SBML Model Report

Model name: "Ueda2001_CircClock"

May 5, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by the following two authors: Nicolas Le Novre[1] and Bruce Shapiro[2] at September 21st 2005 at 5:16 p. m. and last time modified at February 25th 2015 at 12:55 a. 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	3
species types	0	species	13
events	0	constraints	0
reactions	32	function definitions	0
global parameters	0	unit definitions	2
rules	0	initial assignments	0

Model Notes

Bruce Shapiro: Generated by Cellerator Version 1.0 update 3.0303 using Mathematica 4.1 for Microsoft Windows (June 13, 2001), April 2, 2003 16:49:13, using (PC,x86, Microsoft Windows,WindowsNT,Windows)

Bruce Shapiro: Corrected 29 March 2005

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Nicolas Le Novre: Added Dbt and Cyc species, and the corresponding reactions. 23 April 2005

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 nanomole (default)

Definition nmol

2.2 Unit `time`

Name hour (default)

Definition 3600 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 Compartments

This model contains three compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
Drosophilia			3	1	litre	☑	
compartment_0000003	cytoplasm		3	1	litre	☑	
compartment_0000002	nucleus		3	1	litre	☑	compartment_0000003

3.1 Compartment Drosophilia

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

3.2 Compartment compartment_0000003

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

Name cytoplasm

3.3 Compartment compartment_0000002

This is a three dimensional compartment with a constant size of one litre, which is surrounded by compartment_0000003 (cytoplasm).

Name nucleus

4 Species

This model contains 13 species. The boundary condition of three of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 6 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
EmptySet		Drosophilia	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☑
CCc	Clk-Cyc_cyt	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
CCn	Clk-Cyc_nuc	compartment_0000002	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
Clkc	Clk_cyt	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
Clkm	Clk_mRNA	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
Perc	Per_cyt	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
Perm	Per_mRNA	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
PTc	Per-Tim_cyt	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
PTn	Per-Tim_nuc	compartment_0000002	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
Timc	Tim_cyt	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
Timm	Tim_mRNA	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☐	☐
species_0000012	Cyc_cyt	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑	☑
species_0000013	Dbt_cyt	compartment_0000003	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑	☑

5 Reactions

This model contains 32 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 4: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	`Reaction1`	Per transcription	$\text{EmptySet} \xrightarrow{\text{CCn, PTn}} \text{Perm}$	
2	`Reaction2`	non-specific Per mRNA degradation	$\text{Perm} \longrightarrow \text{EmptySet}$	
3	`Reaction3`	Tim transcription	$\text{EmptySet} \xrightarrow{\text{CCn, PTn}} \text{Timm}$	
4	`Reaction4`	non-specific Tim mRNA degradation	$\text{Timm} \longrightarrow \text{EmptySet}$	
5	`Reaction5`	Clk transcription	$\text{EmptySet} \xrightarrow{\text{PTn, CCn}} \text{Clkm}$	
6	`Reaction6`	non-specific Clk mRNA degradation	$\text{Clkm} \longrightarrow \text{EmptySet}$	
7	`Reaction7`	Clk-Cyc nuclear import	$\text{CCc} \longrightarrow \text{CCn}$	
8	`Reaction8`	Clk-Cyc nuclear export	$\text{CCn} \longrightarrow \text{CCc}$	
9	`Reaction9`	Per-Tim nuclear export	$\text{PTn} \longrightarrow \text{PTc}$	
10	`Reaction10`	Per-Tim nuclear import	$\text{PTc} \longrightarrow \text{PTn}$	
11	`Reaction11`	Clk Cyc equilibrium	$\text{species\_0000012} + \text{Clkc} \rightleftharpoons \text{CCc}$	
12	`Reaction12`	Per Tim equilibrium	$\text{Perc} + \text{Timc} \rightleftharpoons \text{PTc}$	
13	`Reaction16`	Tim translation	$\text{EmptySet} \xrightarrow{\text{Timm}} \text{Timc}$	
14	`Reaction18`	Clk translation	$\text{EmptySet} \xrightarrow{\text{Clkm}} \text{Clkc}$	
15	`Reaction19`	Per translation	$\text{EmptySet} \xrightarrow{\text{Perm}} \text{Perc}$	
16	`Reaction20`	non-specific Per_cyt degradation	$\text{Perc} \longrightarrow \text{EmptySet}$	
17	`Reaction21`	non-specific Per-Tim_cyt degradation	$\text{PTc} \longrightarrow \text{EmptySet}$	
18	`Reaction23`	non-specific Per-Tim_nuc degradation	$\text{PTn} \longrightarrow \text{EmptySet}$	
19	`Reaction24`	non-specific Clk-Cyc_cyt degradation	$\text{CCc} \longrightarrow \text{EmptySet}$	
20	`Reaction25`	non-specific Clk_cyt degradation	$\text{Clkc} \longrightarrow \text{EmptySet}$	

№	Id	Name	Reaction Equation	SBO
21	Reaction26	non-specific Clk-Cyc_nuc degradation	CCn $\longrightarrow$ EmptySet	
22	Reaction27	non-specific Tim_cyt degradation	Timc $\longrightarrow$ EmptySet	
23	Reaction28	Per mRNA degradation	Perm $\longrightarrow$ EmptySet	
24	Reaction29	Dbt regulated Per_cyt degradation	Perc $\xrightarrow{\text{species\_0000013}}$ EmptySet	
25	Reaction30	Tim mRNA degradation	Timm $\longrightarrow$ EmptySet	
26	Reaction31	Tim_cyt degradation	Timc $\longrightarrow$ EmptySet	
27	Reaction32	Per-Tim_cyt degradation	PTc $\longrightarrow$ EmptySet	
28	Reaction33	Per-Tim_nuc degradation	PTn $\longrightarrow$ EmptySet	
29	Reaction34	Clk mRNA degradation	Clkm $\longrightarrow$ EmptySet	
30	Reaction35	Clk_cyt degradation	Clkc $\longrightarrow$ EmptySet	
31	Reaction36	Clk-Cyc_cyt degradation	CCc $\longrightarrow$ EmptySet	
32	Reaction37		CCn $\longrightarrow$ EmptySet	

5.1 Reaction Reaction1

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

Name Per transcription

Reaction equation

$$\text{EmptySet} \xrightarrow{\text{CCn, PTn}} \text{Perm} \tag{1}$$

Reactant

Table 5: Properties of each reactant.

Id	Name	SBO
EmptySet		

Modifiers

Table 6: Properties of each modifier.

Id	Name	SBO
CCn	Clk-Cyc_nuc	
PTn	Per-Tim_nuc	

Product

Table 7: Properties of each product.

Id	Name	SBO
Perm	Per_mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \text{vol}\left(\text{compartment\_0000003}\right) \cdot \left(\text{c1} + \frac{\left(\text{B1} + \left(\frac{[\text{CCn}]}{\text{A1}}\right)^{\text{a}}\right) \cdot \text{s1}}{1 + \text{B1} + \left(\frac{[\text{CCn}]}{\text{A1}}\right)^{\text{a}} + \left(\frac{[\text{PTn}]}{\text{r1}}\right)^{\text{r}}} \right) \tag{2}$$

Table 8: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a			1.00		☑
A1			0.45		☑
B1			0.00		☑
c1	C1		0.00		☑
r1	R1		1.02		☑
s1	S1		1.45		☑
r			4.00		☑

5.2 Reaction Reaction2

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

Name non-specific Per mRNA degradation

Reaction equation

$$\text{Perm} \longrightarrow \text{EmptySet} \tag{3}$$

Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
Perm	Per_mRNA	

Product

Table 10: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \text{vol}\left(\text{compartment\_0000003}\right) \cdot \text{D0} \cdot [\text{Perm}] \tag{4}$$

Table 11: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.3 Reaction Reaction3

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

Name Tim transcription

Reaction equation

$$\text{EmptySet} \xrightarrow{\text{CCn, PTn}} \text{Timm} \tag{5}$$

Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
EmptySet		

Modifiers

Table 13: Properties of each modifier.

Id	Name	SBO
CCn	Clk-Cyc_nuc	
PTn	Per-Tim_nuc	

Product

Table 14: Properties of each product.

Id	Name	SBO
Timm	Tim_mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{vol}\left(\mathrm{compartment\_0000003}\right) \cdot \left(\mathrm{c2} + \frac{\left(\mathrm{B2} + \left(\frac{[\mathrm{CCn}]}{\mathrm{A2}}\right)^{\mathrm{a}}\right) \cdot \mathrm{s3}}{1 + \mathrm{B2} + \left(\frac{[\mathrm{CCn}]}{\mathrm{A2}}\right)^{\mathrm{a}} + \left(\frac{[\mathrm{PTn}]}{\mathrm{r2}}\right)^{\mathrm{r}}} \right) \tag{6}$$

Table 15: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a			1.00		☑
A2			0.45		☑
B2			0.00		☑
c2	C2		0.00		☑
r2	R2		1.02		☑
s3	S3		1.45		☑
r			4.00		☑

5.4 Reaction Reaction4

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

Name non-specific Tim mRNA degradation

Reaction equation

$$\mathrm{Timm} \longrightarrow \mathrm{EmptySet} \tag{7}$$

Reactant

Table 16: Properties of each reactant.

Id	Name	SBO
Timm	Tim_mRNA	

Product

Table 17: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \mathrm{vol}\,(\mathrm{Drosophilia}) \cdot \mathrm{D0} \cdot [\mathrm{Timm}] \tag{8}$$

Table 18: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.5 Reaction Reaction5

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

Name Clk transcription

Reaction equation

$$\mathrm{EmptySet} \xrightarrow{\mathrm{PTn,\ CCn}} \mathrm{Clkm} \tag{9}$$

Reactant

Table 19: Properties of each reactant.

Id	Name	SBO
EmptySet		

Modifiers

Table 20: Properties of each modifier.

Id	Name	SBO
PTn	Per-Tim_nuc	
CCn	Clk-Cyc_nuc	

Product

Table 21: Properties of each product.

Id	Name	SBO
Clkm	Clk_mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{vol}\left(\mathrm{compartment\_0000003}\right) \cdot \left(\mathrm{c3} + \frac{\left(\mathrm{B3} + \left(\frac{[\mathrm{PTn}]}{\mathrm{A3}}\right)^{\mathrm{a}}\right) \cdot \mathrm{s5}}{1 + \mathrm{B3} + \left(\frac{[\mathrm{PTn}]}{\mathrm{A3}}\right)^{\mathrm{a}} + \left(\frac{[\mathrm{CCn}]}{\mathrm{r3}}\right)^{\mathrm{r}}} \right) \tag{10}$$

Table 22: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a			1.00		☑
A3			0.80		☑
B3			0.60		☑
c3	C3		0.00		☑
r3	R3		0.89		☑
s5	S5		1.63		☑
r			4.00		☑

5.6 Reaction Reaction6

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

Name non-specific Clk mRNA degradation

Reaction equation

$$\mathrm{Clkm} \longrightarrow \mathrm{EmptySet} \tag{11}$$

Reactant

Table 23: Properties of each reactant.

Id	Name	SBO
Clkm	Clk_mRNA	

Product

Table 24: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \mathrm{vol}\,(\mathrm{Drosophilia}) \cdot [\mathrm{Clkm}] \cdot \mathrm{D0} \tag{12}$$

Table 25: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.7 Reaction Reaction7

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

Name Clk-Cyc nuclear import

Reaction equation

$$\mathrm{CCc} \longrightarrow \mathrm{CCn} \tag{13}$$

Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
CCc	Clk-Cyc_cyt	

Product

Table 27: Properties of each product.

Id	Name	SBO
CCn	Clk-Cyc_nuc	

Id	Name	SBO

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \frac{[\mathrm{CCc}] \cdot \mathrm{T3}}{\mathrm{k3} + [\mathrm{CCc}]} \tag{14}$$

Table 28: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k3	K3		2.00		☑
T3			1.63		☑

5.8 Reaction Reaction8

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

Name Clk-Cyc nuclear export

Reaction equation

$$\mathrm{CCn} \longrightarrow \mathrm{CCc} \tag{15}$$

Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
CCn	Clk-Cyc_nuc	

Product

Table 30: Properties of each product.

Id	Name	SBO
CCc	Clk-Cyc_cyt	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \mathrm{vol}\left(\mathrm{compartment\_0000002}\right) \cdot \frac{[\mathrm{CCn}] \cdot \mathrm{T4}}{\mathrm{k4} + [\mathrm{CCn}]} \tag{16}$$

Table 31: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k4			2.00		☑
T4			0.52		☑

5.9 Reaction Reaction9

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

Name Per-Tim nuclear export

Reaction equation

$$\mathrm{PTn} \longrightarrow \mathrm{PTc} \tag{17}$$

Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
PTn	Per-Tim_nuc	

Product

Table 33: Properties of each product.

Id	Name	SBO
PTc	Per-Tim_cyt	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \mathrm{vol}\left(\mathrm{compartment\_0000002}\right) \cdot \frac{[\mathrm{PTn}] \cdot \mathrm{T2}}{\mathrm{k2} + [\mathrm{PTn}]} \tag{18}$$

Table 34: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k2	K2		2.00		☑
T2			0.72		☑

5.10 Reaction Reaction10

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

Name Per-Tim nuclear import

Reaction equation

$$\mathrm{PTc} \longrightarrow \mathrm{PTn} \tag{19}$$

Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
PTc	Per-Tim_cyt	

Product

Table 36: Properties of each product.

Id	Name	SBO
PTn	Per-Tim_nuc	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \mathrm{vol}\left(\mathrm{compartment\_0000003}\right) \cdot \frac{[\mathrm{PTc}] \cdot \mathrm{T1}}{\mathrm{k1} + [\mathrm{PTc}]} \tag{20}$$

Table 37: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	K1		2.00		☑
T1			1.73		☑

5.11 Reaction Reaction11

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

Name Clk Cyc equilibrium

Reaction equation

$$\text{species\_0000012} + \text{Clkc} \rightleftharpoons \text{CCc} \tag{21}$$

Reactants

Table 38: Properties of each reactant.

Id	Name	SBO
species_0000012	Cyc_cyt	
Clkc	Clk_cyt	

Product

Table 39: Properties of each product.

Id	Name	SBO
CCc	Clk-Cyc_cyt	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \text{vol}\left(\text{compartment\_0000003}\right) \cdot \left(\left[\text{Clkc}\right] \cdot \text{v3} \cdot \left[\text{species\_0000012}\right] - \text{parameter\_0000073} \cdot \left[\text{CCc}\right]\right) \tag{22}$$

Table 40: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
v3	V3		1.63		☑
parameter_0000073	V4		1.63		☑

5.12 Reaction Reaction12

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

Name Per Tim equilibrium

Reaction equation

$$\text{Perc} + \text{Timc} \rightleftharpoons \text{PTc} \tag{23}$$

Reactants

Table 41: Properties of each reactant.

Id	Name	SBO
Perc	Per_cyt	
Timc	Tim_cyt	

Product

Table 42: Properties of each product.

Id	Name	SBO
PTc	Per-Tim_cyt	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{vol}(\text{compartment\_0000003}) \cdot ([\text{Perc}] \cdot [\text{Timc}] \cdot \text{v1} - \text{parameter\_0000072} \cdot [\text{PTc}]) \tag{24}$$

Table 43: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
v1	V1		1.45		☑
parameter_0000072	V2		1.45		☑

5.13 Reaction Reaction16

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

Name Tim translation

Reaction equation

$$\text{EmptySet} \xrightarrow{\text{Timm}} \text{Timc} \tag{25}$$

Reactant

Table 44: Properties of each reactant.

Id	Name	SBO
EmptySet		

Modifier

Table 45: Properties of each modifier.

Id	Name	SBO
Timm	Tim_mRNA	

Product

Table 46: Properties of each product.

Id	Name	SBO
Timc	Tim_cyt	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \mathrm{s4} \cdot [\mathrm{Timm}] \tag{26}$$

Table 47: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
s4	S4		0.48		☑

5.14 Reaction Reaction18

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

Name Clk translation

Reaction equation

$$\mathrm{EmptySet} \xrightarrow{\mathrm{Clkm}} \mathrm{Clkc} \tag{27}$$

Reactant

Table 48: Properties of each reactant.

Id	Name	SBO
EmptySet		

Modifier

Table 49: Properties of each modifier.

Id	Name	SBO
Clkm	Clk_mRNA	

Product

Table 50: Properties of each product.

Id	Name	SBO
Clkc	Clk_cyt	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot [\mathrm{Clkm}] \cdot \mathrm{s6} \tag{28}$$

Table 51: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
s6	S6		0.47		☑

5.15 Reaction Reaction19

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

Name Per translation

Reaction equation

$$\mathrm{EmptySet} \xrightarrow{\mathrm{Perm}} \mathrm{Perc} \tag{29}$$

Reactant

Table 52: Properties of each reactant.

Id	Name	SBO
EmptySet		

Modifier

Table 53: Properties of each modifier.

Id	Name	SBO
Perm	Per_mRNA	

Product

Table 54: Properties of each product.

Id	Name	SBO
Perc	Per_cyt	

Id	Name	SBO

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \mathrm{s2} \cdot [\mathrm{Perm}] \tag{30}$$

Table 55: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
s2	S2		0.48		☑

5.16 Reaction Reaction20

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

Name non-specific Per_cyt degradation

Reaction equation

$$\mathrm{Perc} \longrightarrow \mathrm{EmptySet} \tag{31}$$

Reactant

Table 56: Properties of each reactant.

Id	Name	SBO
Perc	Per_cyt	

Product

Table 57: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \mathrm{vol}\,(\mathrm{Drosophilia}) \cdot \mathrm{D0} \cdot [\mathrm{Perc}] \tag{32}$$

Table 58: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.17 Reaction Reaction21

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

Name non-specific Per-Tim_cyt degradation

Reaction equation

$$\mathrm{PTc} \longrightarrow \mathrm{EmptySet} \tag{33}$$

Reactant

Table 59: Properties of each reactant.

Id	Name	SBO
PTc	Per-Tim_cyt	

Product

Table 60: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \mathrm{D0} \cdot [\mathrm{PTc}] \tag{34}$$

Table 61: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.18 Reaction Reaction23

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

Name non-specific Per-Tim_nuc degradation

Reaction equation

$$\text{PTn} \longrightarrow \text{EmptySet} \tag{35}$$

Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
PTn	Per-Tim_nuc	

Product

Table 63: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \text{vol}\left(\text{compartment\_0000002}\right) \cdot \text{D0} \cdot [\text{PTn}] \tag{36}$$

Table 64: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.19 Reaction Reaction24

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

Name non-specific Clk-Cyc_cyt degradation

Reaction equation

$$\mathrm{CCc} \longrightarrow \mathrm{EmptySet} \tag{37}$$

Reactant

Table 65: Properties of each reactant.

Id	Name	SBO
CCc	Clk-Cyc_cyt	

Product

Table 66: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot [\mathrm{CCc}] \cdot \mathrm{D0} \tag{38}$$

Table 67: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.20 Reaction Reaction25

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

Name non-specific Clk_cyt degradation

Reaction equation

$$\mathrm{Clkc} \longrightarrow \mathrm{EmptySet} \tag{39}$$

Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
Clkc	Clk_cyt	

Product

Table 69: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \mathrm{vol}\left(\mathrm{compartment\_0000003}\right) \cdot [\mathrm{Clkc}] \cdot \mathrm{D0} \tag{40}$$

Table 70: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.21 Reaction Reaction26

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

Name non-specific Clk-Cyc_nuc degradation

Reaction equation

$$\mathrm{CCn} \longrightarrow \mathrm{EmptySet} \tag{41}$$

Reactant

Table 71: Properties of each reactant.

Id	Name	SBO
CCn	Clk-Cyc_nuc	

Product

Table 72: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \mathrm{vol}\,(\mathrm{compartment\_0000002}) \cdot [\mathrm{CCn}] \cdot \mathrm{D0} \tag{42}$$

Table 73: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.22 Reaction Reaction27

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

Name non-specific Tim_cyt degradation

Reaction equation

$$\mathrm{Timc} \longrightarrow \mathrm{EmptySet} \tag{43}$$

Reactant

Table 74: Properties of each reactant.

Id	Name	SBO
Timc	Tim_cyt	

Product

Table 75: Properties of each product.

Id	Name	SBO
EmptySet		

Id	Name	SBO

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \mathrm{D0} \cdot [\mathrm{Timc}] \tag{44}$$

Table 76: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D0			0.012		☑

5.23 Reaction Reaction28

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

Name Per mRNA degradation

Reaction equation

$$\mathrm{Perm} \longrightarrow \mathrm{EmptySet} \tag{45}$$

Reactant

Table 77: Properties of each reactant.

Id	Name	SBO
Perm	Per_mRNA	

Product

Table 78: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \mathrm{vol}\left(\mathrm{compartment\_0000003}\right) \cdot \frac{\mathrm{D1} \cdot [\mathrm{Perm}]}{\mathrm{L1} + [\mathrm{Perm}]} \tag{46}$$

Table 79: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D1			0.94		☑
L1			0.30		☑

5.24 Reaction Reaction29

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

Name Dbt regulated Per_cyt degradation

Reaction equation

$$\mathrm{Perc} \xrightarrow{\mathrm{species\_0000013}} \mathrm{EmptySet} \tag{47}$$

Reactant

Table 80: Properties of each reactant.

Id	Name	SBO
Perc	Per_cyt	

Modifier

Table 81: Properties of each modifier.

Id	Name	SBO
species_0000013	Dbt_cyt	

Product

Table 82: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \mathrm{vol}\left(\mathrm{compartment\_0000003}\right) \cdot \frac{\mathrm{D2} \cdot [\mathrm{species\_0000013}] \cdot [\mathrm{Perc}]}{\mathrm{L2} + [\mathrm{Perc}]} \tag{48}$$

Table 83: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D2			0.44		☑
L2			0.20		☑

5.25 Reaction `Reaction30`

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

Name Tim mRNA degradation

Reaction equation

$$\mathrm{Timm} \longrightarrow \mathrm{EmptySet} \tag{49}$$

Reactant

Table 84: Properties of each reactant.

Id	Name	SBO
`Timm`	Tim_mRNA	

Product

Table 85: Properties of each product.

Id	Name	SBO
`EmptySet`		

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \frac{\mathrm{D3} \cdot [\mathrm{Timm}]}{\mathrm{L3} + [\mathrm{Timm}]} \tag{50}$$

Table 86: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D3			0.94		☑
L3			0.30		☑

5.26 Reaction Reaction31

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

Name Tim_cyt degradation

Reaction equation

$$\mathrm{Timc} \longrightarrow \mathrm{EmptySet} \tag{51}$$

Reactant

Table 87: Properties of each reactant.

Id	Name	SBO
Timc	Tim_cyt	

Product

Table 88: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \frac{\mathrm{D4} \cdot [\mathrm{Timc}]}{\mathrm{L4} + [\mathrm{Timc}]} \tag{52}$$

Table 89: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D4			0.44		☑
L4			0.20		☑

5.27 Reaction Reaction32

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

Name Per-Tim_cyt degradation

Reaction equation

$$\text{PTc} \longrightarrow \text{EmptySet} \tag{53}$$

Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
PTc	Per-Tim_cyt	

Product

Table 91: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{vol}\left(\text{compartment\_0000003}\right) \cdot \frac{\text{D5} \cdot [\text{PTc}]}{\text{L5} + [\text{PTc}]} \tag{54}$$

Table 92: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D5			0.44		☑
L5			0.20		☑

5.28 Reaction Reaction33

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

Name Per-Tim_nuc degradation

Reaction equation

$$\text{PTn} \longrightarrow \text{EmptySet} \tag{55}$$

Reactant

Table 93: Properties of each reactant.

Id	Name	SBO
PTn	Per-Tim_nuc	

Product

Table 94: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \text{vol}\left(\text{compartment\_0000002}\right) \cdot \frac{\text{D6} \cdot [\text{PTn}]}{\text{L6} + [\text{PTn}]} \tag{56}$$

Table 95: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D6			0.29		☑
L6			0.20		☑

5.29 Reaction Reaction34

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

Name Clk mRNA degradation

Reaction equation

$$\text{Clkm} \longrightarrow \text{EmptySet} \tag{57}$$

Reactant

Table 96: Properties of each reactant.

Id	Name	SBO
Clkm	Clk_mRNA	

Product

Table 97: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = \text{vol}\left(\text{compartment\_0000003}\right) \cdot \frac{[\text{Clkm}] \cdot \text{D7}}{[\text{Clkm}] + \text{L7}} \tag{58}$$

Table 98: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D7			0.54		☑
L7			0.13		☑

5.30 Reaction Reaction35

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

Name Clk_cyt degradation

Reaction equation

$$\text{Clkc} \longrightarrow \text{EmptySet} \tag{59}$$

Reactant

Table 99: Properties of each reactant.

Id	Name	SBO
Clkc	Clk_cyt	

Product

Table 100: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = \mathrm{vol}\,(\mathrm{compartment\_0000003}) \cdot \frac{[\mathrm{Clkc}] \cdot \mathrm{D8}}{[\mathrm{Clkc}] + \mathrm{L8}} \tag{60}$$

Table 101: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D8			0.6		☑
L8			0.2		☑

5.31 Reaction Reaction36

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

Name Clk-Cyc_cyt degradation

Reaction equation

$$\mathrm{CCc} \longrightarrow \mathrm{EmptySet} \tag{61}$$

Reactant

Table 102: Properties of each reactant.

Id	Name	SBO
CCc	Clk-Cyc_cyt	

Product

Table 103: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = \mathrm{vol}\left(\mathrm{compartment\_0000003}\right) \cdot \frac{[\mathrm{CCc}] \cdot \mathrm{D9}}{[\mathrm{CCc}] + \mathrm{L9}} \tag{62}$$

Table 104: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D9			0.6		☑
L9			0.2		☑

5.32 Reaction Reaction37

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

Reaction equation

$$\mathrm{CCn} \longrightarrow \mathrm{EmptySet} \tag{63}$$

Reactant

Table 105: Properties of each reactant.

Id	Name	SBO
CCn	Clk-Cyc_nuc	

Product

Table 106: Properties of each product.

Id	Name	SBO
EmptySet		

Kinetic Law

Derived unit contains undeclared units

$$v_{32} = \mathrm{vol}\left(\mathrm{compartment\_0000002}\right) \cdot \frac{[\mathrm{CCn}] \cdot \mathrm{D10}}{[\mathrm{CCn}] + \mathrm{L10}} \tag{64}$$

Table 107: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D10			0.3		☑
L10			0.2		☑

6 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.

6.1 Species EmptySet

Initial amount 0 nmol

This species takes part in 26 reactions (as a reactant in Reaction1, Reaction3, Reaction5, Reaction16, Reaction18, Reaction19 and as a product in Reaction2, Reaction4, Reaction6, Reaction20, Reaction21, Reaction23, Reaction24, Reaction25, Reaction26, Reaction27, Reaction28, Reaction29, Reaction30, Reaction31, Reaction32, Reaction33, Reaction34,

Reaction35, Reaction36, Reaction37), which do not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{EmptySet} = 0 \tag{65}$$

6.2 Species CCc

Name Clk-Cyc_cyt

Initial amount 0.3 nmol

This species takes part in five reactions (as a reactant in Reaction7, Reaction24, Reaction36 and as a product in Reaction8, Reaction11).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CCc} = v_8 + v_{11} - v_7 - v_{19} - v_{31} \tag{66}$$

6.3 Species CCn

Name Clk-Cyc_nuc

Initial amount 0.4 nmol

This species takes part in seven reactions (as a reactant in Reaction8, Reaction26, Reaction37 and as a product in Reaction7 and as a modifier in Reaction1, Reaction3, Reaction5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CCn} = v_7 - v_8 - v_{21} - v_{32} \tag{67}$$

6.4 Species Clkc

Name Clk_cyt

Initial amount 0.2 nmol

This species takes part in four reactions (as a reactant in Reaction11, Reaction25, Reaction35 and as a product in Reaction18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Clkc} = v_{14} - v_{11} - v_{20} - v_{30} \tag{68}$$

6.5 Species Clkm

Name Clk_mRNA

Initial amount 0.1 nmol

This species takes part in four reactions (as a reactant in Reaction6, Reaction34 and as a product in Reaction5 and as a modifier in Reaction18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Clkm} = v_5 - v_6 - v_{29} \tag{69}$$

6.6 Species Perc

Name Per_cyt

Initial amount 0.6 nmol

This species takes part in four reactions (as a reactant in Reaction12, Reaction20, Reaction29 and as a product in Reaction19).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Perc} = v_{15} - v_{12} - v_{16} - v_{24} \tag{70}$$

6.7 Species Perm

Name Per_mRNA

Initial amount 0.5 nmol

This species takes part in four reactions (as a reactant in Reaction2, Reaction28 and as a product in Reaction1 and as a modifier in Reaction19).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Perm} = v_{1} - v_{2} - v_{23} \tag{71}$$

6.8 Species PTc

Name Per-Tim_cyt

Initial amount 0.9 nmol

This species takes part in five reactions (as a reactant in Reaction10, Reaction21, Reaction32 and as a product in Reaction9, Reaction12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PTc} = v_{9} + v_{12} - v_{10} - v_{17} - v_{27} \tag{72}$$

6.9 Species PTn

Name Per-Tim_nuc

Initial amount 1 nmol

This species takes part in seven reactions (as a reactant in Reaction9, Reaction23, Reaction33 and as a product in Reaction10 and as a modifier in Reaction1, Reaction3, Reaction5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PTn} = v_{10} - v_{9} - v_{18} - v_{28} \tag{73}$$

6.10 Species Timc

Name Tim_cyt

Initial amount 0.8 nmol

This species takes part in four reactions (as a reactant in Reaction12, Reaction27, Reaction31 and as a product in Reaction16).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Timc} = v_{13} - v_{12} - v_{22} - v_{26} \tag{74}$$

6.11 Species Timm

Name Tim_mRNA

Initial amount 0.7 nmol

This species takes part in four reactions (as a reactant in Reaction4, Reaction30 and as a product in Reaction3 and as a modifier in Reaction16).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Timm} = v_{3} - v_{4} - v_{25} \tag{75}$$

6.12 Species species_0000012

Name Cyc_cyt

Initial amount 1 nmol

This species takes part in one reaction (as a reactant in Reaction11), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_0000012} = 0 \tag{76}$$

6.13 Species species_0000013

Name Dbt_cyt

Initial amount 1 nmol

This species takes part in one reaction (as a modifier in Reaction29), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_0000013} = 0 \tag{77}$$

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