SBML Model Report

Model name: "Tyson2001_Cell_Cycle_Regulation"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 3 format. This model was created by Lukas Endler[1] at February 26th 2009 at 10:08 a. m. and last time modified at April eighth 2016 at 3:46 p. m. Table 1 shows an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	11
events	1	constraints	0
reactions	20	function definitions	1
global parameters	37	unit definitions	2
rules	4	initial assignments	0

Model Notes

This model describes the budding yeast cell cycle model used in fig 8 a in
Regulation of the eukaryotic cell cycle: molecular antagonism, hysteresis, and irreversible transitions.
Tyson JJ and Novak B., **J Theor Biol** 2001 May;210(2):249-63.
It consitsts of the equations (2)-(8), with mu=0.005 min $^{-1}$. It was taken from Cell Cycle DB (

[1] EMBL-EBI, lukas@ebi.ac.uk

file) and only slightly altered.

To cite BioModels Database, please use: Li C, Donizelli M, Rodriguez N, Dharuri H, Endler L, Chelliah V, Li L, He E, Henry A, Stefan MI, Snoep JL, Hucka M, Le Novre N, Laibe C (2010) BioModels Database: An enhanced, curated and annotated resource for published quantitative kinetic models. BMC Syst Biol., 4:92.

2 Unit Definitions

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

2.1 Unit `substance`

Name normalized

Definition dimensionless

2.2 Unit `time`

Name minutes

Definition 60 s

2.3 Unit `volume`

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

Definition l

2.4 Unit `area`

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

Definition m^2

2.5 Unit `length`

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

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

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

3.1 Compartment `cell`

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

Name cell

4 Species

This model contains eleven species. Section 10 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
CycBt	CycBt	cell	dimensionless	⊟	⊟
CycB	CycB	cell	dimensionless	⊟	⊟
Cdc20a	Cdc20a	cell	dimensionless	⊟	⊟
Trimer	Trimer	cell	dimensionless	⊟	⊟
Cdh1	Cdh1	cell	dimensionless	⊟	⊟
m	m	cell	dimensionless	⊟	⊟
Cdc20t	Cdc20t	cell	dimensionless	⊟	⊟
IEP	IEP	cell	dimensionless	⊟	⊟
Mad	Mad	cell	dimensionless	⊟	⊟
CKIt	CKIt	cell	dimensionless	⊟	⊟
SK	SK	cell	dimensionless	⊟	⊟

5 Parameters

This model contains 37 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.040		☑
k2p	k2p		0.040		☑
k2pp	k2pp		1.000		☑
k2ppp	k2ppp		1.000		☑
k3p	k3p		1.000		☑
k3pp	k3pp		10.000		☑
J3	J3		0.040		☑
k4	k4		35.000		☑
k5p	k5p		0.005		☑
k5pp	k5pp		0.200		☑
J5	J5		0.300		☑
k6	k6		0.100		☑
n	n		4.000		☑
k7	k7		1.000		☑
J7	J7		0.001		☑
k8	k8		0.500		☑
J8	J8		0.001		☑
k9	k9		0.100		☑
k10	k10		0.020		☑
mu	mu		0.005		☑
k11	k11		1.000		☑
k12p	k12p		0.200		☑
k12pp	k12pp		50.000		☑
mmax	mmax		10.000		☑
k12ppp	k12ppp		100.000		☑
Keq	Keq		1000.000		☑
k13	k13		1.000		☑
k14	k14		1.000		☑
k15p	k15p		1.500		☑
k15pp	k15pp		0.050		☑
k16p	k16p		1.000		☑
k16pp	k16pp		3.000		☑
J15	J15		0.010		☑
J16	J16		0.010		☑
k4p	k4p		2.000		☑
J4	J4		0.040		☑
TF	TF		0.000		☐

Id	Name	SBO	Value	Unit	Constant

6 Function definition

This is an overview of one function definition.

6.1 Function definition GK

Name Goldbeter Koshland Function

Arguments A1, A2, A3, A4

Mathematical Expression

$$\frac{2 \cdot \mathrm{A4} \cdot \mathrm{A1}}{\mathrm{A2} - \mathrm{A1} + \mathrm{A3} \cdot \mathrm{A2} + \mathrm{A4} \cdot \mathrm{A1} + \sqrt{(\mathrm{A2} - \mathrm{A1} + \mathrm{A3} \cdot \mathrm{A2} + \mathrm{A4} \cdot \mathrm{A1})^2 - 4 \cdot (\mathrm{A2} - \mathrm{A1}) \cdot \mathrm{A4} \cdot \mathrm{A1}}} \tag{1}$$

7 Rules

This is an overview of four rules.

7.1 Rule CycB

Rule CycB is an assignment rule for species CycB:

$$[\mathrm{CycB}] = \mathrm{CycBt} - \frac{2 \cdot \mathrm{CycBt} \cdot \mathrm{CKIt}}{\mathrm{CycBt} + \mathrm{CKIt} + \frac{1}{\mathrm{Keq}} + \left(\left(\mathrm{CycBt} + \mathrm{CKIt} + \frac{1}{\mathrm{Keq}}\right)^2 - 4 \cdot \mathrm{CycBt} \cdot \mathrm{CKIt}\right)^{\frac{1}{2}}} \tag{2}$$

7.2 Rule Trimer

Rule Trimer is an assignment rule for species Trimer:

$$[\mathrm{Trimer}] = \frac{2 \cdot \mathrm{CycBt} \cdot \mathrm{CKIt}}{\mathrm{CycBt} + \mathrm{CKIt} + \frac{1}{\mathrm{Keq}} + \left(\left(\mathrm{CycBt} + \mathrm{CKIt} + \frac{1}{\mathrm{Keq}}\right)^2 - 4 \cdot \mathrm{CycBt} \cdot \mathrm{CKIt}\right)^{\frac{1}{2}}} \tag{3}$$

7.3 Rule TF

Rule TF is an assignment rule for parameter TF:

$$\mathrm{TF} = \mathrm{GK}\left(\mathrm{k15p} \cdot \mathrm{m} + \mathrm{k15pp} \cdot \mathrm{SK}, \mathrm{k16p} + \mathrm{k16pp} \cdot \mathrm{m} \cdot \mathrm{CycB}, \mathrm{J15}, \mathrm{J16}\right) \tag{4}$$

7.4 Rule Mad

Rule Mad is an assignment rule for species Mad:

$$[\text{Mad}] = 1 \tag{5}$$

8 Event

This is an overview of one event. Each event is initiated whenever its trigger condition switches from false to true. A delay function postpones the effects of an event to a later time point. At the time of execution, an event can assign values to species, parameters or compartments if these are not set to constant.

8.1 Event event_0

Name Cell division

Trigger condition

$$\text{CycB} < 0.1 \tag{6}$$

Delay

$$0 \tag{7}$$

Assignment

$$[\text{m}] = \frac{\text{m}}{2} \tag{8}$$

9 Reactions

This model contains 20 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	CycBt_synthesis	CycBt synthesis	$\emptyset \longrightarrow$ CycBt	
2	CycBdegradation	CycBt degradation	CycBt $\longrightarrow \emptyset$	
3	CycBdegradationviaCdh1	CycBt degradation via Cdh1	CycBt $\xrightarrow{\text{Cdh1}} \emptyset$	
4	CycBtdegradationviaCdc20a	CycBt degradation via Cdc20a	CycBt $\xrightarrow{\text{Cdc20a}} \emptyset$	
5	Cdh1synthesis	Cdh1 synthesis	$\emptyset \xrightarrow{\text{Cdc20a}}$ Cdh1	
6	Cdh1degradation	Cdh1 degradation	Cdh1 $\xrightarrow{\text{SK, m, CycB}} \emptyset$	
7	Cdc20tsynthesis	Cdc20t synthesis	$\emptyset \xrightarrow{\text{CycB, m}}$ Cdc20t	
8	Cdc20t_deg	Cdc20t degradation	Cdc20t $\longrightarrow \emptyset$	
9	Cdc20activation	Cdc20 activation	$\emptyset \xrightarrow{\text{Cdc20t, IEP}}$ Cdc20a	
10	Cdc20ainhibition	Cdc20a inhibition	Cdc20a $\xrightarrow{\text{Mad}} \emptyset$	
11	Cdc20adegradation	Cdc20a degradation	Cdc20a $\longrightarrow \emptyset$	
12	IEPsynthesis	IEP synthesis	$\emptyset \xrightarrow{\text{m, CycB}}$ IEP	
13	IEPdegradation	IEP degradation	IEP $\longrightarrow \emptyset$	
14	growth	growth	$\emptyset \longrightarrow$ m	
15	CKItsynthesis	CKIt synthesis	$\emptyset \longrightarrow$ CKIt	
16	CKIdegradation	CKIt degradation	CKIt $\longrightarrow \emptyset$	
17	CKItphosphorilationviaSK	CKIt phosphorilation via SK	CKIt $\xrightarrow{\text{SK}} \emptyset$	
18	eq_7	CKIt Trimer sequestred	CKIt $\xrightarrow{\text{m, CycB}} \emptyset$	
19	SKsynthesis	SK synthesis	$\emptyset \longrightarrow$ SK	

№	Id	Name	Reaction Equation	SBO
20	SKdegradation	SK degradation	SK $\longrightarrow \emptyset$	

9.1 Reaction CycBt_synthesis

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

Name CycBt synthesis

Reaction equation

$$\emptyset \longrightarrow \text{CycBt} \tag{9}$$

Product

Table 6: Properties of each product.

Id	Name	SBO
CycBt	CycBt	

Kinetic Law

SBO:0000047 mass action rate law for zeroth order irreversible reactions, continuous scheme

Derived unit not available

$$v_1 = \text{k1} \tag{10}$$

9.2 Reaction CycBdegradation

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

Name CycBt degradation

Reaction equation

$$\text{CycBt} \longrightarrow \emptyset \tag{11}$$

Reactant

Table 7: Properties of each reactant.

Id	Name	SBO
CycBt	CycBt	

Kinetic Law

SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme

Derived unit contains undeclared units

$$v_2 = \mathrm{k2p} \cdot \mathrm{CycBt} \tag{12}$$

9.3 Reaction CycBdegradationviaCdh1

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

Name CycBt degradation via Cdh1

Reaction equation

$$\mathrm{CycBt} \xrightarrow{\mathrm{Cdh1}} \emptyset \tag{13}$$

Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
CycBt	CycBt	

Modifier

Table 9: Properties of each modifier.

Id	Name	SBO
Cdh1	Cdh1	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{k2pp} \cdot \mathrm{Cdh1} \cdot \mathrm{CycBt} \tag{14}$$

9.4 Reaction CycBtdegradationviaCdc20a

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

Name CycBt degradation via Cdc20a

Reaction equation

$$\text{CycBt} \xrightarrow{\text{Cdc20a}} \emptyset \tag{15}$$

Reactant

Table 10: Properties of each reactant.

Id	Name	SBO
CycBt	CycBt	

Modifier

Table 11: Properties of each modifier.

Id	Name	SBO
Cdc20a	Cdc20a	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{k2ppp} \cdot \text{Cdc20a} \cdot \text{CycBt} \tag{16}$$

9.5 Reaction Cdh1synthesis

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

Name Cdh1 synthesis

Reaction equation

$$\emptyset \xrightarrow{\text{Cdc20a}} \text{Cdh1} \tag{17}$$

Modifier

Table 12: Properties of each modifier.

Id	Name	SBO
Cdc20a	Cdc20a	

Product

Table 13: Properties of each product.

Id	Name	SBO
Cdh1	Cdh1	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \frac{(\mathrm{k3p} + \mathrm{k3pp} \cdot \mathrm{Cdc20a}) \cdot (1 - \mathrm{Cdh1})}{\mathrm{J3} + 1 - \mathrm{Cdh1}} \tag{18}$$

9.6 Reaction Cdh1degradation

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

Name Cdh1 degradation

Reaction equation

$$\mathrm{Cdh1} \xrightarrow{\mathrm{SK,\ m,\ CycB}} \emptyset \tag{19}$$

Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
Cdh1	Cdh1	

Modifiers

Table 15: Properties of each modifier.

Id	Name	SBO
SK	SK	
m	m	
CycB	CycB	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \frac{\mathrm{k4p} \cdot \mathrm{SK} \cdot \mathrm{Cdh1} + \mathrm{k4} \cdot \mathrm{m} \cdot \mathrm{CycB} \cdot \mathrm{Cdh1}}{\mathrm{J4} + \mathrm{Cdh1}} \tag{20}$$

9.7 Reaction `Cdc20tsynthesis`

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

Name Cdc20t synthesis

Reaction equation

$$\emptyset \xrightarrow{\mathrm{CycB},\ \mathrm{m}} \mathrm{Cdc20t} \tag{21}$$

Modifiers

Table 16: Properties of each modifier.

Id	Name	SBO
`CycB`	CycB	
`m`	m	

Product

Table 17: Properties of each product.

Id	Name	SBO
`Cdc20t`	Cdc20t	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{k5p} + \frac{\mathrm{k5pp} \cdot \left(\frac{\mathrm{CycB} \cdot \mathrm{m}}{\mathrm{J5}}\right)^{\mathrm{n}}}{1 + \left(\frac{\mathrm{CycB} \cdot \mathrm{m}}{\mathrm{J5}}\right)^{\mathrm{n}}} \tag{22}$$

9.8 Reaction `Cdc20t_deg`

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

Name Cdc20t degradation

Reaction equation

$$\text{Cdc20t} \longrightarrow \emptyset \tag{23}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
Cdc20t	Cdc20t	

Kinetic Law

SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme

Derived unit contains undeclared units

$$v_8 = \text{k6} \cdot \text{Cdc20t} \tag{24}$$

9.9 Reaction Cdc20activation

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

Name Cdc20 activation

Reaction equation

$$\emptyset \xrightarrow{\text{Cdc20t, IEP}} \text{Cdc20a} \tag{25}$$

Modifiers

Table 19: Properties of each modifier.

Id	Name	SBO
Cdc20t	Cdc20t	
IEP	IEP	

Product

Table 20: Properties of each product.

Id	Name	SBO
Cdc20a	Cdc20a	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \frac{\mathrm{k7} \cdot \mathrm{IEP} \cdot (\mathrm{Cdc20t} - \mathrm{Cdc20a})}{\mathrm{J7} + \mathrm{Cdc20t} - \mathrm{Cdc20a}} \tag{26}$$

9.10 Reaction Cdc20ainhibition

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

Name Cdc20a inhibition

Reaction equation

$$\mathrm{Cdc20a} \xrightarrow{\mathrm{Mad}} \emptyset \tag{27}$$

Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
Cdc20a	Cdc20a	

Modifier

Table 22: Properties of each modifier.

Id	Name	SBO
Mad	Mad	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \frac{\mathrm{k8} \cdot \mathrm{Mad} \cdot \mathrm{Cdc20a}}{\mathrm{J8} + \mathrm{Cdc20a}} \tag{28}$$

9.11 Reaction Cdc20adegradation

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

Name Cdc20a degradation

Reaction equation

$$\text{Cdc20a} \longrightarrow \emptyset \tag{29}$$

Reactant

Table 23: Properties of each reactant.

Id	Name	SBO
Cdc20a	Cdc20a	

Kinetic Law

SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme

Derived unit contains undeclared units

$$v_{11} = \text{k6} \cdot \text{Cdc20a} \tag{30}$$

9.12 Reaction IEPsynthesis

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

Name IEP synthesis

Reaction equation

$$\emptyset \xrightarrow{\text{m, CycB}} \text{IEP} \tag{31}$$

Modifiers

Table 24: Properties of each modifier.

Id	Name	SBO
m	m	
CycB	CycB	

Product

Table 25: Properties of each product.

Id	Name	SBO
IEP	IEP	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \mathrm{k9} \cdot \mathrm{m} \cdot \mathrm{CycB} \cdot (1 - \mathrm{IEP}) \tag{32}$$

9.13 Reaction IEPdegradation

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

Name IEP degradation

Reaction equation

$$\mathrm{IEP} \longrightarrow \emptyset \tag{33}$$

Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
IEP	IEP	

Kinetic Law

SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme

Derived unit contains undeclared units

$$v_{13} = \mathrm{k10} \cdot \mathrm{IEP} \tag{34}$$

9.14 Reaction growth

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

Name growth

Reaction equation

$$\emptyset \longrightarrow \mathrm{m} \tag{35}$$

Product

Table 27: Properties of each product.

Id	Name	SBO
m	m	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \mathrm{mu} \cdot \mathrm{m} \cdot \left(1 - \frac{\mathrm{m}}{\mathrm{mmax}}\right) \tag{36}$$

9.15 Reaction CKItsynthesis

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

Name CKIt synthesis

Reaction equation

$$\emptyset \longrightarrow \mathrm{CKIt} \tag{37}$$

Product

Table 28: Properties of each product.

Id	Name	SBO
CKIt	CKIt	

Kinetic Law

SBO:0000047 mass action rate law for zeroth order irreversible reactions, continuous scheme

Derived unit not available

$$v_{15} = \mathrm{k11} \tag{38}$$

9.16 Reaction CKIdegradation

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

Name CKIt degradation

Reaction equation

$$\text{CKIt} \longrightarrow \emptyset \tag{39}$$

Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
CKIt	CKIt	

Kinetic Law

SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme

Derived unit contains undeclared units

$$v_{16} = \text{k12p} \cdot \text{CKIt} \tag{40}$$

9.17 Reaction CKItphosphorilationviaSK

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

Name CKIt phosphorilation via SK

Reaction equation

$$\text{CKIt} \xrightarrow{\text{SK}} \emptyset \tag{41}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
CKIt	CKIt	

Modifier

Table 31: Properties of each modifier.

Id	Name	SBO
SK	SK	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \text{k12pp} \cdot \text{SK} \cdot \text{CKIt} \tag{42}$$

9.18 Reaction eq_7

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

Name CKIt Trimer sequestred

Reaction equation

$$\text{CKIt} \xrightarrow{\text{m, CycB}} \emptyset \tag{43}$$

Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
CKIt	CKIt	

Modifiers

Table 33: Properties of each modifier.

Id	Name	SBO
m	m	
CycB	CycB	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \text{k12ppp} \cdot \text{m} \cdot \text{CycB} \cdot \text{CKIt} \tag{44}$$

9.19 Reaction SKsynthesis

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

Name SK synthesis

Reaction equation

$$\emptyset \longrightarrow \mathrm{SK} \tag{45}$$

Product

Table 34: Properties of each product.

Id	Name	SBO
SK	SK	

Kinetic Law

Derived unit not available

$$v_{19} = \mathrm{k13} \cdot \mathrm{TF} \tag{46}$$

9.20 Reaction SKdegradation

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

Name SK degradation

Reaction equation

$$\mathrm{SK} \longrightarrow \emptyset \tag{47}$$

Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
SK	SK	

Kinetic Law

SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme

Derived unit contains undeclared units

$$v_{20} = \mathrm{k14} \cdot \mathrm{SK} \tag{48}$$

10 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.

10.1 Species CycBt

Name CycBt

Initial amount 0.0010 dimensionless

This species takes part in four reactions (as a reactant in CycBdegradation, CycBdegradationviaCdh1, CycBtdegradationviaCdc20a and as a product in CycBt_synthesis).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CycBt} = v_1 - v_2 - v_3 - v_4 \tag{49}$$

10.2 Species CycB

Name CycB

Involved in rule CycB

This species takes part in four reactions (as a modifier in Cdh1degradation, Cdc20tsynthesis, IEPsynthesis, eq_7) and is also involved in one rule which determines this species' quantity.

10.3 Species Cdc20a

Name Cdc20a

Initial amount 0.0010 dimensionless

This species takes part in five reactions (as a reactant in Cdc20ainhibition, Cdc20adegradation and as a product in Cdc20activation and as a modifier in CycBtdegradationviaCdc20a, Cdh1synthesis).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Cdc20a} = v_9 - v_{10} - v_{11} \tag{50}$$

10.4 Species Trimer

Name Trimer

Involved in rule Trimer

One rule which determines this species' quantity.

10.5 Species Cdh1

Name Cdh1

Initial amount 0.0010 dimensionless

This species takes part in three reactions (as a reactant in Cdh1degradation and as a product in Cdh1synthesis and as a modifier in CycBdegradationviaCdh1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Cdh1} = v_5 - v_6 \tag{51}$$

10.6 Species m

Name m

Initial amount 0.5 dimensionless

Involved in event event_0

This species takes part in five reactions (as a product in growth and as a modifier in Cdh1degradation, Cdc20tsynthesis, IEPsynthesis, eq_7).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{m} = v_{14} \tag{52}$$

Furthermore, one event influences this species' rate of change.

10.7 Species Cdc20t

Name Cdc20t

Initial amount 0.0010 dimensionless

This species takes part in three reactions (as a reactant in Cdc20t_deg and as a product in Cdc20tsynthesis and as a modifier in Cdc20activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Cdc20t} = v_7 - v_8 \tag{53}$$

10.8 Species IEP

Name IEP

Initial amount 0.0010 dimensionless

This species takes part in three reactions (as a reactant in IEPdegradation and as a product in IEPsynthesis and as a modifier in Cdc20activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IEP} = v_{12} - v_{13} \tag{54}$$

10.9 Species Mad

Name Mad

Involved in rule Mad

This species takes part in one reaction (as a modifier in Cdc20ainhibition) and is also involved in one rule which determines this species' quantity.

10.10 Species CKIt

Name CKIt

Initial amount 0.0010 dimensionless

This species takes part in four reactions (as a reactant in CKIdegradation, CKItphosphorilationviaSK, eq_7 and as a product in CKItsynthesis).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CKIt} = v_{15} - v_{16} - v_{17} - v_{18} \tag{55}$$

10.11 Species SK

Name SK

Initial amount 0.0010 dimensionless

This species takes part in four reactions (as a reactant in SKdegradation and as a product in SKsynthesis and as a modifier in Cdh1degradation, CKItphosphorilationviaSK).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SK} = v_{19} - v_{20} \tag{56}$$

A Glossary of Systems Biology Ontology Terms

SBO:0000047 mass action rate law for zeroth order irreversible reactions, continuous scheme: Reaction scheme where the products are created from the reactants and the change of a product quantity is proportional to the product of reactant activities. The reaction scheme does not include any reverse process that creates the reactants from the products. The change of a product quantity is constant. It is to be used in a reaction modelled using a continuous framework.

SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme: Reaction scheme where the products are created from the reactants and the change of a product quantity is proportional to the product of reactant activities. The reaction scheme does not include any reverse process that creates the reactants from the products. The change of a product quantity is proportional to the quantity of one reactant. It is to be used in a reaction modelled using a continuous framework.

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

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