SBML Model Report

Model name: “Messiha2013 - combined glycolysis and pentose phosphate pathway model”

May 5, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Vijayalakshmi Chelliah[1] and Kieran Smallbone[2] at November nineth 2008 at no o’ clock in the morning. and last time modified at April eighth 2016 at 5:38 p. m. Table 1 gives 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	76
events	0	constraints	0
reactions	34	function definitions	0
global parameters	10	unit definitions	5
rules	4	initial assignments	0

Model Notes

Messiha2013 - combined glycolysis and pentose phosphate pathway model

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BIOMD0000000502 and MODEL1303260018 are combined to examine the response to oxidative stress.

This model is described in the article:Enzyme characterisation and kinetic modelling of pentose phosphate pathway in yeast.Hanan L. Messiha, Edward Kent, Naglis Malys, Kathleen M. Carroll, Pedro Mendes, Kieran SmallbonePeerJ PrePrints 1:e146v2

Abstract:

We present the quantification and kinetic characterisation of the enzymes of the pentose phosphate pathway in Saccharomyces cerevisiae. The data are combined into a mathematical model that describes the dynamics of this system and allows for the predicting changes in metabolite concentrations and fluxes in response to perturbations. We use the model to study the response of yeast to a glucose pulse. We then combine the model with an existing glycolysis one to study the effect of oxidative stress on carbohydrate metabolism. The combination of these two models was made possible by the standardized enzyme kinetic experiments carried out in both studies. This work demonstrates the feasibility of constructing larger network models by merging smaller pathway models.

This model is hosted on BioModels Database and identifiedby: BIOMD0000000503 .

To cite BioModels Database, please use: BioModels Database: An enhanced, curated and annotated resourcefor published quantitative kinetic models .

2 Unit Definitions

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

2.1 Unit `substance`

Name mmol

Definition mmol

2.2 Unit `mM`

Name mM

Definition $\mathrm{mmol} \cdot \mathrm{l}^{-1}$

2.3 Unit `mM_per_s`

Name mM per s

Definition $\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$

2.4 Unit per_s

Name per s

Definition s^{-1}

2.5 Unit per_mM_per_s

Name per_mM_per_s

Definition $mmol^{-1} \cdot 1 \cdot s^{-1}$

2.6 Unit volume

Notes Litre is the predefined SBML unit for `volume`.

Definition l

2.7 Unit area

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

Definition m^2

2.8 Unit length

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

Definition m

2.9 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
`cell`	cell		3	1	litre	☑	
`extracellular`	extracellular		3	1	litre	☑	

3.1 Compartment `cell`

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

Name cell

3.2 Compartment `extracellular`

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

Name extracellular

4 Species

This model contains 76 species. The boundary condition of 48 of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 8 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
ADP	ADP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
ATP	ATP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
AcAld	AcAld	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
BPG	BPG	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
DHAP	DHAP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
F16bP	F16bP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
F6P	F6P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
G1P	G1P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
G3P	G3P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
G6P	G6P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GAP	GAP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GLC	GLC	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
NAD	NAD	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
P2G	P2G	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
P3G	P3G	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PEP	PEP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PYR	PYR	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
T6P	T6P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
UDP	UDP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
UTP	UTP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
AMP	AMP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
NADH	NADH	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	☑
UDG	UDG	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	☑
ACE	ACE	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
EtOH	EtOH	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
F26bP	F26bP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GLCx	GLCx	extracellular	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GLY	GLY	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
SUC	SUC	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TRH	TRH	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
ADH1	ADH1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
CDC19	CDC19	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
ENO1	ENO1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
ENO2	ENO2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
FBA1	FBA1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GLK1	GLK1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GPD1	GPD1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GPD2	GPD2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GPM1	GPM1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
HOR2	HOR2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
HXK1	HXK1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
HXK2	HXK2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PDC1	PDC1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PDC5	PDC5	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PDC6	PDC6	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PFK1	PFK1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PFK2	PFK2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PGI1	PGI1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
PGK1	PGK1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PGM1	PGM1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
PGM2	PGM2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
RHR2	RHR2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TDH1	TDH1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TDH3	TDH3	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TPI1	TPI1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TPS1	TPS1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TPS2	TPS2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
UGP1	UGP1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
E4P	E4P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
G6L	G6L	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
NADPH	NADPH	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
P6G	P6G	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
R5P	R5P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Ru5P	Ru5P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
S7P	S7P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
X5P	X5P	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
NADP	NADP	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	⊟	☑
GND1	GND1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
GND2	GND2	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
NQM1	NQM1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
RKI1	RKI1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
RPE1	RPE1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
SOL3	SOL3	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TAL1	TAL1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑
TKL1	TKL1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
ZWF1	ZWF1	cell	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑	☑

5 Parameters

This model contains ten global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
sum_AxP			6.020	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
sum_NAD			1.590	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
sum_UxP			1.398	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
sum_NADP			0.330	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kx5p_TAL			0.670	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Ke4p_TAL			0.946	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kr5p_TAL			0.235	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kgap_TAL			0.100	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kf6p_TAL			1.100	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Ks7p_TAL			0.150	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

6 Rules

This is an overview of four rules.

6.1 Rule AMP

Rule AMP is an assignment rule for species AMP:

$$\mathrm{AMP} = \mathrm{sum\_AxP} - [\mathrm{ATP}] - [\mathrm{ADP}] \tag{1}$$

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

6.2 Rule NADH

Rule NADH is an assignment rule for species NADH:

$$\mathrm{NADH} = \mathrm{sum\_NAD} - [\mathrm{NAD}] \tag{2}$$

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

6.3 Rule UDG

Rule UDG is an assignment rule for species UDG:

$$\mathrm{UDG} = \mathrm{sum\_UxP} - [\mathrm{UTP}] - [\mathrm{UDP}] \tag{3}$$

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

6.4 Rule NADP

Rule NADP is an assignment rule for species NADP:

$$\mathrm{NADP} = \mathrm{sum\_NADP} - [\mathrm{NADPH}] \tag{4}$$

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

7 Reactions

This model contains 34 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	ADH	ADH	$\mathrm{AcAld} + \mathrm{NADH} \xleftarrow{\text{ADH1, ADH1, AcAld, NADH, EtOH, NAD}} \mathrm{EtOH} + \mathrm{NAD}$	0000176
2	AK	AK	$2\,\mathrm{ADP} \xleftrightarrow{\text{ADP, AMP, ATP}} \mathrm{ATP} + \mathrm{AMP}$	0000176
3	ATPase	ATPase	$\mathrm{ATP} \xrightarrow{\text{ATP}} \mathrm{ADP}$	0000176
4	ENO	ENO	$\mathrm{P2G} \xleftrightarrow{\text{ENO1, ENO2, ENO1, P2G, PEP, ENO2}} \mathrm{PEP}$	0000176
5	FBA	FBA	$\mathrm{F16bP} \xleftrightarrow{\text{FBA1, FBA1, F16bP, DHAP, GAP}} \mathrm{DHAP} + \mathrm{GAP}$	0000176
6	GPD	GPD	$\mathrm{DHAP} + \mathrm{NADH} \xleftarrow{\text{ADP, ATP, F16bP, GPD1, GPD2, DHAP, NADH, G3P, NAD, F16bP}} \mathrm{NAD}$	0000176
7	GPM	GPM	$\mathrm{P3G} \xleftrightarrow{\text{GPM1, GPM1, P3G, P2G}} \mathrm{P2G}$	0000176
8	GPP	GPP	$\mathrm{G3P} \xrightarrow{\text{HOR2, RHR2, G3P}} \mathrm{GLY}$	0000176
9	HXK	HXK	$\mathrm{GLC} + \mathrm{ATP} \xleftarrow{\text{HXK1, T6P, HXK2, GLK1, HXK1, GLC, ATP, G6P, ADP, T6P, HXK2,}} \mathrm{ADP}$	0000176
10	PDC	PDC	$\mathrm{PYR} \xrightarrow{\text{PDC1, PDC5, PDC6, PDC1, PYR, PDC5, PDC6,}} \mathrm{AcAld}$	0000176
11	PFK	PFK	$\mathrm{ATP} + \mathrm{F6P} \xrightarrow{\text{AMP, F26bP, PFK1, PFK2, PFK2, F6P, ATP, F16bP, ADP, AMP, F26bP}} \mathrm{F16bP}$	0000176
12	PGI	PGI	$\mathrm{G6P} \xleftrightarrow{\text{PGI1, PGI1, G6P, F6P}} \mathrm{F6P}$	0000176

№	Id	Name	Reaction Equation	SBO
13	PGK	PGK	$\mathrm{ADP} + \mathrm{BPG} \xrightleftharpoons{\text{PGK1, PGK1, ADP, BPG, P3G, ATP}} \mathrm{ATP} + \mathrm{P3G}$	0000176
14	PGM	PGM	$\mathrm{G6P} \xrightleftharpoons{\text{PGM1, PGM2, G6P, G1P}} \mathrm{G1P}$	0000176
15	PYK	PYK	$\mathrm{ADP} + \mathrm{PEP} \xrightleftharpoons{\text{CDC19, F16bP, CDC19, PEP, ADP, PYR, ATP, F16bP}} \mathrm{ATP} + \mathrm{PYR}$	0000176
16	TDH	TDH	$\mathrm{GAP} + \mathrm{NAD} \xrightleftharpoons{\text{TDH1, TDH3, TDH1, GAP, NAD, BPG, NADH, TDH3}} \mathrm{BPG} + \mathrm{NADH}$	0000176
17	TPI	TPI	$\mathrm{DHAP} \xrightleftharpoons{\text{TPI1, TPI1, DHAP, GAP}} \mathrm{GAP}$	0000176
18	TPP	TPP	$\mathrm{T6P} \xrightarrow{\text{TPS1, TPS2, T6P}} \mathrm{TRH}$	0000176
19	TPS	TPS	$\mathrm{G6P} + \mathrm{UDG} \xrightarrow{\text{TPS1, TPS2, G6P, UDG}} \mathrm{T6P} + \mathrm{UDP}$	0000176
20	UGP	UGP	$\mathrm{G1P} + \mathrm{UTP} \xrightarrow{\text{UGP1, UTP, G1P, UDG}} \mathrm{UDG}$	0000176
21	acetate_branch	acetate_branch	$\mathrm{AcAld} + \mathrm{NAD} \xrightarrow{\text{AcAld, NAD}} \mathrm{ACE} + \mathrm{NADH}$	0000176
22	udp_to_utp	udp_to_utp	$\mathrm{UDP} + \mathrm{ATP} \xrightarrow{\text{UDP, ATP}} \mathrm{UTP} + \mathrm{ADP}$	0000176
23	HXT	HXT	$\mathrm{GLCx} \xrightleftharpoons{\text{GLCx, GLC}} \mathrm{GLC}$	0000185
24	GND	GND	$\mathrm{P6G} + \mathrm{NADP} \xrightarrow{\text{GND1, GND2, GND1, P6G, NADP, Ru5P, NADPH, GND2}} \mathrm{Ru5P} + \mathrm{NADPH}$	0000176
25	RKI	RKI	$\mathrm{Ru5P} \xrightleftharpoons{\text{RKI1, RKI1, Ru5P, R5P}} \mathrm{R5P}$	0000176
26	RPE	RPE	$\mathrm{Ru5P} \xrightleftharpoons{\text{RPE1, RPE1, Ru5P, X5P}} \mathrm{X5P}$	0000176
27	SOL	SOL	$\mathrm{G6L} \xrightarrow{\text{SOL3, SOL3, G6L, P6G}} \mathrm{P6G}$	0000176
28	TAL	TAL	$\mathrm{GAP} + \mathrm{S7P} \xrightleftharpoons{\text{TAL1, NQM1, TAL1, GAP, S7P, F6P, E4P, NQM1}} \mathrm{F6P} + \mathrm{E4P}$	0000176

№	Id	Name	Reaction Equation	SBO
29	TKL_E4P	TKL (E4P:F6P)	$\mathrm{X5P} + \mathrm{E4P} \xleftrightarrow{\text{TKL1, R5P, S7P, TKL1, X5P, E4P, GAP, F6P, R5P, S7P}} \mathrm{GAP} + \mathrm{F6P}$	0000176
30	TKL_R5P	TKL (R5P:S7P)	$\mathrm{X5P} + \mathrm{R5P} \xleftrightarrow{\text{TKL1, E4P, F6P, TKL1, X5P, R5P, GAP, S7P, E4P, F6P}} \mathrm{GAP} + \mathrm{S7P}$	0000176
31	ZWF	ZWF	$\mathrm{G6P} + \mathrm{NADP} \xrightarrow{\text{ZWF1, ZWF1, G6P, NADP, G6L, NADPH, G6L}} \mathrm{NADPH} +$	0000176
32	NADPH_oxidase	NADPH oxidase	$\mathrm{NADPH} \xrightarrow{\text{NADPH}} \mathrm{NADP}$	0000176
33	E4P_sink	E4P sink	$\mathrm{E4P} \xrightarrow{\text{E4P}} \emptyset$	0000176
34	R5P_sink	R5P sink	$\mathrm{R5P} \xrightarrow{\text{R5P}} \emptyset$	0000176

7.1 Reaction ADH

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

Name ADH

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{AcAld} + \mathrm{NADH} \xrightleftharpoons{\text{ADH1, ADH1, AcAld, NADH, EtOH, NAD}} \mathrm{EtOH} + \mathrm{NAD} \tag{5}$$

Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
AcAld	AcAld	
NADH	NADH	

Modifiers

Table 7: Properties of each modifier.

Id	Name	SBO
ADH1	ADH1	
ADH1	ADH1	
AcAld	AcAld	
NADH	NADH	
EtOH	EtOH	
NAD	NAD	

Products

Table 8: Properties of each product.

Id	Name	SBO
EtOH	EtOH	
NAD	NAD	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{ADH1}] \cdot \mathrm{kcat} \cdot \left(\frac{[\mathrm{AcAld}] \cdot [\mathrm{NADH}]}{\mathrm{Kacald} \cdot \mathrm{Kinadh}} - \frac{[\mathrm{EtOH}] \cdot [\mathrm{NAD}]}{\mathrm{Kacald} \cdot \mathrm{Kinadh} \cdot \mathrm{Keq}} \right)}{1 + \frac{[\mathrm{NADH}]}{\mathrm{Kinadh}} + \frac{[\mathrm{AcAld}] \cdot \mathrm{Knadh}}{\mathrm{Kinadh} \cdot \mathrm{Kacald}} + \frac{[\mathrm{EtOH}] \cdot \mathrm{Knad}}{\mathrm{Kinad} \cdot \mathrm{Ketoh}} + \frac{[\mathrm{NAD}]}{\mathrm{Kinad}} + \frac{[\mathrm{AcAld}] \cdot [\mathrm{NADH}]}{\mathrm{Kinadh} \cdot \mathrm{Kacald}} + \frac{[\mathrm{NADH}] \cdot [\mathrm{EtOH}] \cdot \mathrm{Knad}}{\mathrm{Kinadh} \cdot \mathrm{Kinad} \cdot \mathrm{Ketoh}} + \frac{[\mathrm{AcAld}] \cdot [\mathrm{NAD}] \cdot \mathrm{Knadh}}{\mathrm{Kinadh} \cdot \mathrm{Kinad} \cdot \mathrm{Kacald}} + \frac{[\mathrm{EtOH}]}{\mathrm{Ketoh}}} \tag{6}$$

Table 9: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			176.000	s^{-1}	☑
Ketoh			17.000	$mmol \cdot l^{-1}$	☑
Kinad			0.920	$mmol \cdot l^{-1}$	☑
Knad			0.170	$mmol \cdot l^{-1}$	☑
Knadh			0.110	$mmol \cdot l^{-1}$	☑
Kinadh			0.031	$mmol \cdot l^{-1}$	☑
Kacald			0.462	$mmol \cdot l^{-1}$	☑
Kiacald			1.100	$mmol \cdot l^{-1}$	☑
Kietoh			90.000	$mmol \cdot l^{-1}$	☑
Keq			14492.754	dimensionless	☑

7.2 Reaction AK

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

Name AK

SBO:0000176 biochemical reaction

Reaction equation

$$2\,\mathrm{ADP} \xrightleftharpoons{\mathrm{ADP,\ AMP,\ ATP}} \mathrm{ATP} + \mathrm{AMP} \tag{7}$$

Reactant

Table 10: Properties of each reactant.

Id	Name	SBO
ADP	ADP	

Modifiers

Table 11: Properties of each modifier.

Id	Name	SBO
ADP	ADP	
AMP	AMP	
ATP	ATP	

Products

Table 12: Properties of each product.

Id	Name	SBO
ATP	ATP	
AMP	AMP	

Kinetic Law

Derived unit $0.0010\,\mathrm{mol}\cdot\mathrm{s}^{-1}$

$$v_2 = \mathrm{vol}\,(\mathrm{cell}) \cdot \mathrm{k} \cdot \left([\mathrm{ADP}] \cdot [\mathrm{ADP}] - \frac{[\mathrm{AMP}] \cdot [\mathrm{ATP}]}{\mathrm{Keq}} \right) \tag{8}$$

Table 13: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k			0.75	$\mathrm{mmol}^{-1}\cdot 1\cdot \mathrm{s}^{-1}$	☑
Keq			0.45	dimensionless	☑

7.3 Reaction ATPase

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

Name ATPase

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{ATP} \xrightarrow{\mathrm{ATP}} \mathrm{ADP} \tag{9}$$

Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
ATP	ATP	

Modifier

Table 15: Properties of each modifier.

Id	Name	SBO
ATP	ATP	

Product

Table 16: Properties of each product.

Id	Name	SBO
ADP	ADP	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{\mathrm{Vmax} \cdot [\mathrm{ATP}]}{\mathrm{Katp}}}{1 + \frac{[\mathrm{ATP}]}{\mathrm{Katp}}} \tag{10}$$

Table 17: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vmax			6.16	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$	☑
Katp			3.00	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

7.4 Reaction ENO

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

Name ENO

SBO:0000176 biochemical reaction

Reaction equation

$$\text{P2G} \xrightleftharpoons{\text{ENO1, ENO2, ENO1, P2G, PEP, ENO2}} \text{PEP} \tag{11}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
P2G	P2G	

Modifiers

Table 19: Properties of each modifier.

Id	Name	SBO
ENO1	ENO1	
ENO2	ENO2	
ENO1	ENO1	
P2G	P2G	
PEP	PEP	
ENO2	ENO2	

Product

Table 20: Properties of each product.

Id	Name	SBO
PEP	PEP	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{ENO1}] \cdot \mathrm{kcat\_ENO1} \cdot \left(\frac{[\mathrm{P2G}]}{\mathrm{Kp2g\_ENO1}} - \frac{[\mathrm{PEP}]}{\mathrm{Kp2g\_ENO1} \cdot \mathrm{Keq}} \right)}{1 + \frac{[\mathrm{P2G}]}{\mathrm{Kp2g\_ENO1}} + \frac{[\mathrm{PEP}]}{\mathrm{Kpep\_ENO1}}} + \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{ENO2}] \cdot \mathrm{kcat\_ENO2} \cdot \left(\frac{[\mathrm{P2G}]}{\mathrm{Kp2g\_ENO2}} - \frac{[\mathrm{PEP}]}{\mathrm{Kp2g\_ENO2} \cdot \mathrm{Keq}} \right)}{1 + \frac{[\mathrm{P2G}]}{\mathrm{Kp2g\_ENO2}} + \frac{[\mathrm{PEP}]}{\mathrm{Kpep\_ENO2}}} \tag{12}$$

Table 21: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat_ENO1			7.600	s^{-1}	☑
Kp2g_ENO1			0.043	$mmol \cdot l^{-1}$	☑
Kpep_ENO1			0.500	$mmol \cdot l^{-1}$	☑
kcat_ENO2			19.870	s^{-1}	☑
Kp2g_ENO2			0.104	$mmol \cdot l^{-1}$	☑
Kpep_ENO2			0.500	$mmol \cdot l^{-1}$	☑
Keq			6.700	dimensionless	☑

7.5 Reaction FBA

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

Name FBA

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{F16bP} \xrightleftharpoons{\mathrm{FBA1,\ FBA1,\ F16bP,\ DHAP,\ GAP}} \mathrm{DHAP} + \mathrm{GAP} \tag{13}$$

Reactant

Table 22: Properties of each reactant.

Id	Name	SBO
F16bP	F16bP	

Modifiers

Table 23: Properties of each modifier.

Id	Name	SBO
FBA1	FBA1	
FBA1	FBA1	
F16bP	F16bP	
DHAP	DHAP	
GAP	GAP	

Products

Table 24: Properties of each product.

Id	Name	SBO
DHAP	DHAP	
GAP	GAP	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{FBA1}] \cdot \mathrm{kcat} \cdot \left(\frac{[\mathrm{F16bP}]}{\mathrm{Kf16bp}} - \frac{[\mathrm{DHAP}] \cdot [\mathrm{GAP}]}{\mathrm{Kf16bp} \cdot \mathrm{Keq}} \right)}{1 + \frac{[\mathrm{F16bP}]}{\mathrm{Kf16bp}} + \frac{[\mathrm{DHAP}]}{\mathrm{Kdhap}} + \frac{[\mathrm{GAP}]}{\mathrm{Kgap}} + \frac{[\mathrm{F16bP}] \cdot [\mathrm{GAP}]}{\mathrm{Kf16bp} \cdot \mathrm{Kigap}} + \frac{[\mathrm{DHAP}] \cdot [\mathrm{GAP}]}{\mathrm{Kdhap} \cdot \mathrm{Kgap}}} \tag{14}$$

Table 25: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			4.139	s^{-1}	☑
Kf16bp			0.451	$mmol \cdot l^{-1}$	☑
Keq			0.069	$mmol \cdot l^{-1}$	☑
Kdhap			2.000	$mmol \cdot l^{-1}$	☑
Kgap			2.400	$mmol \cdot l^{-1}$	☑
Kigap			10.000	$mmol \cdot l^{-1}$	☑

7.6 Reaction GPD

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

Name GPD

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{DHAP} + \mathrm{NADH} \xrightleftharpoons{\text{ADP, ATP, F16bP, GPD1, GPD2, DHAP, NADH, G3P, NAD, F16bP, ATP, ADP}} \mathrm{G3P} + \mathrm{NAD} \tag{15}$$

Reactants

Table 26: Properties of each reactant.

Id	Name	SBO
DHAP	DHAP	
NADH	NADH	

Modifiers

Table 27: Properties of each modifier.

Id	Name	SBO
ADP	ADP	
ATP	ATP	
F16bP	F16bP	
GPD1	GPD1	
GPD2	GPD2	
DHAP	DHAP	
NADH	NADH	
G3P	G3P	
NAD	NAD	
F16bP	F16bP	
ATP	ATP	
ADP	ADP	

Products

Table 28: Properties of each product.

Id	Name	SBO
G3P	G3P	
NAD	NAD	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{\mathrm{Vmax}}{\mathrm{Kdhap} \cdot \mathrm{Knadh}} \cdot \left([\mathrm{DHAP}] \cdot [\mathrm{NADH}] - \frac{[\mathrm{G3P}] \cdot [\mathrm{NAD}]}{\mathrm{Keq}} \right)}{\left(1 + \frac{[\mathrm{F16bP}]}{\mathrm{Kfbp}} + \frac{[\mathrm{ATP}]}{\mathrm{Katp}} + \frac{[\mathrm{ADP}]}{\mathrm{Kadp}}\right) \cdot \left(1 + \frac{[\mathrm{DHAP}]}{\mathrm{Kdhap}} + \frac{[\mathrm{G3P}]}{\mathrm{Kg3p}}\right) \cdot \left(1 + \frac{[\mathrm{NADH}]}{\mathrm{Knadh}} + \frac{[\mathrm{NAD}]}{\mathrm{Knad}}\right)} \tag{16}$$

Table 29: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`Vmax`			0.783	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$	☑
`Knadh`			0.023	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Kdhap`			0.540	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Keq`			10000.000	dimensionless	☑
`Kfbp`			4.800	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Katp`			0.730	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Kadp`			2.000	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Knad`			0.930	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Kg3p`			1.200	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

7.7 Reaction `GPM`

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

Name GPM

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{P3G} \xrightleftharpoons{\text{GPM1, GPM1, P3G, P2G}} \mathrm{P2G} \tag{17}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
`P3G`	P3G	

Modifiers

Table 31: Properties of each modifier.

Id	Name	SBO
GPM1	GPM1	
GPM1	GPM1	
P3G	P3G	
P2G	P2G	

Product

Table 32: Properties of each product.

Id	Name	SBO
P2G	P2G	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{vol}(\mathrm{cell}) \cdot \frac{[\mathrm{GPM1}] \cdot \mathrm{kcat} \cdot \left(\frac{[\mathrm{P3G}]}{\mathrm{Kp3g}} - \frac{[\mathrm{P2G}]}{\mathrm{Kp3g} \cdot \mathrm{Keq}} \right)}{1 + \frac{[\mathrm{P3G}]}{\mathrm{Kp3g}} + \frac{[\mathrm{P2G}]}{\mathrm{Kp2g}}} \tag{18}$$

Table 33: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			400.00	s^{-1}	☑
Kp3g			1.20	$mmol \cdot l^{-1}$	☑
Keq			0.19	dimensionless	☑
Kp2g			1.41	$mmol \cdot l^{-1}$	☑

7.8 Reaction GPP

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

Name GPP

SBO:0000176 biochemical reaction

Reaction equation

$$\text{G3P} \xrightarrow{\text{HOR2, RHR2, G3P}} \text{GLY} \tag{19}$$

Reactant

Table 34: Properties of each reactant.

Id	Name	SBO
G3P	G3P	

Modifiers

Table 35: Properties of each modifier.

Id	Name	SBO
HOR2	HOR2	
RHR2	RHR2	
G3P	G3P	

Product

Table 36: Properties of each product.

Id	Name	SBO
GLY	GLY	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \text{vol}(\text{cell}) \cdot \frac{\frac{\text{Vmax} \cdot [\text{G3P}]}{\text{Kg3p}}}{1 + \frac{[\text{G3P}]}{\text{Kg3p}}} \tag{20}$$

Table 37: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vmax			0.883	$\text{mmol} \cdot \text{l}^{-1} \cdot \text{s}^{-1}$	☑
Kg3p			3.500	$\text{mmol} \cdot \text{l}^{-1}$	☑

7.9 Reaction HXK

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

Name HXK

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{GLC} + \mathrm{ATP} \xrightleftharpoons{\text{HXK1, T6P, HXK2, GLK1, HXK1, GLC, ATP, G6P, ADP, T6P, HXK2, GLK1}} \mathrm{G6P} + \mathrm{ADP} \tag{21}$$

Reactants

Table 38: Properties of each reactant.

Id	Name	SBO
GLC	GLC	
ATP	ATP	

Modifiers

Table 39: Properties of each modifier.

Id	Name	SBO
HXK1	HXK1	
T6P	T6P	
HXK2	HXK2	
GLK1	GLK1	
HXK1	HXK1	
GLC	GLC	
ATP	ATP	
G6P	G6P	
ADP	ADP	
T6P	T6P	
HXK2	HXK2	
GLK1	GLK1	

Products

Table 40: Properties of each product.

Id	Name	SBO
G6P	G6P	
ADP	ADP	

Kinetic Law

Derived unit contains undeclared units

$$
\begin{aligned}
v_9 = {} & \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{HXK1}] \cdot \mathrm{kcat\_HXK1} \cdot \left(\frac{[\mathrm{GLC}] \cdot [\mathrm{ATP}]}{\mathrm{Kglc\_HXK1} \cdot \mathrm{Katp\_HXK1}} - \frac{[\mathrm{G6P}] \cdot [\mathrm{ADP}]}{\mathrm{Kglc\_HXK1} \cdot \mathrm{Katp\_HXK1} \cdot \mathrm{Keq}} \right)}{\left(1 + \frac{[\mathrm{GLC}]}{\mathrm{Kglc\_HXK1}} + \frac{[\mathrm{G6P}]}{\mathrm{Kg6p\_HXK1}} + \frac{[\mathrm{T6P}]}{\mathrm{Kit6p\_HXK1}} \right) \cdot \left(1 + \frac{[\mathrm{ATP}]}{\mathrm{Katp\_HXK1}} + \frac{[\mathrm{ADP}]}{\mathrm{Kadp\_HXK1}} \right)} \\
& + \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{HXK2}] \cdot \mathrm{kcat\_HXK2} \cdot \left(\frac{[\mathrm{GLC}] \cdot [\mathrm{ATP}]}{\mathrm{Kglc\_HXK2} \cdot \mathrm{Katp\_HXK2}} - \frac{[\mathrm{G6P}] \cdot [\mathrm{ADP}]}{\mathrm{Kglc\_HXK2} \cdot \mathrm{Katp\_HXK2} \cdot \mathrm{Keq}} \right)}{\left(1 + \frac{[\mathrm{GLC}]}{\mathrm{Kglc\_HXK2}} + \frac{[\mathrm{G6P}]}{\mathrm{Kg6p\_HXK2}} + \frac{[\mathrm{T6P}]}{\mathrm{Kit6p\_HXK2}} \right) \cdot \left(1 + \frac{[\mathrm{ATP}]}{\mathrm{Katp\_HXK2}} + \frac{[\mathrm{ADP}]}{\mathrm{Kadp\_HXK2}} \right)} \\
& + \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{GLK1}] \cdot \mathrm{kcat\_GLK1} \cdot \left(\frac{[\mathrm{GLC}] \cdot [\mathrm{ATP}]}{\mathrm{Kglc\_GLK1} \cdot \mathrm{Katp\_GLK1}} - \frac{[\mathrm{G6P}] \cdot [\mathrm{ADP}]}{\mathrm{Kglc\_GLK1} \cdot \mathrm{Katp\_GLK1} \cdot \mathrm{Keq}} \right)}{\left(1 + \frac{[\mathrm{GLC}]}{\mathrm{Kglc\_GLK1}} + \frac{[\mathrm{G6P}]}{\mathrm{Kg6p\_GLK1}} \right) \cdot \left(1 + \frac{[\mathrm{ATP}]}{\mathrm{Katp\_GLK1}} + \frac{[\mathrm{ADP}]}{\mathrm{Kadp\_GLK1}} \right)}
\end{aligned}
\tag{22}
$$

Table 41: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat_HXK1			10.200	s^{-1}	☑
Kglc_HXK1			0.150	$mmol \cdot l^{-1}$	☑
Katp_HXK1			0.293	$mmol \cdot l^{-1}$	☑
Kg6p_HXK1			30.000	$mmol \cdot l^{-1}$	☑
Kadp_HXK1			0.230	$mmol \cdot l^{-1}$	☑
Kit6p_HXK1			0.200	$mmol \cdot l^{-1}$	☑
kcat_HXK2			63.100	s^{-1}	☑
Kglc_HXK2			0.200	$mmol \cdot l^{-1}$	☑
Katp_HXK2			0.195	$mmol \cdot l^{-1}$	☑
Kg6p_HXK2			30.000	$mmol \cdot l^{-1}$	☑
Kadp_HXK2			0.230	$mmol \cdot l^{-1}$	☑
Kit6p_HXK2			0.040	$mmol \cdot l^{-1}$	☑
kcat_GLK1			0.072	s^{-1}	☑
Kglc_GLK1			0.011	$mmol \cdot l^{-1}$	☑
Katp_GLK1			0.865	$mmol \cdot l^{-1}$	☑
Kg6p_GLK1			30.000	$mmol \cdot l^{-1}$	☑
Kadp_GLK1			0.230	$mmol \cdot l^{-1}$	☑
Keq			2000.000	dimensionless	☑

7.10 Reaction PDC

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

Name PDC

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{PYR} \xrightarrow{\mathrm{PDC1,\ PDC5,\ PDC6,\ PDC1,\ PYR,\ PDC5,\ PDC6}} \mathrm{AcAld} \tag{23}$$

Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
PYR	PYR	

Modifiers

Table 43: Properties of each modifier.

Id	Name	SBO
PDC1	PDC1	
PDC5	PDC5	
PDC6	PDC6	
PDC1	PDC1	
PYR	PYR	
PDC5	PDC5	
PDC6	PDC6	

Product

Table 44: Properties of each product.

Id	Name	SBO
AcAld	AcAld	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{[\mathrm{PDC1}] \cdot \mathrm{kcat\_PDC1} \cdot [\mathrm{PYR}]}{\mathrm{Kpyr\_PDC1}}}{1 + \frac{[\mathrm{PYR}]}{\mathrm{Kpyr\_PDC1}}} + \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{[\mathrm{PDC5}] \cdot \mathrm{kcat\_PDC5} \cdot [\mathrm{PYR}]}{\mathrm{Kpyr\_PDC5}}}{1 + \frac{[\mathrm{PYR}]}{\mathrm{Kpyr\_PDC5}}} + \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{[\mathrm{PDC6}] \cdot \mathrm{kcat\_PDC6} \cdot [\mathrm{PYR}]}{\mathrm{Kpyr\_PDC6}}}{1 + \frac{[\mathrm{PYR}]}{\mathrm{Kpyr\_PDC6}}} \tag{24}$$

Table 45: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat_PDC1			12.14	s^{-1}	☑
Kpyr_PDC1			8.50	$mmol \cdot l^{-1}$	☑
kcat_PDC5			10.32	s^{-1}	☑
Kpyr_PDC5			7.08	$mmol \cdot l^{-1}$	☑
kcat_PDC6			9.21	s^{-1}	☑
Kpyr_PDC6			2.92	$mmol \cdot l^{-1}$	☑

7.11 Reaction PFK

This is an irreversible reaction of two reactants forming two products influenced by eleven modifiers.

Name PFK

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{ATP} + \mathrm{F6P} \xrightarrow{\mathrm{AMP,\ F26bP,\ PFK1,\ PFK2,\ PFK2,\ F6P,\ ATP,\ F16bP,\ ADP,\ AMP,\ F26bP}} \mathrm{ADP} + \mathrm{F16bP} \tag{25}$$

Reactants

Table 46: Properties of each reactant.

Id	Name	SBO
ATP	ATP	
F6P	F6P	

Modifiers

Table 47: Properties of each modifier.

Id	Name	SBO
AMP	AMP	
F26bP	F26bP	
PFK1	PFK1	
PFK2	PFK2	
PFK2	PFK2	
F6P	F6P	
ATP	ATP	
F16bP	F16bP	
ADP	ADP	
AMP	AMP	
F26bP	F26bP	

Products

Table 48: Properties of each product.

Id	Name	SBO
ADP	ADP	
F16bP	F16bP	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \mathrm{vol}\,(\mathrm{cell}) \cdot [\mathrm{PFK2}] \cdot \mathrm{kcat} \cdot \frac{\mathrm{gR} \cdot \frac{[\mathrm{F6P}]}{\mathrm{Kf6p}} \cdot \frac{[\mathrm{ATP}]}{\mathrm{Katp}} \cdot \left(1 - \frac{\frac{[\mathrm{F16bP}]\cdot[\mathrm{ADP}]}{[\mathrm{F6P}]\cdot[\mathrm{ATP}]}}{\mathrm{Keq}}\right) \cdot \left(1 + \frac{[\mathrm{F6P}]}{\mathrm{Kf6p}} + \frac{[\mathrm{ATP}]}{\mathrm{Katp}} + \frac{\frac{\mathrm{gR}\cdot[\mathrm{F6P}]}{\mathrm{Kf6p}}\cdot[\mathrm{ATP}]}{\mathrm{Katp}} + \frac{[\mathrm{F16bP}]}{\mathrm{Kf16}} + \frac{[\mathrm{ADP}]}{\mathrm{Kadp}}\right.}{\left(1 + \frac{[\mathrm{F6P}]}{\mathrm{Kf6p}} + \frac{[\mathrm{ATP}]}{\mathrm{Katp}} + \frac{\frac{\mathrm{gR}\cdot[\mathrm{F6P}]}{\mathrm{Kf6p}}\cdot[\mathrm{ATP}]}{\mathrm{Katp}} + \frac{[\mathrm{F16bP}]}{\mathrm{Kf16}} + \frac{[\mathrm{ADP}]}{\mathrm{Kadp}} + \frac{\frac{\mathrm{gR}\cdot[\mathrm{F16bP}]}{\mathrm{Kf16}}\cdot[\mathrm{ADP}]}{\mathrm{Kadp}}\right)^2 + \mathrm{L0} \cdot \left(\frac{1+\frac{\mathrm{Ciatp}\cdot[\mathrm{ATP}]}{\mathrm{Kiatp}}}{1+\frac{[\mathrm{ATP}]}{\mathrm{Kiatp}}}\right)^2 \cdot \left(\frac{1+\frac{\mathrm{Camp}\cdot[\mathrm{AMP}]}{\mathrm{Kamp}}}{1+\frac{[\mathrm{AMP}]}{\mathrm{Kamp}}}\right)^2 \cdot \left(\right.} \tag{26}$$

Table 49: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			209.600	s^{-1}	☑
gR			5.120	dimensionless	☑
Kf6p			0.100	$mmol \cdot l^{-1}$	☑

Id	Name	SBO	Value	Unit	Constant
Katp			0.710	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
L0			0.660	dimensionless	☑
Ciatp			100.000	dimensionless	☑
Kiatp			0.650	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Camp			0.085	dimensionless	☑
Kamp			0.100	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Cf26			0.017	dimensionless	☑
Kf26			$6.82 \cdot 10^{-4}$	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Cf16			0.397	dimensionless	☑
Kf16			0.111	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Catp			3.000	dimensionless	☑
Kadp			1.000	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Keq			800.000	dimensionless	☑

7.12 Reaction PGI

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

Name PGI

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{G6P} \xrightleftharpoons{\mathrm{PGI1,\ PGI1,\ G6P,\ F6P}} \mathrm{F6P} \tag{27}$$

Reactant

Table 50: Properties of each reactant.

Id	Name	SBO
G6P	G6P	

Modifiers

Table 51: Properties of each modifier.

Id	Name	SBO
PGI1	PGI1	
PGI1	PGI1	
G6P	G6P	

Id	Name	SBO
F6P	F6P	

Product

Table 52: Properties of each product.

Id	Name	SBO
F6P	F6P	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{PGI1}] \cdot \mathrm{kcat} \cdot \left(\frac{[\mathrm{G6P}]}{\mathrm{Kg6p}} - \frac{[\mathrm{F6P}]}{\mathrm{Kg6p} \cdot \mathrm{Keq}} \right)}{1 + \frac{[\mathrm{G6P}]}{\mathrm{Kg6p}} + \frac{[\mathrm{F6P}]}{\mathrm{Kf6p}}} \tag{28}$$

Table 53: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			487.360	s^{-1}	☑
Kg6p			1.026	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Keq			0.290	dimensionless	☑
Kf6p			0.307	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

7.13 Reaction PGK

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

Name PGK

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{ADP} + \mathrm{BPG} \xrightleftharpoons{\text{PGK1, PGK1, ADP, BPG, P3G, ATP}} \mathrm{ATP} + \mathrm{P3G} \tag{29}$$

Reactants

Table 54: Properties of each reactant.

Id	Name	SBO
ADP	ADP	
BPG	BPG	

Modifiers

Table 55: Properties of each modifier.

Id	Name	SBO
PGK1	PGK1	
PGK1	PGK1	
ADP	ADP	
BPG	BPG	
P3G	P3G	
ATP	ATP	

Products

Table 56: Properties of each product.

Id	Name	SBO
ATP	ATP	
P3G	P3G	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{PGK1}] \cdot \mathrm{kcat} \cdot \left(\frac{[\mathrm{ADP}]}{\mathrm{Kadp}}\right)^{\mathrm{nHadp}-1} \cdot \left(\frac{[\mathrm{BPG}]\cdot[\mathrm{ADP}]}{\mathrm{Kbpg}\cdot\mathrm{Kadp}} - \frac{[\mathrm{P3G}]\cdot[\mathrm{ATP}]}{\mathrm{Kbpg}\cdot\mathrm{Kadp}\cdot\mathrm{Keq}}\right)}{\left(1 + \frac{[\mathrm{BPG}]}{\mathrm{Kbpg}} + \frac{[\mathrm{P3G}]}{\mathrm{Kp3g}}\right) \cdot \left(1 + \left(\frac{[\mathrm{ADP}]}{\mathrm{Kadp}}\right)^{\mathrm{nHadp}} + \frac{[\mathrm{ATP}]}{\mathrm{Katp}}\right)} \tag{30}$$

Table 57: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			58.600	s^{-1}	☑
Keq			3200.000	dimensionless	☑
Kp3g			4.580	$mmol \cdot l^{-1}$	☑

Id	Name	SBO	Value	Unit	Constant
Katp			1.990	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kbpg			0.003	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kadp			0.200	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
nHadp			2.000	dimensionless	☑

7.14 Reaction PGM

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

Name PGM

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{G6P} \xrightleftharpoons{\text{PGM1, PGM2, G6P, G1P}} \mathrm{G1P} \tag{31}$$

Reactant

Table 58: Properties of each reactant.

Id	Name	SBO
G6P	G6P	

Modifiers

Table 59: Properties of each modifier.

Id	Name	SBO
PGM1	PGM1	
PGM2	PGM2	
G6P	G6P	
G1P	G1P	

Product

Table 60: Properties of each product.

Id	Name	SBO
G1P	G1P	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\mathrm{Vmax} \cdot \left(\frac{[\mathrm{G6P}]}{\mathrm{Kg6p}} - \frac{[\mathrm{G1P}]}{\mathrm{Kg6p} \cdot \mathrm{Keq}} \right)}{1 + \frac{[\mathrm{G6P}]}{\mathrm{Kg6p}} + \frac{[\mathrm{G1P}]}{\mathrm{Kg1p}}} \tag{32}$$

Table 61: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`Vmax`			0.128	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$	☑
`Kg6p`			0.050	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Kg1p`			0.023	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Keq`			0.167	dimensionless	☑

7.15 Reaction `PYK`

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

Name PYK

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{ADP} + \mathrm{PEP} \xrightleftharpoons{\text{CDC19, F16bP, CDC19, PEP, ADP, PYR, ATP, F16bP}} \mathrm{ATP} + \mathrm{PYR} \tag{33}$$

Reactants

Table 62: Properties of each reactant.

Id	Name	SBO
`ADP`	ADP	
`PEP`	PEP	

Modifiers

Table 63: Properties of each modifier.

Id	Name	SBO
`CDC19`	CDC19	

Id	Name	SBO
F16bP	F16bP	
CDC19	CDC19	
PEP	PEP	
ADP	ADP	
PYR	PYR	
ATP	ATP	
F16bP	F16bP	

Products

Table 64: Properties of each product.

Id	Name	SBO
ATP	ATP	
PYR	PYR	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{[\mathrm{CDC19}] \cdot \mathrm{kcat} \cdot \left([\mathrm{PEP}] \cdot [\mathrm{ADP}] - \frac{[\mathrm{PYR}] \cdot [\mathrm{ATP}]}{\mathrm{Keq}} \right)}{\mathrm{Kpep} \cdot \mathrm{Kadp}}}{\left(1 + \frac{[\mathrm{PEP}]}{\mathrm{Kpep}} + \frac{[\mathrm{PYR}]}{\mathrm{Kpyr}} + \mathrm{L0} \cdot \frac{\frac{[\mathrm{ATP}]}{\mathrm{Kiatp}} + 1}{\frac{[\mathrm{F16bP}]}{\mathrm{Kf16p}} + 1} \right) \cdot \left(1 + \frac{[\mathrm{ADP}]}{\mathrm{Kadp}} + \frac{[\mathrm{ATP}]}{\mathrm{Katp}} \right)} \tag{34}$$

Table 65: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			20.146	s^{-1}	☑
Kpep			0.281	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kadp			0.243	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kpyr			21.000	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Katp			1.500	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kiatp			9.300	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kf16p			0.200	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
L0			100.000	dimensionless	☑
Keq			6500.000	dimensionless	☑

7.16 Reaction TDH

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

Name TDH

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{GAP} + \mathrm{NAD} \xrightleftharpoons{\text{TDH1, TDH3, TDH1, GAP, NAD, BPG, NADH, TDH3}} \mathrm{BPG} + \mathrm{NADH} \quad (35)$$

Reactants

Table 66: Properties of each reactant.

Id	Name	SBO
GAP	GAP	
NAD	NAD	

Modifiers

Table 67: Properties of each modifier.

Id	Name	SBO
TDH1	TDH1	
TDH3	TDH3	
TDH1	TDH1	
GAP	GAP	
NAD	NAD	
BPG	BPG	
NADH	NADH	
TDH3	TDH3	

Products

Table 68: Properties of each product.

Id	Name	SBO
BPG	BPG	
NADH	NADH	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{TDH1}] \cdot \mathrm{kcat\_TDH1} \cdot \left(\frac{[\mathrm{GAP}] \cdot [\mathrm{NAD}]}{\mathrm{Kgap\_TDH1} \cdot \mathrm{Knad\_TDH1}} - \frac{[\mathrm{BPG}] \cdot [\mathrm{NADH}]}{\mathrm{Kgap\_TDH1} \cdot \mathrm{Knad\_TDH1} \cdot \mathrm{Keq}} \right)}{\left(1 + \frac{[\mathrm{GAP}]}{\mathrm{Kgap\_TDH1}} + \frac{[\mathrm{BPG}]}{\mathrm{Kbpg\_TDH1}}\right) \cdot \left(1 + \frac{[\mathrm{NAD}]}{\mathrm{Knad\_TDH1}} + \frac{[\mathrm{NADH}]}{\mathrm{Knadh\_TDH1}}\right)}$$
$$+ \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{[\mathrm{TDH3}] \cdot \mathrm{kcat\_TDH3} \cdot \left(\frac{[\mathrm{GAP}] \cdot [\mathrm{NAD}]}{\mathrm{Kgap\_TDH3} \cdot \mathrm{Knad\_TDH3}} - \frac{[\mathrm{BPG}] \cdot [\mathrm{NADH}]}{\mathrm{Kgap\_TDH3} \cdot \mathrm{Knad\_TDH3} \cdot \mathrm{Keq}} \right)}{\left(1 + \frac{[\mathrm{GAP}]}{\mathrm{Kgap\_TDH3}} + \frac{[\mathrm{BPG}]}{\mathrm{Kbpg\_TDH3}}\right) \cdot \left(1 + \frac{[\mathrm{NAD}]}{\mathrm{Knad\_TDH3}} + \frac{[\mathrm{NADH}]}{\mathrm{Knadh\_TDH3}}\right)} \tag{36}$$

Table 69: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat_TDH1			19.120	s^{-1}	☑
Kgap_TDH1			0.495	$mmol \cdot l^{-1}$	☑
Knad_TDH1			0.090	$mmol \cdot l^{-1}$	☑
Kbpg_TDH1			0.010	$mmol \cdot l^{-1}$	☑
Knadh_TDH1			0.060	$mmol \cdot l^{-1}$	☑
kcat_TDH3			18.162	s^{-1}	☑
Kgap_TDH3			0.423	$mmol \cdot l^{-1}$	☑
Knad_TDH3			0.090	$mmol \cdot l^{-1}$	☑
Kbpg_TDH3			0.909	$mmol \cdot l^{-1}$	☑
Knadh_TDH3			0.060	$mmol \cdot l^{-1}$	☑
Keq			0.005	dimensionless	☑

7.17 Reaction TPI

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

Name TPI

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{DHAP} \xrightleftharpoons{\text{TPI1, TPI1, DHAP, GAP}} \mathrm{GAP} \tag{37}$$

Reactant

Table 70: Properties of each reactant.

Id	Name	SBO
DHAP	DHAP	

Modifiers

Table 71: Properties of each modifier.

Id	Name	SBO
TPI1	TPI1	
TPI1	TPI1	
DHAP	DHAP	
GAP	GAP	

Product

Table 72: Properties of each product.

Id	Name	SBO
GAP	GAP	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{[\mathrm{TPI1}]\cdot \mathrm{kcat}}{\mathrm{Kdhap}} \cdot \left([\mathrm{DHAP}] - \frac{[\mathrm{GAP}]}{\mathrm{Keq}}\right)}{1 + \frac{[\mathrm{DHAP}]}{\mathrm{Kdhap}} + \frac{[\mathrm{GAP}]}{\mathrm{Kgap}} \cdot \left(1 + \left(\frac{[\mathrm{GAP}]}{\mathrm{Kigap}}\right)^4\right)} \tag{38}$$

Table 73: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			564.380	s^{-1}	☑
Kdhap			6.454	$mmol \cdot l^{-1}$	☑
Kgap			5.250	$mmol \cdot l^{-1}$	☑
Kigap			35.100	$mmol \cdot l^{-1}$	☑
Keq			0.045	dimensionless	☑

7.18 Reaction TPP

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

Name TPP

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{T6P} \xrightarrow{\mathrm{TPS1,\ TPS2,\ T6P}} \mathrm{TRH} \tag{39}$$

Reactant

Table 74: Properties of each reactant.

Id	Name	SBO
T6P	T6P	

Modifiers

Table 75: Properties of each modifier.

Id	Name	SBO
TPS1	TPS1	
TPS2	TPS2	
T6P	T6P	

Product

Table 76: Properties of each product.

Id	Name	SBO
TRH	TRH	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{\mathrm{Vmax} \cdot [\mathrm{T6P}]}{\mathrm{Kt6p}}}{1 + \frac{[\mathrm{T6P}]}{\mathrm{Kt6p}}} \tag{40}$$

Table 77: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vmax			2.340	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$	☑
Kt6p			0.500	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

7.19 Reaction TPS

This is an irreversible reaction of two reactants forming two products influenced by four modifiers.

Name TPS

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{G6P} + \mathrm{UDG} \xrightarrow{\mathrm{TPS1,\ TPS2,\ G6P,\ UDG}} \mathrm{T6P} + \mathrm{UDP} \tag{41}$$

Reactants

Table 78: Properties of each reactant.

Id	Name	SBO
G6P	G6P	
UDG	UDG	

Modifiers

Table 79: Properties of each modifier.

Id	Name	SBO
TPS1	TPS1	
TPS2	TPS2	
G6P	G6P	
UDG	UDG	

Products

Table 80: Properties of each product.

Id	Name	SBO
T6P	T6P	
UDP	UDP	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{\mathrm{Vmax} \cdot [\mathrm{G6P}] \cdot [\mathrm{UDG}]}{\mathrm{Kg6p} \cdot \mathrm{Kudg}}}{\left(1 + \frac{[\mathrm{G6P}]}{\mathrm{Kg6p}}\right) \cdot \left(1 + \frac{[\mathrm{UDG}]}{\mathrm{Kudg}}\right)} \tag{42}$$

Table 81: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vmax			0.494	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$	☑
Kg6p			3.800	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kudg			0.886	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

7.20 Reaction UGP

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

Name UGP

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{G1P} + \mathrm{UTP} \xrightarrow{\mathrm{UGP1,\ UTP,\ G1P,\ UDG}} \mathrm{UDG} \tag{43}$$

Reactants

Table 82: Properties of each reactant.

Id	Name	SBO
G1P	G1P	
UTP	UTP	

Modifiers

Table 83: Properties of each modifier.

Id	Name	SBO
UGP1	UGP1	
UTP	UTP	
G1P	G1P	
UDG	UDG	

Product

Table 84: Properties of each product.

Id	Name	SBO
UDG	UDG	

Kinetic Law

Derived unit $0.0010000000000000013\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{20} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{\mathrm{Vmax} \cdot [\mathrm{UTP}] \cdot [\mathrm{G1P}]}{\mathrm{Kutp} \cdot \mathrm{Kg1p}}}{\frac{\mathrm{Kiutp}}{\mathrm{Kutp}} + \frac{[\mathrm{UTP}]}{\mathrm{Kutp}} + \frac{[\mathrm{G1P}]}{\mathrm{Kg1p}} + \frac{[\mathrm{UTP}] \cdot [\mathrm{G1P}]}{\mathrm{Kutp} \cdot \mathrm{Kg1p}} + \frac{\frac{\mathrm{Kiutp}}{\mathrm{Kutp}} \cdot [\mathrm{UDG}]}{\mathrm{Kiudg}} + \frac{[\mathrm{G1P}] \cdot [\mathrm{UDG}]}{\mathrm{Kg1p} \cdot \mathrm{Kiudg}}} \tag{44}$$

Table 85: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vmax			13.255	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$	☑
Kutp			0.110	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kiutp			0.110	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kg1p			0.320	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kiudg			0.004	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

7.21 Reaction acetate_branch

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

Name acetate_branch

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{AcAld} + \mathrm{NAD} \xrightarrow{\mathrm{AcAld,\ NAD}} \mathrm{ACE} + \mathrm{NADH} \tag{45}$$

Reactants

Table 86: Properties of each reactant.

Id	Name	SBO
AcAld	AcAld	
NAD	NAD	

Modifiers

Table 87: Properties of each modifier.

Id	Name	SBO
AcAld	AcAld	
NAD	NAD	

Products

Table 88: Properties of each product.

Id	Name	SBO
ACE	ACE	
NADH	NADH	

Kinetic Law

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

$$v_{21} = \mathrm{vol}\,(\mathrm{cell}) \cdot \mathrm{k} \cdot [\mathrm{AcAld}] \cdot [\mathrm{NAD}] \tag{46}$$

Table 89: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k			0.006	$\mathrm{mmol}^{-1} \cdot 1 \cdot \mathrm{s}^{-1}$	☑

7.22 Reaction udp_to_utp

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

Name udp_to_utp

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{UDP} + \mathrm{ATP} \xrightarrow{\mathrm{UDP,\ ATP}} \mathrm{UTP} + \mathrm{ADP} \tag{47}$$

Reactants

Table 90: Properties of each reactant.

Id	Name	SBO
UDP	UDP	
ATP	ATP	

Modifiers

Table 91: Properties of each modifier.

Id	Name	SBO
UDP	UDP	
ATP	ATP	

Products

Table 92: Properties of each product.

Id	Name	SBO
UTP	UTP	
ADP	ADP	

Kinetic Law

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

$$v_{22} = \mathrm{vol}\,(\mathrm{cell}) \cdot \mathrm{k} \cdot [\mathrm{UDP}] \cdot [\mathrm{ATP}] \tag{48}$$

Table 93: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k			0.075	$\mathrm{mmol}^{-1} \cdot 1 \cdot \mathrm{s}^{-1}$	☑

7.23 Reaction HXT

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

Name HXT

SBO:0000185 transport reaction

Reaction equation

$$\mathrm{GLCx} \xrightleftharpoons{\text{GLCx, GLC}} \mathrm{GLC} \tag{49}$$

Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
GLCx	GLCx	

Modifiers

Table 95: Properties of each modifier.

Id	Name	SBO
GLCx	GLCx	
GLC	GLC	

Product

Table 96: Properties of each product.

Id	Name	SBO
GLC	GLC	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \mathrm{vol}\,(\mathrm{cell}) \cdot \frac{\frac{\mathrm{Vmax} \cdot ([\mathrm{GLCx}] - [\mathrm{GLC}])}{\mathrm{Kglc}}}{1 + \frac{[\mathrm{GLCx}]}{\mathrm{Kglc}} + \frac{[\mathrm{GLC}]}{\mathrm{Kglc}} + \frac{\frac{\mathrm{Ki} \cdot [\mathrm{GLCx}]}{\mathrm{Kglc}} \cdot [\mathrm{GLC}]}{\mathrm{Kglc}}} \tag{50}$$

Table 97: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`Vmax`			3.35	$\mathrm{mmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$	☑
`Kglc`			0.90	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
`Ki`			0.91	dimensionless	☑

7.24 Reaction `GND`

This is an irreversible reaction of two reactants forming two products influenced by eight modifiers.

Name GND

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{P6G} + \mathrm{NADP} \xrightarrow{\text{GND1, GND2, GND1, P6G, NADP, Ru5P, NADPH, GND2}} \mathrm{Ru5P} + \mathrm{NADPH} \tag{51}$$

Reactants

Table 98: Properties of each reactant.

Id	Name	SBO
`P6G`	P6G	
`NADP`	NADP	

Modifiers

Table 99: Properties of each modifier.

Id	Name	SBO
GND1	GND1	
GND2	GND2	
GND1	GND1	
P6G	P6G	
NADP	NADP	
Ru5P	Ru5P	
NADPH	NADPH	
GND2	GND2	

Products

Table 100: Properties of each product.

Id	Name	SBO
Ru5P	Ru5P	
NADPH	NADPH	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \mathrm{vol}\,(\mathrm{cell}) \cdot \left(\frac{\frac{[\mathrm{GND1}] \cdot \mathrm{kcat\_GND1} \cdot [\mathrm{P6G}] \cdot [\mathrm{NADP}]}{\mathrm{Kp6g\_GND1} \cdot \mathrm{Knadp\_GND1}}}{\left(1 + \frac{[\mathrm{P6G}]}{\mathrm{Kp6g\_GND1}} + \frac{[\mathrm{Ru5P}]}{\mathrm{Kru5p\_GND1}}\right) \cdot \left(1 + \frac{[\mathrm{NADP}]}{\mathrm{Knadp\_GND1}} + \frac{[\mathrm{NADPH}]}{\mathrm{Knadph\_GND1}}\right)} + \frac{[\mathrm{GND2}] \cdot \mathrm{kcat\_GND2} \cdot [\mathrm{P6G}] \cdot [\mathrm{NADP}]}{\left(1 + \frac{[\mathrm{P6G}]}{\mathrm{Kp6g\_GND2}} + \frac{[\mathrm{Ru5P}]}{\mathrm{Kru5p\_GND2}}\right) \cdot \left(1 + \frac{[\mathrm{NADP}]}{\mathrm{Knadp\_GND2}} + \frac{[\mathrm{NADPH}]}{\mathrm{Knadph\_GND2}}\right)} \right) \tag{52}$$

Table 101: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat_GND1			28.000	s^{-1}	☑
Kp6g_GND1			0.062	$mmol \cdot l^{-1}$	☑
Knadp_GND1			0.094	$mmol \cdot l^{-1}$	☑
Kru5p_GND1			0.100	$mmol \cdot l^{-1}$	☑
Knadph_GND1			0.055	$mmol \cdot l^{-1}$	☑
kcat_GND2			27.300	s^{-1}	☑

Id	Name	SBO	Value	Unit	Constant
Kp6g_GND2			0.115	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Knadp_GND2			0.094	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Kru5p_GND2			0.100	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑
Knadph_GND2			0.055	$\mathrm{mmol} \cdot \mathrm{l}^{-1}$	☑

7.25 Reaction RKI

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

Name RKI

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{Ru5P} \xrightleftharpoons{\text{RKI1, RKI1, Ru5P, R5P}} \mathrm{R5P} \tag{53}$$

Reactant

Table 102: Properties of each reactant.

Id	Name	SBO
Ru5P	Ru5P	

Modifiers

Table 103: Properties of each modifier.

Id	Name	SBO
RKI1	RKI1	
RKI1	RKI1	
Ru5P	Ru5P	
R5P	R5P	

Product

Table 104: Properties of each product.

Id	Name	SBO
R5P	R5P	

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \frac{\frac{\text{vol(cell)} \cdot [\text{RKI1}] \cdot \text{kcat} \cdot \left([\text{Ru5P}] - \frac{[\text{R5P}]}{\text{Keq}} \right)}{\text{Kru5p}}}{1 + \frac{[\text{Ru5P}]}{\text{Kru5p}} + \frac{[\text{R5P}]}{\text{Kr5p}}} \tag{54}$$

Table 105: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			335.00	s^{-1}	☑
Kru5p			2.47	$mmol \cdot l^{-1}$	☑
Kr5p			5.70	$mmol \cdot l^{-1}$	☑
Kiru5p			9.88	$mmol \cdot l^{-1}$	☑
Keq			4.00	dimensionless	☑

7.26 Reaction RPE

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

Name RPE

SBO:0000176 biochemical reaction

Reaction equation

$$\text{Ru5P} \xrightleftharpoons{\text{RPE1, RPE1, Ru5P, X5P}} \text{X5P} \tag{55}$$

Reactant

Table 106: Properties of each reactant.

Id	Name	SBO
Ru5P	Ru5P	

Modifiers

Table 107: Properties of each modifier.

Id	Name	SBO
RPE1	RPE1	
RPE1	RPE1	
Ru5P	Ru5P	
X5P	X5P	

Product

Table 108: Properties of each product.

Id	Name	SBO
X5P	X5P	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \frac{\frac{\text{vol(cell)} \cdot [\text{RPE1}] \cdot \text{kcat} \cdot \left([\text{Ru5P}] - \frac{[\text{X5P}]}{\text{Keq}} \right)}{\text{Kru5p}}}{1 + \frac{[\text{Ru5P}]}{\text{Kru5p}} + \frac{[\text{X5P}]}{\text{Kx5p}}} \tag{56}$$

Table 109: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			4020.00	s^{-1}	☑
Kru5p			5.97	$mmol \cdot l^{-1}$	☑
Kx5p			7.70	$mmol \cdot l^{-1}$	☑
Keq			1.40	dimensionless	☑

7.27 Reaction SOL

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

Name SOL

SBO:0000176 biochemical reaction

Reaction equation

$$\text{G6L} \xrightarrow{\text{SOL3, SOL3, G6L, P6G}} \text{P6G} \tag{57}$$

Reactant

Table 110: Properties of each reactant.

Id	Name	SBO
G6L	G6L	

Modifiers

Table 111: Properties of each modifier.

Id	Name	SBO
SOL3	SOL3	
SOL3	SOL3	
G6L	G6L	
P6G	P6G	

Product

Table 112: Properties of each product.

Id	Name	SBO
P6G	P6G	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \frac{\frac{\text{vol(cell)} \cdot [\text{SOL3}] \cdot \text{kcat} \cdot [\text{G6L}]}{\text{Kg6l}}}{1 + \frac{[\text{G6L}]}{\text{Kg6l}} + \frac{[\text{P6G}]}{\text{Kp6g}}} \tag{58}$$

Table 113: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			4.3	s^{-1}	☑
Kg6l			0.8	$mmol \cdot l^{-1}$	☑
Kp6g			0.5	$mmol \cdot l^{-1}$	☑

7.28 Reaction TAL

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

Name TAL

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{GAP} + \mathrm{S7P} \xrightleftharpoons{\text{TAL1, NQM1, TAL1, GAP, S7P, F6P, E4P, NQM1}} \mathrm{F6P} + \mathrm{E4P} \qquad (59)$$

Reactants

Table 114: Properties of each reactant.

Id	Name	SBO
GAP	GAP	
S7P	S7P	

Modifiers

Table 115: Properties of each modifier.

Id	Name	SBO
TAL1	TAL1	
NQM1	NQM1	
TAL1	TAL1	
GAP	GAP	
S7P	S7P	
F6P	F6P	
E4P	E4P	
NQM1	NQM1	

Products

Table 116: Properties of each product.

Id	Name	SBO
F6P	F6P	
E4P	E4P	

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \mathrm{vol}\,(\mathrm{cell}) \cdot \left(\frac{\frac{[\mathrm{TAL1}] \cdot \mathrm{kcat\_TAL1} \cdot \left([\mathrm{GAP}] \cdot [\mathrm{S7P}] - \frac{[\mathrm{F6P}] \cdot [\mathrm{E4P}]}{\mathrm{Keq}} \right)}{\mathrm{Kgap\_TAL1} \cdot \mathrm{Ks7p\_TAL1}}}{\left(1 + \frac{[\mathrm{GAP}]}{\mathrm{Kgap\_TAL1}} + \frac{[\mathrm{F6P}]}{\mathrm{Kf6p\_TAL1}} \right) \cdot \left(1 + \frac{[\mathrm{S7P}]}{\mathrm{Ks7p\_TAL1}} + \frac{[\mathrm{E4P}]}{\mathrm{Ke4p\_TAL1}} \right)} + \frac{\frac{[\mathrm{NQM1}] \cdot \mathrm{kcat\_NQM1} \cdot \left([\mathrm{GAP}] \cdot [\mathrm{S7P}] - \frac{[\mathrm{F6P}] \cdot [\mathrm{E4P}]}{\mathrm{Keq}} \right)}{\mathrm{Kgap\_NQM1} \cdot \mathrm{Ks7p\_NQM1}}}{\left(1 + \frac{[\mathrm{GAP}]}{\mathrm{Kgap\_NQM1}} + \frac{[\mathrm{F6P}]}{\mathrm{Kf6p\_NQM1}} \right) \cdot \left(1 + \frac{[\mathrm{S7P}]}{\mathrm{Ks7p\_NQM1}} + \frac{[\mathrm{E4P}]}{\mathrm{Ke4p\_NQM1}} \right)} \right) \tag{60}$$

Table 117: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat_TAL1			0.694	s^{-1}	☑
Kgap_TAL1			0.272	$mmol \cdot l^{-1}$	☑
Ks7p_TAL1			0.786	$mmol \cdot l^{-1}$	☑
Kf6p_TAL1			1.440	$mmol \cdot l^{-1}$	☑
Ke4p_TAL1			0.362	$mmol \cdot l^{-1}$	☑
kcat_NQM1			0.694	s^{-1}	☑
Kgap_NQM1			0.272	$mmol \cdot l^{-1}$	☑
Ks7p_NQM1			0.786	$mmol \cdot l^{-1}$	☑
Kf6p_NQM1			1.040	$mmol \cdot l^{-1}$	☑
Ke4p_NQM1			0.305	$mmol \cdot l^{-1}$	☑
Keq			1.050	dimensionless	☑

7.29 Reaction TKL_E4P

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

Name TKL (E4P:F6P)

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{X5P} + \mathrm{E4P} \xrightleftharpoons{\text{TKL1, R5P, S7P, TKL1, X5P, E4P, GAP, F6P, R5P, S7P}} \mathrm{GAP} + \mathrm{F6P} \tag{61}$$

Reactants

Table 118: Properties of each reactant.

Id	Name	SBO
X5P	X5P	
E4P	E4P	

Modifiers

Table 119: Properties of each modifier.

Id	Name	SBO
TKL1	TKL1	
R5P	R5P	
S7P	S7P	
TKL1	TKL1	
X5P	X5P	
E4P	E4P	
GAP	GAP	
F6P	F6P	
R5P	R5P	
S7P	S7P	

Products

Table 120: Properties of each product.

Id	Name	SBO
GAP	GAP	
F6P	F6P	

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = \frac{\frac{\mathrm{vol(cell)} \cdot [\mathrm{TKL1}] \cdot \mathrm{kcat} \cdot \left([\mathrm{X5P}] \cdot [\mathrm{E4P}] - \frac{[\mathrm{GAP}] \cdot [\mathrm{F6P}]}{\mathrm{Keq}} \right)}{\mathrm{Kx5p\_TAL} \cdot \mathrm{Ke4p\_TAL}}}{\left(1 + \frac{[\mathrm{X5P}]}{\mathrm{Kx5p\_TAL}} + \frac{[\mathrm{GAP}]}{\mathrm{Kgap\_TAL}} \right) \cdot \left(1 + \frac{[\mathrm{E4P}]}{\mathrm{Ke4p\_TAL}} + \frac{[\mathrm{F6P}]}{\mathrm{Kf6p\_TAL}} + \frac{[\mathrm{R5P}]}{\mathrm{Kr5p\_TAL}} + \frac{[\mathrm{S7P}]}{\mathrm{Ks7p\_TAL}} \right)} \tag{62}$$

Table 121: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			47.1	s^{-1}	☑
Keq			10.0	dimensionless	☑

7.30 Reaction TKL_R5P

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

Name TKL (R5P:S7P)

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{X5P} + \mathrm{R5P} \xrightleftharpoons{\text{TKL1, E4P, F6P, TKL1, X5P, R5P, GAP, S7P, E4P, F6P}} \mathrm{GAP} + \mathrm{S7P} \qquad (63)$$

Reactants

Table 122: Properties of each reactant.

Id	Name	SBO
X5P	X5P	
R5P	R5P	

Modifiers

Table 123: Properties of each modifier.

Id	Name	SBO
TKL1	TKL1	
E4P	E4P	
F6P	F6P	
TKL1	TKL1	
X5P	X5P	
R5P	R5P	
GAP	GAP	
S7P	S7P	
E4P	E4P	
F6P	F6P	

Products

Table 124: Properties of each product.

Id	Name	SBO
GAP	GAP	
S7P	S7P	

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = \frac{\frac{\text{vol(cell)} \cdot [\text{TKL1}] \cdot \text{kcat} \cdot \left([\text{X5P}] \cdot [\text{R5P}] - \frac{[\text{GAP}] \cdot [\text{S7P}]}{\text{Keq}} \right)}{\text{Kx5p\_TAL} \cdot \text{Kr5p\_TAL}}}{\left(1 + \frac{[\text{X5P}]}{\text{Kx5p\_TAL}} + \frac{[\text{GAP}]}{\text{Kgap\_TAL}}\right) \cdot \left(1 + \frac{[\text{E4P}]}{\text{Ke4p\_TAL}} + \frac{[\text{F6P}]}{\text{Kf6p\_TAL}} + \frac{[\text{R5P}]}{\text{Kr5p\_TAL}} + \frac{[\text{S7P}]}{\text{Ks7p\_TAL}}\right)} \quad (64)$$

Table 125: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			40.5	s^{-1}	☑
Keq			1.2	dimensionless	☑

7.31 Reaction ZWF

This is an irreversible reaction of two reactants forming two products influenced by six modifiers.

Name ZWF

SBO:0000176 biochemical reaction

Reaction equation

$$\text{G6P} + \text{NADP} \xrightarrow{\text{ZWF1, ZWF1, G6P, NADP, G6L, NADPH}} \text{G6L} + \text{NADPH} \quad (65)$$

Reactants

Table 126: Properties of each reactant.

Id	Name	SBO
G6P	G6P	
NADP	NADP	

Modifiers

Table 127: Properties of each modifier.

Id	Name	SBO
ZWF1	ZWF1	
ZWF1	ZWF1	
G6P	G6P	
NADP	NADP	
G6L	G6L	
NADPH	NADPH	

Products

Table 128: Properties of each product.

Id	Name	SBO
G6L	G6L	
NADPH	NADPH	

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = \frac{\frac{\text{vol(cell)} \cdot [\text{ZWF1}] \cdot \text{kcat} \cdot [\text{G6P}] \cdot [\text{NADP}]}{\text{Kg6p} \cdot \text{Knadp}}}{\left(1 + \frac{[\text{G6P}]}{\text{Kg6p}} + \frac{[\text{G6L}]}{\text{Kg6l}}\right) \cdot \left(1 + \frac{[\text{NADP}]}{\text{Knadp}} + \frac{[\text{NADPH}]}{\text{Knadph}}\right)} \tag{66}$$

Table 129: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kcat			189.000	s^{-1}	☑
Kg6p			0.042	$mmol \cdot l^{-1}$	☑
Knadp			0.045	$mmol \cdot l^{-1}$	☑
Kg6l			0.010	$mmol \cdot l^{-1}$	☑
Knadph			0.017	$mmol \cdot l^{-1}$	☑

7.32 Reaction NADPH_oxidase

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

Name NADPH oxidase

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{NADPH} \xrightarrow{\mathrm{NADPH}} \mathrm{NADP} \tag{67}$$

Reactant

Table 130: Properties of each reactant.

Id	Name	SBO
NADPH	NADPH	

Modifier

Table 131: Properties of each modifier.

Id	Name	SBO
NADPH	NADPH	

Product

Table 132: Properties of each product.

Id	Name	SBO
NADP	NADP	

Kinetic Law

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

$$v_{32} = \mathrm{vol}\,(\mathrm{cell}) \cdot \mathrm{k} \cdot [\mathrm{NADPH}] \tag{68}$$

Table 133: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k			1.0	s^{-1}	☑

7.33 Reaction E4P_sink

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

Name E4P sink

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{E4P} \xrightarrow{\mathrm{E4P}} \emptyset \tag{69}$$

Reactant

Table 134: Properties of each reactant.

Id	Name	SBO
E4P	E4P	

Modifier

Table 135: Properties of each modifier.

Id	Name	SBO
E4P	E4P	

Kinetic Law

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

$$v_{33} = \mathrm{vol}\,(\mathrm{cell}) \cdot \mathrm{k} \cdot [\mathrm{E4P}] \tag{70}$$

Table 136: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k			1.0	s^{-1}	☑

7.34 Reaction R5P_sink

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

Name R5P sink

SBO:0000176 biochemical reaction

Reaction equation

$$\mathrm{R5P} \xrightarrow{\mathrm{R5P}} \emptyset \tag{71}$$

Reactant

Table 137: Properties of each reactant.

Id	Name	SBO
R5P	R5P	

Modifier

Table 138: Properties of each modifier.

Id	Name	SBO
R5P	R5P	

Kinetic Law

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

$$v_{34} = \mathrm{vol}\,(\mathrm{cell}) \cdot \mathrm{k} \cdot [\mathrm{R5P}] \tag{72}$$

Table 139: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k			1.0	s^{-1}	☑

8 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.

8.1 Species ADP

Name ADP

SBO:0000247 simple chemical

Initial concentration $1.29\ \text{mmol} \cdot \text{l}^{-1}$

This species takes part in 14 reactions (as a reactant in AK, PGK, PYK and as a product in ATPase, HXK, PFK, udp_to_utp and as a modifier in AK, GPD, GPD, HXK, PFK, PGK, PYK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ADP} = v_3 + v_9 + v_{11} + v_{22} - 2v_2 - v_{13} - v_{15} \tag{73}$$

8.2 Species ATP

Name ATP

SBO:0000247 simple chemical

Initial concentration $4.29\ \text{mmol} \cdot \text{l}^{-1}$

This species takes part in 16 reactions (as a reactant in ATPase, HXK, PFK, udp_to_utp and as a product in AK, PGK, PYK and as a modifier in AK, ATPase, GPD, GPD, HXK, PFK, PGK, PYK, udp_to_utp).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ATP} = v_2 + v_{13} + v_{15} - v_3 - v_9 - v_{11} - v_{22} \tag{74}$$

8.3 Species AcAld

Name AcAld

SBO:0000247 simple chemical

Initial concentration $0.178140579850657\ \text{mmol} \cdot \text{l}^{-1}$

This species takes part in five reactions (as a reactant in ADH, acetate_branch and as a product in PDC and as a modifier in ADH, acetate_branch).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AcAld} = v_{10} - v_1 - v_{21} \tag{75}$$

8.4 Species BPG

Name BPG

SBO:0000247 simple chemical

Initial concentration $7.36873499865602 \cdot 10^{-4}$ mmol $\cdot$ l^{-1}

This species takes part in four reactions (as a reactant in PGK and as a product in TDH and as a modifier in PGK, TDH).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{BPG} = v_{16} - v_{13} \tag{76}$$

8.5 Species DHAP

Name DHAP

SBO:0000247 simple chemical

Initial concentration 1.1613768527467 mmol $\cdot$ l^{-1}

This species takes part in six reactions (as a reactant in GPD, TPI and as a product in FBA and as a modifier in FBA, GPD, TPI).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{DHAP} = v_5 - v_6 - v_{17} \tag{77}$$

8.6 Species F16bP

Name F16bP

SBO:0000247 simple chemical

Initial concentration 4.58321859006931 mmol $\cdot$ l^{-1}

This species takes part in eight reactions (as a reactant in FBA and as a product in PFK and as a modifier in FBA, GPD, GPD, PFK, PYK, PYK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{F16bP} = v_{11} - v_5 \tag{78}$$

8.7 Species F6P

Name F6P

SBO:0000247 simple chemical

Initial concentration 0.235441221891221 mmol $\cdot$ l^{-1}

This species takes part in ten reactions (as a reactant in PFK and as a product in PGI, TAL, TKL_E4P and as a modifier in PFK, PGI, TAL, TKL_E4P, TKL_R5P, TKL_R5P).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{F6P} = v_{12} + v_{28} + v_{29} - v_{11} \tag{79}$$

8.8 Species G1P

Name G1P

SBO:0000247 simple chemical

Initial concentration 0.539248506344921 mmol · l^{-1}

This species takes part in four reactions (as a reactant in UGP and as a product in PGM and as a modifier in PGM, UGP).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{G1P} = v_{14} - v_{20} \tag{80}$$

8.9 Species G3P

Name G3P

SBO:0000247 simple chemical

Initial concentration 0.274002929191284 mmol · l^{-1}

This species takes part in four reactions (as a reactant in GPP and as a product in GPD and as a modifier in GPD, GPP).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{G3P} = v_{6} - v_{8} \tag{81}$$

8.10 Species G6P

Name G6P

SBO:0000247 simple chemical

Initial concentration 0.772483203645216 mmol · l^{-1}

This species takes part in ten reactions (as a reactant in PGI, PGM, TPS, ZWF and as a product in HXK and as a modifier in HXK, PGI, PGM, TPS, ZWF).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{G6P} = v_{9} - v_{12} - v_{14} - v_{19} - v_{31} \tag{82}$$

8.11 Species GAP

Name GAP

SBO:0000247 simple chemical

Initial concentration 0.315891028770503 mmol · l^{-1}

This species takes part in twelve reactions (as a reactant in TDH, TAL and as a product in FBA, TPI, TKL_E4P, TKL_R5P and as a modifier in FBA, TDH, TPI, TAL, TKL_E4P, TKL_R5P).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GAP} = v_{5} + v_{17} + v_{29} + v_{30} - v_{16} - v_{28} \tag{83}$$

8.12 Species GLC

Name GLC

SBO:0000247 simple chemical

Initial concentration 6.28000179338242 mmol·l^{-1}

This species takes part in four reactions (as a reactant in HXK and as a product in HXT and as a modifier in HXK, HXT).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GLC} = v_{23} - v_9 \tag{84}$$

8.13 Species NAD

Name NAD

SBO:0000247 simple chemical

Initial concentration 1.50329030201531 mmol·l^{-1}

This species takes part in eight reactions (as a reactant in TDH, acetate_branch and as a product in ADH, GPD and as a modifier in ADH, GPD, TDH, acetate_branch).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NAD} = v_1 + v_6 - v_{16} - v_{21} \tag{85}$$

8.14 Species P2G

Name P2G

SBO:0000247 simple chemical

Initial concentration 0.0677379081099344 mmol·l^{-1}

This species takes part in four reactions (as a reactant in ENO and as a product in GPM and as a modifier in ENO, GPM).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{P2G} = v_7 - v_4 \tag{86}$$

8.15 Species P3G

Name P3G

SBO:0000247 simple chemical

Initial concentration 0.469825011134444 mmol·l^{-1}

This species takes part in four reactions (as a reactant in GPM and as a product in PGK and as a modifier in GPM, PGK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{P3G} = v_{13} - v_7 \tag{87}$$

8.16 Species PEP

Name PEP

SBO:0000247 simple chemical

Initial concentration 0.610005413358042 mmol · l^{-1}

This species takes part in four reactions (as a reactant in PYK and as a product in ENO and as a modifier in ENO, PYK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PEP} = v_4 - v_{15} \tag{88}$$

8.17 Species PYR

Name PYR

SBO:0000247 simple chemical

Initial concentration 2.10847140717419 mmol · l^{-1}

This species takes part in four reactions (as a reactant in PDC and as a product in PYK and as a modifier in PDC, PYK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PYR} = v_{15} - v_{10} \tag{89}$$

8.18 Species T6P

Name T6P

SBO:0000247 simple chemical

Initial concentration 0.02 mmol · l^{-1}

This species takes part in five reactions (as a reactant in TPP and as a product in TPS and as a modifier in HXK, HXK, TPP).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{T6P} = v_{19} - v_{18} \tag{90}$$

8.19 Species UDP

Name UDP

SBO:0000247 simple chemical

Initial concentration 0.2815 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{UDP} = v_{19} - v_{22} \tag{91}$$

8.20 Species UTP

Name UTP

SBO:0000247 simple chemical

Initial concentration $0.6491\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{UTP} = v_{22} - v_{20} \tag{92}$$

8.21 Species AMP

Name AMP

SBO:0000247 simple chemical

Initial concentration $0.44\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule AMP

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

8.22 Species NADH

Name NADH

SBO:0000247 simple chemical

Initial concentration $0.0867096979846952\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule NADH

This species takes part in seven reactions (as a reactant in ADH, GPD and as a product in TDH, acetate_branch and as a modifier in ADH, GPD, TDH). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

8.23 Species UDG

Name UDG

SBO:0000247 simple chemical

Initial concentration $0.467246194874247\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule UDG

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

8.24 Species ACE

Name ACE

SBO:0000247 simple chemical

Initial concentration 223.000253398294 $\mathrm{mmol} \cdot \mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ACE} = 0 \tag{93}$$

8.25 Species EtOH

Name EtOH

SBO:0000247 simple chemical

Initial concentration 221.890311417536 $\mathrm{mmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a product in ADH and as a modifier in ADH), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{EtOH} = 0 \tag{94}$$

8.26 Species F26bP

Name F26bP

SBO:0000247 simple chemical

Initial concentration 0.0030 $\mathrm{mmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in PFK, PFK), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{F26bP} = 0 \tag{95}$$

8.27 Species GLCx

Name GLCx

SBO:0000247 simple chemical

Initial concentration 74 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GLCx} = 0 \tag{96}$$

8.28 Species GLY

Name GLY

SBO:0000247 simple chemical

Initial concentration 0.15 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GLY} = 0 \tag{97}$$

8.29 Species SUC

Name SUC

SBO:0000247 simple chemical

Initial concentration 0 mmol · l^{-1}

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SUC} = 0 \tag{98}$$

8.30 Species TRH

Name TRH

SBO:0000247 simple chemical

Initial concentration 0.0153878853696526 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TRH} = 0 \tag{99}$$

8.31 Species ADH1

Name ADH1

SBO:0000252 polypeptide chain

Initial concentration $0.163908510928009\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in ADH, ADH), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ADH1} = 0 \tag{100}$$

8.32 Species CDC19

Name CDC19

SBO:0000252 polypeptide chain

Initial concentration $2.0483901071712\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in PYK, PYK), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CDC19} = 0 \tag{101}$$

8.33 Species ENO1

Name ENO1

SBO:0000252 polypeptide chain

Initial concentration $0.686371954155832\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in ENO, ENO), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ENO1} = 0 \tag{102}$$

8.34 Species ENO2

Name ENO2

SBO:0000252 polypeptide chain

Initial concentration $1.97444629317817\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in ENO, ENO), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ENO2} = 0 \tag{103}$$

8.35 Species FBA1

Name FBA1

SBO:0000252 polypeptide chain

Initial concentration $1.33839465704882\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in FBA, FBA), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{FBA1} = 0 \tag{104}$$

8.36 Species GLK1

Name GLK1

SBO:0000252 polypeptide chain

Initial concentration $0.0450869624419226\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in HXK, HXK), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GLK1} = 0 \tag{105}$$

8.37 Species GPD1

Name GPD1

SBO:0000252 polypeptide chain

Initial concentration $0.00683511177089872\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GPD1} = 0 \tag{106}$$

8.38 Species GPD2

Name GPD2

SBO:0000252 polypeptide chain

Initial concentration $7.93405666424228 \cdot 10^{-4}\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GPD2} = 0 \tag{107}$$

8.39 Species GPM1

Name GPM1

SBO:0000252 polypeptide chain

Initial concentration 0.73000029889707 mmol · l^{-1}

This species takes part in two reactions (as a modifier in GPM, GPM), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GPM1} = 0 \tag{108}$$

8.40 Species HOR2

Name HOR2

SBO:0000252 polypeptide chain

Initial concentration 0.0054734695639756 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{HOR2} = 0 \tag{109}$$

8.41 Species HXK1

Name HXK1

SBO:0000252 polypeptide chain

Initial concentration 0.0167807457149784 mmol · l^{-1}

This species takes part in two reactions (as a modifier in HXK, HXK), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{HXK1} = 0 \tag{110}$$

8.42 Species HXK2

Name HXK2

SBO:0000252 polypeptide chain

Initial concentration 0.0613313539705155 mmol · l^{-1}

This species takes part in two reactions (as a modifier in HXK, HXK), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{HXK2} = 0 \tag{111}$$

8.43 Species PDC1

Name PDC1

SBO:0000252 polypeptide chain

Initial concentration $1.06781077822834\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in PDC, PDC), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PDC1} = 0 \tag{112}$$

8.44 Species PDC5

Name PDC5

SBO:0000252 polypeptide chain

Initial concentration $0.0123547443267676\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in PDC, PDC), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PDC5} = 0 \tag{113}$$

8.45 Species PDC6

Name PDC6

SBO:0000252 polypeptide chain

Initial concentration $0.00654086421106118\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in PDC, PDC), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PDC6} = 0 \tag{114}$$

8.46 Species PFK1

Name PFK1

SBO:0000252 polypeptide chain

Initial concentration $0.0467850299063124\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PFK1} = 0 \tag{115}$$

8.47 Species PFK2

Name PFK2

SBO:0000252 polypeptide chain

Initial concentration 0.0390366215332091 mmol · l^{-1}

This species takes part in two reactions (as a modifier in PFK, PFK), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PFK2} = 0 \tag{116}$$

8.48 Species PGI1

Name PGI1

SBO:0000252 polypeptide chain

Initial concentration 0.1382907072901 mmol · l^{-1}

This species takes part in two reactions (as a modifier in PGI, PGI), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGI1} = 0 \tag{117}$$

8.49 Species PGK1

Name PGK1

SBO:0000252 polypeptide chain

Initial concentration 0.257656912658955 mmol · l^{-1}

This species takes part in two reactions (as a modifier in PGK, PGK), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGK1} = 0 \tag{118}$$

8.50 Species PGM1

Name PGM1

SBO:0000252 polypeptide chain

Initial concentration 0.00326229546307459 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGM1} = 0 \tag{119}$$

8.51 Species PGM2

Name PGM2

SBO:0000252 polypeptide chain

Initial concentration 0.00125868877176552 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGM2} = 0 \tag{120}$$

8.52 Species RHR2

Name RHR2

SBO:0000252 polypeptide chain

Initial concentration 0.0511804773718313 mmol · l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RHR2} = 0 \tag{121}$$

8.53 Species TDH1

Name TDH1

SBO:0000252 polypeptide chain

Initial concentration 0.350864642801396 mmol · l^{-1}

This species takes part in two reactions (as a modifier in TDH, TDH), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TDH1} = 0 \tag{122}$$

8.54 Species TDH3

Name TDH3

SBO:0000252 polypeptide chain

Initial concentration 4.20440474648547 mmol · l^{-1}

This species takes part in two reactions (as a modifier in TDH, TDH), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TDH3} = 0 \tag{123}$$

8.55 Species TPI1

Name TPI1

SBO:0000252 polypeptide chain

Initial concentration 0.294357819645508 mmol $\cdot$ l^{-1}

This species takes part in two reactions (as a modifier in TPI, TPI), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TPI1} = 0 \tag{124}$$

8.56 Species TPS1

Name TPS1

SBO:0000252 polypeptide chain

Initial concentration 0.00339248174237065 mmol $\cdot$ l^{-1}

This species takes part in two reactions (as a modifier in TPP, TPS), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TPS1} = 0 \tag{125}$$

8.57 Species TPS2

Name TPS2

SBO:0000252 polypeptide chain

Initial concentration 0.00265985181347494 mmol $\cdot$ l^{-1}

This species takes part in two reactions (as a modifier in TPP, TPS), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TPS2} = 0 \tag{126}$$

8.58 Species UGP1

Name UGP1

SBO:0000252 polypeptide chain

Initial concentration 0.00620211419860714 mmol $\cdot$ l^{-1}

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{UGP1} = 0 \tag{127}$$

8.59 Species E4P

Name E4P

SBO:0000247 simple chemical

Initial concentration $0.029\ \text{mmol} \cdot \text{l}^{-1}$

This species takes part in eight reactions (as a reactant in TKL_E4P, E4P_sink and as a product in TAL and as a modifier in TAL, TKL_E4P, TKL_R5P, TKL_R5P, E4P_sink).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E4P} = v_{28} - v_{29} - v_{33} \tag{128}$$

8.60 Species G6L

Name G6L

SBO:0000247 simple chemical

Initial concentration $0.1\ \text{mmol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in SOL and as a product in ZWF and as a modifier in SOL, ZWF).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{G6L} = v_{31} - v_{27} \tag{129}$$

8.61 Species NADPH

Name NADPH

SBO:0000247 simple chemical

Initial concentration $0.16\ \text{mmol} \cdot \text{l}^{-1}$

This species takes part in six reactions (as a reactant in NADPH_oxidase and as a product in GND, ZWF and as a modifier in GND, ZWF, NADPH_oxidase).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NADPH} = v_{24} + v_{31} - v_{32} \tag{130}$$

8.62 Species P6G

Name P6G

SBO:0000247 simple chemical

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

This species takes part in four reactions (as a reactant in GND and as a product in SOL and as a modifier in GND, SOL).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{P6G} = v_{27} - v_{24} \tag{131}$$

8.63 Species R5P

Name R5P

SBO:0000247 simple chemical

Initial concentration $0.118\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in eight reactions (as a reactant in TKL_R5P, R5P_sink and as a product in RKI and as a modifier in RKI, TKL_E4P, TKL_E4P, TKL_R5P, R5P_sink).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5P} = v_{25} - v_{30} - v_{34} \tag{132}$$

8.64 Species Ru5P

Name Ru5P

SBO:0000247 simple chemical

Initial concentration $0.033\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in six reactions (as a reactant in RKI, RPE and as a product in GND and as a modifier in GND, RKI, RPE).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ru5P} = v_{24} - v_{25} - v_{26} \tag{133}$$

8.65 Species S7P

Name S7P

SBO:0000247 simple chemical

Initial concentration $0.082\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in six reactions (as a reactant in TAL and as a product in TKL_R5P and as a modifier in TAL, TKL_E4P, TKL_E4P, TKL_R5P).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{S7P} = v_{30} - v_{28} \tag{134}$$

8.66 Species X5P

Name X5P

SBO:0000247 simple chemical

Initial concentration $0.041\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in six reactions (as a reactant in TKL_E4P, TKL_R5P and as a product in RPE and as a modifier in RPE, TKL_E4P, TKL_R5P).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{X5P} = v_{26} - v_{29} - v_{30} \tag{135}$$

8.67 Species NADP

Name NADP

SBO:0000247 simple chemical

Initial concentration $0.17\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

Involved in rule NADP

This species takes part in five reactions (as a reactant in GND, ZWF and as a product in NADPH_oxidase and as a modifier in GND, ZWF). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

8.68 Species GND1

Name GND1

SBO:0000252 polypeptide chain

Initial concentration $0.013\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in GND, GND), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GND1} = 0 \tag{136}$$

8.69 Species GND2

Name GND2

SBO:0000252 polypeptide chain

Initial concentration $0.0030\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in GND, GND), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GND2} = 0 \tag{137}$$

8.70 Species NQM1

Name NQM1

SBO:0000252 polypeptide chain

Initial concentration $0.02\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in TAL, TAL), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NQM1} = 0 \tag{138}$$

8.71 Species RKI1

Name RKI1

SBO:0000252 polypeptide chain

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

This species takes part in two reactions (as a modifier in RKI, RKI), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RKI1} = 0 \tag{139}$$

8.72 Species RPE1

Name RPE1

SBO:0000252 polypeptide chain

Initial concentration $0.03\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in RPE, RPE), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RPE1} = 0 \tag{140}$$

8.73 Species SOL3

Name SOL3

SBO:0000252 polypeptide chain

Initial concentration $0.0296\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in SOL, SOL), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SOL3} = 0 \tag{141}$$

8.74 Species TAL1

Name TAL1

SBO:0000252 polypeptide chain

Initial concentration $0.144\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in TAL, TAL), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TAL1} = 0 \tag{142}$$

8.75 Species TKL1

Name TKL1

SBO:0000252 polypeptide chain

Initial concentration $0.455\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a modifier in TKL_E4P, TKL_E4P, TKL_R5P, TKL_R5P), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TKL1} = 0 \tag{143}$$

8.76 Species ZWF1

Name ZWF1

SBO:0000252 polypeptide chain

Initial concentration $0.02\ \mathrm{mmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a modifier in ZWF, ZWF), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ZWF1} = 0 \tag{144}$$

A Glossary of Systems Biology Ontology Terms

SBO:0000176 biochemical reaction: An event involving one or more chemical entities that modifies the electrochemical structure of at least one of the participants.

SBO:0000185 transport reaction: Movement of a physical entity without modification of the structure of the entity

SBO:0000247 simple chemical: Simple, non-repetitive chemical entity

SBO:0000252 polypeptide chain: Naturally occurring macromolecule formed by the repetition of amino-acid residues linked by peptidic bonds. A polypeptide chain is synthesized by the ribosome. CHEBI:1654

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