SBML Model Report

Model name: "Salcedo-Sora2016 - Microbial folate biosynthesis and utilisation"

February 10, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: J. Enrique Salcedo-Sora[1] and Mark T. McAuley[2] at June 28th 2015 at 2:24 p. m. and last time modified at June 28th 2015 at 2:24 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	1
species types	0	species	51
events	0	constraints	0
reactions	31	function definitions	24
global parameters	0	unit definitions	2
rules	0	initial assignments	0

Model Notes

Salcedo-Sora2016 - Microbial folate biosynthesis and utilisation

This model is described in the article:A mathematical model of microbial folate biosynthesis and utilisation: implications for antifolate development.Enrique Salcedo-Sora J, Mc Auley MT.Mol Biosyst. 2016 Jan 21.

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Abstract:

The metabolic biochemistry of folate biosynthesis and utilisation has evolved into a complex network of reactions. Although this complexity represents challenges to the field of folate research it has also provided a renewed source for antimetabolite targets. A range of improved folate chemotherapy continues to be developed and applied particularly to cancer and chronic inflammatory diseases. However, new or better antifolates against infectious diseases remain much more elusive. In this paper we describe the assembly of a generic deterministic mathematical model of microbial folate metabolism. Our aim is to explore how a mathematical model could be used to explore the dynamics of this inherently complex set of biochemical reactions. Using the model it was found that: (1) a particular small set of folate intermediates are overrepresented, (2) inhibitory profiles can be quantified by the level of key folate products, (3) using the model to scan for the most effective combinatorial inhibitions of folate enzymes we identified specific targets which could complement current antifolates, and (4) the model substantiates the case for a substrate cycle in the folinic acid biosynthesis reaction. Our model is coded in the systems biology markup language and has been deposited in the BioModels Database (MODEL1511020000), this makes it accessible to the community as a whole.

This model is hosted on BioModels Database and identified by: MODEL1511020000.

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

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 time

Name time

Definition 60 s

2.2 Unit substance

Name substance

Definition µmol

2.3 Unit volume

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

Definition l

2.4 Unit `area`

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

Definition m^2

2.5 Unit `length`

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

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

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

3.1 Compartment `compartment`

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

Name compartment

4 Species

This model contains 51 species. The boundary condition of 13 of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 7 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
DAHP	DAHP	compartment	$\mu mol \cdot l^{-1}$	☐	☐
PEP	PEP	compartment	$\mu mol \cdot l^{-1}$	☑	☑
Pi	Pi	compartment	$\mu mol \cdot l^{-1}$	☐	☐
DHQ	DHQ	compartment	$\mu mol \cdot l^{-1}$	☐	☐
EP	EP	compartment	$\mu mol \cdot l^{-1}$	☑	☑
DHSK	DHSK	compartment	$\mu mol \cdot l^{-1}$	☐	☐
SK	SK	compartment	$\mu mol \cdot l^{-1}$	☐	☐
SKP	SKP	compartment	$\mu mol \cdot l^{-1}$	☐	☐
CVPSK	CVPSK	compartment	$\mu mol \cdot l^{-1}$	☐	☐
CM	CM	compartment	$\mu mol \cdot l^{-1}$	☐	☐
Gln	Gln	compartment	$\mu mol \cdot l^{-1}$	☑	☑
Glu	Glu	compartment	$\mu mol \cdot l^{-1}$	☐	☐
ADC	ADC	compartment	$\mu mol \cdot l^{-1}$	☐	☐
Pyr	Pyr	compartment	$\mu mol \cdot l^{-1}$	☐	☐
pABA	pABA	compartment	$\mu mol \cdot l^{-1}$	☐	☐
DHNTP	DHNTP	compartment	$\mu mol \cdot l^{-1}$	☐	☐
GTP	GTP	compartment	$\mu mol \cdot l^{-1}$	☑	☑
AHMDHP	AHMDHP	compartment	$\mu mol \cdot l^{-1}$	☐	☐
HAD	HAD	compartment	$\mu mol \cdot l^{-1}$	☐	☐
PTHP	PTHP	compartment	$\mu mol \cdot l^{-1}$	☐	☐
AHMDPP	AHMDPP	compartment	$\mu mol \cdot l^{-1}$	☐	☐

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
`DHP`	DHP	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`DHF`	DHF	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`THF`	THF	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`THFGlu`	THFGlu	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`Gly`	Gly	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`Ser`	Ser	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`myTHFGlu`	myTHFGlu	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`MTHFGlu`	MTHFGlu	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`Hcy`	Hcy	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`Met`	Met	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`dTMP`	dTMP	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`dUMP`	dUMP	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`meTHFGlu`	meTHFGlu	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`fTHFGlu`	fTHFGlu	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`fmtRNA`	fmtRNA	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`mtRNA`	mtRNA	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`COTwo`	COTwo	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`ADP`	ADP	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`ATP`	ATP	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`NADP`	NADP	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`NADPH`	NADPH	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`AMP`	AMP	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`DLp`	DLp	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`SAmDLp`	SAmDLp	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`Lp`	Lp	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑
`NAD`	NAD	`compartment`	$\mu\text{mol} \cdot l^{-1}$	⊟	⊟
`NADH`	NADH	`compartment`	$\mu\text{mol} \cdot l^{-1}$	☑	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
`Ammonia`	Ammonia	`compartment`	$\mu mol \cdot l^{-1}$	$\boxminus$	$\boxminus$
`Formyl`	Formyl	`compartment`	$\mu mol \cdot l^{-1}$	$\boxminus$	$\boxminus$
`ffTHFGlu`	ffTHFGlu	`compartment`	$\mu mol \cdot l^{-1}$	$\boxminus$	$\boxminus$

5 Function definitions

This is an overview of 24 function definitions.

5.1 Function definition `Henri_Michaelis_Menten__irreversible`

Name Henri-Michaelis-Menten (irreversible)

Arguments substrate, Km, V

Mathematical Expression

$$\frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{1}$$

5.2 Function definition `Rate_Law_for_R1`

Name Rate Law for R1

Notes `Taken from DeLeo et al  1973, JBC 248, 2344-2353`

Arguments vmax, [PEP], [EP], kpep, kep

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{EP}] \cdot [\mathrm{PEP}]}{\mathrm{kpep} \cdot \mathrm{kep} + \mathrm{kpep} \cdot [\mathrm{EP}] + \mathrm{kep} \cdot [\mathrm{PEP}] + [\mathrm{EP}] \cdot [\mathrm{PEP}]} \tag{2}$$

5.3 Function definition `Rate_Law_for_R6`

Name Rate Law for R6

Arguments [PEP], vmax, [SKP], kpep, kskp

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{PEP}] \cdot [\mathrm{SKP}]}{\mathrm{kpep} \cdot \mathrm{kskp} + \mathrm{kpep} \cdot [\mathrm{SKP}] + \mathrm{kskp} \cdot [\mathrm{PEP}] + [\mathrm{SKP}] \cdot [\mathrm{PEP}]} \tag{3}$$

5.4 Function definition `Rate_Law_for_R8`

Name Rate Law for R8

Arguments vmax, [CM], [Gln], kcm, kgln

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{CM}] \cdot [\mathrm{Gln}]}{\mathrm{kcm} \cdot \mathrm{kgln} + \mathrm{kcm} \cdot [\mathrm{Gln}] + \mathrm{kgln} \cdot [\mathrm{CM}] + [\mathrm{CM}] \cdot [\mathrm{Gln}]} \tag{4}$$

5.5 Function definition `Rate_Law_for_R14`

Name Rate Law for R14

Arguments vmax, [DHP], [Glu], kdhp, kglu, [ATP], katp

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{DHP}] \cdot [\mathrm{Glu}] \cdot [\mathrm{ATP}]}{\mathrm{kdhp} \cdot \mathrm{kglu} \cdot \mathrm{katp} + \mathrm{kdhp} \cdot ([\mathrm{Glu}] + [\mathrm{ATP}]) + \mathrm{kglu} \cdot ([\mathrm{DHP}] + [\mathrm{ATP}]) + \mathrm{katp} \cdot ([\mathrm{Glu}] + [\mathrm{ATP}]) + [\mathrm{DHP}] \cdot [\mathrm{Glu}] \cdot [\mathrm{A}} \tag{5}$$

5.6 Function definition `Rate_Law_for_R16`

Name Rate Law for R16

Arguments vmax, [THF], [Glu], kthf, kglu, [ATP], katp, [DHF], kidhf

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{THF}] \cdot [\mathrm{Glu}] \cdot [\mathrm{ATP}]}{\mathrm{kthf} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{kglu} \cdot \mathrm{katp} + \mathrm{kthf} \cdot ([\mathrm{Glu}] + [\mathrm{ATP}]) + \mathrm{kglu} \cdot ([\mathrm{THF}] + [\mathrm{ATP}]) + \mathrm{katp} \cdot ([\mathrm{THF}] + [\mathrm{Glu}]) + [\mathrm{THI}} \tag{6}$$

5.7 Function definition `Rate_Law_for_R17`

Name Rate Law for R17

Arguments vmax, [THFGlu], [Ser], kthfglu, kser, [THF], kithf

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{THFGlu}] \cdot [\mathrm{Ser}]}{\mathrm{kthfglu} \cdot \left(1 + \frac{[\mathrm{THF}]}{\mathrm{kithf}}\right) \cdot \mathrm{kser} + \mathrm{kthfglu} \cdot [\mathrm{Ser}] + \mathrm{kser} \cdot [\mathrm{THFGlu}] + [\mathrm{THFGlu}] \cdot [\mathrm{Ser}]} \tag{7}$$

5.8 Function definition `Rate_Law_for_R18c`

Name Rate Law for R18c

Arguments vmax, [THFGlu], kthfglu, [SAmDLp], ksamdlp

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{THFGlu}] \cdot [\mathrm{SAmDLp}]}{\mathrm{kthfglu} \cdot \mathrm{ksamdlp} + \mathrm{kthfglu} \cdot [\mathrm{SAmDLp}] + \mathrm{ksamdlp} \cdot [\mathrm{THFGlu}] + [\mathrm{THFGlu}] \cdot [\mathrm{SAmDLp}]} \tag{8}$$

5.9 Function definition Rate_Law_for_R20

Name Rate Law for R20

Arguments vmax, [MTHFGlu], [Hcy], kmthfglu, khcy

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{MTHFGlu}] \cdot [\mathrm{Hcy}]}{\mathrm{kmthfglu} \cdot \mathrm{khcy} + \mathrm{kmthfglu} \cdot [\mathrm{Hcy}] + \mathrm{khcy} \cdot [\mathrm{MTHFGlu}] + [\mathrm{MTHFGlu}] \cdot [\mathrm{Hcy}]} \tag{9}$$

5.10 Function definition Rate_Law_for_R21

Name Rate Law for R21

Arguments vmax, [myTHFGlu], [dUMP], kdump, kmythfglu, [DHF], kidhf

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{dUMP}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{kdump} + \mathrm{kmythfglu} \cdot [\mathrm{dUMP}] + \mathrm{kdump} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{dUMP}]} \tag{10}$$

5.11 Function definition Rate_Law_for_R18b

Name Rate Law for R18b

Arguments vmax, [Gly], [DLp], kgly, kdlp

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{Gly}] \cdot [\mathrm{DLp}]}{\mathrm{kgly} \cdot \mathrm{kdlp} + \mathrm{kgly} \cdot [\mathrm{DLp}] + \mathrm{kdlp} \cdot [\mathrm{Gly}] + [\mathrm{Gly}] \cdot [\mathrm{DLp}]} \tag{11}$$

5.12 Function definition Rate_Law_for_R18a

Name Rate Law for R18a

Arguments vmax, [NADH], [Lp], knadh, klp

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{NADH}] \cdot [\mathrm{Lp}]}{\mathrm{knadh} \cdot \mathrm{klp} + \mathrm{knadh} \cdot [\mathrm{Lp}] + \mathrm{klp} \cdot [\mathrm{NADH}] + [\mathrm{NADH}] \cdot [\mathrm{Lp}]} \tag{12}$$

5.13 Function definition Rate_Law_for_R4

Name Rate Law for R4

Arguments vmax, [DHSK], [NADPH], kdhsk, knadph

Mathematical Expression

$$\frac{\text{vmax} \cdot [\text{DHSK}] \cdot [\text{NADPH}]}{\text{kdhsk} \cdot \text{knadph} + \text{kdhsk} \cdot [\text{NADPH}] + \text{knadph} \cdot [\text{DHSK}] + [\text{DHSK}] \cdot [\text{NADPH}]} \quad (13)$$

5.14 Function definition Rate_Law_for_R5

Name Rate Law for R5

Arguments vmax, [SK], [ATP], ksk, katp

Mathematical Expression

$$\frac{\text{vmax} \cdot [\text{SK}] \cdot [\text{ATP}]}{\text{ksk} \cdot \text{katp} + \text{ksk} \cdot [\text{ATP}] + \text{katp} \cdot [\text{SK}] + [\text{SK}] \cdot [\text{ATP}]} \quad (14)$$

5.15 Function definition Rate_Law_for_R12

Name Rate Law for R12

Arguments vmax, [ATP], katp, [AHMDHP], kahmdhp

Mathematical Expression

$$\frac{\text{vmax} \cdot [\text{AHMDHP}] \cdot [\text{ATP}]}{\text{kahmdhp} \cdot \text{katp} + \text{katp} \cdot [\text{AHMDHP}] + \text{kahmdhp} \cdot [\text{ATP}] + [\text{AHMDHP}] \cdot [\text{ATP}]} \quad (15)$$

5.16 Function definition Rate_Law_for_R15

Name Rate Law for R15

Arguments vmax, [DHF], [NADPH], kdhf, knadph

Mathematical Expression

$$\frac{\text{vmax} \cdot [\text{DHF}] \cdot [\text{NADPH}]}{\text{kdhf} \cdot \text{knadph} + \text{kdhf} \cdot [\text{NADPH}] + \text{knadph} \cdot [\text{DHF}] + [\text{DHF}] \cdot [\text{NADPH}]} \quad (16)$$

5.17 Function definition Rate_Law_for_R19

Name Rate Law for R19

Arguments vmax, [myTHFGlu], [NADPH], knadph, kmythfglu, [DHF], kidhf

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{NADPH}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{knadph} + \mathrm{kmythfglu} \cdot [\mathrm{NADPH}] + \mathrm{knadph} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{NADPH}]} \tag{17}$$

5.18 Function definition Rate_Law_for_R22

Name Rate Law for R22

Arguments vmax, [myTHFGlu], [NADP], kmythfglu, knadp, [DHF], kidhf

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{NADP}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{knadp} + \mathrm{kmythfglu} \cdot [\mathrm{NADP}] + \mathrm{knadp} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{NADP}]} \tag{18}$$

5.19 Function definition Rate_Law_for_R25

Name Rate Law for R25

Arguments vmax, [fTHFGlu], [mtRNA], kfthfglu, kmtrna

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{fTHFGlu}] \cdot [\mathrm{mtRNA}]}{\mathrm{kfthfglu} \cdot \mathrm{kmtrna} + \mathrm{kfthfglu} \cdot [\mathrm{mtRNA}] + \mathrm{kmtrna} \cdot [\mathrm{fTHFGlu}] + [\mathrm{fTHFGlu}] \cdot [\mathrm{mtRNA}]} \tag{19}$$

5.20 Function definition Rate_Law_for_R26

Name Rate Law for R26

Arguments vmax, [fTHFGlu], [NADP], kfthfglu, knadp

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{fTHFGlu}] \cdot [\mathrm{NADP}]}{\mathrm{kfthfglu} \cdot \mathrm{knadp} + \mathrm{kfthfglu} \cdot [\mathrm{NADP}] + \mathrm{knadp} \cdot [\mathrm{fTHFGlu}] + [\mathrm{fTHFGlu}] \cdot [\mathrm{NADP}]} \tag{20}$$

5.21 Function definition Rate_Law_for_R13

Name Rate Law for R13

Arguments vmax, kahmdpp, kpaba, [AHMDPP], [pABA]

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{AHMDPP}] \cdot [\mathrm{pABA}]}{\mathrm{kahmdpp} \cdot \mathrm{kpaba} + \mathrm{kpaba} \cdot [\mathrm{AHMDPP}] + \mathrm{kahmdpp} \cdot [\mathrm{pABA}] + [\mathrm{AHMDPP}] \cdot [\mathrm{pABA}]} \tag{21}$$

5.22 Function definition Rate_Law_for_R24

Name Rate Law for R24

Arguments vmax, kthfglu, kformyl, katp, [THFGlu], [Formyl], [ATP]

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{THFGlu}] \cdot [\mathrm{Formyl}] \cdot [\mathrm{ATP}]}{\mathrm{kthfglu} \cdot \mathrm{kformyl} \cdot \mathrm{katp} + \mathrm{kthfglu} \cdot ([\mathrm{Formyl}] + [\mathrm{ATP}]) + \mathrm{kformyl} \cdot ([\mathrm{THFGlu}] + [\mathrm{ATP}]) + \mathrm{katp} \cdot ([\mathrm{Formyl}] + [\mathrm{THF}}\tag{22}$$

5.23 Function definition Rate_Law_for_R10

Name Rate Law for R10

Arguments vmax, [GTP], kgtp, [THF], kiTHF

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{GTP}]}{\mathrm{kgtp} \cdot \left(1 + \frac{[\mathrm{THF}]}{\mathrm{kiTHF}}\right) + [\mathrm{GTP}]} \tag{23}$$

5.24 Function definition Rate_Law_for_R29

Name Rate Law for R29

Arguments vmax, [ATP], [ffTHFGlu], katp, kffthfglu

Mathematical Expression

$$\frac{\mathrm{vmax} \cdot [\mathrm{ATP}] \cdot [\mathrm{ffTHFGlu}]}{\mathrm{katp} \cdot \mathrm{kffthfglu} + \mathrm{katp} \cdot [\mathrm{ffTHFGlu}] + \mathrm{kffthfglu} \cdot [\mathrm{ATP}] + [\mathrm{ATP}] \cdot [\mathrm{ffTHFGlu}]} \tag{24}$$

6 Reactions

This model contains 31 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 4: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	R1	R1	$\mathrm{PEP}+\mathrm{EP}\xrightarrow{\mathrm{PEP,\ EP}}\mathrm{DAHP}+\mathrm{Pi}$	
2	R2	R2	$\mathrm{DAHP}\xrightarrow{\mathrm{DAHP}}\mathrm{DHQ}+\mathrm{Pi}$	
3	R3	R3	$\mathrm{DHQ}\xrightarrow{\mathrm{DHQ}}\mathrm{DHSK}$	
4	R4	R4	$\mathrm{DHSK}+\mathrm{NADPH}\xrightarrow{\mathrm{DHSK,\ NADPH}}\mathrm{SK}+\mathrm{NADP}$	
5	R5	R5	$\mathrm{SK}+\mathrm{ATP}\xrightarrow{\mathrm{SK,\ ATP}}\mathrm{SKP}+\mathrm{ADP}+\mathrm{Pi}$	
6	R6	R6	$\mathrm{SKP}+\mathrm{PEP}\xrightarrow{\mathrm{SKP,\ PEP}}\mathrm{CVPSK}+\mathrm{Pi}$	
7	R7	R7	$\mathrm{CVPSK}\xrightarrow{\mathrm{CVPSK}}\mathrm{CM}+\mathrm{Pi}$	
8	R8	R8	$\mathrm{CM}+\mathrm{Gln}\xrightarrow{\mathrm{CM,\ Gln}}\mathrm{ADC}+\mathrm{Glu}$	
9	R9	R9	$\mathrm{ADC}\xrightarrow{\mathrm{ADC}}\mathrm{pABA}+\mathrm{Pyr}$	
10	R10	R10	$\mathrm{GTP}\xrightarrow{\mathrm{THF,\ GTP,\ THF}}\mathrm{DHNTP}+\mathrm{Formyl}$	
11	R11	R11	$\mathrm{DHNTP}\xrightarrow{\mathrm{DHNTP}}\mathrm{AHMDHP}+\mathrm{HAD}+\mathrm{Pi}$	
12	R27	R27	$\mathrm{DHNTP}\xrightarrow{\mathrm{DHNTP}}\mathrm{PTHP}+\mathrm{Pi}$	
13	R12	R12	$\mathrm{AHMDHP}+\mathrm{ATP}\xrightarrow{\mathrm{AHMDHP,\ ATP}}\mathrm{AHMDPP}+\mathrm{AMP}$	
14	R14	R14	$\mathrm{DHP}+\mathrm{Glu}+\mathrm{ATP}\xrightarrow{\mathrm{DHP,\ Glu,\ ATP}}\mathrm{DHF}+\mathrm{ADP}+\mathrm{Pi}$	
15	R15	R15	$\mathrm{DHF}+\mathrm{NADPH}\xrightarrow{\mathrm{DHF,\ NADPH}}\mathrm{THF}+\mathrm{NADP}$	

№	Id	Name	Reaction Equation	SBO
16	`R16`	R16	$\mathrm{THF} + \mathrm{Glu} + \mathrm{ATP} \xrightarrow{\mathrm{DHF,\ THF,\ Glu,\ ATP,\ DHF}} \mathrm{THFGlu} + \mathrm{ADP} + \mathrm{Pi}$	
17	`R17`	R17	$\mathrm{THFGlu} + \mathrm{Ser} \xrightleftharpoons{\mathrm{THF,\ THFGlu,\ Ser,\ THF}} \mathrm{myTHFGlu} + \mathrm{Gly}$	
18	`R18b`	R18b	$\mathrm{DLp} + \mathrm{Gly} \xrightleftharpoons{\mathrm{DLp,\ Gly}} \mathrm{SAmDLp} + \mathrm{COTwo}$	
19	`R19`	R19	$\mathrm{myTHFGlu} + \mathrm{NADPH} \xrightarrow{\mathrm{DHF,\ myTHFGlu,\ NADPH,\ DHF}} \mathrm{MTHFGlu} + \mathrm{NADP}$	
20	`R20`	R20	$\mathrm{MTHFGlu} + \mathrm{Hcy} \xrightarrow{\mathrm{MTHFGlu,\ Hcy}} \mathrm{THFGlu} + \mathrm{Met}$	
21	`R21`	R21	$\mathrm{myTHFGlu} + \mathrm{dUMP} \xrightarrow{\mathrm{DHF,\ myTHFGlu,\ dUMP,\ DHF}} \mathrm{dTMP} + \mathrm{DHF}$	
22	`R22`	R22	$\mathrm{myTHFGlu} + \mathrm{NADP} \xrightleftharpoons{\mathrm{DHF,\ myTHFGlu,\ NADP,\ DHF}} \mathrm{meTHFGlu} + \mathrm{NADPH}$	
23	`R25`	R25	$\mathrm{fTHFGlu} + \mathrm{mtRNA} \xrightleftharpoons{\mathrm{fTHFGlu,\ mtRNA}} \mathrm{fmtRNA} + \mathrm{THFGlu}$	
24	`R26`	R26	$\mathrm{fTHFGlu} + \mathrm{NADP} \xrightleftharpoons{\mathrm{fTHFGlu,\ NADP}} \mathrm{THFGlu} + \mathrm{COTwo} + \mathrm{NADPH}$	
25	`R18c`	R18c	$\mathrm{THFGlu} + \mathrm{SAmDLp} \xrightleftharpoons{\mathrm{THFGlu,\ SAmDLp}} \mathrm{myTHFGlu} + \mathrm{Lp} + \mathrm{Ammonia}$	
26	`R18a`	R18a	$\mathrm{Lp} + \mathrm{NADH} \xrightleftharpoons{\mathrm{NADH,\ Lp}} \mathrm{DLp} + \mathrm{NAD}$	
27	`R13`	R13	$\mathrm{AHMDPP} + \mathrm{pABA} \xrightarrow{\mathrm{AHMDPP,\ pABA}} \mathrm{DHP} + \mathrm{Pi}$	
28	`R24`	R24	$\mathrm{fTHFGlu} + \mathrm{ADP} + \mathrm{Pi} \xrightleftharpoons{\mathrm{fTHFGlu,\ ADP,\ Pi}} \mathrm{THFGlu} + \mathrm{ATP} + \mathrm{Formyl}$	

№	Id	Name	Reaction Equation	SBO
29	`R23`	R23	$\text{meTHFGlu} \xrightleftharpoons{\text{meTHFGlu, fTHFGlu}} \text{fTHFGlu}$	
30	`R28`	R28	$\text{meTHFGlu} \xrightarrow{\text{meTHFGlu}} \text{ffTHFGlu}$	
31	`R29`	R29	$\text{ATP} + \text{ffTHFGlu} \xrightarrow{\text{ATP, ffTHFGlu}} \text{ADP} + \text{Pi} + \text{meTHFGlu}$	

6.1 Reaction R1

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

Name R1

Reaction equation

$$\mathrm{PEP} + \mathrm{EP} \xrightarrow{\mathrm{PEP},\ \mathrm{EP}} \mathrm{DAHP} + \mathrm{Pi} \tag{25}$$

Reactants

Table 5: Properties of each reactant.

Id	Name	SBO
PEP	PEP	
EP	EP	

Modifiers

Table 6: Properties of each modifier.

Id	Name	SBO
PEP	PEP	
EP	EP	

Products

Table 7: Properties of each product.

Id	Name	SBO
DAHP	DAHP	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R1}\left(\mathrm{vmax}, [\mathrm{PEP}], [\mathrm{EP}], \mathrm{kpep}, \mathrm{kep}\right) \tag{26}$$

$$\text{Rate\_Law\_for\_R1}\left(\text{vmax}, [\text{PEP}], [\text{EP}], \text{kpep}, \text{kep}\right) = \frac{\text{vmax} \cdot [\text{EP}] \cdot [\text{PEP}]}{\text{kpep} \cdot \text{kep} + \text{kpep} \cdot [\text{EP}] + \text{kep} \cdot [\text{PEP}] + [\text{EP}] \cdot [\text{PEP}]} \tag{27}$$

$$\text{Rate\_Law\_for\_R1}\left(\text{vmax}, [\text{PEP}], [\text{EP}], \text{kpep}, \text{kep}\right) = \frac{\text{vmax} \cdot [\text{EP}] \cdot [\text{PEP}]}{\text{kpep} \cdot \text{kep} + \text{kpep} \cdot [\text{EP}] + \text{kep} \cdot [\text{PEP}] + [\text{EP}] \cdot [\text{PEP}]} \tag{28}$$

Table 8: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		578.76		☑
kpep	kpep		36.00		☑
kep	kep		285.00		☑

6.2 Reaction R2

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

Name R2

Reaction equation

$$\text{DAHP} \xrightarrow{\text{DAHP}} \text{DHQ} + \text{Pi} \tag{29}$$

Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
DAHP	DAHP	

Modifier

Table 10: Properties of each modifier.

Id	Name	SBO
DAHP	DAHP	

Products

Table 11: Properties of each product.

Id	Name	SBO
DHQ	DHQ	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\left[\mathrm{DAHP}\right], \mathrm{Km}, \mathrm{V}\right) \tag{30}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{31}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{32}$$

Table 12: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km		4.700		☑
V	V		7.462		☑

6.3 Reaction R3

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

Name R3

Reaction equation

$$\mathrm{DHQ} \xrightarrow{\mathrm{DHQ}} \mathrm{DHSK} \tag{33}$$

Reactant

Table 13: Properties of each reactant.

Id	Name	SBO
DHQ	DHQ	

Modifier

Table 14: Properties of each modifier.

Id	Name	SBO
DHQ	DHQ	

Product

Table 15: Properties of each product.

Id	Name	SBO
DHSK	DHSK	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left([\mathrm{DHQ}], \mathrm{Km}, \mathrm{V}\right) \tag{34}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{35}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{36}$$

Table 16: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km		58.00		☑
V	V		116.48		☑

6.4 Reaction R4

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

Name R4

Reaction equation

$$\text{DHSK} + \text{NADPH} \xrightarrow{\text{DHSK, NADPH}} \text{SK} + \text{NADP} \quad (37)$$

Reactants

Table 17: Properties of each reactant.

Id	Name	SBO
DHSK	DHSK	
NADPH	NADPH	

Modifiers

Table 18: Properties of each modifier.

Id	Name	SBO
DHSK	DHSK	
NADPH	NADPH	

Products

Table 19: Properties of each product.

Id	Name	SBO
SK	SK	
NADP	NADP	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{vol}(\text{compartment}) \cdot \text{Rate\_Law\_for\_R4}(\text{vmax}, [\text{DHSK}], [\text{NADPH}], \text{kdhsk}, \text{knadph}) \quad (38)$$

$$\text{Rate\_Law\_for\_R4}\left(\text{vmax}, [\text{DHSK}], [\text{NADPH}], \text{kdhsk}, \text{knadph}\right) = \frac{\text{vmax} \cdot [\text{DHSK}] \cdot [\text{NADPH}]}{\text{kdhsk} \cdot \text{knadph} + \text{kdhsk} \cdot [\text{NADPH}] + \text{knadph} \cdot [\text{DHSK}] + [\text{DHSK}] \cdot [\text{NADPH}]} \quad (39)$$

$$\text{Rate\_Law\_for\_R4}\left(\text{vmax}, [\text{DHSK}], [\text{NADPH}], \text{kdhsk}, \text{knadph}\right) = \frac{\text{vmax} \cdot [\text{DHSK}] \cdot [\text{NADPH}]}{\text{kdhsk} \cdot \text{knadph} + \text{kdhsk} \cdot [\text{NADPH}] + \text{knadph} \cdot [\text{DHSK}] + [\text{DHSK}] \cdot [\text{NADPH}]} \quad (40)$$

Table 20: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		17290.0		☑
kdhsk	kdhsk		30.0		☑
knadph	knadph		11.0		☑

6.5 Reaction R5

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

Name R5

Reaction equation

$$\text{SK} + \text{ATP} \xrightarrow{\text{SK, ATP}} \text{SKP} + \text{ADP} + \text{Pi} \quad (41)$$

Reactants

Table 21: Properties of each reactant.

Id	Name	SBO
SK	SK	
ATP	ATP	

Modifiers

Table 22: Properties of each modifier.

Id	Name	SBO
SK	SK	
ATP	ATP	

Products

Table 23: Properties of each product.

Id	Name	SBO
SKP	SKP	
ADP	ADP	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R5}\left(\mathrm{vmax}, [\mathrm{SK}], [\mathrm{ATP}], \mathrm{ksk}, \mathrm{katp}\right) \tag{42}$$

$$\begin{aligned}&\mathrm{Rate\_Law\_for\_R5}\left(\mathrm{vmax}, [\mathrm{SK}], [\mathrm{ATP}], \mathrm{ksk}, \mathrm{katp}\right)\\&= \frac{\mathrm{vmax} \cdot [\mathrm{SK}] \cdot [\mathrm{ATP}]}{\mathrm{ksk} \cdot \mathrm{katp} + \mathrm{ksk} \cdot [\mathrm{ATP}] + \mathrm{katp} \cdot [\mathrm{SK}] + [\mathrm{SK}] \cdot [\mathrm{ATP}]}\end{aligned} \tag{43}$$

$$\begin{aligned}&\mathrm{Rate\_Law\_for\_R5}\left(\mathrm{vmax}, [\mathrm{SK}], [\mathrm{ATP}], \mathrm{ksk}, \mathrm{katp}\right)\\&= \frac{\mathrm{vmax} \cdot [\mathrm{SK}] \cdot [\mathrm{ATP}]}{\mathrm{ksk} \cdot \mathrm{katp} + \mathrm{ksk} \cdot [\mathrm{ATP}] + \mathrm{katp} \cdot [\mathrm{SK}] + [\mathrm{SK}] \cdot [\mathrm{ATP}]}\end{aligned} \tag{44}$$

Table 24: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		18200.0		☑
ksk	ksk		200.0		☑
katp	katp		151.5		☑

6.6 Reaction R6

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

Name R6

Reaction equation

$$\text{SKP} + \text{PEP} \xrightarrow{\text{SKP, PEP}} \text{CVPSK} + \text{Pi} \tag{45}$$

Reactants

Table 25: Properties of each reactant.

Id	Name	SBO
SKP	SKP	
PEP	PEP	

Modifiers

Table 26: Properties of each modifier.

Id	Name	SBO
SKP	SKP	
PEP	PEP	

Products

Table 27: Properties of each product.

Id	Name	SBO
CVPSK	CVPSK	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \text{vol}(\text{compartment}) \cdot \text{Rate\_Law\_for\_R6}([\text{SKP}], \text{vmax}, [\text{PEP}], \text{kpep}, \text{kskp}) \tag{46}$$

$$\begin{aligned}&\mathrm{Rate\_Law\_for\_R6}\left([\mathrm{PEP}],\mathrm{vmax},[\mathrm{SKP}],\mathrm{kpep},\mathrm{kskp}\right)\\&=\frac{\mathrm{vmax}\cdot[\mathrm{PEP}]\cdot[\mathrm{SKP}]}{\mathrm{kpep}\cdot\mathrm{kskp}+\mathrm{kpep}\cdot[\mathrm{SKP}]+\mathrm{kskp}\cdot[\mathrm{PEP}]+[\mathrm{SKP}]\cdot[\mathrm{PEP}]}\end{aligned}\tag{47}$$

$$\begin{aligned}&\mathrm{Rate\_Law\_for\_R6}\left([\mathrm{PEP}],\mathrm{vmax},[\mathrm{SKP}],\mathrm{kpep},\mathrm{kskp}\right)\\&=\frac{\mathrm{vmax}\cdot[\mathrm{PEP}]\cdot[\mathrm{SKP}]}{\mathrm{kpep}\cdot\mathrm{kskp}+\mathrm{kpep}\cdot[\mathrm{SKP}]+\mathrm{kskp}\cdot[\mathrm{PEP}]+[\mathrm{SKP}]\cdot[\mathrm{PEP}]}\end{aligned}\tag{48}$$

Table 28: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		1547.0		☑
kpep	kpep		93.0		☑
kskp	kskp		80.0		☑

6.7 Reaction R7

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

Name R7

Reaction equation

$$\mathrm{CVPSK}\xrightarrow{\mathrm{CVPSK}}\mathrm{CM}+\mathrm{Pi}\tag{49}$$

Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
CVPSK	CVPSK	

Modifier

Table 30: Properties of each modifier.

Id	Name	SBO
CVPSK	CVPSK	

Products

Table 31: Properties of each product.

Id	Name	SBO
CM	CM	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\left[\mathrm{CVPSK}\right], \mathrm{Km}, \mathrm{V}\right) \quad (50)$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \quad (51)$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \quad (52)$$

Table 32: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km		12.7		☑
V	V		728.0		☑

6.8 Reaction R8

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

Name R8

Reaction equation

$$\mathrm{CM} + \mathrm{Gln} \xrightarrow{\mathrm{CM},\, \mathrm{Gln}} \mathrm{ADC} + \mathrm{Glu} \quad (53)$$

Reactants

Table 33: Properties of each reactant.

Id	Name	SBO
CM	CM	
Gln	Gln	

Modifiers

Table 34: Properties of each modifier.

Id	Name	SBO
CM	CM	
Gln	Gln	

Products

Table 35: Properties of each product.

Id	Name	SBO
ADC	ADC	
Glu	Glu	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R8}\left(\mathrm{vmax}, [\mathrm{CM}], [\mathrm{Gln}], \mathrm{kcm}, \mathrm{kgln}\right) \tag{54}$$

$$\begin{aligned} &\mathrm{Rate\_Law\_for\_R8}\left(\mathrm{vmax}, [\mathrm{CM}], [\mathrm{Gln}], \mathrm{kcm}, \mathrm{kgln}\right) \\ &= \frac{\mathrm{vmax} \cdot [\mathrm{CM}] \cdot [\mathrm{Gln}]}{\mathrm{kcm} \cdot \mathrm{kgln} + \mathrm{kcm} \cdot [\mathrm{Gln}] + \mathrm{kgln} \cdot [\mathrm{CM}] + [\mathrm{CM}] \cdot [\mathrm{Gln}]} \end{aligned} \tag{55}$$

$$\begin{aligned} &\mathrm{Rate\_Law\_for\_R8}\left(\mathrm{vmax}, [\mathrm{CM}], [\mathrm{Gln}], \mathrm{kcm}, \mathrm{kgln}\right) \\ &= \frac{\mathrm{vmax} \cdot [\mathrm{CM}] \cdot [\mathrm{Gln}]}{\mathrm{kcm} \cdot \mathrm{kgln} + \mathrm{kcm} \cdot [\mathrm{Gln}] + \mathrm{kgln} \cdot [\mathrm{CM}] + [\mathrm{CM}] \cdot [\mathrm{Gln}]} \end{aligned} \tag{56}$$

Table 36: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		26.0		☑
kcm	kcm		13.0		☑
kgln	kgln		1100.0		☑

6.9 Reaction R9

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

Name R9

Reaction equation

$$\mathrm{ADC} \xrightarrow{\mathrm{ADC}} \mathrm{pABA} + \mathrm{Pyr} \tag{57}$$

Reactant

Table 37: Properties of each reactant.

Id	Name	SBO
ADC	ADC	

Modifier

Table 38: Properties of each modifier.

Id	Name	SBO
ADC	ADC	

Products

Table 39: Properties of each product.

Id	Name	SBO
pABA	pABA	
Pyr	Pyr	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\left[\mathrm{ADC}\right], \mathrm{Km}, \mathrm{V}\right) \tag{58}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{59}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{60}$$

Table 40: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km		1.1		☑
V	V		2.2		☑

6.10 Reaction R10

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

Name R10

Reaction equation

$$\mathrm{GTP} \xrightarrow{\mathrm{THF,\ GTP,\ THF}} \mathrm{DHNTP} + \mathrm{Formyl} \tag{61}$$

Reactant

Table 41: Properties of each reactant.

Id	Name	SBO
GTP	GTP	

Modifiers

Table 42: Properties of each modifier.

Id	Name	SBO
THF	THF	
GTP	GTP	
THF	THF	

Products

Table 43: Properties of each product.

Id	Name	SBO
DHNTP	DHNTP	
Formyl	Formyl	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R10}\left(\mathrm{vmax}, [\mathrm{GTP}], \mathrm{kgtp}, [\mathrm{THF}], \mathrm{kiTHF}\right) \tag{62}$$

$$\mathrm{Rate\_Law\_for\_R10}\left(\mathrm{vmax}, [\mathrm{GTP}], \mathrm{kgtp}, [\mathrm{THF}], \mathrm{kiTHF}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{GTP}]}{\mathrm{kgtp} \cdot \left(1 + \frac{[\mathrm{THF}]}{\mathrm{kiTHF}}\right) + [\mathrm{GTP}]} \tag{63}$$

$$\mathrm{Rate\_Law\_for\_R10}\left(\mathrm{vmax}, [\mathrm{GTP}], \mathrm{kgtp}, [\mathrm{THF}], \mathrm{kiTHF}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{GTP}]}{\mathrm{kgtp} \cdot \left(1 + \frac{[\mathrm{THF}]}{\mathrm{kiTHF}}\right) + [\mathrm{GTP}]} \tag{64}$$

Table 44: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		1515.150		☑
kgtp	kgtp		17.600		☑
kiTHF	kiTHF		0.157		☑

6.11 Reaction R11

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

Name R11

Reaction equation

$$\mathrm{DHNTP} \xrightarrow{\mathrm{DHNTP}} \mathrm{AHMDHP} + \mathrm{HAD} + \mathrm{Pi} \tag{65}$$

Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
DHNTP	DHNTP	

Modifier

Table 46: Properties of each modifier.

Id	Name	SBO
DHNTP	DHNTP	

Products

Table 47: Properties of each product.

Id	Name	SBO
AHMDHP	AHMDHP	
HAD	HAD	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left([\mathrm{DHNTP}], \mathrm{Km}, \mathrm{V}\right) \tag{66}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{67}$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{68}$$

Table 48: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km		7.400		☑
V	V		792.064		☑

6.12 Reaction R27

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

Name R27

Reaction equation

$$\mathrm{DHNTP} \xrightarrow{\mathrm{DHNTP}} \mathrm{PTHP} + \mathrm{Pi} \tag{69}$$

Reactant

Table 49: Properties of each reactant.

Id	Name	SBO
DHNTP	DHNTP	

Modifier

Table 50: Properties of each modifier.

Id	Name	SBO
DHNTP	DHNTP	

Products

Table 51: Properties of each product.

Id	Name	SBO
PTHP	PTHP	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left([\mathrm{DHNTP}], \mathrm{Km}, \mathrm{V}\right) \quad (70)$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \quad (71)$$

$$\mathrm{Henri\_Michaelis\_Menten\_\_irreversible}\left(\mathrm{substrate}, \mathrm{Km}, \mathrm{V}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \quad (72)$$

Table 52: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km		10.000		☑
V	V		22.659		☑

6.13 Reaction R12

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

Name R12

Reaction equation

$$\mathrm{AHMDHP} + \mathrm{ATP} \xrightarrow{\mathrm{AHMDHP},\ \mathrm{ATP}} \mathrm{AHMDPP} + \mathrm{AMP} \quad (73)$$

Reactants

Table 53: Properties of each reactant.

Id	Name	SBO
AHMDHP	AHMDHP	
ATP	ATP	

Modifiers

Table 54: Properties of each modifier.

Id	Name	SBO
AHMDHP	AHMDHP	
ATP	ATP	

Products

Table 55: Properties of each product.

Id	Name	SBO
AHMDPP	AHMDPP	
AMP	AMP	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R12}\left(\mathrm{vmax}, [\mathrm{AHMDHP}], \mathrm{katp}, [\mathrm{ATP}], \mathrm{kahmdhp}\right) \quad (74)$$

$$\mathrm{Rate\_Law\_for\_R12}\left(\mathrm{vmax}, [\mathrm{ATP}], \mathrm{katp}, [\mathrm{AHMDHP}], \mathrm{kahmdhp}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{AHMDHP}] \cdot [\mathrm{ATP}]}{\mathrm{kahmdhp} \cdot \mathrm{katp} + \mathrm{katp} \cdot [\mathrm{AHMDHP}] + \mathrm{kahmdhp} \cdot [\mathrm{ATP}] + [\mathrm{AHMDHP}] \cdot [\mathrm{ATP}]} \quad (75)$$

$$\mathrm{Rate\_Law\_for\_R12}\left(\mathrm{vmax}, [\mathrm{ATP}], \mathrm{katp}, [\mathrm{AHMDHP}], \mathrm{kahmdhp}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{AHMDHP}] \cdot [\mathrm{ATP}]}{\mathrm{kahmdhp} \cdot \mathrm{katp} + \mathrm{katp} \cdot [\mathrm{AHMDHP}] + \mathrm{kahmdhp} \cdot [\mathrm{ATP}] + [\mathrm{AHMDHP}] \cdot [\mathrm{ATP}]} \quad (76)$$

Table 56: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		382.2		☑
katp	katp		15.0		☑
kahmdhp	kahmdhp		3.6		☑

6.14 Reaction R14

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

Name R14

Reaction equation

$$\mathrm{DHP} + \mathrm{Glu} + \mathrm{ATP} \xrightarrow{\mathrm{DHP},\ \mathrm{Glu},\ \mathrm{ATP}} \mathrm{DHF} + \mathrm{ADP} + \mathrm{Pi} \quad (77)$$

Reactants

Table 57: Properties of each reactant.

Id	Name	SBO
`DHP`	DHP	
`Glu`	Glu	
`ATP`	ATP	

Modifiers

Table 58: Properties of each modifier.

Id	Name	SBO
`DHP`	DHP	
`Glu`	Glu	
`ATP`	ATP	

Products

Table 59: Properties of each product.

Id	Name	SBO
`DHF`	DHF	
`ADP`	ADP	
`Pi`	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R14}\left(\mathrm{vmax}, [\mathrm{DHP}], [\mathrm{Glu}], \mathrm{kdhp}, \mathrm{kglu}, [\mathrm{ATP}], \mathrm{katp}\right) \quad (78)$$

$$\mathrm{Rate\_Law\_for\_R14}\left(\mathrm{vmax}, [\mathrm{DHP}], [\mathrm{Glu}], \mathrm{kdhp}, \mathrm{kglu}, [\mathrm{ATP}], \mathrm{katp}\right) \quad (79)$$
$$= \frac{\mathrm{vmax} \cdot [\mathrm{DHP}] \cdot [\mathrm{Glu}] \cdot [\mathrm{ATP}]}{\mathrm{kdhp} \cdot \mathrm{kglu} \cdot \mathrm{katp} + \mathrm{kdhp} \cdot ([\mathrm{Glu}] + [\mathrm{ATP}]) + \mathrm{kglu} \cdot ([\mathrm{DHP}] + [\mathrm{ATP}]) + \mathrm{katp} \cdot ([\mathrm{Glu}] + [\mathrm{ATP}]) + [\mathrm{DHP}] \cdot [\mathrm{Glu}] \cdot [}$$

$$\mathrm{Rate\_Law\_for\_R14}\left(\mathrm{vmax}, [\mathrm{DHP}], [\mathrm{Glu}], \mathrm{kdhp}, \mathrm{kglu}, [\mathrm{ATP}], \mathrm{katp}\right) \quad (80)$$
$$= \frac{\mathrm{vmax} \cdot [\mathrm{DHP}] \cdot [\mathrm{Glu}] \cdot [\mathrm{ATP}]}{\mathrm{kdhp} \cdot \mathrm{kglu} \cdot \mathrm{katp} + \mathrm{kdhp} \cdot ([\mathrm{Glu}] + [\mathrm{ATP}]) + \mathrm{kglu} \cdot ([\mathrm{DHP}] + [\mathrm{ATP}]) + \mathrm{katp} \cdot ([\mathrm{Glu}] + [\mathrm{ATP}]) + [\mathrm{DHP}] \cdot [\mathrm{Glu}] \cdot [}$$

Table 60: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		2.821		☑
kdhp	kdhp		1.000		☑
kglu	kglu		1380.000		☑
katp	katp		100.000		☑

6.15 Reaction R15

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

Name R15

Reaction equation

$$\mathrm{DHF} + \mathrm{NADPH} \xrightarrow{\mathrm{DHF},\ \mathrm{NADPH}} \mathrm{THF} + \mathrm{NADP} \tag{81}$$

Reactants

Table 61: Properties of each reactant.

Id	Name	SBO
DHF	DHF	
NADPH	NADPH	

Modifiers

Table 62: Properties of each modifier.

Id	Name	SBO
DHF	DHF	
NADPH	NADPH	

Products

Table 63: Properties of each product.

Id	Name	SBO
THF	THF	

Id	Name	SBO
NADP	NADP	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R15}\left(\mathrm{vmax}, [\mathrm{DHF}], [\mathrm{NADPH}], \mathrm{kdhf}, \mathrm{knadph}\right) \quad (82)$$

$$\mathrm{Rate\_Law\_for\_R15}\left(\mathrm{vmax}, [\mathrm{DHF}], [\mathrm{NADPH}], \mathrm{kdhf}, \mathrm{knadph}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{DHF}] \cdot [\mathrm{NADPH}]}{\mathrm{kdhf} \cdot \mathrm{knadph} + \mathrm{kdhf} \cdot [\mathrm{NADPH}] + \mathrm{knadph} \cdot [\mathrm{DHF}] + [\mathrm{DHF}] \cdot [\mathrm{NADPH}]} \quad (83)$$

$$\mathrm{Rate\_Law\_for\_R15}\left(\mathrm{vmax}, [\mathrm{DHF}], [\mathrm{NADPH}], \mathrm{kdhf}, \mathrm{knadph}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{DHF}] \cdot [\mathrm{NADPH}]}{\mathrm{kdhf} \cdot \mathrm{knadph} + \mathrm{kdhf} \cdot [\mathrm{NADPH}] + \mathrm{knadph} \cdot [\mathrm{DHF}] + [\mathrm{DHF}] \cdot [\mathrm{NADPH}]} \quad (84)$$

Table 64: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		3000.00		☑
kdhf	kdhf		3.00		☑
knadph	knadph		6.12		☑

6.16 Reaction R16

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

Name R16

Reaction equation

$$\mathrm{THF} + \mathrm{Glu} + \mathrm{ATP} \xrightarrow{\mathrm{DHF, THF, Glu, ATP, DHF}} \mathrm{THFGlu} + \mathrm{ADP} + \mathrm{Pi} \quad (85)$$

Reactants

Table 65: Properties of each reactant.

Id	Name	SBO
THF	THF	
Glu	Glu	
ATP	ATP	

Modifiers

Table 66: Properties of each modifier.

Id	Name	SBO
DHF	DHF	
THF	THF	
Glu	Glu	
ATP	ATP	
DHF	DHF	

Products

Table 67: Properties of each product.

Id	Name	SBO
THFGlu	THFGlu	
ADP	ADP	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R16}\left(\mathrm{vmax}, [\mathrm{THF}], [\mathrm{Glu}], \mathrm{kthf}, \mathrm{kglu}, [\mathrm{ATP}], \mathrm{katp}, [\mathrm{DHF}], \mathrm{kidhf}\right) \tag{86}$$

$$\mathrm{Rate\_Law\_for\_R16}\left(\mathrm{vmax}, [\mathrm{THF}], [\mathrm{Glu}], \mathrm{kthf}, \mathrm{kglu}, [\mathrm{ATP}], \mathrm{katp}, [\mathrm{DHF}], \mathrm{kidhf}\right) \tag{87}$$
$$= \frac{\mathrm{vmax} \cdot [\mathrm{THF}] \cdot [\mathrm{Glu}] \cdot [\mathrm{ATP}]}{\mathrm{kthf} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{kglu} \cdot \mathrm{katp} + \mathrm{kthf} \cdot \left([\mathrm{Glu}] + [\mathrm{ATP}]\right) + \mathrm{kglu} \cdot \left([\mathrm{THF}] + [\mathrm{ATP}]\right) + \mathrm{katp} \cdot \left([\mathrm{THF}] + [\mathrm{Glu}]\right) + [\mathrm{TH}}$$

$$\mathrm{Rate\_Law\_for\_R16}\left(\mathrm{vmax}, [\mathrm{THF}], [\mathrm{Glu}], \mathrm{kthf}, \mathrm{kglu}, [\mathrm{ATP}], \mathrm{katp}, [\mathrm{DHF}], \mathrm{kidhf}\right) \tag{88}$$
$$= \frac{\mathrm{vmax} \cdot [\mathrm{THF}] \cdot [\mathrm{Glu}] \cdot [\mathrm{ATP}]}{\mathrm{kthf} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{kglu} \cdot \mathrm{katp} + \mathrm{kthf} \cdot \left([\mathrm{Glu}] + [\mathrm{ATP}]\right) + \mathrm{kglu} \cdot \left([\mathrm{THF}] + [\mathrm{ATP}]\right) + \mathrm{katp} \cdot \left([\mathrm{THF}] + [\mathrm{Glu}]\right) + [\mathrm{TH}}$$

Table 68: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		84.63		☑
kthf	kthf		26.00		☑
kglu	kglu		740.00		☑
katp	katp		128.00		☑
kidhf	kidhf		3.10		☑

6.17 Reaction R17

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

Name R17

Reaction equation

$$\mathrm{THFGlu} + \mathrm{Ser} \xrightleftharpoons[]{\mathrm{THF,\ THFGlu,\ Ser,\ THF}} \mathrm{myTHFGlu} + \mathrm{Gly} \tag{89}$$

Reactants

Table 69: Properties of each reactant.

Id	Name	SBO
THFGlu	THFGlu	
Ser	Ser	

Modifiers

Table 70: Properties of each modifier.

Id	Name	SBO
THF	THF	
THFGlu	THFGlu	
Ser	Ser	
THF	THF	

Products

Table 71: Properties of each product.

Id	Name	SBO
myTHFGlu	myTHFGlu	
Gly	Gly	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R17}\left(\mathrm{vmax}, [\mathrm{THFGlu}], [\mathrm{Ser}], \mathrm{kthfglu}, \mathrm{kser}, [\mathrm{THF}], \mathrm{kithf}\right) \tag{90}$$

$$\mathrm{Rate\_Law\_for\_R17}\left(\mathrm{vmax}, [\mathrm{THFGlu}], [\mathrm{Ser}], \mathrm{kthfglu}, \mathrm{kser}, [\mathrm{THF}], \mathrm{kithf}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{THFGlu}] \cdot [\mathrm{Ser}]}{\mathrm{kthfglu} \cdot \left(1 + \frac{[\mathrm{THF}]}{\mathrm{kithf}}\right) \cdot \mathrm{kser} + \mathrm{kthfglu} \cdot [\mathrm{Ser}] + \mathrm{kser} \cdot [\mathrm{THFGlu}] + [\mathrm{THFGlu}] \cdot [\mathrm{Ser}]} \tag{91}$$

$$\mathrm{Rate\_Law\_for\_R17}\left(\mathrm{vmax}, [\mathrm{THFGlu}], [\mathrm{Ser}], \mathrm{kthfglu}, \mathrm{kser}, [\mathrm{THF}], \mathrm{kithf}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{THFGlu}] \cdot [\mathrm{Ser}]}{\mathrm{kthfglu} \cdot \left(1 + \frac{[\mathrm{THF}]}{\mathrm{kithf}}\right) \cdot \mathrm{kser} + \mathrm{kthfglu} \cdot [\mathrm{Ser}] + \mathrm{kser} \cdot [\mathrm{THFGlu}] + [\mathrm{THFGlu}] \cdot [\mathrm{Ser}]} \tag{92}$$

Table 72: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		682.500		☑
kthfglu	kthfglu		40.000		☑
kser	kser		700.000		☑
kithf	kithf		0.157		☑

6.18 Reaction R18b

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

Name R18b

Reaction equation

$$\mathrm{DLp} + \mathrm{Gly} \xrightleftharpoons{\mathrm{DLp,\ Gly}} \mathrm{SAmDLp} + \mathrm{COTwo} \tag{93}$$

Reactants

Table 73: Properties of each reactant.

Id	Name	SBO
DLp	DLp	
Gly	Gly	

Modifiers

Table 74: Properties of each modifier.

Id	Name	SBO
DLp	DLp	
Gly	Gly	

Products

Table 75: Properties of each product.

Id	Name	SBO
SAmDLp	SAmDLp	
COTwo	COTwo	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R18b}\left(\mathrm{vmax}, [\mathrm{DLp}], [\mathrm{Gly}], \mathrm{kgly}, \mathrm{kdlp}\right) \tag{94}$$

$$\begin{aligned} &\mathrm{Rate\_Law\_for\_R18b}\left(\mathrm{vmax}, [\mathrm{Gly}], [\mathrm{DLp}], \mathrm{kgly}, \mathrm{kdlp}\right) \\ &= \frac{\mathrm{vmax} \cdot [\mathrm{Gly}] \cdot [\mathrm{DLp}]}{\mathrm{kgly} \cdot \mathrm{kdlp} + \mathrm{kgly} \cdot [\mathrm{DLp}] + \mathrm{kdlp} \cdot [\mathrm{Gly}] + [\mathrm{Gly}] \cdot [\mathrm{DLp}]} \end{aligned} \tag{95}$$

$$\begin{aligned} &\mathrm{Rate\_Law\_for\_R18b}\left(\mathrm{vmax}, [\mathrm{Gly}], [\mathrm{DLp}], \mathrm{kgly}, \mathrm{kdlp}\right) \\ &= \frac{\mathrm{vmax} \cdot [\mathrm{Gly}] \cdot [\mathrm{DLp}]}{\mathrm{kgly} \cdot \mathrm{kdlp} + \mathrm{kgly} \cdot [\mathrm{DLp}] + \mathrm{kdlp} \cdot [\mathrm{Gly}] + [\mathrm{Gly}] \cdot [\mathrm{DLp}]} \end{aligned} \tag{96}$$

Table 76: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		751.66		☑
kgly	kgly		4505.00		☑
kdlp	kdlp		290.00		☑

6.19 Reaction R19

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

Name R19

Reaction equation

$$\mathrm{myTHFGlu} + \mathrm{NADPH} \xrightarrow{\mathrm{DHF,\ myTHFGlu,\ NADPH,\ DHF}} \mathrm{MTHFGlu} + \mathrm{NADP} \qquad (97)$$

Reactants

Table 77: Properties of each reactant.

Id	Name	SBO
myTHFGlu	myTHFGlu	
NADPH	NADPH	

Modifiers

Table 78: Properties of each modifier.

Id	Name	SBO
DHF	DHF	
myTHFGlu	myTHFGlu	
NADPH	NADPH	
DHF	DHF	

Products

Table 79: Properties of each product.

Id	Name	SBO
MTHFGlu	MTHFGlu	
NADP	NADP	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R19}\left(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{NADPH}], \mathrm{knadph}, \mathrm{kmythfglu}, [\mathrm{DHF}], \mathrm{kidhf}\right) \quad (98)$$

$$\mathrm{Rate\_Law\_for\_R19}\left(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{NADPH}], \mathrm{knadph}, \mathrm{kmythfglu}, [\mathrm{DHF}], \mathrm{kidhf}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{NADPH}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{knadph} + \mathrm{kmythfglu} \cdot [\mathrm{NADPH}] + \mathrm{knadph} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{NADPH}]} \quad (99)$$

$$\mathrm{Rate\_Law\_for\_R19}\left(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{NADPH}], \mathrm{knadph}, \mathrm{kmythfglu}, [\mathrm{DHF}], \mathrm{kidhf}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{NADPH}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{knadph} + \mathrm{kmythfglu} \cdot [\mathrm{NADPH}] + \mathrm{knadph} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{NADPH}]} \quad (100)$$

Table 80: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		738.920		☑
knadph	knadph		19.000		☑
kmythfglu	kmythfglu		33.000		☑
kidhf	kidhf		0.428		☑

6.20 Reaction R20

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

Name R20

Reaction equation

$$\mathrm{MTHFGlu} + \mathrm{Hcy} \xrightarrow{\mathrm{MTHFGlu},\ \mathrm{Hcy}} \mathrm{THFGlu} + \mathrm{Met} \quad (101)$$

Reactants

Table 81: Properties of each reactant.

Id	Name	SBO
MTHFGlu	MTHFGlu	
Hcy	Hcy	

Modifiers

Table 82: Properties of each modifier.

Id	Name	SBO
MTHFGlu	MTHFGlu	
Hcy	Hcy	

Products

Table 83: Properties of each product.

Id	Name	SBO
THFGlu	THFGlu	
Met	Met	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R20}\left(\mathrm{vmax}, [\mathrm{MTHFGlu}], [\mathrm{Hcy}], \mathrm{kmthfglu}, \mathrm{khcy}\right) \tag{102}$$

$$\begin{split}&\mathrm{Rate\_Law\_for\_R20}\left(\mathrm{vmax}, [\mathrm{MTHFGlu}], [\mathrm{Hcy}], \mathrm{kmthfglu}, \mathrm{khcy}\right)\\ &= \frac{\mathrm{vmax} \cdot [\mathrm{MTHFGlu}] \cdot [\mathrm{Hcy}]}{\mathrm{kmthfglu} \cdot \mathrm{khcy} + \mathrm{kmthfglu} \cdot [\mathrm{Hcy}] + \mathrm{khcy} \cdot [\mathrm{MTHFGlu}] + [\mathrm{MTHFGlu}] \cdot [\mathrm{Hcy}]}\end{split} \tag{103}$$

$$\begin{split}&\mathrm{Rate\_Law\_for\_R20}\left(\mathrm{vmax}, [\mathrm{MTHFGlu}], [\mathrm{Hcy}], \mathrm{kmthfglu}, \mathrm{khcy}\right)\\ &= \frac{\mathrm{vmax} \cdot [\mathrm{MTHFGlu}] \cdot [\mathrm{Hcy}]}{\mathrm{kmthfglu} \cdot \mathrm{khcy} + \mathrm{kmthfglu} \cdot [\mathrm{Hcy}] + \mathrm{khcy} \cdot [\mathrm{MTHFGlu}] + [\mathrm{MTHFGlu}] \cdot [\mathrm{Hcy}]}\end{split} \tag{104}$$

Table 84: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		379.925		☑
kmthfglu	kmthfglu		30.000		☑
khcy	khcy		17.000		☑

6.21 Reaction R21

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

Name R21

Reaction equation

$$\text{myTHFGlu} + \text{dUMP} \xrightarrow{\text{DHF, myTHFGlu, dUMP, DHF}} \text{dTMP} + \text{DHF} \tag{105}$$

Reactants

Table 85: Properties of each reactant.

Id	Name	SBO
myTHFGlu	myTHFGlu	
dUMP	dUMP	

Modifiers

Table 86: Properties of each modifier.

Id	Name	SBO
DHF	DHF	
myTHFGlu	myTHFGlu	
dUMP	dUMP	
DHF	DHF	

Products

Table 87: Properties of each product.

Id	Name	SBO
dTMP	dTMP	
DHF	DHF	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \mathrm{vol}\,(\mathrm{compartment}) \cdot \mathrm{Rate\_Law\_for\_R21}\,(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{dUMP}], \mathrm{kdump}, \mathrm{kmythfglu}, [\mathrm{DHF}], \mathrm{kidhf}) \tag{106}$$

$$\mathrm{Rate\_Law\_for\_R21}\,(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{dUMP}], \mathrm{kdump}, \mathrm{kmythfglu}, [\mathrm{DHF}], \mathrm{kidhf}) = \frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{dUMP}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{kdump} + \mathrm{kmythfglu} \cdot [\mathrm{dUMP}] + \mathrm{kdump} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{dUMP}]} \tag{107}$$

$$\mathrm{Rate\_Law\_for\_R21}\,(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{dUMP}], \mathrm{kdump}, \mathrm{kmythfglu}, [\mathrm{DHF}], \mathrm{kidhf}) = \frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{dUMP}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{kdump} + \mathrm{kmythfglu} \cdot [\mathrm{dUMP}] + \mathrm{kdump} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{dUMP}]} \tag{108}$$

Table 88: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		49.140		☑
kdump	kdump		5.400		☑
kmythfglu	kmythfglu		17.000		☑
kidhf	kidhf		0.428		☑

6.22 Reaction R22

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

Name R22

Reaction equation

$$\mathrm{myTHFGlu} + \mathrm{NADP} \xrightleftharpoons{\mathrm{DHF,\ myTHFGlu,\ NADP,\ DHF}} \mathrm{meTHFGlu} + \mathrm{NADPH} \tag{109}$$

Reactants

Table 89: Properties of each reactant.

Id	Name	SBO
myTHFGlu	myTHFGlu	
NADP	NADP	

Modifiers

Table 90: Properties of each modifier.

Id	Name	SBO
DHF	DHF	
myTHFGlu	myTHFGlu	
NADP	NADP	
DHF	DHF	

Products

Table 91: Properties of each product.

Id	Name	SBO
meTHFGlu	meTHFGlu	
NADPH	NADPH	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \mathrm{vol}(\mathrm{compartment}) \cdot \mathrm{Rate\_Law\_for\_R22}(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{NADP}], \mathrm{kmythfglu}, \mathrm{knadp}, [\mathrm{DHF}], \mathrm{kidhf}) \quad (110)$$

$$\mathrm{Rate\_Law\_for\_R22}(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{NADP}], \mathrm{kmythfglu}, \mathrm{knadp}, [\mathrm{DHF}], \mathrm{kidhf}) = \frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{NADP}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{knadp} + \mathrm{kmythfglu} \cdot [\mathrm{NADP}] + \mathrm{knadp} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{NADP}]} \quad (111)$$

$$\mathrm{Rate\_Law\_for\_R22}(\mathrm{vmax}, [\mathrm{myTHFGlu}], [\mathrm{NADP}], \mathrm{kmythfglu}, \mathrm{knadp}, [\mathrm{DHF}], \mathrm{kidhf}) = \frac{\mathrm{vmax} \cdot [\mathrm{myTHFGlu}] \cdot [\mathrm{NADP}]}{\mathrm{kmythfglu} \cdot \left(1 + \frac{[\mathrm{DHF}]}{\mathrm{kidhf}}\right) \cdot \mathrm{knadp} + \mathrm{kmythfglu} \cdot [\mathrm{NADP}] + \mathrm{knadp} \cdot [\mathrm{myTHFGlu}] + [\mathrm{myTHFGlu}] \cdot [\mathrm{NADP}]} \quad (112)$$

Table 92: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		1892.800		☑
kmythfglu	kmythfglu		25.000		☑
knadp	knadp		22.000		☑
kidhf	kidhf		0.428		☑

6.23 Reaction R25

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

Name R25

Reaction equation

$$\text{fTHFGlu} + \text{mtRNA} \xrightleftharpoons{\text{fTHFGlu, mtRNA}} \text{fmtRNA} + \text{THFGlu} \tag{113}$$

Reactants

Table 93: Properties of each reactant.

Id	Name	SBO
fTHFGlu	fTHFGlu	
mtRNA	mtRNA	

Modifiers

Table 94: Properties of each modifier.

Id	Name	SBO
fTHFGlu	fTHFGlu	
mtRNA	mtRNA	

Products

Table 95: Properties of each product.

Id	Name	SBO
fmtRNA	fmtRNA	
THFGlu	THFGlu	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R25}\left(\mathrm{vmax}, [\mathrm{fTHFGlu}], [\mathrm{mtRNA}], \mathrm{kfthfglu}, \mathrm{kmtrna}\right) \tag{114}$$

$$\mathrm{Rate\_Law\_for\_R25}\left(\mathrm{vmax}, [\mathrm{fTHFGlu}], [\mathrm{mtRNA}], \mathrm{kfthfglu}, \mathrm{kmtrna}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{fTHFGlu}] \cdot [\mathrm{mtRNA}]}{\mathrm{kfthfglu} \cdot \mathrm{kmtrna} + \mathrm{kfthfglu} \cdot [\mathrm{mtRNA}] + \mathrm{kmtrna} \cdot [\mathrm{fTHFGlu}] + [\mathrm{fTHFGlu}] \cdot [\mathrm{mtRNA}]} \tag{115}$$

$$\mathrm{Rate\_Law\_for\_R25}\left(\mathrm{vmax}, [\mathrm{fTHFGlu}], [\mathrm{mtRNA}], \mathrm{kfthfglu}, \mathrm{kmtrna}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{fTHFGlu}] \cdot [\mathrm{mtRNA}]}{\mathrm{kfthfglu} \cdot \mathrm{kmtrna} + \mathrm{kfthfglu} \cdot [\mathrm{mtRNA}] + \mathrm{kmtrna} \cdot [\mathrm{fTHFGlu}] + [\mathrm{fTHFGlu}] \cdot [\mathrm{mtRNA}]} \tag{116}$$

Table 96: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		116.48		☑
kfthfglu	kfthfglu		12.15		☑
kmtrna	kmtrna		1.07		☑

6.24 Reaction R26

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

Name R26

Reaction equation

$$\mathrm{fTHFGlu} + \mathrm{NADP} \xrightleftharpoons{\mathrm{fTHFGlu,\ NADP}} \mathrm{THFGlu} + \mathrm{COTwo} + \mathrm{NADPH} \tag{117}$$

Reactants

Table 97: Properties of each reactant.

Id	Name	SBO
fTHFGlu	fTHFGlu	
NADP	NADP	

Modifiers

Table 98: Properties of each modifier.

Id	Name	SBO
fTHFGlu	fTHFGlu	
NADP	NADP	

Products

Table 99: Properties of each product.

Id	Name	SBO
THFGlu	THFGlu	
COTwo	COTwo	
NADPH	NADPH	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R26}\left(\mathrm{vmax}, [\mathrm{fTHFGlu}], [\mathrm{NADP}], \mathrm{kfthfglu}, \mathrm{knadp}\right) \tag{118}$$

$$\mathrm{Rate\_Law\_for\_R26}\left(\mathrm{vmax}, [\mathrm{fTHFGlu}], [\mathrm{NADP}], \mathrm{kfthfglu}, \mathrm{knadp}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{fTHFGlu}] \cdot [\mathrm{NADP}]}{\mathrm{kfthfglu} \cdot \mathrm{knadp} + \mathrm{kfthfglu} \cdot [\mathrm{NADP}] + \mathrm{knadp} \cdot [\mathrm{fTHFGlu}] + [\mathrm{fTHFGlu}] \cdot [\mathrm{NADP}]} \tag{119}$$

$$\mathrm{Rate\_Law\_for\_R26}\left(\mathrm{vmax}, [\mathrm{fTHFGlu}], [\mathrm{NADP}], \mathrm{kfthfglu}, \mathrm{knadp}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{fTHFGlu}] \cdot [\mathrm{NADP}]}{\mathrm{kfthfglu} \cdot \mathrm{knadp} + \mathrm{kfthfglu} \cdot [\mathrm{NADP}] + \mathrm{knadp} \cdot [\mathrm{fTHFGlu}] + [\mathrm{fTHFGlu}] \cdot [\mathrm{NADP}]} \tag{120}$$

Table 100: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		59.332		☑
kfthfglu	kfthfglu		7.850		☑
knadp	knadp		0.900		☑

6.25 Reaction R18c

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

Name R18c

Reaction equation

$$\text{THFGlu} + \text{SAmDLp} \xrightleftharpoons{\text{THFGlu, SAmDLp}} \text{myTHFGlu} + \text{Lp} + \text{Ammonia} \tag{121}$$

Reactants

Table 101: Properties of each reactant.

Id	Name	SBO
THFGlu	THFGlu	
SAmDLp	SAmDLp	

Modifiers

Table 102: Properties of each modifier.

Id	Name	SBO
THFGlu	THFGlu	
SAmDLp	SAmDLp	

Products

Table 103: Properties of each product.

Id	Name	SBO
myTHFGlu	myTHFGlu	
Lp	Lp	
Ammonia	Ammonia	

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \text{vol}(\text{compartment}) \cdot \text{Rate\_Law\_for\_R18c}(\text{vmax}, [\text{THFGlu}], \text{kthfglu}, [\text{SAmDLp}], \text{ksamdlp}) \tag{122}$$

$$\text{Rate\_Law\_for\_R18c}\left(\text{vmax}, [\text{THFGlu}], \text{kthfglu}, [\text{SAmDLp}], \text{ksamdlp}\right) = \frac{\text{vmax} \cdot [\text{THFGlu}] \cdot [\text{SAmDLp}]}{\text{kthfglu} \cdot \text{ksamdlp} + \text{kthfglu} \cdot [\text{SAmDLp}] + \text{ksamdlp} \cdot [\text{THFGlu}] + [\text{THFGlu}] \cdot [\text{SAmDLp}]} \quad (123)$$

$$\text{Rate\_Law\_for\_R18c}\left(\text{vmax}, [\text{THFGlu}], \text{kthfglu}, [\text{SAmDLp}], \text{ksamdlp}\right) = \frac{\text{vmax} \cdot [\text{THFGlu}] \cdot [\text{SAmDLp}]}{\text{kthfglu} \cdot \text{ksamdlp} + \text{kthfglu} \cdot [\text{SAmDLp}] + \text{ksamdlp} \cdot [\text{THFGlu}] + [\text{THFGlu}] \cdot [\text{SAmDLp}]} \quad (124)$$

Table 104: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		196.56		☑
kthfglu	kthfglu		67.70		☑
ksamdlp	ksamdlp		290.00		☑

6.26 Reaction R18a

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

Name R18a

Reaction equation

$$\text{Lp} + \text{NADH} \xrightleftharpoons{\text{NADH, Lp}} \text{DLp} + \text{NAD} \quad (125)$$

Reactants

Table 105: Properties of each reactant.

Id	Name	SBO
Lp	Lp	
NADH	NADH	

Modifiers

Table 106: Properties of each modifier.

Id	Name	SBO
NADH	NADH	

Id	Name	SBO
Lp	Lp	

Products

Table 107: Properties of each product.

Id	Name	SBO
DLp	DLp	
NAD	NAD	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R18a}\left(\mathrm{vmax}, [\mathrm{NADH}], [\mathrm{Lp}], \mathrm{knadh}, \mathrm{klp}\right) \quad (126)$$

$$\mathrm{Rate\_Law\_for\_R18a}\left(\mathrm{vmax}, [\mathrm{NADH}], [\mathrm{Lp}], \mathrm{knadh}, \mathrm{klp}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{NADH}] \cdot [\mathrm{Lp}]}{\mathrm{knadh} \cdot \mathrm{klp} + \mathrm{knadh} \cdot [\mathrm{Lp}] + \mathrm{klp} \cdot [\mathrm{NADH}] + [\mathrm{NADH}] \cdot [\mathrm{Lp}]} \quad (127)$$

$$\mathrm{Rate\_Law\_for\_R18a}\left(\mathrm{vmax}, [\mathrm{NADH}], [\mathrm{Lp}], \mathrm{knadh}, \mathrm{klp}\right) = \frac{\mathrm{vmax} \cdot [\mathrm{NADH}] \cdot [\mathrm{Lp}]}{\mathrm{knadh} \cdot \mathrm{klp} + \mathrm{knadh} \cdot [\mathrm{Lp}] + \mathrm{klp} \cdot [\mathrm{NADH}] + [\mathrm{NADH}] \cdot [\mathrm{Lp}]} \quad (128)$$

Table 108: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		5432.7		☑
knadh	knadh		58.0		☑
klp	klp		1280.0		☑

6.27 Reaction R13

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

Name R13

Reaction equation

$$\mathrm{AHMDPP} + \mathrm{pABA} \xrightarrow{\mathrm{AHMDPP},\ \mathrm{pABA}} \mathrm{DHP} + \mathrm{Pi} \tag{129}$$

Reactants

Table 109: Properties of each reactant.

Id	Name	SBO
AHMDPP	AHMDPP	
pABA	pABA	

Modifiers

Table 110: Properties of each modifier.

Id	Name	SBO
AHMDPP	AHMDPP	
pABA	pABA	

Products

Table 111: Properties of each product.

Id	Name	SBO
DHP	DHP	
Pi	Pi	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R13}\left(\mathrm{vmax}, \mathrm{kahmdpp}, \mathrm{kpaba}, [\mathrm{AHMDPP}], [\mathrm{pABA}]\right) \tag{130}$$

$$\begin{aligned}&\mathrm{Rate\_Law\_for\_R13}\left(\mathrm{vmax}, \mathrm{kahmdpp}, \mathrm{kpaba}, [\mathrm{AHMDPP}], [\mathrm{pABA}]\right)\\ &= \frac{\mathrm{vmax} \cdot [\mathrm{AHMDPP}] \cdot [\mathrm{pABA}]}{\mathrm{kahmdpp} \cdot \mathrm{kpaba} + \mathrm{kpaba} \cdot [\mathrm{AHMDPP}] + \mathrm{kahmdpp} \cdot [\mathrm{pABA}] + [\mathrm{AHMDPP}] \cdot [\mathrm{pABA}]}\end{aligned} \tag{131}$$

$$\text{Rate\_Law\_for\_R13}(\text{vmax}, \text{kahmdpp}, \text{kpaba}, [\text{AHMDPP}], [\text{pABA}]) = \frac{\text{vmax} \cdot [\text{AHMDPP}] \cdot [\text{pABA}]}{\text{kahmdpp} \cdot \text{kpaba} + \text{kpaba} \cdot [\text{AHMDPP}] + \text{kahmdpp} \cdot [\text{pABA}] + [\text{AHMDPP}] \cdot [\text{pABA}]} \quad (132)$$

Table 112: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vmax	vmax		105.014		☑
kahmdpp	kahmdpp		3.150		☑
kpaba	kpaba		2.600		☑

6.28 Reaction R24

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

Name R24

Reaction equation

$$\text{fTHFGlu} + \text{ADP} + \text{Pi} \xrightleftharpoons{\text{fTHFGlu, ADP, Pi}} \text{THFGlu} + \text{ATP} + \text{Formyl} \quad (133)$$

Reactants

Table 113: Properties of each reactant.

Id	Name	SBO
fTHFGlu	fTHFGlu	
ADP	ADP	
Pi	Pi	

Modifiers

Table 114: Properties of each modifier.

Id	Name	SBO
fTHFGlu	fTHFGlu	
ADP	ADP	
Pi	Pi	

Products

Table 115: Properties of each product.

Id	Name	SBO
`THFGlu`	THFGlu	
`ATP`	ATP	
`Formyl`	Formyl	

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R24}\left(\mathrm{vmax}, \mathrm{kthfglu}, \mathrm{kformyl}, \mathrm{katp}, [\mathrm{fTHFGlu}], [\mathrm{ADP}], [\mathrm{Pi}]\right) \tag{134}$$

$$\mathrm{Rate\_Law\_for\_R24}\left(\mathrm{vmax}, \mathrm{kthfglu}, \mathrm{kformyl}, \mathrm{katp}, [\mathrm{THFGlu}], [\mathrm{Formyl}], [\mathrm{ATP}]\right) = \frac{\mathrm{vmax} \cdot [\mathrm{THFGlu}] \cdot [\mathrm{Formyl}] \cdot [\mathrm{ATP}]}{\mathrm{kthfglu} \cdot \mathrm{kformyl} \cdot \mathrm{katp} + \mathrm{kthfglu} \cdot ([\mathrm{Formyl}] + [\mathrm{ATP}]) + \mathrm{kformyl} \cdot ([\mathrm{THFGlu}] + [\mathrm{ATP}]) + \mathrm{katp} \cdot ([\mathrm{Formyl}] + [\mathrm{TH}} \tag{135}$$

$$\mathrm{Rate\_Law\_for\_R24}\left(\mathrm{vmax}, \mathrm{kthfglu}, \mathrm{kformyl}, \mathrm{katp}, [\mathrm{THFGlu}], [\mathrm{Formyl}], [\mathrm{ATP}]\right) = \frac{\mathrm{vmax} \cdot [\mathrm{THFGlu}] \cdot [\mathrm{Formyl}] \cdot [\mathrm{ATP}]}{\mathrm{kthfglu} \cdot \mathrm{kformyl} \cdot \mathrm{katp} + \mathrm{kthfglu} \cdot ([\mathrm{Formyl}] + [\mathrm{ATP}]) + \mathrm{kformyl} \cdot ([\mathrm{THFGlu}] + [\mathrm{ATP}]) + \mathrm{katp} \cdot ([\mathrm{Formyl}] + [\mathrm{TH}} \tag{136}$$

Table 116: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`vmax`	vmax		15315.3		☑
`kthfglu`	kthfglu		134.0		☑
`kformyl`	kformyl		3190.0		☑
`katp`	katp		74.5		☑

6.29 Reaction `R23`

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

Name R23

Reaction equation

$$\mathrm{meTHFGlu} \xrightleftharpoons{\mathrm{meTHFGlu,\ fTHFGlu}} \mathrm{fTHFGlu} \qquad (137)$$

Reactant

Table 117: Properties of each reactant.

Id	Name	SBO
`meTHFGlu`	meTHFGlu	

Modifiers

Table 118: Properties of each modifier.

Id	Name	SBO
`meTHFGlu`	meTHFGlu	
`fTHFGlu`	fTHFGlu	

Product

Table 119: Properties of each product.

Id	Name	SBO
`fTHFGlu`	fTHFGlu	

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \left(\mathrm{k1} \cdot [\mathrm{meTHFGlu}] - \mathrm{k2} \cdot [\mathrm{fTHFGlu}]\right) \qquad (138)$$

Table 120: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`k1`	k1		0.080		☑
`k2`	k2		0.031		☑

6.30 Reaction R28

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

Name R28

Reaction equation

$$\text{meTHFGlu} \xrightarrow{\text{meTHFGlu}} \text{ffTHFGlu} \tag{139}$$

Reactant

Table 121: Properties of each reactant.

Id	Name	SBO
meTHFGlu	meTHFGlu	

Modifier

Table 122: Properties of each modifier.

Id	Name	SBO
meTHFGlu	meTHFGlu	

Product

Table 123: Properties of each product.

Id	Name	SBO
ffTHFGlu	ffTHFGlu	

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = \text{vol}(\text{compartment}) \cdot \text{Henri\_Michaelis\_Menten\_\_irreversible}([\text{meTHFGlu}], \text{Km}, \text{V}) \tag{140}$$

$$\text{Henri\_Michaelis\_Menten\_\_irreversible}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{141}$$

$$\text{Henri\_Michaelis\_Menten\_\_irreversible}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{142}$$

Table 124: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km		67.0		☑
V	V		200.0		☑

6.31 Reaction R29

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

Name R29

Reaction equation

$$\mathrm{ATP} + \mathrm{ffTHFGlu} \xrightarrow{\mathrm{ATP},\ \mathrm{ffTHFGlu}} \mathrm{ADP} + \mathrm{Pi} + \mathrm{meTHFGlu} \tag{143}$$

Reactants

Table 125: Properties of each reactant.

Id	Name	SBO
ATP	ATP	
ffTHFGlu	ffTHFGlu	

Modifiers

Table 126: Properties of each modifier.

Id	Name	SBO
ATP	ATP	
ffTHFGlu	ffTHFGlu	

Products

Table 127: Properties of each product.

Id	Name	SBO
ADP	ADP	
Pi	Pi	
meTHFGlu	meTHFGlu	

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = \mathrm{vol}\left(\mathrm{compartment}\right) \cdot \mathrm{Rate\_Law\_for\_R29}\left(\mathrm{vmax}, [\mathrm{ATP}], [\mathrm{ffTHFGlu}], \mathrm{katp}, \mathrm{kffthfglu}\right) \quad (144)$$

$$\begin{aligned}&\mathrm{Rate\_Law\_for\_R29}\left(\mathrm{vmax}, [\mathrm{ATP}], [\mathrm{ffTHFGlu}], \mathrm{katp}, \mathrm{kffthfglu}\right)\\ &= \frac{\mathrm{vmax} \cdot [\mathrm{ATP}] \cdot [\mathrm{ffTHFGlu}]}{\mathrm{katp} \cdot \mathrm{kffthfglu} + \mathrm{katp} \cdot [\mathrm{ffTHFGlu}] + \mathrm{kffthfglu} \cdot [\mathrm{ATP}] + [\mathrm{ATP}] \cdot [\mathrm{ffTHFGlu}]}\end{aligned} \quad (145)$$

$$\begin{aligned}&\mathrm{Rate\_Law\_for\_R29}\left(\mathrm{vmax}, [\mathrm{ATP}], [\mathrm{ffTHFGlu}], \mathrm{katp}, \mathrm{kffthfglu}\right)\\ &= \frac{\mathrm{vmax} \cdot [\mathrm{ATP}] \cdot [\mathrm{ffTHFGlu}]}{\mathrm{katp} \cdot \mathrm{kffthfglu} + \mathrm{katp} \cdot [\mathrm{ffTHFGlu}] + \mathrm{kffthfglu} \cdot [\mathrm{ATP}] + [\mathrm{ATP}] \cdot [\mathrm{ffTHFGlu}]}\end{aligned} \quad (146)$$

Table 128: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`vmax`	vmax		500.0		☑
`katp`	katp		50.0		☑
`kffthfglu`	kffthfglu		5.0		☑

7 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.

7.1 Species `DAHP`

Name DAHP

Initial concentration $0.9796078511\ \mu\mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in `R2` and as a product in `R1` and as a modifier in `R2`).

$$\frac{d}{dt}\text{DAHP} = v_1 - v_2 \tag{147}$$

7.2 Species PEP

Name PEP

Initial concentration 16.01031821 $\mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in R1, R6 and as a modifier in R1, R6), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{PEP} = 0 \tag{148}$$

7.3 Species Pi

Name Pi

Initial concentration 2.725541316 $\mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in 13 reactions (as a reactant in R24 and as a product in R1, R2, R5, R6, R7, R11, R27, R14, R16, R13, R29 and as a modifier in R24).

$$\frac{d}{dt}\text{Pi} = v_1 + v_2 + v_5 + v_6 + v_7 + v_{11} + v_{12} + v_{14} + v_{16} + v_{27} + v_{31} - v_{28} \tag{149}$$

7.4 Species DHQ

Name DHQ

Initial concentration 0.9994087764 $\mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R3 and as a product in R2 and as a modifier in R3).

$$\frac{d}{dt}\text{DHQ} = v_2 - v_3 \tag{150}$$

7.5 Species EP

Name EP

Initial concentration 107.502052 $\mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a reactant in R1 and as a modifier in R1), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{EP} = 0 \tag{151}$$

7.6 Species DHSK

Name DHSK

Initial concentration $1.92788104\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R4 and as a product in R3 and as a modifier in R4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{DHSK} = v_3 - v_4 \tag{152}$$

7.7 Species SK

Name SK

Initial concentration $5.06777189\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R5 and as a product in R4 and as a modifier in R5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{SK} = v_4 - v_5 \tag{153}$$

7.8 Species SKP

Name SKP

Initial concentration $2\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R6 and as a product in R5 and as a modifier in R6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{SKP} = v_5 - v_6 \tag{154}$$

7.9 Species CVPSK

Name CVPSK

Initial concentration $0.9174312684\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R7 and as a product in R6 and as a modifier in R7).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{CVPSK} = v_6 - v_7 \tag{155}$$

7.10 Species CM

Name CM

Initial concentration $1.009195849\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R8 and as a product in R7 and as a modifier in R8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CM} = v_7 - v_8 \tag{156}$$

7.11 Species Gln

Name Gln

Initial concentration $381.0009289\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a reactant in R8 and as a modifier in R8), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Gln} = 0 \tag{157}$$

7.12 Species Glu

Name Glu

Initial concentration $959.9999225\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in five reactions (as a reactant in R14, R16 and as a product in R8 and as a modifier in R14, R16).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Glu} = v_8 - v_{14} - v_{16} \tag{158}$$

7.13 Species ADC

Name ADC

Initial concentration $0.9907047071\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R9 and as a product in R8 and as a modifier in R9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ADC} = v_8 - v_9 \tag{159}$$

7.14 Species Pyr

Name Pyr

Initial concentration $1.000006539\ \mu\text{mol}\cdot\text{l}^{-1}$

This species takes part in one reaction (as a product in R9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Pyr} = v_9 \tag{160}$$

7.15 Species pABA

Name pABA

Initial concentration $1.00378139\ \mu\text{mol}\cdot\text{l}^{-1}$

This species takes part in three reactions (as a reactant in R13 and as a product in R9 and as a modifier in R13).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{pABA} = v_9 - v_{27} \tag{161}$$

7.16 Species DHNTP

Name DHNTP

Initial concentration $4\ \mu\text{mol}\cdot\text{l}^{-1}$

This species takes part in five reactions (as a reactant in R11, R27 and as a product in R10 and as a modifier in R11, R27).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{DHNTP} = v_{10} - v_{11} - v_{12} \tag{162}$$

7.17 Species GTP

Name GTP

Initial concentration $487.4867469\ \mu\text{mol}\cdot\text{l}^{-1}$

This species takes part in two reactions (as a reactant in R10 and as a modifier in R10), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{GTP} = 0 \tag{163}$$

7.18 Species AHMDHP

Name AHMDHP

Initial concentration $2.01877235\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R12 and as a product in R11 and as a modifier in R12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AHMDHP} = v_{11} - v_{13} \tag{164}$$

7.19 Species HAD

Name HAD

Initial concentration $2.002305849\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in R11).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{HAD} = v_{11} \tag{165}$$

7.20 Species PTHP

Name PTHP

Initial concentration $1.002298517\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in R27).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PTHP} = v_{12} \tag{166}$$

7.21 Species AHMDPP

Name AHMDPP

Initial concentration $0.9873083466\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R13 and as a product in R12 and as a modifier in R13).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AHMDPP} = v_{13} - v_{27} \tag{167}$$

7.22 Species DHP

Name DHP

Initial concentration $0.9963801483\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R14 and as a product in R13 and as a modifier in R14).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{DHP} = v_{27} - v_{14} \tag{168}$$

7.23 Species DHF

Name DHF

Initial concentration $1.142744159\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in twelve reactions (as a reactant in R15 and as a product in R14, R21 and as a modifier in R15, R16, R16, R19, R19, R21, R21, R22, R22).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{DHF} = v_{14} + v_{21} - v_{15} \tag{169}$$

7.24 Species THF

Name THF

Initial concentration $8\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in seven reactions (as a reactant in R16 and as a product in R15 and as a modifier in R10, R10, R16, R17, R17).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{THF} = v_{15} - v_{16} \tag{170}$$

7.25 Species THFGlu

Name THFGlu

Initial concentration $1\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in nine reactions (as a reactant in R17, R18c and as a product in R16, R20, R25, R26, R24 and as a modifier in R17, R18c).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{THFGlu} = v_{16} + v_{20} + v_{23} + v_{24} + v_{28} - v_{17} - v_{25} \tag{171}$$

7.26 Species Gly

Name Gly

Initial concentration $499.9974679\ \mu\text{mol} \cdot l^{-1}$

This species takes part in three reactions (as a reactant in R18b and as a product in R17 and as a modifier in R18b), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{Gly} = 0 \tag{172}$$

7.27 Species Ser

Name Ser

Initial concentration $6.803576818\ \mu\text{mol} \cdot l^{-1}$

This species takes part in two reactions (as a reactant in R17 and as a modifier in R17), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{Ser} = 0 \tag{173}$$

7.28 Species myTHFGlu

Name myTHFGlu

Initial concentration $1.04350884\ \mu\text{mol} \cdot l^{-1}$

This species takes part in eight reactions (as a reactant in R19, R21, R22 and as a product in R17, R18c and as a modifier in R19, R21, R22).

$$\frac{d}{dt}\text{myTHFGlu} = v_{17} + v_{25} - v_{19} - v_{21} - v_{22} \tag{174}$$

7.29 Species MTHFGlu

Name MTHFGlu

Initial concentration $1.000096392\ \mu\text{mol} \cdot l^{-1}$

This species takes part in three reactions (as a reactant in R20 and as a product in R19 and as a modifier in R20).

$$\frac{d}{dt}\text{MTHFGlu} = v_{19} - v_{20} \tag{175}$$

7.30 Species Hcy

Name Hcy

Initial concentration $1.000182797\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a reactant in R20 and as a modifier in R20), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Hcy} = 0 \tag{176}$$

7.31 Species Met

Name Met

Initial concentration $0.9998172031\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in R20).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Met} = v_{20} \tag{177}$$

7.32 Species dTMP

Name dTMP

Initial concentration $0.9974700923\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in R21).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{dTMP} = v_{21} \tag{178}$$

7.33 Species dUMP

Name dUMP

Initial concentration $20.00252991\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a reactant in R21 and as a modifier in R21), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{dUMP} = 0 \tag{179}$$

7.34 Species meTHFGlu

Name meTHFGlu

Initial concentration $0.9082384182 \mu\text{mol} \cdot l^{-1}$

This species takes part in six reactions (as a reactant in R23, R28 and as a product in R22, R29 and as a modifier in R23, R28).

$$\frac{d}{dt}\text{meTHFGlu} = v_{22} + v_{31} - v_{29} - v_{30} \tag{180}$$

7.35 Species fTHFGlu

Name fTHFGlu

Initial concentration $1.83347183 \mu\text{mol} \cdot l^{-1}$

This species takes part in eight reactions (as a reactant in R25, R26, R24 and as a product in R23 and as a modifier in R25, R26, R24, R23).

$$\frac{d}{dt}\text{fTHFGlu} = v_{29} - v_{23} - v_{24} - v_{28} \tag{181}$$

7.36 Species fmtRNA

Name fmtRNA

Initial concentration $0.9968760756 \mu\text{mol} \cdot l^{-1}$

This species takes part in one reaction (as a product in R25).

$$\frac{d}{dt}\text{fmtRNA} = v_{23} \tag{182}$$

7.37 Species mtRNA

Name mtRNA

Initial concentration $1.003123924 \mu\text{mol} \cdot l^{-1}$

This species takes part in two reactions (as a reactant in R25 and as a modifier in R25), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{mtRNA} = 0 \tag{183}$$

7.38 Species COTwo

Name COTwo

Initial concentration $0.988683328\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a product in R18b, R26).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{COTwo} = v_{18} + v_{24} \tag{184}$$

7.39 Species ADP

Name ADP

Initial concentration $2.828115142\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in six reactions (as a reactant in R24 and as a product in R5, R14, R16, R29 and as a modifier in R24).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{ADP} = v_5 + v_{14} + v_{16} + v_{31} - v_{28} \tag{185}$$

7.40 Species ATP

Name ATP

Initial concentration $963.0188351\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in eleven reactions (as a reactant in R5, R12, R14, R16, R29 and as a product in R24 and as a modifier in R5, R12, R14, R16, R29), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{ATP} = 0 \tag{186}$$

7.41 Species NADP

Name NADP

Initial concentration $2\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in seven reactions (as a reactant in R22, R26 and as a product in R4, R15, R19 and as a modifier in R22, R26).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{NADP} = v_4 + v_{15} + v_{19} - v_{22} - v_{24} \tag{187}$$

7.42 Species NADPH

Name NADPH

Initial concentration $12.19849409\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in eight reactions (as a reactant in R4, R15, R19 and as a product in R22, R26 and as a modifier in R4, R15, R19), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{NADPH} = 0 \tag{188}$$

7.43 Species AMP

Name AMP

Initial concentration $0.983533495\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in R12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{AMP} = v_{13} \tag{189}$$

7.44 Species DLp

Name DLp

Initial concentration $0.7017503089\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R18b and as a product in R18a and as a modifier in R18b).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{DLp} = v_{26} - v_{18} \tag{190}$$

7.45 Species SAmDLp

Name SAmDLp

Initial concentration $1.000015336\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R18c and as a product in R18b and as a modifier in R18c).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{SAmDLp} = v_{18} - v_{25} \tag{191}$$

7.46 Species Lp

Name Lp

Initial concentration $1.298234355\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R18a and as a product in R18c and as a modifier in R18a), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

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

7.47 Species NAD

Name NAD

Initial concentration $0.7017656449\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in R18a).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NAD} = v_{26} \tag{193}$$

7.48 Species NADH

Name NADH

Initial concentration $8.349823436\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a reactant in R18a and as a modifier in R18a), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NADH} = 0 \tag{194}$$

7.49 Species Ammonia

Name Ammonia

Initial concentration $0.9895374253\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in R18c).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ammonia} = v_{25} \tag{195}$$

7.50 Species Formyl

Name Formyl

Initial concentration $8\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a product in R10, R24).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Formyl} = v_{10} + v_{28} \tag{196}$$

7.51 Species ffTHFGlu

Name ffTHFGlu

Initial concentration $1\ \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in R29 and as a product in R28 and as a modifier in R29).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{ffTHFGlu} = v_{30} - v_{31} \tag{197}$$

SBML2LaTeX was developed by Andreas Dräger[a], Hannes Planatscher[a], Dieudonné M Wouamba[a], Adrian Schröder[a], Michael Hucka[b], Lukas Endler[c], Martin Golebiewski[d] and Andreas Zell[a]. Please see http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX for more information.

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