

## SBML Model Report

# Model name: “Kerkhoven2013 - Glycolysis and Pentose Phosphate Pathway in T.brucei - MODEL C in fructose medium (with glucosomal ribokinase)”



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<sup>1</sup> and Eduard Kerkhoven<sup>2</sup> at February tenth 2014 at 2:41 p. m. and last time modified at March fifth 2014 at 4:02 p. m. Table 1 provides 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	3
species types	0	species	51
events	0	constraints	0
reactions	40	function definitions	7
global parameters	0	unit definitions	5
rules	0	initial assignments	0

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## Model Notes

Kerkhoven2013 - Glycolysis and Pentose Phosphate Pathway in T.brucei - MODEL C in fructose medium (with glucosomal ribokinase)

There are six models (Model A, B, C, C-fruc, D, D-fruc) described in the paper. Model A ([BIOMD0000000513](#)) is the model developed originally by Achar et al. (2012) ([BIOMD0000000428](#)), which describes glycolysis in T.brucei. This glycolysis model is extended to include pentose phosphate pathway (PPP), which is Model B ([BIOMD0000000514](#)). Model B is further extended to include glucosomal ribokinase, leading to Model C ([BIOMD0000000510](#)). Model D ([BIOMD0000000511](#)) is again an extension of Model B, which includes an ATP:ADP antiporter. Model C-fruc ([BIOMD0000000515](#)) and Model D-fruc ([BIOMD0000000516](#)) are extensions of Model C and D, respectively, which includes fructose transporter and its subsequent utilizing reactions. This model correspond to Model C-fruc of the paper.

This model is described in the article:[Handling uncertainty in dynamic models: the pentose phosphate pathway in Trypanosoma brucei](#). Kerkhoven EJ, Achcar F, Alibu VP, Burchmore RJ, Gilbert IH, Trybio M, Driessen NN, Gilbert D, Breitling R, Bakker BM, Barrett MP. PLoS Comput Biol. 2013 Dec;9(12):e1003371.

### Abstract:

Dynamic models of metabolism can be useful in identifying potential drug targets, especially in unicellular organisms. A model of glycolysis in the causative agent of human African trypanosomiasis, *Trypanosoma brucei*, has already shown the utility of this approach. Here we add the pentose phosphate pathway (PPP) of *T. brucei* to the glycolytic model. The PPP is localized to both the cytosol and the glycosome and adding it to the glycolytic model without further adjustments leads to a draining of the essential bound-phosphate moiety within the glycosome. This phosphate „leak,, must be resolved for the model to be a reasonable representation of parasite physiology. Two main types of theoretical solution to the problem could be identified: (i) including additional enzymatic reactions in the glycosome, or (ii) adding a mechanism to transfer bound phosphates between cytosol and glycosome. One example of the first type of solution would be the presence of a glucosomal ribokinase to regenerate ATP from ribose 5-phosphate and ADP. Experimental characterization of ribokinase in *T. brucei* showed that very low enzyme levels are sufficient for parasite survival, indicating that other mechanisms are required in controlling the phosphate leak. Examples of the second type would involve the presence of an ATP:ADP exchanger or recently described permeability pores in the glucosomal membrane, although the current absence of identified genes encoding such molecules impedes experimental testing by genetic manipulation. Confronted with this uncertainty, we present a modeling strategy that identifies robust predictions in the context of incomplete system characterization. We illustrate this strategy by exploring the mechanism underlying the essential function of one of the PPP enzymes, and validate it by confirming the model predictions experimentally.

This model is hosted on [BioModels Database](#) and identified by: [BIOMD0000000515](#).

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## 2 Unit Definitions

This is an overview of five unit definitions.

### 2.1 Unit volume

**Definition**  $\mu\text{l}$

### 2.2 Unit length

**Definition**  $\text{m}$

### 2.3 Unit substance

**Definition**  $\text{nmol}$

### 2.4 Unit time

**Definition**  $60 \text{ s}$

### 2.5 Unit area

**Definition**  $\text{m}^2$

## 3 Compartments

This model contains three compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
cytosol	cytosol	0000290	3	5.4549	$\mu\text{l}$	<input checked="" type="checkbox"/>	
glycosome	glycosome	0000290	3	0.2451	$\mu\text{l}$	<input checked="" type="checkbox"/>	
default	default	0000290	3	1	litre	<input checked="" type="checkbox"/>	

### 3.1 Compartment cytosol

This is a three dimensional compartment with a constant size of  $5.4549 \mu\text{l}$ .

**Name** cytosol

**SBO:0000290** physical compartment

### 3.2 Compartment glycosome

This is a three dimensional compartment with a constant size of 0.2451  $\mu\text{l}$ .

**Name** glycosome

**SBO:0000290** physical compartment

### 3.3 Compartment default

This is a three dimensional compartment with a constant size of one  $\mu\text{l}$ .

**Name** default

**SBO:0000290** physical compartment

## 4 Species

This model contains 51 species. The boundary condition of eleven 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
Fru_e	Fru_e	default	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
_2PGA_c	_2PGA_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Fru_g	Fru_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Fru_c	Fru_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
DHAP_c	DHAP_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
ATP_g	ATP_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
DHAP_g	DHAP_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
ADP_g	ADP_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Glc6P_g	Glc6P_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
ADP_c	ADP_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_3PGA_c	_3PGA_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
NADPH_c	NADPH_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Fru6P_g	Fru6P_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Fru6P_c	Fru6P_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pi_g	Pi_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
O2_c	O2_c	default	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
NADP_c	NADP_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
ATP_c	ATP_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
NADP_g	NADP_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_6PG_g	_6PG_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
CO2_c	CO2_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Rul5P_c	Rul5P_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_6PG_c	_6PG_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Rul5P_g	Rul5P_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Glc6P_c	Glc6P_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Rib5P_c	Rib5P_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
_13BPGA_g	_13BPGA_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Glc_c	Glc_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Rib5P_g	Rib5P_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Glc_g	Glc_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Glc_e	Glc_e	default	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
NADPH_g	NADPH_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Rib_g	Rib_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pyr_c	Pyr_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Pyr_e	Pyr_e	default	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
NAD_g	NAD_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Fru16BP_g	Fru16BP_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
GA3P_g	GA3P_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Gly_e	Gly_e	default	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
TSH2_c	TSH2_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
CO2_g	CO2_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Gly3P_c	Gly3P_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
Gly3P_g	Gly3P_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_6PGL_c	_6PGL_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
TS2_c	TS2_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_6PGL_g	_6PGL_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
PEP_c	PEP_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
AMP_g	AMP_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
_3PGA_g	_3PGA_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
AMP_c	AMP_c	cytosol	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
NADH_g	NADH_g	glycosome	$\text{nmol} \cdot \mu\text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>

## 5 Function definitions

This is an overview of seven function definitions.

### 5.1 Function definition $v_{AK}$

**Name**  $v_{AK}$

**Arguments** ADP, AMP, ATP,  $k_1$ ,  $k_2$

**Mathematical Expression**

$$k_1 \cdot \text{ADP}^2 - \text{AMP} \cdot \text{ATP} \cdot k_2 \quad (1)$$

### 5.2 Function definition $v_{2\text{sub}2\text{prod}}$

**Name**  $v_{2\text{sub}2\text{prod}}$

**Arguments**  $V_{\text{fmax}}$ ,  $K_{\text{eq}}$ ,  $S_1$ ,  $K_{s1}$ ,  $S_2$ ,  $K_{s2}$ ,  $P_1$ ,  $K_{p1}$ ,  $P_2$ ,  $K_{p2}$

**Mathematical Expression**

$$\frac{V_{\text{fmax}} \cdot S_1 \cdot S_2 \cdot \left(1 - \frac{P_1 \cdot P_2}{K_{\text{eq}} \cdot S_1 \cdot S_2}\right)}{K_{s1} \cdot K_{s2} \cdot \left(1 + \frac{S_1}{K_{s1}} + \frac{P_1}{K_{p1}}\right) \cdot \left(1 + \frac{S_2}{K_{s2}} + \frac{P_2}{K_{p2}}\right)} \quad (2)$$

### 5.3 Function definition $v_{1\text{sub}}$

**Name**  $v_{1\text{sub}}$

**Arguments**  $V_{\text{fmax}}$ ,  $S$ ,  $K_s$

**Mathematical Expression**

$$\frac{V_{\text{fmax}} \cdot S}{K_s \cdot \left(1 + \frac{S}{K_s}\right)} \quad (3)$$

### 5.4 Function definition $v_{2\text{sub}2\text{prod\_compinhib}}$

**Name**  $v_{2\text{sub}2\text{prod\_compinhib}}$

**Arguments**  $V_{\text{fmax}}$ ,  $K_{\text{eq}}$ ,  $S_1$ ,  $K_{s1}$ ,  $S_2$ ,  $K_{s2}$ ,  $P_1$ ,  $K_{p1}$ ,  $P_2$ ,  $K_{p2}$ ,  $I_1$ ,  $K_{i1}$ ,  $I_2$ ,  $K_{i2}$

**Mathematical Expression**

$$\frac{V_{\text{fmax}} \cdot S_1 \cdot S_2 \cdot \left(1 - \frac{P_1 \cdot P_2}{K_{\text{eq}} \cdot S_1 \cdot S_2}\right)}{K_{s1} \cdot K_{s2} \cdot \left(1 + \frac{S_1}{K_{s1}} + \frac{P_1}{K_{p1}}\right) \cdot \left(1 + \frac{S_2}{K_{s2}} + \frac{P_2}{K_{p2}} + \frac{I_1}{K_{i1}} + \frac{I_2}{K_{i2}}\right)} \quad (4)$$



### 5.5 Function definition `mass_action_rev`

**Name** `mass_action_rev`

**Arguments** `k1`, `S`, `k2`, `P`

**Mathematical Expression**

$$k1 \cdot S - k2 \cdot P \quad (5)$$

### 5.6 Function definition `v1sub1prod`

**Name** `v1sub1prod`

**Arguments** `Vfmax`, `Keq`, `S`, `Ks`, `P`, `Kp`

**Mathematical Expression**

$$\frac{V_{fmax} \cdot S \cdot \left(1 - \frac{P}{K_{eq} \cdot S}\right)}{K_s \cdot \left(1 + \frac{S}{K_s} + \frac{P}{K_p}\right)} \quad (6)$$

### 5.7 Function definition `mass_action_irrev`

**Name** `mass_action_irrev`

**Arguments** `k`, `S`

**Mathematical Expression**

$$k \cdot S \quad (7)$$

## 6 Reactions

This model contains 40 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

Nº	Id	Name	Reaction Equation	SBO
1	TPI_g	TPI_g	$\text{DHAP}_g \xrightleftharpoons{\text{DHAP}_g, \text{GA3P}_g} \text{GA3P}_g$	
2	PYK_c	PYK_c	$\text{PEP}_c + \text{ADP}_c \xrightleftharpoons{\text{ADP}_c, \text{Pyr}_c, \text{ATP}_c, \text{PEP}_c} \text{Pyr}_c + \text{ATP}_c$	
3	PFK_g	PFK_g	$\text{ATP}_g + \text{Fru6P}_g \xrightleftharpoons{\text{Fru6P}_g, \text{ATP}_g, \text{Fru16BP}_g, \text{ADP}_g} \text{Fru16BP}_g + \text{ADP}_g$	
4	G6PDH_g	G6PDH_g	$\text{Glc6P}_g + \text{NADP}_g \xrightleftharpoons{\text{Glc6P}_g, \text{NADP}_g, \text{6PGL}_g, \text{NADPH}_g} \text{6PGL}_g + \text{NADPH}_g$	
5	PGAM_c	PGAM_c	$\text{3PGA}_c \xrightleftharpoons{\text{3PGA}_c, \text{2PGA}_c} \text{2PGA}_c$	
6	PyrT_c	PyrT_c	$\text{Pyr}_c \xrightarrow{\text{Pyr}_c} \text{Pyr}_e$	
7	G6PDH_c	G6PDH_c	$\text{Glc6P}_c + \text{NADP}_c \xrightleftharpoons{\text{Glc6P}_c, \text{NADP}_c, \text{6PGL}_c, \text{NADPH}_c} \text{NADPH}_c + \text{6PGL}_c$	
8	ENO_c	ENO_c	$\text{2PGA}_c \xrightleftharpoons{\text{2PGA}_c, \text{PEP}_c} \text{PEP}_c$	
9	HXK_g	HXK_g	$\text{ATP}_g + \text{Glc}_g \xrightleftharpoons{\text{Fru}_g, \text{Fru6P}_g, \text{Glc}_g, \text{ATP}_g, \text{Glc6P}_g, \text{ADP}_g, \text{Fru}_g, \text{Fru6P}_g} \text{Glc6P}_g + \text{ADP}_g$	
10	RK_g	RK_g	$\text{ADP}_g + \text{Rib5P}_g \xrightleftharpoons{\text{Rib5P}_g, \text{ADP}_g, \text{Rib}_g, \text{ATP}_g} \text{ATP}_g + \text{Rib}_g$	
11	3PGAT_g	3PGAT_g	$\text{3PGA}_g \xrightleftharpoons{\text{3PGA}_g, \text{3PGA}_c} \text{3PGA}_c$	

Nº	Id	Name	Reaction Equation	SBO
12	NADPHu_c	NADPHu_c	$\text{NADPH}_c \xrightarrow{\text{NADPH}_c} \text{NADP}_c$	
13	HXK_c	HXK_c	$\text{Glc}_c + \text{ATP}_c \xrightleftharpoons[\text{ADP}_c]{\text{Fru}_c, \text{Fru6P}_c, \text{Glc}_c, \text{ATP}_c, \text{Glc6P}_c, \text{ADP}_c, \text{Fru}_c, \text{Fru6P}_c} \text{Glc6P}_c$	
14	NADPHu_g	NADPHu_g	$\text{NADPH}_g \xrightarrow{\text{NADPH}_g} \text{NADP}_g$	
15	HXKfru_g	HXKfru_g	$\text{Fru}_g + \text{ATP}_g \xrightleftharpoons[\text{Fru6P}_g]{\text{Glc}_g, \text{Glc6P}_g, \text{Fru}_g, \text{ATP}_g, \text{Fru6P}_g, \text{ADP}_g, \text{Glc}_g, \text{Glc6P}_g} \text{ADP}_g$	
16	G6PP_c	G6PP_c	$\text{Glc6P}_c \xrightleftharpoons[\text{Glc}_c]{\text{Glc6P}_c, \text{Glc}_c} \text{Glc}_c$	
17	AK_c	AK_c	$2 \text{ADP}_c \xrightleftharpoons[\text{AMP}_c + \text{ATP}_c]{\text{ADP}_c, \text{AMP}_c, \text{ATP}_c} \text{AMP}_c$	
18	PGI_g	PGI_g	$\text{Glc6P}_g \xrightleftharpoons[\text{Fru6P}_g]{\_6\text{PG}_g, \text{Glc6P}_g, \text{Fru6P}_g, \_6\text{PG}_g} \text{Fru6P}_g$	
19	HXKfru_c	HXKfru_c	$\text{Fru}_c + \text{ATP}_c \xrightleftharpoons[\text{Fru6P}_c]{\text{Glc}_c, \text{Glc6P}_c, \text{Fru}_c, \text{ATP}_c, \text{Fru6P}_c, \text{ADP}_c, \text{Glc}_c, \text{Glc6P}_c} \text{ADP}_c$	
20	TOX_c	TOX_c	$\text{TSH2}_c \xrightarrow{\text{TSH2}_c} \text{TS2}_c$	
21	GDA_g	GDA_g	$\text{Gly3P}_g + \text{DHAP}_c \xrightleftharpoons[\text{DHAP}_g]{\text{Gly3P}_g, \text{DHAP}_c, \text{Gly3P}_c, \text{DHAP}_g} \text{Gly3P}_c + \text{DHAP}_g$	
22	FruT_g	FruT_g	$\text{Fru}_c \xrightleftharpoons[\text{Fru}_g]{\text{Fru}_c, \text{Fru}_g} \text{Fru}_g$	
23	PGL_c	PGL_c	$\_6\text{PGL}_c \xrightleftharpoons[\_6\text{PG}_c]{\_6\text{PGL}_c, \_6\text{PG}_c} \_6\text{PG}_c$	
24	FruT_c	FruT_c	$\text{Fru}_e \xrightleftharpoons[\text{Fru}_c]{\text{Fru}_e, \text{Fru}_c} \text{Fru}_c$	
25	AK_g	AK_g	$2 \text{ADP}_g \xrightleftharpoons[\text{AMP}_g + \text{ATP}_g]{\text{ADP}_g, \text{AMP}_g, \text{ATP}_g} \text{AMP}_g$	
26	_6PGDH_c	_6PGDH_c	$\text{NADP}_c + \_6\text{PG}_c \xrightleftharpoons[\text{NADPH}_c + \text{Rul5P}_c]{\_6\text{PG}_c, \text{NADP}_c, \text{Rul5P}_c, \text{NADPH}_c} \text{CO2}_c + \text{Rul5P}_c$	
27	PPI_c	PPI_c	$\text{Rul5P}_c \xrightleftharpoons[\text{Rib5P}_c]{\text{Rul5P}_c, \text{Rib5P}_c} \text{Rib5P}_c$	

Nº	Id	Name	Reaction Equation	SBO
28	PPI_g	PPI_g	$\text{Rul5P\_g} \xrightleftharpoons{\text{Rul5P\_g, Rib5P\_g}} \text{Rib5P\_g}$	
29	_6PGDH_g	_6PGDH_g	$\text{_6PG\_g} + \text{NADP\_g} \xrightleftharpoons{\text{_6PG\_g, NADP\_g, Rul5P\_g, NADPH\_g}} \text{Rul5P\_g} + \text{CO2\_g} + \text{NADPH\_g}$	
30	GlcT_g	GlcT_g	$\text{Glc\_c} \xrightleftharpoons{\text{Glc\_c, Glc\_g}} \text{Glc\_g}$	
31	GlcT_c	GlcT_c	$\text{Glc\_e} \xrightleftharpoons{\text{Glc\_e, Glc\_c}} \text{Glc\_c}$	
32	PGL_g	PGL_g	$\text{_6PGL\_g} \xrightleftharpoons{\text{_6PGL\_g, _6PG\_g}} \text{_6PG\_g}$	
33	TR_c	TR_c	$\text{TS2\_c} + \text{NADPH\_c} \xrightleftharpoons{\text{TS2\_c, NADPH\_c, TSH2\_c, NADP\_c}} \text{NADP\_c} + \text{TSH2\_c}$	
34	PGK_g	PGK_g	$\text{_13BPGA\_g} + \text{ADP\_g} \xrightleftharpoons{\text{_13BPGA\_g, ADP\_g, _3PGA\_g, ATP\_g}} \text{_3PGA\_g} + \text{ATP\_g}$	
35	G3PDH_g	G3PDH_g	$\text{NADH\_g} + \text{DHAP\_g} \xrightleftharpoons{\text{DHAP\_g, NADH\_g, Gly3P\_g, NAD\_g}} \text{Gly3P\_g} + \text{NAD\_g}$	
36	ATPu_c	ATPu_c	$\text{ATP\_c} \xrightarrow{\text{ATP\_c, ADP\_c}} \text{ADP\_c}$	
37	GK_g	GK_g	$\text{Gly3P\_g} + \text{ADP\_g} \xrightleftharpoons{\text{Gly3P\_g, ADP\_g, Gly\_e, ATP\_g}} \text{Gly\_e} + \text{ATP\_g}$	
38	ALD_g	ALD_g	$\text{Fru16BP\_g} \xrightleftharpoons{\text{ATP\_g, ADP\_g, AMP\_g, Fru16BP\_g, GA3P\_g, DHAP\_g, ATP\_g, ADP\_g, A}}$	
39	GAPDH_g	GAPDH_g	$\text{GA3P\_g} + \text{NAD\_g} + \text{Pi\_g} \xrightleftharpoons{\text{GA3P\_g, NAD\_g, _13BPGA\_g, NADH\_g}} \text{NADH\_g} + \text{_13BPGA\_g}$	
40	GPO_c	GPO_c	$\text{Gly3P\_c} \xrightarrow{\text{Gly3P\_c}} \text{DHAP\_c}$	

## 6.1 Reaction TPI\_g

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

**Name** TPI\_g

### Reaction equation



### Reactant

Table 5: Properties of each reactant.

Id	Name	SBO
DHAP_g	DHAP_g	

### Modifiers

Table 6: Properties of each modifier.

Id	Name	SBO
DHAP_g	DHAP_g	
GA3P_g	GA3P_g	

### Product

Table 7: Properties of each product.

Id	Name	SBO
GA3P_g	GA3P_g	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_1 = v_{1\text{sub1prod}}(\text{TPI\_g\_Vmax}, \text{TPI\_g\_Keq}, [\text{DHAP\_g}], \text{TPI\_g\_KmDHAP}, [\text{GA3P\_g}], \text{TPI\_g\_KmGA3P}) \quad (9)$$

$$v_{1\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left(1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}}\right)}{\text{Ks} \cdot \left(1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}}\right)} \quad (10)$$

Table 8: Properties of each parameter.

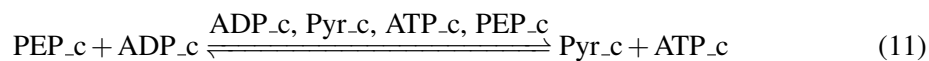
Id	Name	SBO	Value	Unit	Constant
TPI_g_Vmax	TPI_g_Vmax		999.300		<input checked="" type="checkbox"/>
TPI_g_Keq	TPI_g_Keq		0.046		<input checked="" type="checkbox"/>
TPI_g_KmDHAP	TPI_g_KmDHAP		1.200		<input checked="" type="checkbox"/>
TPI_g_KmGA3P	TPI_g_KmGA3P		0.250		<input checked="" type="checkbox"/>

## 6.2 Reaction PYK\_c

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

**Name** PYK\_c

### Reaction equation



### Reactants

Table 9: Properties of each reactant.

Id	Name	SBO
PEP_c	PEP_c	
ADP_c	ADP_c	

### Modifiers

Table 10: Properties of each modifier.

Id	Name	SBO
ADP_c	ADP_c	
Pyr_c	Pyr_c	
ATP_c	ATP_c	
PEP_c	PEP_c	

### Products

Table 11: Properties of each product.

Id	Name	SBO
Pyr_c	Pyr_c	
ATP_c	ATP_c	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_2 = \frac{\text{PYK\_c\_Vmax} \cdot [\text{ADP\_c}] \cdot \left(1 - \frac{[\text{Pyr\_c}] \cdot [\text{ATP\_c}]}{\text{PYK\_c\_Keq} \cdot [\text{PEP\_c}] \cdot [\text{ADP\_c}]}\right) \cdot \left(\frac{[\text{PEP\_c}]}{\text{PYK\_c\_KmPEP} \cdot \left(1 + \frac{[\text{ADP\_c}]}{\text{PYK\_c\_KiADP}} + \frac{[\text{ATP\_c}]}{\text{PYK\_c\_KiATP}}\right)}\right)^{\text{PYK\_c\_n}}}{\text{PYK\_c\_KmADP} \cdot \left(1 + \left(\frac{[\text{PEP\_c}]}{\text{PYK\_c\_KmPEP} \cdot \left(1 + \frac{[\text{ADP\_c}]}{\text{PYK\_c\_KiADP}} + \frac{[\text{ATP\_c}]}{\text{PYK\_c\_KiATP}}\right)}\right)^{\text{PYK\_c\_n}} + \frac{[\text{Pyr\_c}]}{\text{PYK\_c\_KmPyr}}\right) \cdot \left(1 + \frac{[\text{ADP\_c}]}{\text{PYK\_c\_KmADP}} + \frac{[\text{ATP\_c}]}{\text{PYK\_c\_KmATP}}\right)}$$

Table 12: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
PYK_c_Vmax	PYK_c_Vmax		1020.000		✓
PYK_c_KmPEP	PYK_c_KmPEP		0.340		✓
PYK_c_KiATP	PYK_c_KiATP		0.570		✓
PYK_c_KiADP	PYK_c_KiADP		0.640		✓
PYK_c_n	PYK_c_n		2.500		✓
PYK_c_KmADP	PYK_c_KmADP		0.114		✓
PYK_c_Keq	PYK_c_Keq		10800.000		✓
PYK_c_KmPyr	PYK_c_KmPyr		50.000		✓
PYK_c_KmATP	PYK_c_KmATP		15.000		✓

### 6.3 Reaction PFK\_g

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

**Name** PFK\_g

#### Reaction equation



## Reactants



Table 13: Properties of each reactant.

Id	Name	SBO
ATP_g	ATP_g	
Fru6P_g	Fru6P_g	

Modifiers

Table 14: Properties of each modifier.

Id	Name	SBO
Fru6P_g	Fru6P_g	
ATP_g	ATP_g	
Fru16BP_g	Fru16BP_g	
ADP_g	ADP_g	

Products

Table 15: Properties of each product.

Id	Name	SBO
Fru16BP_g	Fru16BP_g	
ADP_g	ADP_g	

Kinetic Law

**Derived unit** contains undeclared units

$$v_3 = \frac{\text{PFK\_g\_Vmax} \cdot \text{PFK\_g\_Ki1} \cdot [\text{Fru6P\_g}] \cdot [\text{ATP\_g}] \cdot \left(1 - \frac{[\text{Fru16BP\_g}]}{\text{PFK\_g\_Ki1}}\right)}{\text{PFK\_g\_KmFru6P} \cdot \text{PFK\_g\_KmATP} \cdot ([\text{Fru16BP\_g}] + \text{PFK\_g\_Ki1}) \cdot \left(\frac{\text{PFK\_g\_KsATP}}{\text{PFK\_g\_KmATP}} + \frac{[\text{Fru6P\_g}]}{\text{PFK\_g\_KmFru6P}} + \frac{[\text{ATP\_g}]}{\text{PFK\_g\_KmATP}}\right)}$$

(14)

Table 16: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
PFK_g_Vmax	PFK_g_Vmax		1708.000		✓
PFK_g_Ki1	PFK_g_Ki1		15.800		✓
PFK_g_KmFru6P	PFK_g_KmFru6P		0.999		✓

Id	Name	SBO	Value	Unit	Constant
PFK_g_KmATP	PFK_g_KmATP		0.065		<input checked="" type="checkbox"/>
PFK_g_Keq	PFK_g_Keq		1035.000		<input checked="" type="checkbox"/>
PFK_g_KsATP	PFK_g_KsATP		0.039		<input checked="" type="checkbox"/>
PFK_g_KmADP	PFK_g_KmADP		1.000		<input checked="" type="checkbox"/>
PFK_g_Ki2	PFK_g_Ki2		10.700		<input checked="" type="checkbox"/>

## 6.4 Reaction G6PDH\_g

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

**Name** G6PDH\_g

### Reaction equation



### Reactants

Table 17: Properties of each reactant.

Id	Name	SBO
Glc6P_g	Glc6P_g	
NADP_g	NADP_g	

### Modifiers

Table 18: Properties of each modifier.

Id	Name	SBO
Glc6P_g	Glc6P_g	
NADP_g	NADP_g	
\_6PGL_g	\_6PGL_g	
NADPH_g	NADPH_g	

### Products

Table 19: Properties of each product.

Id	Name	SBO
\_6PGL_g	\_6PGL_g	

Id	Name	SBO
NADPH_g	NADPH_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_4 = v_{\text{sub2prod}}(\text{G6PDH\_g\_Vmax}, \text{G6PDH\_g\_Keq}, [\text{Glc6P\_g}], \text{G6PDH\_g\_KmGlc6P}, [\text{NADP\_g}], \text{G6PDH\_g\_KmNADP}, [-\text{6PGL\_g}], \text{G6PDH\_g\_Km6PGL}, [\text{NADPH\_g}], \text{G6PDH\_g\_KmNADPH}) \quad (16)$$

$$v_{\text{sub2prod}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}}\right)} \quad (17)$$

Table 20: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
G6PDH_g_Vmax	G6PDH_g_Vmax		8.400		✓
G6PDH_g_Keq	G6PDH_g_Keq		5.020		✓
G6PDH_g-_KmGlc6P	G6PDH_g-_KmGlc6P		0.058		✓
G6PDH_g-_KmNADP	G6PDH_g-_KmNADP		0.009		✓
G6PDH_g-_Km6PGL	G6PDH_g-_Km6PGL		0.040		✓
G6PDH_g-_KmNADPH	G6PDH_g-_KmNADPH		10 <sup>-4</sup>		✓

## 6.5 Reaction PGAM\_c

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

**Name** PGAM\_c

### Reaction equation



## Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
_3PGA_c	_3PGA_c	

## Modifiers

Table 22: Properties of each modifier.

Id	Name	SBO
_3PGA_c	_3PGA_c	
_2PGA_c	_2PGA_c	

## Product

Table 23: Properties of each product.

Id	Name	SBO
_2PGA_c	_2PGA_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_5 = v_{\text{sub1prod}}(\text{PGAM\_c\_Vmax}, \text{PGAM\_c\_Keq}, [_3\text{PGA\_c}], \text{PGAM\_c\_Km3PGA}, [_2\text{PGA\_c}], \text{PGAM\_c\_Km2PGA}) \quad (19)$$

$$v_{\text{sub1prod}}(V_{\text{fmax}}, K_{\text{eq}}, S, K_{\text{s}}, P, K_{\text{p}}) = \frac{V_{\text{fmax}} \cdot S \cdot \left(1 - \frac{P}{K_{\text{eq}} \cdot S}\right)}{K_{\text{s}} \cdot \left(1 + \frac{S}{K_{\text{s}}} + \frac{P}{K_{\text{p}}}\right)} \quad (20)$$

Table 24: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
PGAM_c_Vmax	PGAM_c_Vmax		225.00		✓
PGAM_c_Keq	PGAM_c_Keq		0.17		✓
PGAM_c-_Km3PGA	PGAM_c-_Km3PGA		0.15		✓

Id	Name	SBO	Value	Unit	Constant
PGAM_c- _Km2PGA	PGAM_c- _Km2PGA		0.16		<input checked="" type="checkbox"/>

## 6.6 Reaction PyrT\_c

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

**Name** PyrT\_c

### Reaction equation



### Reactant

Table 25: Properties of each reactant.

Id	Name	SBO
Pyr_c	Pyr_c	

### Modifier

Table 26: Properties of each modifier.

Id	Name	SBO
Pyr_c	Pyr_c	

### Product

Table 27: Properties of each product.

Id	Name	SBO
Pyr_e	Pyr_e	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_6 = v_{\text{sub}}(\text{PyrT}_c\text{-Vmax}, [\text{Pyr}_c], \text{PyrT}_c\text{-KmPyr}) \quad (22)$$

$$v_{\text{sub}}(V_{\text{fmax}}, S, K_s) = \frac{V_{\text{fmax}} \cdot S}{K_s \cdot \left(1 + \frac{S}{K_s}\right)} \quad (23)$$

Table 28: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
PyrT_c_Vmax	PyrT_c_Vmax		230.00		<input checked="" type="checkbox"/>
PyrT_c_KmPyr	PyrT_c_KmPyr		1.96		<input checked="" type="checkbox"/>

## 6.7 Reaction G6PDH\_c

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

**Name** G6PDH\_c

### Reaction equation



### Reactants

Table 29: Properties of each reactant.

Id	Name	SBO
Glc6P_c	Glc6P_c	
NADP_c	NADP_c	

### Modifiers

Table 30: Properties of each modifier.

Id	Name	SBO
Glc6P_c	Glc6P_c	
NADP_c	NADP_c	
_6PGL_c	_6PGL_c	
NADPH_c	NADPH_c	

### Products

Table 31: Properties of each product.

Id	Name	SBO
NADPH_c	NADPH_c	
_6PGL_c	_6PGL_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_7 = v_{\text{sub2prod}}(\text{G6PDH\_c\_Vmax}, \text{G6PDH\_c\_Keq}, [\text{Glc6P\_c}], \text{G6PDH\_c\_KmGlc6P}, [\text{NADP\_c}], \text{G6PDH\_c\_KmNADP}, [_6\text{PGL\_c}], \text{G6PDH\_c\_Km6PGL}, [\text{NADPH\_c}], \text{G6PDH\_c\_KmNADPH}) \quad (25)$$

$$v_{\text{sub2prod}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}}\right)} \quad (26)$$

Table 32: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
G6PDH_c_Vmax	G6PDH_c_Vmax		8.400		✓
G6PDH_c_Keq	G6PDH_c_Keq		5.020		✓
G6PDH_c-_KmGlc6P	G6PDH_c-_KmGlc6P		0.058		✓
G6PDH_c-_KmNADP	G6PDH_c-_KmNADP		0.009		✓
G6PDH_c-_Km6PGL	G6PDH_c-_Km6PGL		0.040		✓
G6PDH_c-_KmNADPH	G6PDH_c-_KmNADPH		10 <sup>-4</sup>		✓

## 6.8 Reaction ENO\_c

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

**Name** ENO\_c

## Reaction equation



## Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
<u>_2PGA_c</u>	<u>_2PGA_c</u>	

## Modifiers

Table 34: Properties of each modifier.

Id	Name	SBO
<u>_2PGA_c</u>	<u>_2PGA_c</u>	
PEP_c	PEP_c	

## Product

Table 35: Properties of each product.

Id	Name	SBO
PEP_c	PEP_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_8 = v1sub1prod(ENO\_c\_Vmax, ENO\_c\_Keq, [_2PGA\_c], ENO\_c\_Km2PGA, [PEP\_c], ENO\_c\_KmPEP) \quad (28)$$

$$v1sub1prod(Vfmax, Keq, S, Ks, P, Kp) = \frac{Vfmax \cdot S \cdot \left(1 - \frac{P}{Keq \cdot S}\right)}{Ks \cdot \left(1 + \frac{S}{Ks} + \frac{P}{Kp}\right)} \quad (29)$$



Table 36: Properties of each parameter.

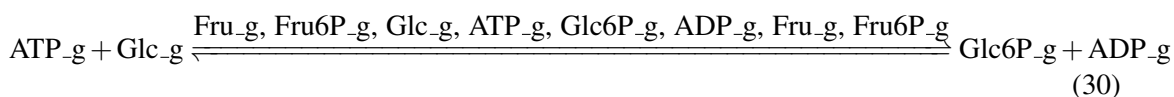
Id	Name	SBO	Value	Unit	Constant
ENO_c_Vmax	ENO_c_Vmax		598.000		<input checked="" type="checkbox"/>
ENO_c_Keq	ENO_c_Keq		4.170		<input checked="" type="checkbox"/>
ENO_c_Km2PGA	ENO_c_Km2PGA		0.054		<input checked="" type="checkbox"/>
ENO_c_KmPEP	ENO_c_KmPEP		0.240		<input checked="" type="checkbox"/>

## 6.9 Reaction HXK\_g

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

**Name** HXK\_g

### Reaction equation



### Reactants

Table 37: Properties of each reactant.

Id	Name	SBO
ATP_g	ATP_g	
Glc_g	Glc_g	

### Modifiers

Table 38: Properties of each modifier.

Id	Name	SBO
Fru_g	Fru_g	
Fru6P_g	Fru6P_g	
Glc_g	Glc_g	
ATP_g	ATP_g	
Glc6P_g	Glc6P_g	
ADP_g	ADP_g	
Fru_g	Fru_g	
Fru6P_g	Fru6P_g	

## Products

Table 39: Properties of each product.

Id	Name	SBO
Glc6P_g	Glc6P_g	
ADP_g	ADP_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_9 = v_{\text{sub2prod\_compinhib}}(\text{HXX\_g\_Vmax}, \text{HXX\_g\_Keq}, [\text{Glc\_g}], \text{HXX\_g\_KmGlc}, [\text{ATP\_g}], \text{HXX\_g\_KmATP}, [\text{Glc6P\_g}], \text{HXX\_g\_KmGlc6P}, [\text{ADP\_g}], \text{HXX\_g\_KmADP}, [\text{Fru\_g}], \text{HXX\_g\_KiFru}, [\text{Fru6P\_g}], \text{HXX\_g\_KiFru6P}) \quad (31)$$

$$v_{\text{sub2prod\_compinhib}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}, \text{I1}, \text{Ki1}, \text{I2}, \text{Ki2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}} + \frac{\text{I1}}{\text{Ki1}} + \frac{\text{I2}}{\text{Ki2}}\right)} \quad (32)$$

Table 40: Properties of each parameter.

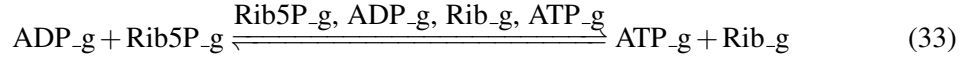
Id	Name	SBO	Value	Unit	Constant
HXX_g_Vmax	HXX_g_Vmax		1774.680		✓
HXX_g_Keq	HXX_g_Keq		759.000		✓
HXX_g_KmGlc	HXX_g_KmGlc		0.100		✓
HXX_g_KmATP	HXX_g_KmATP		0.116		✓
HXX_g_KmGlc6P	HXX_g_KmGlc6P		2.700		✓
HXX_g_KmADP	HXX_g_KmADP		0.126		✓
HXX_g_KiFru	HXX_g_KiFru		0.350		✓
HXX_g_KiFru6P	HXX_g_KiFru6P		2.700		✓

## 6.10 Reaction RK\_g

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

**Name** RK\_g

## Reaction equation



## Reactants

Table 41: Properties of each reactant.

Id	Name	SBO
ADP_g	ADP_g	
Rib5P_g	Rib5P_g	

## Modifiers

Table 42: Properties of each modifier.

Id	Name	SBO
Rib5P_g	Rib5P_g	
ADP_g	ADP_g	
Rib_g	Rib_g	
ATP_g	ATP_g	

## Products

Table 43: Properties of each product.

Id	Name	SBO
ATP_g	ATP_g	
Rib_g	Rib_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{10} = v_{2\text{sub}2\text{prod}}(\text{RK\_g\_Vmax}, \text{RK\_g\_Keq}, [\text{Rib5P\_g}], \text{RK\_g\_KmRib5P}, [\text{ADP\_g}], \text{RK\_g\_KmADP}, [\text{Rib\_g}], \text{RK\_g\_KmRib}, [\text{ATP\_g}], \text{RK\_g\_KmATP}) \quad (34)$$

$$v_{2\text{sub}2\text{prod}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}}\right)} \quad (35)$$

Table 44: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
RK_g_Vmax	RK_g_Vmax		10.000		<input checked="" type="checkbox"/>
RK_g_Keq	RK_g_Keq		0.004		<input checked="" type="checkbox"/>
RK_g_KmRib5P	RK_g_KmRib5P		0.390		<input checked="" type="checkbox"/>
RK_g_KmADP	RK_g_KmADP		0.250		<input checked="" type="checkbox"/>
RK_g_KmRib	RK_g_KmRib		0.510		<input checked="" type="checkbox"/>
RK_g_KmATP	RK_g_KmATP		0.240		<input checked="" type="checkbox"/>

### 6.11 Reaction \_3PGAT\_g

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

**Name** \_3PGAT\_g

#### Reaction equation



#### Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
_3PGA_g	_3PGA_g	

#### Modifiers

Table 46: Properties of each modifier.

Id	Name	SBO
_3PGA_g	_3PGA_g	
_3PGA_c	_3PGA_c	

#### Product

Table 47: Properties of each product.

Id	Name	SBO
_3PGA_c	_3PGA_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{11} = \text{mass\_action\_rev}(\_3\text{PGAT\_g\_k}, [\_3\text{PGA\_g}], \_3\text{PGAT\_g\_k}, [\_3\text{PGA\_c}]) \quad (37)$$

$$\text{mass\_action\_rev}(k1, S, k2, P) = k1 \cdot S - k2 \cdot P \quad (38)$$

Table 48: Properties of each parameter.

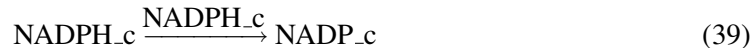
Id	Name	SBO	Value	Unit	Constant
<code>_3PGAT_g_k</code>	<code>_3PGAT_g_k</code>		250.0		<input checked="" type="checkbox"/>

## 6.12 Reaction `NADPHu_c`

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

**Name** `NADPHu_c`

### Reaction equation



### Reactant

Table 49: Properties of each reactant.

Id	Name	SBO
<code>NADPH_c</code>	<code>NADPH_c</code>	

### Modifier

Table 50: Properties of each modifier.

Id	Name	SBO
<code>NADPH_c</code>	<code>NADPH_c</code>	

### Product

Table 51: Properties of each product.

Id	Name	SBO
NADP_c	NADP_c	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{12} = \text{mass\_action\_irrev}(\text{NADPHu\_c\_k}, [\text{NADPH\_c}]) \quad (40)$$

$$\text{mass\_action\_irrev}(k, S) = k \cdot S \quad (41)$$

Table 52: Properties of each parameter.

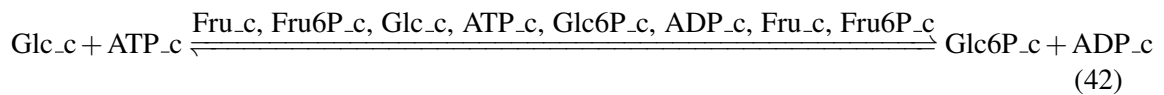
Id	Name	SBO	Value	Unit	Constant
NADPHu_c_k	NADPHu_c_k		2.0		<input checked="" type="checkbox"/>

### 6.13 Reaction HXK\_c

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

**Name** HXK\_c

#### Reaction equation



### Reactants

Table 53: Properties of each reactant.

Id	Name	SBO
Glc_c	Glc_c	
ATP_c	ATP_c	

### Modifiers

Table 54: Properties of each modifier.

Id	Name	SBO
Fru_c	Fru_c	
Fru6P_c	Fru6P_c	
Glc_c	Glc_c	
ATP_c	ATP_c	
Glc6P_c	Glc6P_c	
ADP_c	ADP_c	
Fru_c	Fru_c	
Fru6P_c	Fru6P_c	

## Products

Table 55: Properties of each product.

Id	Name	SBO
Glc6P_c	Glc6P_c	
ADP_c	ADP_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{13} = v_{2\text{sub}2\text{prod\_compinhib}}(\text{HXK\_c\_Vmax}, \text{HXK\_c\_Keq}, [\text{Glc\_c}], \text{HXK\_c\_KmGlc}, [\text{ATP\_c}], \text{HXK\_c\_KmATP}, [\text{Glc6P\_c}], \text{HXK\_c\_KmGlc6P}, [\text{ADP\_c}], \text{HXK\_c\_KmADP}, [\text{Fru\_c}], \text{HXK\_c\_KiFru}, [\text{Fru6P\_c}], \text{HXK\_c\_KiFru6P}) \quad (43)$$

$$v_{2\text{sub}2\text{prod\_compinhib}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}, \text{I1}, \text{Ki1}, \text{I2}, \text{Ki2}) \\ = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}} + \frac{\text{I1}}{\text{Ki1}} + \frac{\text{I2}}{\text{Ki2}}\right)} \quad (44)$$

Table 56: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
HXK_c_Vmax	HXK_c_Vmax		154.320		✓
HXK_c_Keq	HXK_c_Keq		759.000		✓
HXK_c_KmGlc	HXK_c_KmGlc		0.100		✓

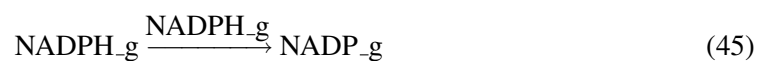
Id	Name	SBO	Value	Unit	Constant
HXX_c_KmATP	HXX_c_KmATP		0.116		<input checked="" type="checkbox"/>
HXX_c-_KmGlc6P	HXX_c_KmGlc6P		2.700		<input checked="" type="checkbox"/>
HXX_c_KmADP	HXX_c_KmADP		0.126		<input checked="" type="checkbox"/>
HXX_c_KiFru	HXX_c_KiFru		0.350		<input checked="" type="checkbox"/>
HXX_c-_KiFru6P	HXX_c_KiFru6P		2.700		<input checked="" type="checkbox"/>

## 6.14 Reaction NADPHu\_g

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

**Name** NADPHu\_g

### Reaction equation



### Reactant

Table 57: Properties of each reactant.

Id	Name	SBO
NADPH_g	NADPH_g	

### Modifier

Table 58: Properties of each modifier.

Id	Name	SBO
NADPH_g	NADPH_g	

### Product

Table 59: Properties of each product.

Id	Name	SBO
NADP_g	NADP_g	



## Kinetic Law

**Derived unit** contains undeclared units

$$v_{14} = \text{mass\_action\_irrev}(\text{NADPHu\_g\_k}, [\text{NADPH\_g}]) \quad (46)$$

$$\text{mass\_action\_irrev}(k, S) = k \cdot S \quad (47)$$

Table 60: Properties of each parameter.

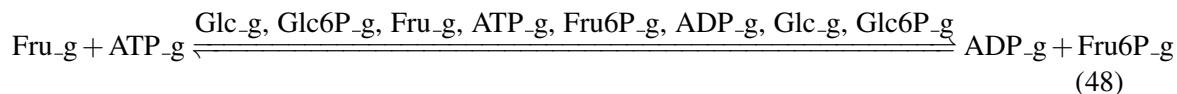
Id	Name	SBO	Value	Unit	Constant
NADPHu_g_k	NADPHu_g_k		2.0		<input checked="" type="checkbox"/>

## 6.15 Reaction HXKfru\_g

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

**Name** HXKfru\_g

### Reaction equation



## Reactants

Table 61: Properties of each reactant.

Id	Name	SBO
Fru_g	Fru_g	
ATP_g	ATP_g	

## Modifiers

Table 62: Properties of each modifier.

Id	Name	SBO
Glc_g	Glc_g	
Glc6P_g	Glc6P_g	
Fru_g	Fru_g	
ATP_g	ATP_g	

Id	Name	SBO
Fru6P_g	Fru6P_g	
ADP_g	ADP_g	
Glc_g	Glc_g	
Glc6P_g	Glc6P_g	

## Products

Table 63: Properties of each product.

Id	Name	SBO
ADP_g	ADP_g	
Fru6P_g	Fru6P_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{15} = v_{2sub2prod\_compinhib}(HXXfru\_g\_Vmax, HXXfru\_g\_K_{eq}, [Fru\_g], HXXfru\_g\_K_{mFru}, [ATP\_g], HXXfru\_g\_K_{mATP}, [Fru6P\_g], HXXfru\_g\_K_{mFru6P}, [ADP\_g], HXXfru\_g\_K_{mADP}, [Glc\_g], HXXfru\_g\_K_{iGlc}, [Glc6P\_g], HXXfru\_g\_K_{iGlc6P}) \quad (49)$$

$$v_{2sub2prod\_compinhib}(V_{fmax}, K_{eq}, S1, K_{s1}, S2, K_{s2}, P1, K_{p1}, P2, K_{p2}, I1, K_{i1}, I2, K_{i2}) = \frac{V_{fmax} \cdot S1 \cdot S2 \cdot \left(1 - \frac{P1 \cdot P2}{K_{eq} \cdot S1 \cdot S2}\right)}{K_{s1} \cdot K_{s2} \cdot \left(1 + \frac{S1}{K_{s1}} + \frac{P1}{K_{p1}}\right) \cdot \left(1 + \frac{S2}{K_{s2}} + \frac{P2}{K_{p2}} + \frac{I1}{K_{i1}} + \frac{I2}{K_{i2}}\right)} \quad (50)$$

Table 64: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
HXXfru_g-_Vmax	HXXfru_g_Vmax		1774.680		✓
HXXfru_g_Keq	HXXfru_g_Keq		631.000		✓
HXXfru_g-_KmFru	HXXfru_g_KmFru		0.350		✓
HXXfru_g-_KmATP	HXXfru_g_KmATP		0.116		✓
HXXfru_g-_KmFru6P	HXXfru_g_KmFru6P		2.700		✓

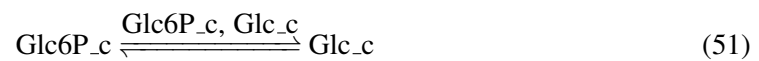
Id	Name	SBO	Value	Unit	Constant
HXXfru_g-_KmADP	HXXfru_g-_KmADP		0.126		<input checked="" type="checkbox"/>
HXXfru_g-_KiGlc	HXXfru_g_KiGlc		0.100		<input checked="" type="checkbox"/>
HXXfru_g-_KiGlc6P	HXXfru_g-_KiGlc6P		2.700		<input checked="" type="checkbox"/>

## 6.16 Reaction G6PP\_c

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

**Name** G6PP\_c

### Reaction equation



### Reactant

Table 65: Properties of each reactant.

Id	Name	SBO
Glc6P_c	Glc6P_c	

### Modifiers

Table 66: Properties of each modifier.

Id	Name	SBO
Glc6P_c	Glc6P_c	
Glc_c	Glc_c	

### Product

Table 67: Properties of each product.

Id	Name	SBO
Glc_c	Glc_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{16} = v_{1\text{sub1prod}}(\text{G6PP\_c\_Vmax}, \text{G6PP\_c\_Keq}, [\text{Glc6P\_c}], \text{G6PP\_c\_KmGlc6P}, [\text{Glc\_c}], \text{G6PP\_c\_KmGlc}) \quad (52)$$

$$v_{1\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left(1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}}\right)}{\text{Ks} \cdot \left(1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}}\right)} \quad (53)$$

Table 68: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
G6PP_c_Vmax	G6PP_c_Vmax		28.0		✓
G6PP_c_Keq	G6PP_c_Keq		263.0		✓
G6PP_c_KmGlc6P	G6PP_c_KmGlc6P		5.6		✓
G6PP_c_KmGlc	G6PP_c_KmGlc		5.6		✓

## 6.17 Reaction AK\_c

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

**Name** AK\_c

### Reaction equation



### Reactant

Table 69: Properties of each reactant.

Id	Name	SBO
ADP_c	ADP_c	

### Modifiers

Table 70: Properties of each modifier.

Id	Name	SBO
ADP_c	ADP_c	
AMP_c	AMP_c	
ATP_c	ATP_c	

## Products

Table 71: Properties of each product.

Id	Name	SBO
AMP_c	AMP_c	
ATP_c	ATP_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{17} = v_{AK}([ADP\_c], [AMP\_c], [ATP\_c], AK\_c\_k1, AK\_c\_k2) \quad (55)$$

$$v_{AK}(ADP, AMP, ATP, k1, k2) = k1 \cdot ADP^2 - AMP \cdot ATP \cdot k2 \quad (56)$$

Table 72: Properties of each parameter.

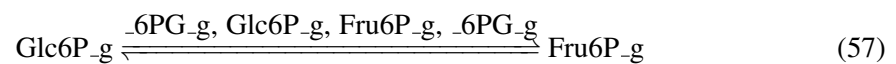
Id	Name	SBO	Value	Unit	Constant
AK_c_k1	AK_c_k1		480.0		✓
AK_c_k2	AK_c_k2		1000.0		✓

### 6.18 Reaction PGI\_g

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

**Name** PGI\_g

#### Reaction equation



#### Reactant

Table 73: Properties of each reactant.

Id	Name	SBO
Glc6P_g	Glc6P_g	

## Modifiers

Table 74: Properties of each modifier.

Id	Name	SBO
_6PG_g	_6PG_g	
Glc6P_g	Glc6P_g	
Fru6P_g	Fru6P_g	
_6PG_g	_6PG_g	

## Product

Table 75: Properties of each product.

Id	Name	SBO
Fru6P_g	Fru6P_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{18} = \frac{\text{PGI\_g\_Vmax} \cdot [\text{Glc6P\_g}] \cdot \left(1 - \frac{[\text{Fru6P\_g}]}{\text{PGI\_g\_Keq} \cdot [\text{Glc6P\_g}]}\right)}{\text{PGI\_g\_KmGlc6P} \cdot \left(1 + \frac{[\text{Glc6P\_g}]}{\text{PGI\_g\_KmGlc6P}} + \frac{[\text{Fru6P\_g}]}{\text{PGI\_g\_KmFru6P}} + \frac{[\text{\_6PG\_g}]}{\text{PGI\_g\_Ki6PG}}\right)} \quad (58)$$

Table 76: Properties of each parameter.

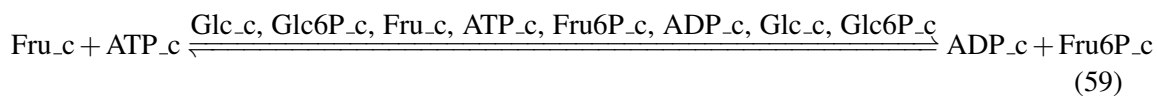
Id	Name	SBO	Value	Unit	Constant
PGI_g_Vmax	PGI_g_Vmax		1305.000		✓
PGI_g-_KmGlc6P	PGI_g_KmGlc6P		0.400		✓
PGI_g_Keq	PGI_g_Keq		0.457		✓
PGI_g-_KmFru6P	PGI_g_KmFru6P		0.120		✓
PGI_g_Ki6PG	PGI_g_Ki6PG		0.140		✓

## 6.19 Reaction HXKfru\_c

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

**Name** HXKfru\_c

### Reaction equation



### Reactants

Table 77: Properties of each reactant.

Id	Name	SBO
Fru_c	Fru_c	
ATP_c	ATP_c	

### Modifiers

Table 78: Properties of each modifier.

Id	Name	SBO
Glc_c	Glc_c	
Glc6P_c	Glc6P_c	
Fru_c	Fru_c	
ATP_c	ATP_c	
Fru6P_c	Fru6P_c	
ADP_c	ADP_c	
Glc_c	Glc_c	
Glc6P_c	Glc6P_c	

### Products

Table 79: Properties of each product.

Id	Name	SBO
ADP_c	ADP_c	
Fru6P_c	Fru6P_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{19} = v_{2\text{sub}2\text{prod\_compinhib}}(\text{HXKfru\_c\_Vmax}, \text{HXKfru\_c\_Keq}, [\text{Fru\_c}], \text{HXKfru\_c\_KmFru}, [\text{ATP\_c}], \text{HXKfru\_c\_KmATP}, [\text{Fru6P\_c}], \text{HXKfru\_c\_KmFru6P}, [\text{ADP\_c}], \text{HXKfru\_c\_KmADP}, [\text{Glc\_c}], \text{HXKfru\_c\_KiGlc}, [\text{Glc6P\_c}], \text{HXKfru\_c\_KiGlc6P}) \quad (60)$$

$$v_{2\text{sub}2\text{prod\_compinhib}}(V_{\text{fmax}}, K_{\text{eq}}, S_1, K_{s1}, S_2, K_{s2}, P_1, K_{p1}, P_2, K_{p2}, I_1, K_{i1}, I_2, K_{i2}) = \frac{V_{\text{fmax}} \cdot S_1 \cdot S_2 \cdot \left(1 - \frac{P_1 \cdot P_2}{K_{\text{eq}} \cdot S_1 \cdot S_2}\right)}{K_{s1} \cdot K_{s2} \cdot \left(1 + \frac{S_1}{K_{s1}} + \frac{P_1}{K_{p1}}\right) \cdot \left(1 + \frac{S_2}{K_{s2}} + \frac{P_2}{K_{p2}} + \frac{I_1}{K_{i1}} + \frac{I_2}{K_{i2}}\right)} \quad (61)$$

Table 80: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
HXKfru_c-Vmax	HXKfru_c_Vmax		154.320		✓
HXKfru_c-Keq	HXKfru_c_Keq		631.000		✓
HXKfru_c-KmFru	HXKfru_c_KmFru		0.350		✓
HXKfru_c-KmATP	HXKfru_c_KmATP		0.116		✓
HXKfru_c-KmFru6P	HXKfru_c_KmFru6P		2.700		✓
HXKfru_c-KmADP	HXKfru_c_KmADP		0.126		✓
HXKfru_c-KiGlc	HXKfru_c_KiGlc		0.100		✓
HXKfru_c-KiGlc6P	HXKfru_c_KiGlc6P		2.700		✓

## 6.20 Reaction TOX\_c

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

**Name** TOX\_c

### Reaction equation





## Reactant

Table 81: Properties of each reactant.

Id	Name	SBO
TSH2_c	TSH2_c	

## Modifier

Table 82: Properties of each modifier.

Id	Name	SBO
TSH2_c	TSH2_c	

## Product

Table 83: Properties of each product.

Id	Name	SBO
TS2_c	TS2_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{20} = \text{mass\_action\_irrev}(\text{TOX\_c\_k}, [\text{TSH2\_c}]) \quad (63)$$

$$\text{mass\_action\_irrev}(k, S) = k \cdot S \quad (64)$$

Table 84: Properties of each parameter.

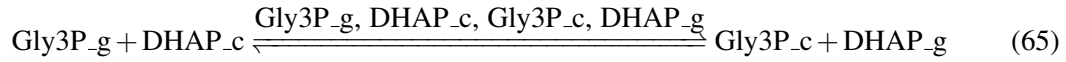
Id	Name	SBO	Value	Unit	Constant
TOX_c_k	TOX_c_k		2.0		<input checked="" type="checkbox"/>

### 6.21 Reaction GDA\_g

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

**Name** GDA\_g

## Reaction equation



## Reactants

Table 85: Properties of each reactant.

Id	Name	SBO
Gly3P_g	Gly3P_g	
DHAP_c	DHAP_c	

## Modifiers

Table 86: Properties of each modifier.

Id	Name	SBO
Gly3P_g	Gly3P_g	
DHAP_c	DHAP_c	
Gly3P_c	Gly3P_c	
DHAP_g	DHAP_g	

## Products

Table 87: Properties of each product.

Id	Name	SBO
Gly3P_c	Gly3P_c	
DHAP_g	DHAP_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{21} = [\text{Gly3P\_g}] \cdot \text{GDA\_g\_k} \cdot [\text{DHAP\_c}] - [\text{Gly3P\_c}] \cdot \text{GDA\_g\_k} \cdot [\text{DHAP\_g}] \quad (66)$$

Table 88: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
GDA_g_k	GDA_g_k		600.0		<input checked="" type="checkbox"/>

6.22 Reaction FruT\_g

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

**Name** FruT\_g

Reaction equation



Reactant

Table 89: Properties of each reactant.

Id	Name	SBO
Fru_c	Fru_c	

Modifiers

Table 90: Properties of each modifier.

Id	Name	SBO
Fru_c	Fru_c	
Fru_g	Fru_g	

Product

Table 91: Properties of each product.

Id	Name	SBO
Fru_g	Fru_g	

Kinetic Law

**Derived unit** contains undeclared units

$$v_{22} = \text{mass\_action\_rev}(\text{FruT\_g\_k1}, [\text{Fru\_c}], \text{FruT\_g\_k2}, [\text{Fru\_g}])$$

(68)

$$\text{mass\_action\_rev}(k1, S, k2, P) = k1 \cdot S - k2 \cdot P$$

(69)

Table 92: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
FruT_g_k1	FruT_g_k1		250000.0		<input checked="" type="checkbox"/>
FruT_g_k2	FruT_g_k2		250000.0		<input checked="" type="checkbox"/>

### 6.23 Reaction PGL\_c

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

**Name** PGL\_c

#### Reaction equation



#### Reactant

Table 93: Properties of each reactant.

Id	Name	SBO
<u>_6PGL_c</u>	<u>_6PGL_c</u>	

#### Modifiers

Table 94: Properties of each modifier.

Id	Name	SBO
<u>_6PGL_c</u>	<u>_6PGL_c</u>	
<u>_6PG_c</u>	<u>_6PG_c</u>	

#### Product

Table 95: Properties of each product.

Id	Name	SBO
<u>_6PG_c</u>	<u>_6PG_c</u>	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{23} = \text{PGL\_c\_k} \cdot \text{vol}(\text{cytosol}) \cdot \left( [-6\text{PGL\_c}] - \frac{[-6\text{PG\_c}]}{\text{PGL\_c\_Keq}} \right) + v_{1\text{sub1prod}}(\text{PGL\_c\_Vmax}, \text{PGL\_c\_Keq}, [-6\text{PGL\_c}], \text{PGL\_c\_Km6PGL}, [-6\text{PG\_c}], \text{PGL\_c\_Km6PG}) \quad (71)$$

$$v_{1\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left( 1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}} \right)}{\text{Ks} \cdot \left( 1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}} \right)} \quad (72)$$

$$v_{1\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left( 1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}} \right)}{\text{Ks} \cdot \left( 1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}} \right)} \quad (73)$$

Table 96: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
PGL_c_Vmax	PGL_c_Vmax		28.000		☑
PGL_c_Keq	PGL_c_Keq		20000.000		☑
PGL_c_Km6PGL	PGL_c_Km6PGL		0.050		☑
PGL_c_Km6PG	PGL_c_Km6PG		0.050		☑
PGL_c_k	PGL_c_k		0.055		☑

## 6.24 Reaction FruT\_c

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

**Name** FruT\_c

### Reaction equation



### Reactant

Table 97: Properties of each reactant.

Id	Name	SBO
Fru_e	Fru_e	

## Modifiers

Table 98: Properties of each modifier.

Id	Name	SBO
Fru_e	Fru_e	
Fru_c	Fru_c	

## Product

Table 99: Properties of each product.

Id	Name	SBO
Fru_c	Fru_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{24} = \frac{\text{FruT\_c\_Vmax} \cdot ([\text{Fru\_e}] - [\text{Fru\_c}])}{\text{FruT\_c\_KmFru} + [\text{Fru\_e}] + [\text{Fru\_c}] + \frac{\text{FruT\_c\_alpha} \cdot [\text{Fru\_e}] \cdot [\text{Fru\_c}]}{\text{FruT\_c\_KmFru}}} \quad (75)$$

Table 100: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
FruT_c_Vmax	FruT_c_Vmax		69.10		✓
FruT_c_KmFru	FruT_c_KmFru		3.91		✓
FruT_c_alpha	FruT_c_alpha		0.75		✓

## 6.25 Reaction AK\_g

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

**Name** AK\_g

### Reaction equation



## Reactant

Table 101: Properties of each reactant.

Id	Name	SBO
ADP_g	ADP_g	

## Modifiers

Table 102: Properties of each modifier.

Id	Name	SBO
ADP_g	ADP_g	
AMP_g	AMP_g	
ATP_g	ATP_g	

## Products

Table 103: Properties of each product.

Id	Name	SBO
AMP_g	AMP_g	
ATP_g	ATP_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{25} = vAK([ADP\_g], [AMP\_g], [ATP\_g], AK\_g\_k1, AK\_g\_k2) \quad (77)$$

$$vAK(ADP, AMP, ATP, k1, k2) = k1 \cdot ADP^2 - AMP \cdot ATP \cdot k2 \quad (78)$$

Table 104: Properties of each parameter.

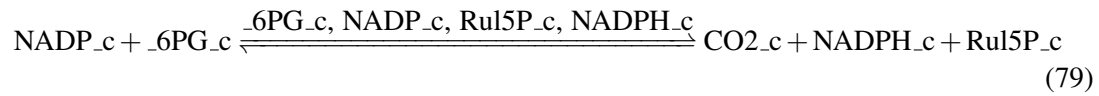
Id	Name	SBO	Value	Unit	Constant
AK_g_k1	AK_g_k1		480.0		<input checked="" type="checkbox"/>
AK_g_k2	AK_g_k2		1000.0		<input checked="" type="checkbox"/>

## 6.26 Reaction \_6PGDH\_c

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

**Name** \_6PGDH\_c

### Reaction equation



### Reactants

Table 105: Properties of each reactant.

Id	Name	SBO
NADP_c	NADP_c	
_6PG_c	_6PG_c	

### Modifiers

Table 106: Properties of each modifier.

Id	Name	SBO
_6PG_c	_6PG_c	
NADP_c	NADP_c	
Ru15P_c	Ru15P_c	
NADPH_c	NADPH_c	

### Products

Table 107: Properties of each product.

Id	Name	SBO
CO2_c	CO2_c	
NADPH_c	NADPH_c	
Ru15P_c	Ru15P_c	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{26} = v_{2\text{sub}2\text{prod}}(\text{\_6PGDH\_c\_Vmax}, \text{\_6PGDH\_c\_Keq}, [\text{\_6PG\_c}], \text{\_6PGDH\_c\_Km6PG}, [\text{NADP\_c}], \text{\_6PGDH\_c\_KmNADP}, [\text{Ru15P\_c}], \text{\_6PGDH\_c\_KmRu15P}, [\text{NADPH\_c}], \text{\_6PGDH\_c\_KmNADPH}) \quad (80)$$



$$\begin{aligned}
& v_{2\text{sub}2\text{prod}}(V_{\text{fmax}}, K_{\text{eq}}, S1, K_{\text{s1}}, S2, K_{\text{s2}}, P1, K_{\text{p1}}, P2, K_{\text{p2}}) \\
&= \frac{V_{\text{fmax}} \cdot S1 \cdot S2 \cdot \left(1 - \frac{P1 \cdot P2}{K_{\text{eq}} \cdot S1 \cdot S2}\right)}{K_{\text{s1}} \cdot K_{\text{s2}} \cdot \left(1 + \frac{S1}{K_{\text{s1}}} + \frac{P1}{K_{\text{p1}}}\right) \cdot \left(1 + \frac{S2}{K_{\text{s2}}} + \frac{P2}{K_{\text{p2}}}\right)}
\end{aligned} \tag{81}$$

Table 108: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
_6PGDH_c_Vmax	_6PGDH_c_Vmax		10.600		☑
_6PGDH_c_Keq	_6PGDH_c_Keq		47.000		☑
_6PGDH_c-	_6PGDH_c-		0.004		☑
_Km6PG	_Km6PG				
_6PGDH_c-	_6PGDH_c-		0.001		☑
_KmNADP	_KmNADP				
_6PGDH_c-	_6PGDH_c-		0.030		☑
_KmRu15P	_KmRu15P				
_6PGDH_c-	_6PGDH_c-		$6 \cdot 10^{-4}$		☑
_KmNADPH	_KmNADPH				

## 6.27 Reaction PPI\_c

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

**Name** PPI\_c

### Reaction equation



### Reactant

Table 109: Properties of each reactant.

Id	Name	SBO
Ru15P_c	Ru15P_c	

### Modifiers

Table 110: Properties of each modifier.

Id	Name	SBO
Rul5P_c	Rul5P_c	
Rib5P_c	Rib5P_c	

## Product

Table 111: Properties of each product.

Id	Name	SBO
Rib5P_c	Rib5P_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{27} = v_{\text{sub1prod}}(\text{PPI\_c\_Vmax}, \text{PPI\_c\_Keq}, [\text{Rul5P\_c}], \text{PPI\_c\_KmRul5P}, [\text{Rib5P\_c}], \text{PPI\_c\_KmRib5P}) \quad (83)$$

$$v_{\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left(1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}}\right)}{\text{Ks} \cdot \left(1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}}\right)} \quad (84)$$

Table 112: Properties of each parameter.

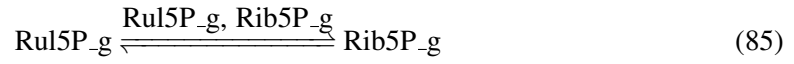
Id	Name	SBO	Value	Unit	Constant
PPI_c_Vmax	PPI_c_Vmax		72.0		✓
PPI_c_Keq	PPI_c_Keq		5.6		✓
PPI_c-_KmRul5P	PPI_c_KmRul5P		1.4		✓
PPI_c-_KmRib5P	PPI_c_KmRib5P		4.0		✓

## 6.28 Reaction PPI\_g

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

**Name** PPI\_g

## Reaction equation



## Reactant

Table 113: Properties of each reactant.

Id	Name	SBO
Rul5P_g	Rul5P_g	

## Modifiers

Table 114: Properties of each modifier.

Id	Name	SBO
Rul5P_g	Rul5P_g	
Rib5P_g	Rib5P_g	

## Product

Table 115: Properties of each product.

Id	Name	SBO
Rib5P_g	Rib5P_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{28} = v_{\text{sub1prod}}(\text{PPI\_g\_Vmax}, \text{PPI\_g\_Keq}, [\text{Rul5P\_g}], \text{PPI\_g\_KmRul5P}, [\text{Rib5P\_g}], \text{PPI\_g\_KmRib5P}) \quad (86)$$

$$v_{\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left(1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}}\right)}{\text{Ks} \cdot \left(1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}}\right)} \quad (87)$$

Table 116: Properties of each parameter.

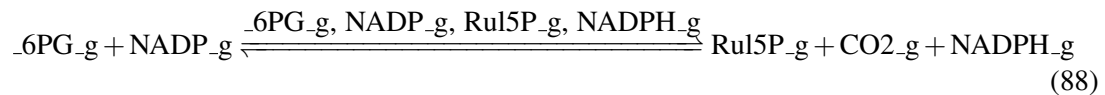
Id	Name	SBO	Value	Unit	Constant
PPI_g_Vmax	PPI_g_Vmax		72.0		<input checked="" type="checkbox"/>
PPI_g_Keq	PPI_g_Keq		5.6		<input checked="" type="checkbox"/>
PPI_g- _KmRul5P	PPI_g_KmRul5P		1.4		<input checked="" type="checkbox"/>
PPI_g- _KmRib5P	PPI_g_KmRib5P		4.0		<input checked="" type="checkbox"/>

### 6.29 Reaction \_6PGDH\_g

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

**Name** \_6PGDH\_g

#### Reaction equation



#### Reactants

Table 117: Properties of each reactant.

Id	Name	SBO
_6PG_g	_6PG_g	
NADP_g	NADP_g	

#### Modifiers

Table 118: Properties of each modifier.

Id	Name	SBO
_6PG_g	_6PG_g	
NADP_g	NADP_g	
Rul5P_g	Rul5P_g	
NADPH_g	NADPH_g	

#### Products

Table 119: Properties of each product.

Id	Name	SBO
Ru15P_g	Ru15P_g	
CO2_g	CO2_g	
NADPH_g	NADPH_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{29} = v_{2\text{sub}2\text{prod}}(_6\text{PGDH\_g\_Vmax}, _6\text{PGDH\_g\_Keq}, [_6\text{PG\_g}], _6\text{PGDH\_g\_Km6PG}, \\ [_\text{NADP\_g}], _6\text{PGDH\_g\_KmNADP}, [\text{Ru15P\_g}], _6\text{PGDH\_g\_KmRu15P}, \\ [_\text{NADPH\_g}], _6\text{PGDH\_g\_KmNADPH}) \quad (89)$$

$$v_{2\text{sub}2\text{prod}}(V_{\text{fmax}}, K_{\text{eq}}, S_1, K_{s1}, S_2, K_{s2}, P_1, K_{p1}, P_2, K_{p2}) \\ = \frac{V_{\text{fmax}} \cdot S_1 \cdot S_2 \cdot \left(1 - \frac{P_1 \cdot P_2}{K_{\text{eq}} \cdot S_1 \cdot S_2}\right)}{K_{s1} \cdot K_{s2} \cdot \left(1 + \frac{S_1}{K_{s1}} + \frac{P_1}{K_{p1}}\right) \cdot \left(1 + \frac{S_2}{K_{s2}} + \frac{P_2}{K_{p2}}\right)} \quad (90)$$

Table 120: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
_6PGDH_g_Vmax	_6PGDH_g_Vmax		10.600		✓
_6PGDH_g_Keq	_6PGDH_g_Keq		47.000		✓
_6PGDH_g-_Km6PG	_6PGDH_g-_Km6PG		0.004		✓
_6PGDH_g-_KmNADP	_6PGDH_g-_KmNADP		0.001		✓
_6PGDH_g-_KmRu15P	_6PGDH_g-_KmRu15P		0.030		✓
_6PGDH_g-_KmNADPH	_6PGDH_g-_KmNADPH		$6 \cdot 10^{-4}$		✓

## 6.30 Reaction GlcT\_g

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

**Name** GlcT\_g

## Reaction equation



## Reactant

Table 121: Properties of each reactant.

Id	Name	SBO
Glc_c	Glc_c	

## Modifiers

Table 122: Properties of each modifier.

Id	Name	SBO
Glc_c	Glc_c	
Glc_g	Glc_g	

## Product

Table 123: Properties of each product.

Id	Name	SBO
Glc_g	Glc_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{30} = \text{mass\_action\_rev}(\text{GlcT\_g\_k1}, [\text{Glc\_c}], \text{GlcT\_g\_k2}, [\text{Glc\_g}]) \quad (92)$$

$$\text{mass\_action\_rev}(k1, S, k2, P) = k1 \cdot S - k2 \cdot P \quad (93)$$

Table 124: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
GlcT_g_k1	GlcT_g_k1		250000.0		<input checked="" type="checkbox"/>
GlcT_g_k2	GlcT_g_k2		250000.0		<input checked="" type="checkbox"/>

### 6.31 Reaction GlcT\_c

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

**Name** GlcT\_c

#### Reaction equation



#### Reactant

Table 125: Properties of each reactant.

Id	Name	SBO
Glc_e	Glc_e	

#### Modifiers

Table 126: Properties of each modifier.

Id	Name	SBO
Glc_e	Glc_e	
Glc_c	Glc_c	

#### Product

Table 127: Properties of each product.

Id	Name	SBO
Glc_c	Glc_c	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{31} = \frac{\text{GlcT\_c\_Vmax} \cdot ([\text{Glc\_e}] - [\text{Glc\_c}])}{\text{GlcT\_c\_KmGlc} + [\text{Glc\_e}] + [\text{Glc\_c}] + \frac{\text{GlcT\_c\_alpha} \cdot [\text{Glc\_e}] \cdot [\text{Glc\_c}]}{\text{GlcT\_c\_KmGlc}}} \quad (95)$$

Table 128: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
GlcT_c_Vmax	GlcT_c_Vmax		111.70		<input checked="" type="checkbox"/>
GlcT_c_KmGlc	GlcT_c_KmGlc		1.00		<input checked="" type="checkbox"/>
GlcT_c_alpha	GlcT_c_alpha		0.75		<input checked="" type="checkbox"/>

### 6.32 Reaction PGL\_g

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

**Name** PGL\_g

#### Reaction equation



#### Reactant

Table 129: Properties of each reactant.

Id	Name	SBO
_{6PGL\_g}	_{6PGL\_g}	

#### Modifiers

Table 130: Properties of each modifier.

Id	Name	SBO
_{6PGL\_g}	_{6PGL\_g}	
_{6PG\_g}	_{6PG\_g}	

#### Product

Table 131: Properties of each product.

Id	Name	SBO
_{6PG\_g}	_{6PG\_g}	



## Kinetic Law

**Derived unit** contains undeclared units

$$v_{32} = \text{vol}(\text{glycosome}) \cdot \text{PGL\_g\_k} \cdot \left( [-6\text{PGL\_g}] - \frac{[-6\text{PG\_g}]}{\text{PGL\_g\_Keq}} \right) + v_{1\text{sub1prod}}(\text{PGL\_g\_Vmax}, \text{PGL\_g\_Keq}, [-6\text{PGL\_g}], \text{PGL\_g\_Km6PGL}, [-6\text{PG\_g}], \text{PGL\_g\_Km6PG}) \quad (97)$$

$$v_{1\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left( 1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}} \right)}{\text{Ks} \cdot \left( 1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}} \right)} \quad (98)$$

$$v_{1\text{sub1prod}}(\text{Vfmax}, \text{Keq}, \text{S}, \text{Ks}, \text{P}, \text{Kp}) = \frac{\text{Vfmax} \cdot \text{S} \cdot \left( 1 - \frac{\text{P}}{\text{Keq} \cdot \text{S}} \right)}{\text{Ks} \cdot \left( 1 + \frac{\text{S}}{\text{Ks}} + \frac{\text{P}}{\text{Kp}} \right)} \quad (99)$$

Table 132: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
PGL_g_Vmax	PGL_g_Vmax		5.000		✓
PGL_g_Keq	PGL_g_Keq		20000.000		✓
PGL_g_Km6PGL	PGL_g_Km6PGL		0.050		✓
PGL_g_Km6PG	PGL_g_Km6PG		0.050		✓
PGL_g_k	PGL_g_k		0.055		✓

### 6.33 Reaction TR\_c

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

**Name** TR\_c

#### Reaction equation



#### Reactants

Table 133: Properties of each reactant.

Id	Name	SBO
TS2_c	TS2_c	
NADPH_c	NADPH_c	

## Modifiers

Table 134: Properties of each modifier.

Id	Name	SBO
TS2_c	TS2_c	
NADPH_c	NADPH_c	
TSH2_c	TSH2_c	
NADP_c	NADP_c	

## Products

Table 135: Properties of each product.

Id	Name	SBO
NADP_c	NADP_c	
TSH2_c	TSH2_c	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{33} = v_{2\text{sub}2\text{prod}}(\text{TR\_c\_Vmax}, \text{TR\_c\_Keq}, [\text{TS2\_c}], \text{TR\_c\_KmTS2}, [\text{NADPH\_c}], \text{TR\_c\_KmNADPH}, [\text{TSH2\_c}], \text{TR\_c\_KmTSH2}, [\text{NADP\_c}], \text{TR\_c\_KmNADP}) \quad (101)$$

$$v_{2\text{sub}2\text{prod}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}}\right)} \quad (102)$$

Table 136: Properties of each parameter.

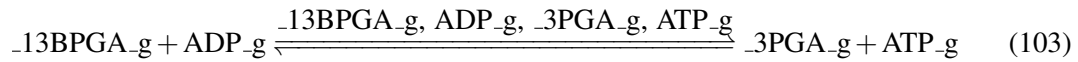
Id	Name	SBO	Value	Unit	Constant
TR_c_Vmax	TR_c_Vmax		252.000		<input checked="" type="checkbox"/>
TR_c_Keq	TR_c_Keq		434.000		<input checked="" type="checkbox"/>
TR_c_KmTS2	TR_c_KmTS2		0.007		<input checked="" type="checkbox"/>
TR_c_KmNADPH	TR_c_KmNADPH		$7.7 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
TR_c_KmTSH2	TR_c_KmTSH2		0.002		<input checked="" type="checkbox"/>
TR_c_KmNADP	TR_c_KmNADP		0.081		<input checked="" type="checkbox"/>

### 6.34 Reaction PGK\_g

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

**Name** PGK\_g

#### Reaction equation



#### Reactants

Table 137: Properties of each reactant.

Id	Name	SBO
_13BPGA_g	_13BPGA_g	
ADP_g	ADP_g	

#### Modifiers

Table 138: Properties of each modifier.

Id	Name	SBO
_13BPGA_g	_13BPGA_g	
ADP_g	ADP_g	
_3PGA_g	_3PGA_g	
ATP_g	ATP_g	

#### Products

Table 139: Properties of each product.

Id	Name	SBO
_3PGA_g	_3PGA_g	
ATP_g	ATP_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{34} = v_{\text{sub2prod}}(\text{PGK\_g\_Vmax}, \text{PGK\_g\_Keq}, [_{13}\text{BPGA\_g}], \text{PGK\_g\_Km13BPGA}, [\text{ADP\_g}], \text{PGK\_g\_KmADP}, [_{3}\text{PGA\_g}], \text{PGK\_g\_Km3PGA}, [\text{ATP\_g}], \text{PGK\_g\_KmATP}) \quad (104)$$

$$v_{\text{sub2prod}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}}\right)} \quad (105)$$

Table 140: Properties of each parameter.

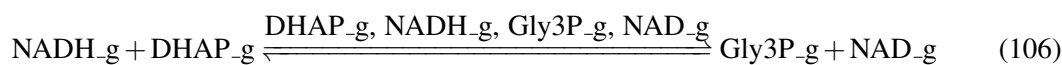
Id	Name	SBO	Value	Unit	Constant
PGK_g_Vmax	PGK_g_Vmax		2862.000		✓
PGK_g_Keq	PGK_g_Keq		3377.000		✓
PGK_g-_Km13BPGA	PGK_g-_Km13BPGA		0.003		✓
PGK_g_KmADP	PGK_g_KmADP		0.100		✓
PGK_g_Km3PGA	PGK_g_Km3PGA		1.620		✓
PGK_g_KmATP	PGK_g_KmATP		0.290		✓

## 6.35 Reaction G3PDH\_g

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

**Name** G3PDH\_g

## Reaction equation



## Reactants

Table 141: Properties of each reactant.

Id	Name	SBO
NADH_g	NADH_g	
DHAP_g	DHAP_g	

## Modifiers

Table 142: Properties of each modifier.

Id	Name	SBO
DHAP_g	DHAP_g	
NADH_g	NADH_g	
Gly3P_g	Gly3P_g	
NAD_g	NAD_g	

## Products

Table 143: Properties of each product.

Id	Name	SBO
Gly3P_g	Gly3P_g	
NAD_g	NAD_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{35} = v_{2\text{sub}2\text{prod}}(G3PDH\_g\_Vmax, G3PDH\_g\_Keq, [DHAP\_g], G3PDH\_g\_KmDHAP, [NADH\_g], G3PDH\_g\_KmNADH, [Gly3P\_g], G3PDH\_g\_KmGly3P, [NAD\_g], G3PDH\_g\_KmNAD) \quad (107)$$

$$v_{2\text{sub}2\text{prod}}(Vfmax, Keq, S1, Ks1, S2, Ks2, P1, Kp1, P2, Kp2) = \frac{Vfmax \cdot S1 \cdot S2 \cdot \left(1 - \frac{P1 \cdot P2}{Keq \cdot S1 \cdot S2}\right)}{Ks1 \cdot Ks2 \cdot \left(1 + \frac{S1}{Ks1} + \frac{P1}{Kp1}\right) \cdot \left(1 + \frac{S2}{Ks2} + \frac{P2}{Kp2}\right)} \quad (108)$$

Table 144: Properties of each parameter.

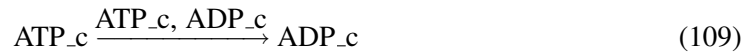
Id	Name	SBO	Value	Unit	Constant
G3PDH_g_Vmax	G3PDH_g_Vmax		465.00		<input checked="" type="checkbox"/>
G3PDH_g_Keq	G3PDH_g_Keq		17085.00		<input checked="" type="checkbox"/>
G3PDH_g-_KmDHAP	G3PDH_g-_KmDHAP		0.10		<input checked="" type="checkbox"/>
G3PDH_g-_KmNADH	G3PDH_g-_KmNADH		0.01		<input checked="" type="checkbox"/>
G3PDH_g-_KmGly3P	G3PDH_g-_KmGly3P		2.00		<input checked="" type="checkbox"/>
G3PDH_g-_KmNAD	G3PDH_g-_KmNAD		0.40		<input checked="" type="checkbox"/>

### 6.36 Reaction ATP\_u\_c

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

**Name** ATP\_u\_c

#### Reaction equation



#### Reactant

Table 145: Properties of each reactant.

Id	Name	SBO
ATP_c	ATP_c	

#### Modifiers

Table 146: Properties of each modifier.

Id	Name	SBO
ATP_c	ATP_c	
ADP_c	ADP_c	

#### Product

Table 147: Properties of each product.

Id	Name	SBO
ADP_c	ADP_c	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{36} = \frac{\text{ATPu\_c\_k} \cdot [\text{ATP\_c}]}{[\text{ADP\_c}]} \quad (110)$$

Table 148: Properties of each parameter.

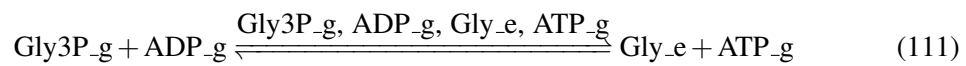
Id	Name	SBO	Value	Unit	Constant
ATPu_c_k	ATPu_c_k		50.0		<input checked="" type="checkbox"/>

### 6.37 Reaction GK\_g

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

**Name** GK\_g

#### Reaction equation



#### Reactants

Table 149: Properties of each reactant.

Id	Name	SBO
Gly3P_g	Gly3P_g	
ADP_g	ADP_g	

#### Modifiers

Table 150: Properties of each modifier.

Id	Name	SBO
Gly3P_g	Gly3P_g	

Id	Name	SBO
ADP_g	ADP_g	
Gly_e	Gly_e	
ATP_g	ATP_g	

## Products

Table 151: Properties of each product.

Id	Name	SBO
Gly_e	Gly_e	
ATP_g	ATP_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{37} = v_{\text{sub2prod}}(\text{GK\_g\_Vmax}, \text{GK\_g\_Keq}, [\text{Gly3P\_g}], \text{GK\_g\_KmGly3P}, [\text{ADP\_g}], \text{GK\_g\_KmADP}, [\text{Gly\_e}], \text{GK\_g\_KmGly}, [\text{ATP\_g}], \text{GK\_g\_KmATP}) \quad (112)$$

$$v_{\text{sub2prod}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}}\right)} \quad (113)$$

Table 152: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
GK_g_Vmax	GK_g_Vmax		200.000		✓
GK_g_Keq	GK_g_Keq		$8.37 \cdot 10^{-4}$		✓
GK_g_KmGly3P	GK_g_KmGly3P		3.830		✓
GK_g_KmADP	GK_g_KmADP		0.560		✓
GK_g_KmGly	GK_g_KmGly		0.440		✓
GK_g_KmATP	GK_g_KmATP		0.240		✓

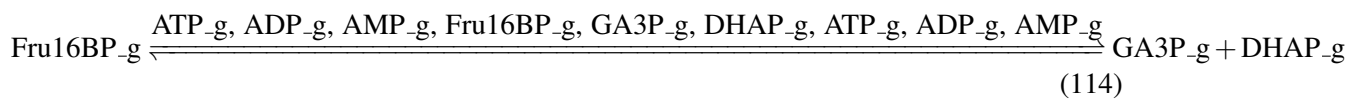
## 6.38 Reaction ALD\_g

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



**Name** ALD\_g

### Reaction equation



### Reactant

Table 153: Properties of each reactant.

Id	Name	SBO
Fru16BP_g	Fru16BP_g	

### Modifiers

Table 154: Properties of each modifier.

Id	Name	SBO
ATP_g	ATP_g	
ADP_g	ADP_g	
AMP_g	AMP_g	
Fru16BP_g	Fru16BP_g	
GA3P_g	GA3P_g	
DHAP_g	DHAP_g	
ATP_g	ATP_g	
ADP_g	ADP_g	
AMP_g	AMP_g	

### Products

Table 155: Properties of each product.

Id	Name	SBO
GA3P_g	GA3P_g	
DHAP_g	DHAP_g	

### Kinetic Law

**Derived unit** contains undeclared units

$$= \frac{\text{ALD\_g\_KmFru16BP} \cdot \left(1 + \frac{[\text{ATP\_g}]}{\text{ALD\_g\_KiATP}} + \frac{[\text{ADP\_g}]}{\text{ALD\_g\_KiADP}} + \frac{[\text{AMP\_g}]}{\text{ALD\_g\_KiAMP}}\right) \cdot \left(1 + \frac{[\text{GA3P\_g}]}{\text{ALD\_g\_KmGA3P}} + \frac{[\text{DHAP\_g}]}{\text{ALD\_g\_KmDHAP}} + \dots\right)}{\dots}$$

Table 156: Properties of each parameter.

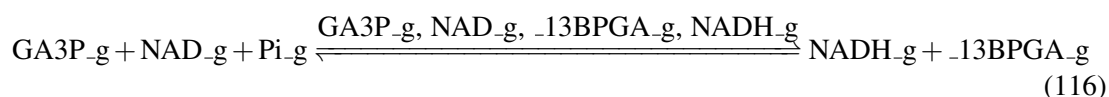
Id	Name	SBO	Value	Unit	Constant
ALD_g_Vmax	ALD_g_Vmax		560.000		✓
ALD_g_-	ALD_g_-		0.009		✓
_KmFru16BP	_KmFru16BP				
ALD_g_KiATP	ALD_g_KiATP		0.680		✓
ALD_g_KiADP	ALD_g_KiADP		1.510		✓
ALD_g_KiAMP	ALD_g_KiAMP		3.650		✓
ALD_g_Keq	ALD_g_Keq		0.084		✓
ALD_g_KmGA3P	ALD_g_KmGA3P		0.067		✓
ALD_g_KmDHAP	ALD_g_KmDHAP		0.015		✓
ALD_g_KiGA3P	ALD_g_KiGA3P		0.098		✓

### 6.39 Reaction GAPDH\_g

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

**Name** GAPDH\_g

#### Reaction equation



#### Reactants

Table 157: Properties of each reactant.

Id	Name	SBO
GA3P_g	GA3P_g	
NAD_g	NAD_g	
Pi_g	Pi_g	

#### Modifiers

Table 158: Properties of each modifier.

Id	Name	SBO
GA3P_g	GA3P_g	
NAD_g	NAD_g	
_13BPGA_g	_13BPGA_g	
NADH_g	NADH_g	

## Products

Table 159: Properties of each product.

Id	Name	SBO
NADH_g	NADH_g	
_13BPGA_g	_13BPGA_g	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{39} = v_{2\text{sub}2\text{prod}}(\text{GAPDH\_g\_Vmax}, \text{GAPDH\_g\_Keq}, [\text{GA3P\_g}], \text{GAPDH\_g\_KmGA3P}, [\text{NAD\_g}], \text{GAPDH\_g\_KmNAD}, [_{13}\text{BPGA\_g}], \text{GAPDH\_g\_Km13BPGA}, [\text{NADH\_g}], \text{GAPDH\_g\_KmNADH}) \quad (117)$$

$$v_{2\text{sub}2\text{prod}}(\text{Vfmax}, \text{Keq}, \text{S1}, \text{Ks1}, \text{S2}, \text{Ks2}, \text{P1}, \text{Kp1}, \text{P2}, \text{Kp2}) = \frac{\text{Vfmax} \cdot \text{S1} \cdot \text{S2} \cdot \left(1 - \frac{\text{P1} \cdot \text{P2}}{\text{Keq} \cdot \text{S1} \cdot \text{S2}}\right)}{\text{Ks1} \cdot \text{Ks2} \cdot \left(1 + \frac{\text{S1}}{\text{Ks1}} + \frac{\text{P1}}{\text{Kp1}}\right) \cdot \left(1 + \frac{\text{S2}}{\text{Ks2}} + \frac{\text{P2}}{\text{Kp2}}\right)} \quad (118)$$

Table 160: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
GAPDH_g_Vmax	GAPDH_g_Vmax		720.900		✓
GAPDH_g_Keq	GAPDH_g_Keq		0.066		✓
GAPDH_g-_KmGA3P	GAPDH_g-_KmGA3P		0.150		✓
GAPDH_g-_KmNAD	GAPDH_g-_KmNAD		0.450		✓
GAPDH_g-_Km13BPGA	GAPDH_g-_Km13BPGA		0.100		✓

Id	Name	SBO	Value	Unit	Constant
GAPDH_g- _KmNADH	GAPDH_g- _KmNADH		0.020		<input checked="" type="checkbox"/>

#### 6.40 Reaction GPO\_c

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

**Name** GPO\_c

#### Reaction equation



#### Reactant

Table 161: Properties of each reactant.

Id	Name	SBO
Gly3P_c	Gly3P_c	

#### Modifier

Table 162: Properties of each modifier.

Id	Name	SBO
Gly3P_c	Gly3P_c	

#### Product

Table 163: Properties of each product.

Id	Name	SBO
DHAP_c	DHAP_c	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{40} = v_{1\text{sub}}(\text{GPO}_c.V_{\text{max}}, [\text{Gly3P}_c], \text{GPO}_c.K_{\text{mGly3P}}) \quad (120)$$

$$v_{\text{sub}}(V_{\text{fmax}}, S, K_s) = \frac{V_{\text{fmax}} \cdot S}{K_s \cdot \left(1 + \frac{S}{K_s}\right)} \quad (121)$$

Table 164: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
GPO_c_Vmax	GPO_c_Vmax		368.0		✓
GPO_c-_KmGly3P	GPO_c_KmGly3P		1.7		✓

## 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 Fru\_e

**Name** Fru\_e

**Initial concentration** 5 nmol · μl<sup>-1</sup>

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

$$\frac{d}{dt} \text{Fru}_e = 0 \quad (122)$$

### 7.2 Species \_2PGA\_c

**Name** \_2PGA\_c

**Initial concentration** 0.1 nmol · μl<sup>-1</sup>

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

$$\frac{d}{dt} \text{_2PGA}_c = v_5 - v_8 \quad (123)$$

### 7.3 Species Fru<sub>g</sub>

**Name** Fru<sub>g</sub>

**Initial concentration** 0.1 nmol · μl<sup>-1</sup>

This species takes part in six reactions (as a reactant in HXKfru<sub>g</sub> and as a product in FruT<sub>g</sub> and as a modifier in HXK<sub>g</sub>, HXK<sub>g</sub>, HXKfru<sub>g</sub>, FruT<sub>g</sub>).

$$\frac{d}{dt}\text{Fru}_g = v_{22} - v_{15} \quad (124)$$

### 7.4 Species Fru<sub>c</sub>

**Name** Fru<sub>c</sub>

**Initial concentration** 0.1 nmol · μl<sup>-1</sup>

This species takes part in eight reactions (as a reactant in HXKfru<sub>c</sub>, FruT<sub>g</sub> and as a product in FruT<sub>c</sub> and as a modifier in HXK<sub>c</sub>, HXK<sub>c</sub>, HXKfru<sub>c</sub>, FruT<sub>g</sub>, FruT<sub>c</sub>).

$$\frac{d}{dt}\text{Fru}_c = v_{24} - v_{19} - v_{22} \quad (125)$$

### 7.5 Species DHAP<sub>c</sub>

**Name** DHAP<sub>c</sub>

**Initial concentration** 2.23132912 nmol · μl<sup>-1</sup>

This species takes part in three reactions (as a reactant in GDA<sub>g</sub> and as a product in GPO<sub>c</sub> and as a modifier in GDA<sub>g</sub>).

$$\frac{d}{dt}\text{DHAP}_c = v_{40} - v_{21} \quad (126)$$

### 7.6 Species ATP<sub>g</sub>

**Name** ATP<sub>g</sub>

**Initial concentration** 0.2405 nmol · μl<sup>-1</sup>

This species takes part in 16 reactions (as a reactant in PFK<sub>g</sub>, HXK<sub>g</sub>, HXKfru<sub>g</sub> and as a product in RK<sub>g</sub>, AK<sub>g</sub>, PGK<sub>g</sub>, GK<sub>g</sub> and as a modifier in PFK<sub>g</sub>, HXK<sub>g</sub>, RK<sub>g</sub>, HXKfru<sub>g</sub>, AK<sub>g</sub>, PGK<sub>g</sub>, GK<sub>g</sub>, ALD<sub>g</sub>, ALD<sub>g</sub>).

$$\frac{d}{dt}\text{ATP}_g = v_{10} + v_{25} + v_{34} + v_{37} - v_3 - v_9 - v_{15} \quad (127)$$

## 7.7 Species DHAP\_g

**Name** DHAP\_g

**Initial concentration** 8.483130623 nmol · μl<sup>-1</sup>

This species takes part in eight reactions (as a reactant in [TPI\\_g](#), [G3PDH\\_g](#) and as a product in [GDA\\_g](#), [ALD\\_g](#) and as a modifier in [TPI\\_g](#), [GDA\\_g](#), [G3PDH\\_g](#), [ALD\\_g](#)).

$$\frac{d}{dt}\text{DHAP}_g = v_{21} + v_{38} - v_1 - v_{35} \quad (128)$$

## 7.8 Species ADP\_g

**Name** ADP\_g

**Initial concentration** 1.519 nmol · μl<sup>-1</sup>

This species takes part in 16 reactions (as a reactant in [RK\\_g](#), [AK\\_g](#), [PGK\\_g](#), [GK\\_g](#) and as a product in [PFK\\_g](#), [HXK\\_g](#), [HXKfru\\_g](#) and as a modifier in [PFK\\_g](#), [HXK\\_g](#), [RK\\_g](#), [HXKfru\\_g](#), [AK\\_g](#), [PGK\\_g](#), [GK\\_g](#), [ALD\\_g](#), [ALD\\_g](#)).

$$\frac{d}{dt}\text{ADP}_g = v_3 + v_9 + v_{15} - v_{10} - 2v_{25} - v_{34} - v_{37} \quad (129)$$

## 7.9 Species Glc6P\_g

**Name** Glc6P\_g

**Initial concentration** 0.5 nmol · μl<sup>-1</sup>

This species takes part in eight reactions (as a reactant in [G6PDH\\_g](#), [PGI\\_g](#) and as a product in [HXK\\_g](#) and as a modifier in [G6PDH\\_g](#), [HXK\\_g](#), [HXKfru\\_g](#), [HXKfru\\_g](#), [PGI\\_g](#)).

$$\frac{d}{dt}\text{Glc6P}_g = v_9 - v_4 - v_{18} \quad (130)$$

## 7.10 Species ADP\_c

**Name** ADP\_c

**Initial concentration** 1.3165 nmol · μl<sup>-1</sup>

This species takes part in ten reactions (as a reactant in [PYK\\_c](#), [AK\\_c](#) and as a product in [HXK\\_c](#), [HXKfru\\_c](#), [ATPu\\_c](#) and as a modifier in [PYK\\_c](#), [HXK\\_c](#), [AK\\_c](#), [HXKfru\\_c](#), [ATPu\\_c](#)).

$$\frac{d}{dt}\text{ADP}_c = v_{13} + v_{19} + v_{36} - v_2 - 2v_{17} \quad (131)$$

### 7.11 Species [\\_3PGA\\_c](#)

**Name** [\\_3PGA\\_c](#)

**Initial concentration**  $0.1 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a reactant in [PGAM\\_c](#) and as a product in [\\_3PGAT\\_g](#) and as a modifier in [PGAM\\_c](#), [\\_3PGAT\\_g](#)).

$$\frac{d}{dt} \text{_3PGA\_c} = v_{11} - v_5 \quad (132)$$

### 7.12 Species [NADPH\\_c](#)

**Name** [NADPH\\_c](#)

**Initial concentration**  $3.9 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in eight reactions (as a reactant in [NADPHu\\_c](#), [TR\\_c](#) and as a product in [G6PDH\\_c](#), [\\_6PGDH\\_c](#) and as a modifier in [G6PDH\\_c](#), [NADPHu\\_c](#), [\\_6PGDH\\_c](#), [TR\\_c](#)).

$$\frac{d}{dt} \text{NADPH\_c} = v_7 + v_{26} - v_{12} - v_{33} \quad (133)$$

### 7.13 Species [Fru6P\\_g](#)

**Name** [Fru6P\\_g](#)

**Initial concentration**  $0.5 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in eight reactions (as a reactant in [PFK\\_g](#) and as a product in [HXKfru\\_g](#), [PGI\\_g](#) and as a modifier in [PFK\\_g](#), [HXK\\_g](#), [HXKfru\\_g](#), [PGI\\_g](#)).

$$\frac{d}{dt} \text{Fru6P\_g} = v_{15} + v_{18} - v_3 \quad (134)$$

### 7.14 Species [Fru6P\\_c](#)

**Name** [Fru6P\\_c](#)

**Initial concentration**  $0.9 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a product in [HXKfru\\_c](#) and as a modifier in [HXK\\_c](#), [HXK\\_c](#), [HXKfru\\_c](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt} \text{Fru6P\_c} = 0 \quad (135)$$



### 7.15 Species $\text{Pi}_g$

**Name**  $\text{Pi}_g$

**Initial concentration**  $0 \text{ nmol} \cdot \mu\text{l}^{-1}$

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

$$\frac{d}{dt}\text{Pi}_g = 0 \quad (136)$$

### 7.16 Species $\text{O2}_c$

**Name**  $\text{O2}_c$

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

$$\frac{d}{dt}\text{O2}_c = 0 \quad (137)$$

### 7.17 Species $\text{NADP}_c$

**Name**  $\text{NADP}_c$

**Initial concentration**  $0.1 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in seven reactions (as a reactant in [G6PDH\\_c](#), [\\_6PGDH\\_c](#) and as a product in [NADPHu\\_c](#), [TR\\_c](#) and as a modifier in [G6PDH\\_c](#), [\\_6PGDH\\_c](#), [TR\\_c](#)).

$$\frac{d}{dt}\text{NADP}_c = v_{12} + v_{33} - v_7 - v_{26} \quad (138)$$

### 7.18 Species $\text{ATP}_c$

**Name**  $\text{ATP}_c$

**Initial concentration**  $0.3417 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in ten reactions (as a reactant in [H XK\\_c](#), [H XKfru\\_c](#), [ATPu\\_c](#) and as a product in [PYK\\_c](#), [AK\\_c](#) and as a modifier in [PYK\\_c](#), [H XK\\_c](#), [AK\\_c](#), [H XKfru\\_c](#), [ATPu\\_c](#)).

$$\frac{d}{dt}\text{ATP}_c = v_2 + v_{17} - v_{13} - v_{19} - v_{36} \quad (139)$$

### 7.19 Species NADP\_g

**Name** NADP\_g

**Initial concentration**  $0.1 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in five reactions (as a reactant in G6PDH\_g, \_6PGDH\_g and as a product in NADPHu\_g and as a modifier in G6PDH\_g, \_6PGDH\_g).

$$\frac{d}{dt}\text{NADP\_g} = v_{14} - v_4 - v_{29} \quad (140)$$

### 7.20 Species \_6PG\_g

**Name** \_6PG\_g

**Initial concentration**  $0.0841958 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in six reactions (as a reactant in \_6PGDH\_g and as a product in PGL\_g and as a modifier in PGI\_g, PGI\_g, \_6PGDH\_g, PGL\_g).

$$\frac{d}{dt}\text{_6PG\_g} = v_{32} - v_{29} \quad (141)$$

### 7.21 Species CO2\_c

**Name** CO2\_c

**Initial concentration**  $0 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in one reaction (as a product in \_6PGDH\_c), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{CO2\_c} = 0 \quad (142)$$

### 7.22 Species Ru15P\_c

**Name** Ru15P\_c

**Initial concentration**  $0.41282 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a reactant in PPI\_c and as a product in \_6PGDH\_c and as a modifier in \_6PGDH\_c, PPI\_c).

$$\frac{d}{dt}\text{Ru15P\_c} = v_{26} - v_{27} \quad (143)$$

### 7.23 Species [\\_6PG\\_c](#)

**Name** [\\_6PG\\_c](#)

**Initial concentration**  $0.0841958 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a reactant in [\\_6PGDH\\_c](#) and as a product in [PGL\\_c](#) and as a modifier in [PGL\\_c](#), [\\_6PGDH\\_c](#)).

$$\frac{d}{dt} \text{\_6PG\_c} = v_{23} - v_{26} \quad (144)$$

### 7.24 Species [Rul5P\\_g](#)

**Name** [Rul5P\\_g](#)

**Initial concentration**  $0.41282 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a reactant in [PPI\\_g](#) and as a product in [\\_6PGDH\\_g](#) and as a modifier in [PPI\\_g](#), [\\_6PGDH\\_g](#)).

$$\frac{d}{dt} \text{Rul5P\_g} = v_{29} - v_{28} \quad (145)$$

### 7.25 Species [Glc6P\\_c](#)

**Name** [Glc6P\\_c](#)

**Initial concentration**  $0.5 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in eight reactions (as a reactant in [G6PDH\\_c](#), [G6PP\\_c](#) and as a product in [H XK\\_c](#) and as a modifier in [G6PDH\\_c](#), [H XK\\_c](#), [G6PP\\_c](#), [H XKfru\\_c](#), [H XKfru\\_c](#)).

$$\frac{d}{dt} \text{Glc6P\_c} = v_{13} - v_7 - v_{16} \quad (146)$$

### 7.26 Species [Rib5P\\_c](#)

**Name** [Rib5P\\_c](#)

**Initial concentration**  $0.01 \text{ nmol} \cdot \mu\text{l}^{-1}$

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

$$\frac{d}{dt} \text{Rib5P\_c} = 0 \quad (147)$$

### 7.27 Species `_13BPGA_g`

**Name** `_13BPGA_g`

**Initial concentration**  $0.5 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a reactant in `PGK_g` and as a product in `GAPDH_g` and as a modifier in `PGK_g`, `GAPDH_g`).

$$\frac{d}{dt} \text{\_13BPGA\_g} = v_{39} - v_{34} \quad (148)$$

### 7.28 Species `Glc_c`

**Name** `Glc_c`

**Initial concentration**  $0.1 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in ten reactions (as a reactant in `HXK_c`, `GlcT_g` and as a product in `G6PP_c`, `GlcT_c` and as a modifier in `HXK_c`, `G6PP_c`, `HXKfru_c`, `HXKfru_g`, `GlcT_g`, `GlcT_c`).

$$\frac{d}{dt} \text{Glc\_c} = v_{16} + v_{31} - v_{13} - v_{30} \quad (149)$$

### 7.29 Species `Rib5P_g`

**Name** `Rib5P_g`

**Initial concentration**  $0.01 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a reactant in `RK_g` and as a product in `PPI_g` and as a modifier in `RK_g`, `PPI_g`).

$$\frac{d}{dt} \text{Rib5P\_g} = v_{28} - v_{10} \quad (150)$$

### 7.30 Species `Glc_g`

**Name** `Glc_g`

**Initial concentration**  $0.1 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in six reactions (as a reactant in `HXK_g` and as a product in `GlcT_g` and as a modifier in `HXK_g`, `HXKfru_g`, `HXKfru_g`, `GlcT_g`).

$$\frac{d}{dt} \text{Glc\_g} = v_{30} - v_9 \quad (151)$$

### 7.31 Species Glc\_e

**Name** Glc\_e

**Initial concentration** 5 nmol · μl<sup>-1</sup>

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

$$\frac{d}{dt}\text{Glc}_e = 0 \quad (152)$$

### 7.32 Species NADPH\_g

**Name** NADPH\_g

**Initial concentration** 3.9 nmol · μl<sup>-1</sup>

This species takes part in six reactions (as a reactant in NADPHu\_g and as a product in G6PDH\_g, \_6PGDH\_g and as a modifier in G6PDH\_g, NADPHu\_g, \_6PGDH\_g).

$$\frac{d}{dt}\text{NADPH}_g = v_4 + v_{29} - v_{14} \quad (153)$$

### 7.33 Species Rib\_g

**Name** Rib\_g

**Initial concentration** 0.01 nmol · μl<sup>-1</sup>

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

$$\frac{d}{dt}\text{Rib}_g = 0 \quad (154)$$

### 7.34 Species Pyr\_c

**Name** Pyr\_c

**Initial concentration** 10 nmol · μl<sup>-1</sup>

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

$$\frac{d}{dt}\text{Pyr}_c = v_2 - v_6 \quad (155)$$

### 7.35 Species `Pyr_e`

**Name** `Pyr_e`

**Initial concentration**  $0 \text{ nmol} \cdot \mu\text{l}^{-1}$

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

$$\frac{d}{dt}\text{Pyr}_e = 0 \quad (156)$$

### 7.36 Species `NAD_g`

**Name** `NAD_g`

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

This species takes part in four reactions (as a reactant in `GAPDH_g` and as a product in `G3PDH_g` and as a modifier in `G3PDH_g`, `GAPDH_g`).

$$\frac{d}{dt}\text{NAD}_g = v_{35} - v_{39} \quad (157)$$

### 7.37 Species `Fru16BP_g`

**Name** `Fru16BP_g`

**Initial concentration**  $10 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in four reactions (as a reactant in `ALD_g` and as a product in `PFK_g` and as a modifier in `PFK_g`, `ALD_g`).

$$\frac{d}{dt}\text{Fru16BP}_g = v_3 - v_{38} \quad (158)$$

### 7.38 Species `GA3P_g`

**Name** `GA3P_g`

**Initial concentration**  $2.5 \text{ nmol} \cdot \mu\text{l}^{-1}$

This species takes part in six reactions (as a reactant in `GAPDH_g` and as a product in `TPI_g`, `ALD_g` and as a modifier in `TPI_g`, `ALD_g`, `GAPDH_g`).

$$\frac{d}{dt}\text{GA3P}_g = v_1 + v_{38} - v_{39} \quad (159)$$

### 7.39 Species Gly\_e

**Name** Gly\_e

**Initial concentration** 0 nmol · μl<sup>-1</sup>

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

$$\frac{d}{dt}\text{Gly}_e = 0 \quad (160)$$

### 7.40 Species TSH2\_c

**Name** TSH2\_c

**Initial concentration** 0.01 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a reactant in TOX\_c and as a product in TR\_c and as a modifier in TOX\_c, TR\_c).

$$\frac{d}{dt}\text{TSH2}_c = v_{33} - v_{20} \quad (161)$$

### 7.41 Species CO2\_g

**Name** CO2\_g

**Initial concentration** 0 nmol · μl<sup>-1</sup>

This species takes part in one reaction (as a product in 6PGDH\_g), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{CO2}_g = 0 \quad (162)$$

### 7.42 Species Gly3P\_c

**Name** Gly3P\_c

**Initial concentration** 2.76867088 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a reactant in GP0\_c and as a product in GDA\_g and as a modifier in GDA\_g, GP0\_c).

$$\frac{d}{dt}\text{Gly3P}_c = v_{21} - v_{40} \quad (163)$$

### 7.43 Species Gly3P\_g

**Name** Gly3P\_g

**Initial concentration** 10.51686938 nmol · μl<sup>-1</sup>

This species takes part in six reactions (as a reactant in GDA\_g, GK\_g and as a product in G3PDH\_g and as a modifier in GDA\_g, G3PDH\_g, GK\_g).

$$\frac{d}{dt}\text{Gly3P\_g} = v_{35} - v_{21} - v_{37} \quad (164)$$

### 7.44 Species \_6PGL\_c

**Name** \_6PGL\_c

**Initial concentration** 0.0795278 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a reactant in PGL\_c and as a product in G6PDH\_c and as a modifier in G6PDH\_c, PGL\_c).

$$\frac{d}{dt}\text{_6PGL\_c} = v_7 - v_{23} \quad (165)$$

### 7.45 Species TS2\_c

**Name** TS2\_c

**Initial concentration** 0.37 nmol · μl<sup>-1</sup>

This species takes part in three reactions (as a reactant in TR\_c and as a product in TOX\_c and as a modifier in TR\_c).

$$\frac{d}{dt}\text{TS2\_c} = v_{20} - v_{33} \quad (166)$$

### 7.46 Species \_6PGL\_g

**Name** \_6PGL\_g

**Initial concentration** 0.0795278 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a reactant in PGL\_g and as a product in G6PDH\_g and as a modifier in G6PDH\_g, PGL\_g).

$$\frac{d}{dt}\text{_6PGL\_g} = v_4 - v_{32} \quad (167)$$



### 7.47 Species PEP\_c

**Name** PEP\_c

**Initial concentration** 1 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a reactant in [PYK\\_c](#) and as a product in [ENO\\_c](#) and as a modifier in [PYK\\_c](#), [ENO\\_c](#)).

$$\frac{d}{dt}\text{PEP}_c = v_8 - v_2 \quad (168)$$

### 7.48 Species AMP\_g

**Name** AMP\_g

**Initial concentration** 4.2405 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a product in [AK\\_g](#) and as a modifier in [AK\\_g](#), [ALD\\_g](#), [ALD\\_g](#)).

$$\frac{d}{dt}\text{AMP}_g = v_{25} \quad (169)$$

### 7.49 Species \_3PGA\_g

**Name** \_3PGA\_g

**Initial concentration** 0.1 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a reactant in [\\_3PGAT\\_g](#) and as a product in [PGK\\_g](#) and as a modifier in [\\_3PGAT\\_g](#), [PGK\\_g](#)).

$$\frac{d}{dt}\text{_3PGA}_g = v_{34} - v_{11} \quad (170)$$

### 7.50 Species AMP\_c

**Name** AMP\_c

**Initial concentration** 2.2418 nmol · μl<sup>-1</sup>

This species takes part in two reactions (as a product in [AK\\_c](#) and as a modifier in [AK\\_c](#)).

$$\frac{d}{dt}\text{AMP}_c = v_{17} \quad (171)$$

## 7.51 Species NADH\_g

**Name** NADH\_g

**Initial concentration** 2 nmol · μl<sup>-1</sup>

This species takes part in four reactions (as a reactant in G3PDH\_g and as a product in GAPDH\_g and as a modifier in G3PDH\_g, GAPDH\_g).

$$\frac{d}{dt}\text{NADH}_g = v_{39} - v_{35} \quad (172)$$

## A Glossary of Systems Biology Ontology Terms

**SBO:0000290 physical compartment:** Specific location of space, that can be bounded or not.  
A physical compartment can have 1, 2 or 3 dimensions

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