products influenced by one modifier.

Name GCEA dehydrogenase

Reaction equation

$$\mathrm{HPRc} + \mathrm{NADH} \overset{\mathrm{HPRc}}{\rightleftharpoons} \mathrm{GCEAc} + \mathrm{NAD} \tag{170}$$

Reactants

Table 131: Properties of each reactant.

Id	Name	SBO
HPRc	HPRc	
NADH	NADH	

Modifier

Table 132: Properties of each modifier.

Id	Name	SBO
HPRc	HPRc	

Products

Table 133: Properties of each product.

Id	Name	SBO
GCEAc	GCEAc	
NAD	NAD	

Kinetic Law

Derived unit contains undeclared units

$$v_{34} = \mathrm{function\_21}\left(\mathrm{Vm}, [\mathrm{HPRc}], [\mathrm{NADH}], [\mathrm{GCEAc}], [\mathrm{NAD}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{HPRc}], \mathrm{Kr1}\right) \tag{171}$$

$$\mathrm{function\_21}\left(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}\right) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)} \tag{172}$$

Table 134: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	10.010		☑
q	q	0000009	250000.000		☑
Ks1	Ks1	0000009	0.090		☑
Kr1	Kr1	0000009	12.000		☑

8.35 Reaction GLUcGOAc_AT

This is a reversible reaction of two reactants forming two products influenced by one modifier.

Name GLUc:GOAc aminotransferase

Reaction equation

$$\mathrm{GLUc} + \mathrm{GOAc} \overset{\mathrm{GLYc}}{\rightleftharpoons} \mathrm{KGc} + \mathrm{GLYc} \tag{173}$$

Reactants

Table 135: Properties of each reactant.

Id	Name	SBO
GLUc	GLUc	
GOAc	GOAc	

Modifier

Table 136: Properties of each modifier.

Id	Name	SBO
GLYc	GLYc	

Products

Table 137: Properties of each product.

Id	Name	SBO
KGc	KGc	
GLYc	GLYc	

Kinetic Law

Derived unit contains undeclared units

$$v_{35} = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{function\_20}\,(\mathrm{Vm}, [\mathrm{GLUc}], [\mathrm{GOAc}], [\mathrm{KGc}], [\mathrm{GLYc}], \mathrm{q}, \mathrm{Ks1}, [\mathrm{GLYc}], \mathrm{Kr1}, \mathrm{Ks2}) \tag{174}$$

$$\mathrm{function\_20}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{Ks2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{175}$$

$$\mathrm{function\_20}\,(\mathrm{Vm}, \mathrm{s1}, \mathrm{s2}, \mathrm{p1}, \mathrm{p2}, \mathrm{q}, \mathrm{Ks1}, \mathrm{r1}, \mathrm{Kr1}, \mathrm{Ks2}) = \frac{\mathrm{Vm} \cdot \left(\mathrm{s1} \cdot \mathrm{s2} - \frac{\mathrm{p1} \cdot \mathrm{p2}}{\mathrm{q}}\right)}{\left(\mathrm{s1} + \mathrm{Ks1} \cdot \left(1 + \frac{\mathrm{r1}}{\mathrm{Kr1}}\right)\right) \cdot (\mathrm{s2} + \mathrm{Ks2})} \tag{176}$$

Table 138: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	2.746		☑
q	q	0000009	607.000		☑
Ks1	Ks1	0000009	1.700		☑
Kr1	Kr1	0000009	2.000		☑
Ks2	Ks2	0000009	0.150		☑

8.36 Reaction GLYc_DC

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name GLYc decarboxylase

Reaction equation

$$2\,\mathrm{GLYc} \xrightarrow{\mathrm{SERc}} \mathrm{SERc} \tag{177}$$

Reactant

Table 139: Properties of each reactant.

Id	Name	SBO
GLYc	GLYc	

Modifier

Table 140: Properties of each modifier.

Id	Name	SBO
SERc	SERc	

Product

Table 141: Properties of each product.

Id	Name	SBO
SERc	SERc	

Kinetic Law

Derived unit contains undeclared units

$$v_{36} = \text{vol}\,(\text{cytosol}) \cdot \text{function\_22}\,(\text{Vm}, [\text{GLYc}], \text{Ks1}, [\text{SERc}], \text{Kr1}) \tag{178}$$

$$\text{function\_22}\,(\text{Vm}, \text{s1}, \text{Ks1}, \text{r1}, \text{Kr1}) = \frac{\text{Vm} \cdot \text{s1}}{\text{s1} + \text{Ks1} \cdot \left(1 + \frac{\text{r1}}{\text{Kr1}}\right)} \tag{179}$$

$$\text{function\_22}\,(\text{Vm}, \text{s1}, \text{Ks1}, \text{r1}, \text{Kr1}) = \frac{\text{Vm} \cdot \text{s1}}{\text{s1} + \text{Ks1} \cdot \left(1 + \frac{\text{r1}}{\text{Kr1}}\right)} \tag{180}$$

Table 142: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vm	Vm	0000009	2.495		☑
Ks1	Ks1	0000009	6.000		☑
Kr1	Kr1	0000009	4.000		☑

9 Derived Rate Equations

When interpreted as an ordinary differential equation framework, this model implies the following set of equations for the rates of change of each species.

Identifiers for kinetic laws highlighted in gray cannot be verified to evaluate to units of SBML substance per time. As a result, some SBML interpreters may not be able to verify the

consistency of the units on quantities in the model. Please check if

- parameters without an unit definition are involved or
- volume correction is necessary because the `hasOnlySubstanceUnits` flag may be set to `false` and `spacialDimensions`> 0 for certain species.

9.1 Species PGA

Name PGA

Initial concentration $2.4\ \mathrm{mmol} \cdot \mathrm{l}^{-1}$

This species takes part in twelve reactions (as a reactant in PGA_K, TPT_PGA and as a product in RuBisCO_CO2, RuBisCO_O2, GCEA_K and as a modifier in RuBisCO_CO2, Ru5P_K, AGPase, TPT_GAP, TPT_DHAP, RuBisCO_O2, GCEA_K).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGA} = 2\,v_1 + v_{29} + v_{31} - v_2 - v_{13} \tag{181}$$

9.2 Species DPGA

Name DPGA

Initial concentration $0.0011\ \mathrm{mmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in GAP_DH and as a product in PGA_K).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{DPGA} = v_2 - v_3 \tag{182}$$

9.3 Species GAP

Name GAP

Initial concentration $0.0238095238095238\ \mathrm{mmol} \cdot \mathrm{l}^{-1}$

Involved in rule GAP

This species takes part in seven reactions (as a modifier in GAP_DH, FBP_A, F6P_TK, S7P_TK, TPT_PGA, TPT_GAP, TPT_DHAP). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.4 Species DHAP

Name DHAP

Initial concentration $0.476190476190476\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule DHAP

This species takes part in five reactions (as a modifier in FBP_A, SBP_A, TPT_PGA, TPT_GAP, TPT_DHAP). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.5 Species TP

Name TP

Initial concentration $0.5\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in seven reactions (as a reactant in FBP_A, F6P_TK, SBP_A, S7P_TK, TPT-_GAP, TPT_DHAP and as a product in GAP_DH).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TP} = v_3 - 2\,v_4 - v_6 - v_7 - v_9 - v_{14} - v_{15} \tag{183}$$

9.6 Species FBP

Name FBP

Initial concentration $0.669999999999999\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in FBPase and as a product in FBP_A and as a modifier in RuBisCO_CO2, AGPase, RuBisCO_O2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{FBP} = v_4 - v_5 \tag{184}$$

9.7 Species F6P

Name F6P

Initial concentration $0.640764257004718\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule F6P

This species takes part in three reactions (as a modifier in FBPase, F6P_TK, AGPase). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.8 Species G6P

Name G6P

Initial concentration $1.47375779111085\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule G6P

One rule determines the species' quantity.

9.9 Species G1P

Name G1P

Initial concentration $0.0854779518844294\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule G1P

This species takes part in one reaction (as a modifier in AGPase). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.10 Species HeP

Name HeP

Initial concentration $2.2\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in F6P_TK, AGPase and as a product in FBPase).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{HeP} = v_5 - v_6 - v_{12} \tag{185}$$

9.11 Species E4P

Name E4P

Initial concentration $0.05\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in SBP_A and as a product in F6P_TK and as a modifier in F6P_TK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E4P} = v_6 - v_7 \tag{186}$$

9.12 Species SBP

Name SBP

Initial concentration $0.3\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in SBPase and as a product in SBP_A and as a modifier in RuBisCO_CO2, RuBisCO_O2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SBP} = v_7 - v_8 \tag{187}$$

9.13 Species S7P

Name S7P

Initial concentration $2\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in S7P_TK and as a product in SBPase).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{S7P} = v_8 - v_9 \tag{188}$$

9.14 Species X5P

Name X5P

Initial concentration $0.0747384155455904\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule X5P

This species takes part in two reactions (as a modifier in F6P_TK, S7P_TK). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.15 Species R5P

Name R5P

Initial concentration $0.125186846038864\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule R5P

This species takes part in one reaction (as a modifier in S7P_TK). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.16 Species Ru5P

Name Ru5P

Initial concentration $0.0500747384155456\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule Ru5P

This species takes part in one reaction (as a modifier in Ru5P_K). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.17 Species PeP

Name PeP

Initial concentration $0.25\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in Ru5P_K and as a product in F6P_TK, S7P_TK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PeP} = v_6 + 2\,v_9 - v_{10} \tag{189}$$

9.18 Species RuBP

Name RuBP

Initial concentration $2\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in RuBisCO_CO2, RuBisCO_O2 and as a product in Ru5P_K and as a modifier in Ru5P_K).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RuBP} = v_{10} - v_1 - v_{29} \tag{190}$$

9.19 Species ATP

Name ATP

Initial concentration $0.68\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in PGA_K, Ru5P_K, AGPase, GCEA_K and as a product in ATP_S).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ATP} = v_{11} - v_2 - v_{10} - v_{12} - v_{31} \tag{191}$$

9.20 Species ADP

Name ADP

Initial concentration $0.82\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule ADP

This species takes part in seven reactions (as a reactant in ATP_S and as a product in PGA_K, Ru5P_K, GCEA_K and as a modifier in PGA_K, Ru5P_K, AGPase). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.21 Species NADPH

Name NADPH

Initial concentration $0.21\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in GAP_DH and as a modifier in RuBisCO_CO2, RuBisCO_O2), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NADPH} = 0 \tag{192}$$

9.22 Species Pi

Name Pi

Initial concentration $1.4749\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule Pi

This species takes part in 13 reactions (as a reactant in ATP_S and as a product in FBPase, SBPase and as a modifier in RuBisCO_CO2, FBPase, SBPase, Ru5P_K, AGPase, TPT_PGA, TPT_GAP, TPT_DHAP, RuBisCO_O2, PGCA_P). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.23 Species PGCA

Name PGCA

Initial concentration $0.0029\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in PGCA_P and as a product in RuBisCO_O2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGCA} = v_{29} - v_{30} \tag{193}$$

9.24 Species GCA

Name GCA

Initial concentration $0.36\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in GPT_GCA and as a product in GPT_GCAc, PGCA_P and as a modifier in GPT_GCEA, PGCA_P).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GCA} = v_{28} + v_{30} - v_{27} \tag{194}$$

9.25 Species GCEA

Name GCEA

Initial concentration $0.1812\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in GPT_GCEA, GCEA_K and as a product in GPT_GCEAc and as a modifier in GPT_GCA).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GCEA} = v_{25} - v_{26} - v_{31} \tag{195}$$

9.26 Species CO2

Name CO2

Initial concentration $0.0090\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CO2} = 0 \tag{196}$$

9.27 Species O2

Name O2

Initial concentration $0.2646\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{O2} = 0 \tag{197}$$

9.28 Species NADP

Name NADP

Initial concentration $0.29\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in GAP_DH), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NADP} = 0 \tag{198}$$

9.29 Species HPRc

Name HPRc

Initial concentration $0.0035\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in GCEA_DH and as a product in SERcGOAc_AT and as a modifier in GCEA_DH).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{HPRc} = v_{33} - v_{34} \tag{199}$$

9.30 Species GCAc

Name GCAc

Initial concentration $0.36\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in GPT_GCAc, GCAc_Ox and as a product in GPT_GCA and as a modifier in GPT_GCEAc).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GCAc} = v_{27} - v_{28} - v_{32} \tag{200}$$

9.31 Species GOAc

Name GOAc

Initial concentration $0.028\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in SERcGOAc_AT, GLUcGOAc_AT and as a product in GCAc_Ox).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GOAc} = v_{32} - v_{33} - v_{35} \tag{201}$$

9.32 Species GLYc

Name GLYc

Initial concentration $1.8\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in GLYc_DC and as a product in SERcGOAc_AT, GLUcGOAc_AT and as a modifier in SERcGOAc_AT, GLUcGOAc_AT).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GLYc} = v_{33} + v_{35} - 2\,v_{36} \tag{202}$$

9.33 Species SERc

Name SERc

Initial concentration $7.5\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in SERcGOAc_AT and as a product in GLYc_DC and as a modifier in GLYc_DC).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SERc} = v_{36} - v_{33} \tag{203}$$

9.34 Species GCEAc

Name GCEAc

Initial concentration $0.1812\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in GPT_GCEAc and as a product in GPT_GCEA, GCEA_DH and as a modifier in GPT_GCAc).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GCEAc} = v_{26} + v_{34} - v_{25} \tag{204}$$

9.35 Species PGAc

Name PGAc

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in PGAc_Deg and as a product in TPT_PGA).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGAc} = v_{13} - v_{24} \tag{205}$$

9.36 Species GAPc

Name GAPc

Initial concentration $0.109523809523809\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule GAPc

This species takes part in two reactions (as a modifier in TPT_GAP, FBPc_A). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.37 Species DHAPc

Name DHAPc

Initial concentration $2.19047619047619\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule DHAPc

This species takes part in three reactions (as a modifier in TPT_DHAP, FBPc_A, F6Pc_K). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.38 Species TPc

Name TPc

Initial concentration $2.3\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in FBPc_A and as a product in TPT_GAP, TPT_DHAP).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TPc} = v_{14} + v_{15} - 2\,v_{16} \tag{206}$$

9.39 Species FBPc

Name FBPc

Initial concentration $2\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in FBPcase and as a product in FBPc_A and as a modifier in SucPc_S).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{FBPc} = v_{16} - v_{17} \tag{207}$$

9.40 Species F6Pc

Name F6Pc

Initial concentration $1.68883505322742\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule F6Pc

This species takes part in four reactions (as a modifier in FBPcase, SucPc_S, F6Pc_K, F26BPc_P). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.41 Species G6Pc

Name G6Pc

Initial concentration $3.88432062242307\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule G6Pc

One rule determines the species' quantity.

9.42 Species G1Pc

Name G1Pc

Initial concentration $0.226844324349507\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule G1Pc

This species takes part in one reaction (as a modifier in UGPase). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.43 Species HePc

Name HePc

Initial concentration $5.8\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in UGPase, SucPc_S, F6Pc_K and as a product in FBPcase, F26BPc_P).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{HePc} = v_{17} + v_{22} - v_{18} - v_{19} - v_{21} \tag{208}$$

9.44 Species F26BPc

Name F26BPc

Initial concentration $7.8\cdot 10^{-6}\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in F26BPc_P and as a product in F6Pc_K and as a modifier in F6Pc_K).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{F26BPc} = v_{21} - v_{22} \tag{209}$$

9.45 Species UDPGc

Name UDPGc

Initial concentration $0.57\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in SucPc_S and as a product in UGPase).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{UDPGc} = v_{18} - v_{19} \tag{210}$$

9.46 Species SucPc

Name SucPc

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in SucPc_P and as a product in SucPc_S and as a modifier in SucPc_S).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SucPc} = v_{19} - v_{20} \tag{211}$$

9.47 Species Succ

Name Succ

Initial concentration $0\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in Succ_Deg and as a product in SucPc_P and as a modifier in SucPc_S, SucPc_P).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Succ} = v_{20} - v_{23} \tag{212}$$

9.48 Species UTPc

Name UTPc

Initial concentration $0.75\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in UGPase), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{UTPc} = 0 \tag{213}$$

9.49 Species UDPc

Name UDPc

Initial concentration $0.18\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule UDPc

This species takes part in two reactions (as a product in SucPc_S and as a modifier in SucPc_S). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.50 Species NAD

Name NAD

Initial concentration $0.4\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in GCEA_DH), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NAD} = 0 \tag{214}$$

9.51 Species NADH

Name NADH

Initial concentration $0.47\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in GCEA_DH), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NADH} = 0 \tag{215}$$

9.52 Species GLUc

Name GLUc

Initial concentration $24\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in GLUcGOAc_AT), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GLUc} = 0 \tag{216}$$

9.53 Species KGc

Name KGc

Initial concentration $0.4\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in GLUcGOAc_AT), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{KGc} = 0 \tag{217}$$

9.54 Species Pic

Name Pic

Initial concentration $4.09998299977232\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule Pic

This species takes part in eight reactions (as a product in FBPcase, SucPc_P, F26BPc_P and as a modifier in TPT_PGA, TPT_GAP, TPT_DHAP, SucPc_S, F26BPc_P). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.55 Species PiTc

Name PiTc

Initial concentration $4.0999844\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule PiTc

One rule determines the species' quantity.

9.56 Species ATPc

Name ATPc

Initial concentration $0.35\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in F6Pc_K), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ATPc} = 0 \tag{218}$$

9.57 Species ADPc

Name ADPc

Initial concentration $0.65\ \mathrm{mmol} \cdot \mathrm{l}^{-1}$

Involved in rule ADPc

This species takes part in two reactions (as a product in F6Pc_K and as a modifier in F6Pc_K). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

9.58 Species PiPic

Name PiPic

Initial concentration $1.40022767958214 \cdot 10^{-6}\ \mathrm{mmol} \cdot \mathrm{l}^{-1}$

Involved in rule PiPic

This species takes part in one reaction (as a product in UGPase). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

A Glossary of Systems Biology Ontology Terms

SBO:0000009 kinetic constant: Numerical parameter that quantifies the velocity of a chemical reaction

SBO:0000027 Michaelis constant: Substrate concentration at which the velocity of reaction is half its maximum. Michaelis constant is an experimental parameter. According to the underlying molecular mechanism it can be interpreted differently in terms of microscopic constants

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