SBML Model Report

Model name: "Leloup2003_CircClock_DD_REV-ERBalpha"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Enuo He[1] at October 19th 2006 at 10:21 a. m. and last time modified at February 25th 2015 at 1:01 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	1
species types	0	species	19
events	0	constraints	0
reactions	57	function definitions	4
global parameters	0	unit definitions	2
rules	0	initial assignments	0

Model Notes

This is model in continous darkness (DD) described in the article *Toward a detailed computational model for the mammalian circadian clock*

This model features the full interlocked negative and positive regulation of Per,Cry,Bmal and REV-ERBalpha. The model exhibits robust oscillations quite independent of the initial conditions for teh parameters given. Each species is assigned zero as initial value, and the graph started at time=120h.

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Simulation results could be reproduced using Copasi 4.0.19(development) and roadRunner online.

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To cite BioModels Database, please use Le Novre N., Bornstein B., Broicher A., Courtot M., Donizelli M., Dharuri H., Li L., Sauro H., Schilstra M., Shapiro B., Snoep J.L., Hucka M. (2006) BioModels Database: A Free, Centralized Database of Curated, Published, Quantitative Kinetic Models of Biochemical and Cellular Systems Nucleic Acids Res., 34: D689-D691.

2 Unit Definitions

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

2.1 Unit `time`

Definition 3600 s

2.2 Unit `substance`

Definition nmol

2.3 Unit `volume`

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

Definition l

2.4 Unit `area`

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

Definition m^2

2.5 Unit `length`

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

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
compartment_0	cell		3	1	litre	☑	

3.1 Compartment compartment_0

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

Name cell

4 Species

This model contains 19 species. 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
species_0	Mb	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_1	Bc	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_2	Bcp	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_3	Bn	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_4	Cc	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_5	Mc	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_6	Ccp	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_7	Mp	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_8	Pc	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_9	Pcp	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_10	PCc	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_11	PCcp	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_12	PCn	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_13	Bnp	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_14	PCnp	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_15	In	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_16	Mr	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_17	Rc	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
species_18	Rn	compartment_0	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Function definitions

This is an overview of four function definitions.

5.1 Function definition `function_3`

Name Activation of gene

Arguments Vs, B, n, K

Mathematical Expression

$$\frac{\mathrm{Vs} \cdot \mathrm{B}^{\mathrm{n}}}{\mathrm{K}^{\mathrm{n}} + \mathrm{B}^{\mathrm{n}}} \tag{1}$$

5.2 Function definition `function_2`

Name Michaelis-Menten (irreversible)

Arguments V, substrate, Km

Mathematical Expression

$$\frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{2}$$

5.3 Function definition `function_1`

Name mRNA translated into protein

Arguments k, mRNA

Mathematical Expression

$$\mathrm{k} \cdot \mathrm{mRNA} \tag{3}$$

5.4 Function definition `function_0`

Name Inhibition of gene

Arguments vsb, K, m, Bn

Mathematical Expression

$$\frac{\mathrm{vsb} \cdot \mathrm{K}^{\mathrm{m}}}{\mathrm{K}^{\mathrm{m}} + \mathrm{Bn}^{\mathrm{m}}} \tag{4}$$

6 Reactions

This model contains 57 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	reaction_0	Mb synthesized	$\emptyset \xrightarrow{\text{species\_18}} \text{species\_0}$	
2	reaction_1	Mb translated into protein	$\emptyset \xrightarrow{\text{species\_0}} \text{species\_1}$	
3	reaction_2	Mb nonspecific degradation	$\text{species\_0} \longrightarrow \emptyset$	
4	reaction_3	Bc phosphorylation	$\text{species\_1} \longrightarrow \text{species\_2}$	
5	reaction_4	Bc transfered from cytosolic to nuclear	$\text{species\_1} \rightleftharpoons \text{species\_3}$	
6	reaction_5	Mc translated into protein	$\emptyset \xrightarrow{\text{species\_5}} \text{species\_4}$	
7	reaction_6	Mc nonspecific degradation	$\text{species\_5} \longrightarrow \emptyset$	
8	reaction_7	Cc phosphorylation	$\text{species\_4} \longrightarrow \text{species\_6}$	
9	reaction_8	Ccp specific degradation	$\text{species\_6} \longrightarrow \emptyset$	
10	reaction_9	Mp synthesis	$\emptyset \xrightarrow{\text{species\_3}} \text{species\_7}$	
11	reaction_10	Mp translated into protein	$\emptyset \xrightarrow{\text{species\_7}} \text{species\_8}$	
12	reaction_11	Pcp specific degradation	$\text{species\_9} \longrightarrow \emptyset$	
13	reaction_12	Pc phospholation	$\text{species\_8} \longrightarrow \text{species\_9}$	
14	reaction_13	Cc and Pc produce PCc	$\text{species\_4} + \text{species\_8} \rightleftharpoons \text{species\_10}$	
15	reaction_14	PCc phospholation	$\text{species\_10} \longrightarrow \text{species\_11}$	
16	reaction_15	PCcp specific degradation	$\text{species\_11} \longrightarrow \emptyset$	
17	reaction_16	PCc transfered into nuclear	$\text{species\_10} \rightleftharpoons \text{species\_12}$	
18	reaction_17	PCnp nonspecific degradation	$\text{species\_14} \longrightarrow \emptyset$	
19	reaction_18	Bcp nonspecific degradation	$\text{species\_2} \longrightarrow \emptyset$	
20	reaction_19	Bnp nonspecific degradation	$\text{species\_13} \longrightarrow \emptyset$	

№	Id	Name	Reaction Equation	SBO
21	reaction_20	Mc synthesis	$\emptyset \xrightarrow{\text{species\_3}} \text{species\_5}$	
22	reaction_21	PCn phospholation	$\text{species\_12} \longrightarrow \text{species\_14}$	
23	reaction_22	Mp nonspecific degradation	$\text{species\_7} \longrightarrow \emptyset$	
24	reaction_23	Per_Cry and Clock_Bmal form inactive complex	$\text{species\_12} + \text{species\_3} \rightleftharpoons \text{species\_15}$	
25	reaction_24	Mb specific degradation	$\text{species\_0} \longrightarrow \emptyset$	
26	reaction_25	Mc specific degradation	$\text{species\_5} \longrightarrow \emptyset$	
27	reaction_26	Mp specific degradation	$\text{species\_7} \longrightarrow \emptyset$	
28	reaction_27	Pc nonspecific degradation	$\text{species\_8} \longrightarrow \emptyset$	
29	reaction_28	Cc nonspecific degradation	$\text{species\_4} \longrightarrow \emptyset$	
30	reaction_29	Pcp nonspecific degradation	$\text{species\_9} \longrightarrow \emptyset$	
31	reaction_30	Ccp nonspecific degradation	$\text{species\_6} \longrightarrow \emptyset$	
32	reaction_31	PCcp nonspecific degradation	$\text{species\_11} \longrightarrow \emptyset$	
33	reaction_32	PCc nonspecific degradation	$\text{species\_10} \longrightarrow \emptyset$	
34	reaction_33	PCnp specific degradation	$\text{species\_14} \longrightarrow \emptyset$	
35	reaction_34	Bc nonspecific degradation	$\text{species\_1} \longrightarrow \emptyset$	
36	reaction_35	Bcp specific degradation	$\text{species\_2} \longrightarrow \emptyset$	
37	reaction_36	Bn phospholation	$\text{species\_3} \longrightarrow \text{species\_13}$	
38	reaction_37	Bnp specific degradation	$\text{species\_13} \longrightarrow \emptyset$	
39	reaction_38	In nonspecific degration	$\text{species\_15} \longrightarrow \emptyset$	
40	reaction_39	In specific degradation	$\text{species\_15} \longrightarrow \emptyset$	
41	reaction_40	Bn nonspecific degradation	$\text{species\_3} \longrightarrow \emptyset$	
42	reaction_41	Bcp dephospholation	$\text{species\_2} \longrightarrow \text{species\_1}$	
43	reaction_42	Bnp dephospholation	$\text{species\_13} \longrightarrow \text{species\_3}$	
44	reaction_43	Ccp dephospholation	$\text{species\_6} \longrightarrow \text{species\_4}$	
45	reaction_44	Pcp dephospholation	$\text{species\_9} \longrightarrow \text{species\_8}$	
46	reaction_45	PCnp dephospholation	$\text{species\_14} \longrightarrow \text{species\_12}$	
47	reaction_46	PCn nonspecific degradation	$\text{species\_12} \longrightarrow \emptyset$	

№	Id	Name	Reaction Equation	SBO
48	reaction_47	PCcp dephospholation	species_11 $\longrightarrow$ species_10	
49	reaction_48	Mr synthesized	$\emptyset \xrightarrow{\text{species\_3}}$ species_16	
50	reaction_49	Mr nonspecific degradation	species_16 $\longrightarrow \emptyset$	
51	reaction_50	Mr specific degradation	species_16 $\longrightarrow \emptyset$	
52	reaction_51	Mr translated into protein	$\emptyset \xrightarrow{\text{species\_16}}$ species_17	
53	reaction_52	Rc transfered into nuclear	species_17 $\rightleftharpoons$ species_18	
54	reaction_53	Rc specific degradation	species_17 $\longrightarrow \emptyset$	
55	reaction_54	Rc nonspecific degradation	species_17 $\longrightarrow \emptyset$	
56	reaction_55	Rn specific degradation	species_18 $\longrightarrow \emptyset$	
57	reaction_56	Rn nonspecific degradation	species_18 $\longrightarrow \emptyset$	

6.1 Reaction reaction_0

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

Name Mb synthesized

Reaction equation

$$\emptyset \xrightarrow{\text{species\_18}} \text{species\_0} \tag{5}$$

Modifier

Table 5: Properties of each modifier.

Id	Name	SBO
species_18	Rn	

Product

Table 6: Properties of each product.

Id	Name	SBO
species_0	Mb	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \text{vol}(\text{compartment\_0}) \cdot \text{function\_0}(\text{vsb}, \text{K}, \text{m}, [\text{species\_18}]) \tag{6}$$

$$\text{function\_0}(\text{vsb}, \text{K}, \text{m}, \text{Bn}) = \frac{\text{vsb} \cdot \text{K}^{\text{m}}}{\text{K}^{\text{m}} + \text{Bn}^{\text{m}}} \tag{7}$$

$$\text{function\_0}(\text{vsb}, \text{K}, \text{m}, \text{Bn}) = \frac{\text{vsb} \cdot \text{K}^{\text{m}}}{\text{K}^{\text{m}} + \text{Bn}^{\text{m}}} \tag{8}$$

Table 7: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
vsb	vsb		1.8		☑
K	Kib		1.0		☑
m	m		2.0		☑

6.2 Reaction reaction_1

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

Name Mb translated into protein

Reaction equation

$$\emptyset \xrightarrow{\text{species\_0}} \text{species\_1} \tag{9}$$

Modifier

Table 8: Properties of each modifier.

Id	Name	SBO
species_0	Mb	

Product

Table 9: Properties of each product.

Id	Name	SBO
species_1	Bc	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_1}\left(\text{k}, [\text{species\_0}]\right) \tag{10}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{11}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{12}$$

Table 10: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	ksb		0.32		☑

6.3 Reaction reaction_2

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

Name Mb nonspecific degradation

Reaction equation

$$\text{species\_0} \longrightarrow \emptyset \tag{13}$$

Reactant

Table 11: Properties of each reactant.

Id	Name	SBO
species_0	Mb	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \text{vol}\,(\text{compartment\_0}) \cdot \text{k1} \cdot [\text{species\_0}] \tag{14}$$

Table 12: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdmb		0.02		☑

6.4 Reaction reaction_3

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

Name Bc phosphorylation

Reaction equation

$$\text{species\_1} \longrightarrow \text{species\_2} \tag{15}$$

Reactant

Table 13: Properties of each reactant.

Id	Name	SBO
species_1	Bc	

Product

Table 14: Properties of each product.

Id	Name	SBO
species_2	Bcp	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_1}], \text{Km}\right) \tag{16}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{17}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{18}$$

Table 15: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V1b		1.400		☑
Km	Kp		1.006		☑

6.5 Reaction reaction_4

This is a reversible reaction of one reactant forming one product.

Name Bc transfered from cytosolic to nuclear

Reaction equation

$$\text{species\_1} \rightleftharpoons \text{species\_3} \tag{19}$$

Reactant

Table 16: Properties of each reactant.

Id	Name	SBO
species_1	Bc	

Product

Table 17: Properties of each product.

Id	Name	SBO
species_3	Bn	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{vol}\left(\mathrm{compartment\_0}\right) \cdot \left(\mathrm{k1} \cdot [\mathrm{species\_1}] - \mathrm{k2} \cdot [\mathrm{species\_3}]\right) \tag{20}$$

Table 18: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k5		0.8		☑
k2	k6		0.4		☑

6.6 Reaction reaction_5

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

Name Mc translated into protein

Reaction equation

$$\emptyset \xrightarrow{\mathrm{species\_5}} \mathrm{species\_4} \tag{21}$$

Modifier

Table 19: Properties of each modifier.

Id	Name	SBO
species_5	Mc	

Product

Table 20: Properties of each product.

Id	Name	SBO
species_4	Cc	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_1}\left(\text{k}, [\text{species\_5}]\right) \tag{22}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{23}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{24}$$

Table 21: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	ksc		3.2		☑

6.7 Reaction reaction_6

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

Name Mc nonspecific degradation

Reaction equation

$$\text{species\_5} \longrightarrow \emptyset \tag{25}$$

Reactant

Table 22: Properties of each reactant.

Id	Name	SBO
species_5	Mc	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_5}] \tag{26}$$

Table 23: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdmc		0.02		☑

6.8 Reaction reaction_7

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

Name Cc phosphorylation

Reaction equation

$$\mathrm{species\_4} \longrightarrow \mathrm{species\_6} \tag{27}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
species_4	Cc	

Product

Table 25: Properties of each product.

Id	Name	SBO
species_6	Ccp	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_2}\,(\mathrm{V}, [\mathrm{species\_4}], \mathrm{Km}) \tag{28}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{29}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{30}$$

Table 26: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`V`	V1c		1.200		☑
`Km`	Kp		1.006		☑

6.9 Reaction `reaction_8`

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

Name Ccp specific degradation

Reaction equation

$$\mathrm{species\_6} \longrightarrow \emptyset \tag{31}$$

Reactant

Table 27: Properties of each reactant.

Id	Name	SBO
`species_6`	Ccp	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_2}\,(\mathrm{V}, [\mathrm{species\_6}], \mathrm{Km}) \tag{32}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{33}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{34}$$

Table 28: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdcc		1.4		☑
Km	Kd		0.3		☑

6.10 Reaction reaction_9

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

Name Mp synthesis

Reaction equation

$$\emptyset \xrightarrow{\text{species\_3}} \text{species\_7} \tag{35}$$

Modifier

Table 29: Properties of each modifier.

Id	Name	SBO
species_3	Bn	

Product

Table 30: Properties of each product.

Id	Name	SBO
species_7	Mp	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_3}\left(\text{Vs}, [\text{species\_3}], \text{n}, \text{K}\right) \tag{36}$$

$$\text{function\_3}\left(\text{Vs}, \text{B}, \text{n}, \text{K}\right) = \frac{\text{Vs} \cdot \text{B}^{\text{n}}}{\text{K}^{\text{n}} + \text{B}^{\text{n}}} \tag{37}$$

$$\text{function\_3}\left(\text{Vs}, \text{B}, \text{n}, \text{K}\right) = \frac{\text{Vs} \cdot \text{B}^{\text{n}}}{\text{K}^{\text{n}} + \text{B}^{\text{n}}} \tag{38}$$

Table 31: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vs	vsp		2.4		☑
n			2.0		☑
K	Kap		0.6		☑

6.11 Reaction reaction_10

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

Name Mp translated into protein

Reaction equation

$$\emptyset \xrightarrow{\text{species\_7}} \text{species\_8} \tag{39}$$

Modifier

Table 32: Properties of each modifier.

Id	Name	SBO
species_7	Mp	

Product

Table 33: Properties of each product.

Id	Name	SBO
species_8	Pc	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_1}\left(\text{k}, [\text{species\_7}]\right) \tag{40}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{41}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{42}$$

Table 34: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	ksp		1.2		☑

6.12 Reaction reaction_11

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

Name Pcp specific degradation

Reaction equation

$$\text{species\_9} \longrightarrow \emptyset \tag{43}$$

Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
species_9	Pcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_9}], \text{Km}\right) \tag{44}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{45}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{46}$$

Table 36: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdpc		3.4		☑
Km	Kd		0.3		☑

6.13 Reaction reaction_12

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

Name Pc phospholation

Reaction equation

$$\text{species\_8} \longrightarrow \text{species\_9} \tag{47}$$

Reactant

Table 37: Properties of each reactant.

Id	Name	SBO
species_8	Pc	

Product

Table 38: Properties of each product.

Id	Name	SBO
species_9	Pcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_8}], \text{Km}\right) \tag{48}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{49}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{50}$$

Table 39: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V1p		9.600		☑
Km	Kp		1.006		☑

6.14 Reaction reaction_13

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

Name Cc and Pc produce PCc

Reaction equation

$$\text{species\_4} + \text{species\_8} \rightleftharpoons \text{species\_10} \tag{51}$$

Reactants

Table 40: Properties of each reactant.

Id	Name	SBO
species_4	Cc	
species_8	Pc	

Product

Table 41: Properties of each product.

Id	Name	SBO
species_10	PCc	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \text{vol}\,(\text{compartment\_0}) \cdot (\text{k1} \cdot [\text{species\_4}] \cdot [\text{species\_8}] - \text{k2} \cdot [\text{species\_10}]) \tag{52}$$

Table 42: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k3		0.8		☑
k2	k4		0.4		☑

6.15 Reaction reaction_14

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

Name PCc phospholation

Reaction equation

$$\text{species\_10} \longrightarrow \text{species\_11} \tag{53}$$

Reactant

Table 43: Properties of each reactant.

Id	Name	SBO
species_10	PCc	

Product

Table 44: Properties of each product.

Id	Name	SBO
species_11	PCcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_10}], \text{Km}\right) \tag{54}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{55}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{56}$$

Table 45: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V1pc		2.400		☑
Km	Kp		1.006		☑

6.16 Reaction reaction_15

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

Name PCcp specific degradation

Reaction equation

$$\text{species\_11} \longrightarrow \emptyset \tag{57}$$

Reactant

Table 46: Properties of each reactant.

Id	Name	SBO
species_11	PCcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \text{vol}\,(\text{compartment\_0}) \cdot \text{function\_2}\,(\text{V}, [\text{species\_11}], \text{Km}) \tag{58}$$

$$\text{function\_2}\,(\text{V}, \text{substrate}, \text{Km}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{59}$$

$$\text{function\_2}\,(\text{V}, \text{substrate}, \text{Km}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{60}$$

Table 47: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdpcc		1.4		☑
Km	Kd		0.3		☑

6.17 Reaction reaction_16

This is a reversible reaction of one reactant forming one product.

Name PCc transfered into nuclear

Reaction equation

$$\text{species\_10} \rightleftharpoons \text{species\_12} \tag{61}$$

Reactant

Table 48: Properties of each reactant.

Id	Name	SBO
species_10	PCc	

Product

Table 49: Properties of each product.

Id	Name	SBO
species_12	PCn	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot (\mathrm{k1} \cdot [\mathrm{species\_10}] - \mathrm{k2} \cdot [\mathrm{species\_12}]) \tag{62}$$

Table 50: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.8		☑
k2	k2		0.4		☑

6.18 Reaction reaction_17

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

Name PCnp nonspecific degradation

Reaction equation

$$\mathrm{species\_14} \longrightarrow \emptyset \tag{63}$$

Reactant

Table 51: Properties of each reactant.

Id	Name	SBO
species_14	PCnp	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_14}] \tag{64}$$

Table 52: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.19 Reaction reaction_18

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

Name Bcp nonspecific degradation

Reaction equation

$$\mathrm{species\_2} \longrightarrow \emptyset \tag{65}$$

Reactant

Table 53: Properties of each reactant.

Id	Name	SBO
species_2	Bcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_2}] \tag{66}$$

Table 54: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.20 Reaction reaction_19

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

Name Bnp nonspecific degradation

Reaction equation

$$\text{species\_13} \longrightarrow \emptyset \tag{67}$$

Reactant

Table 55: Properties of each reactant.

Id	Name	SBO
species_13	Bnp	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \text{vol}(\text{compartment\_0}) \cdot \text{k1} \cdot [\text{species\_13}] \tag{68}$$

Table 56: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.21 Reaction reaction_20

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

Name Mc synthesis

Reaction equation

$$\emptyset \xrightarrow{\text{species\_3}} \text{species\_5} \tag{69}$$

Modifier

Table 57: Properties of each modifier.

Id	Name	SBO
species_3	Bn	

Product

Table 58: Properties of each product.

Id	Name	SBO
species_5	Mc	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \mathrm{vol}\left(\mathrm{compartment\_0}\right) \cdot \mathrm{function\_3}\left(\mathrm{Vs}, [\mathrm{species\_3}], \mathrm{n}, \mathrm{K}\right) \tag{70}$$

$$\mathrm{function\_3}\left(\mathrm{Vs}, \mathrm{B}, \mathrm{n}, \mathrm{K}\right) = \frac{\mathrm{Vs} \cdot \mathrm{B}^{\mathrm{n}}}{\mathrm{K}^{\mathrm{n}} + \mathrm{B}^{\mathrm{n}}} \tag{71}$$

$$\mathrm{function\_3}\left(\mathrm{Vs}, \mathrm{B}, \mathrm{n}, \mathrm{K}\right) = \frac{\mathrm{Vs} \cdot \mathrm{B}^{\mathrm{n}}}{\mathrm{K}^{\mathrm{n}} + \mathrm{B}^{\mathrm{n}}} \tag{72}$$

Table 59: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vs	vsc		2.2		☑
n			2.0		☑
K	Kac		0.6		☑

6.22 Reaction reaction_21

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

Name PCn phospholation

Reaction equation

$$\mathrm{species\_12} \longrightarrow \mathrm{species\_14} \tag{73}$$

Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
species_12	PCn	

Product

Table 61: Properties of each product.

Id	Name	SBO
species_14	PCnp	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_12}], \text{Km}\right) \tag{74}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{75}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{76}$$

Table 62: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V3pc		2.400		☑
Km	Kp		1.006		☑

6.23 Reaction reaction_22

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

Name Mp nonspecific degradation

Reaction equation

$$\text{species\_7} \longrightarrow \emptyset \tag{77}$$

Reactant

Table 63: Properties of each reactant.

Id	Name	SBO
species_7	Mp	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_7}] \tag{78}$$

Table 64: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdmp		0.02		☑

6.24 Reaction reaction_23

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

Name Per_Cry and Clock_Bmal form inactive complex

Reaction equation

$$\mathrm{species\_12} + \mathrm{species\_3} \rightleftharpoons \mathrm{species\_15} \tag{79}$$

Reactants

Table 65: Properties of each reactant.

Id	Name	SBO
species_12	PCn	
species_3	Bn	

Product

Table 66: Properties of each product.

Id	Name	SBO
species_15	In	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot (\mathrm{k1} \cdot [\mathrm{species\_12}] \cdot [\mathrm{species\_3}] - \mathrm{k2} \cdot [\mathrm{species\_15}]) \tag{80}$$

Table 67: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k7		1.0		☑
k2	k8		0.2		☑

6.25 Reaction reaction_24

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

Name Mb specific degradation

Reaction equation

$$\mathrm{species\_0} \longrightarrow \emptyset \tag{81}$$

Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
species_0	Mb	

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_2}\,(\mathrm{V}, [\mathrm{species\_0}], \mathrm{Km}) \tag{82}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{83}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{84}$$

Table 69: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vmb		1.3		☑
Km	Kmb		0.4		☑

6.26 Reaction reaction_25

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

Name Mc specific degradation

Reaction equation

$$\text{species\_5} \longrightarrow \emptyset \tag{85}$$

Reactant

Table 70: Properties of each reactant.

Id	Name	SBO
species_5	Mc	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_5}], \text{Km}\right) \tag{86}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{87}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{88}$$

Table 71: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vmc		2.0		☑
Km	Kmc		0.4		☑

6.27 Reaction reaction_26

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

Name Mp specific degradation

Reaction equation

$$\text{species\_7} \longrightarrow \emptyset \tag{89}$$

Reactant

Table 72: Properties of each reactant.

Id	Name	SBO
species_7	Mp	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_7}], \text{Km}\right) \tag{90}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{91}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{92}$$

Table 73: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vmp		2.2		☑
Km	Kmp		0.3		☑

6.28 Reaction reaction_27

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

Name Pc nonspecific degradation

Reaction equation

$$\text{species\_8} \longrightarrow \emptyset \tag{93}$$

Reactant

Table 74: Properties of each reactant.

Id	Name	SBO
species_8	Pc	

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \text{vol}(\text{compartment\_0}) \cdot \text{k1} \cdot [\text{species\_8}] \tag{94}$$

Table 75: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.29 Reaction reaction_28

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

Name Cc nonspecific degradation

Reaction equation

$$\text{species\_4} \longrightarrow \emptyset \tag{95}$$

Reactant

Table 76: Properties of each reactant.

Id	Name	SBO
species_4	Cc	

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_4}] \tag{96}$$

Table 77: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdnc		0.02		☑

6.30 Reaction reaction_29

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

Name Pcp nonspecific degradation

Reaction equation

$$\mathrm{species\_9} \longrightarrow \emptyset \tag{97}$$

Reactant

Table 78: Properties of each reactant.

Id	Name	SBO
species_9	Pcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_9}] \tag{98}$$

Table 79: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.31 Reaction reaction_30

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

Name Ccp nonspecific degradation

Reaction equation

$$\text{species\_6} \longrightarrow \emptyset \tag{99}$$

Reactant

Table 80: Properties of each reactant.

Id	Name	SBO
species_6	Ccp	

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = \text{vol}\,(\text{compartment\_0}) \cdot \text{k1} \cdot [\text{species\_6}] \tag{100}$$

Table 81: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.32 Reaction reaction_31

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

Name PCcp nonspecific degradation

Reaction equation

$$\text{species\_11} \longrightarrow \emptyset \tag{101}$$

Reactant

Table 82: Properties of each reactant.

Id	Name	SBO
species_11	PCcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{32} = \mathrm{vol}(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_11}] \tag{102}$$

Table 83: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.33 Reaction reaction_32

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

Name PCc nonspecific degradation

Reaction equation

$$\mathrm{species\_10} \longrightarrow \emptyset \tag{103}$$

Reactant

Table 84: Properties of each reactant.

Id	Name	SBO
species_10	PCc	

Kinetic Law

Derived unit contains undeclared units

$$v_{33} = \mathrm{vol}(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_10}] \tag{104}$$

Table 85: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.34 Reaction reaction_33

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

Name PCnp specific degradation

Reaction equation

$$\text{species\_14} \longrightarrow \emptyset \tag{105}$$

Reactant

Table 86: Properties of each reactant.

Id	Name	SBO
species_14	PCnp	

Kinetic Law

Derived unit contains undeclared units

$$v_{34} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_14}], \text{Km}\right) \tag{106}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{107}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{108}$$

Table 87: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdpcn		1.4		☑
Km	Kd		0.3		☑

6.35 Reaction reaction_34

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

Name Bc nonspecific degradation

Reaction equation

$$\text{species\_1} \longrightarrow \emptyset \tag{109}$$

Reactant

Table 88: Properties of each reactant.

Id	Name	SBO
species_1	Bc	

Kinetic Law

Derived unit contains undeclared units

$$v_{35} = \text{vol}(\text{compartment\_0}) \cdot \text{k1} \cdot [\text{species\_1}] \tag{110}$$

Table 89: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.36 Reaction reaction_35

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

Name Bcp specific degradation

Reaction equation

$$\text{species\_2} \longrightarrow \emptyset \tag{111}$$

Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
species_2	Bcp	

Kinetic Law

Derived unit contains undeclared units

$$v_{36} = \mathrm{vol}\left(\mathrm{compartment\_0}\right) \cdot \mathrm{function\_2}\left(\mathrm{V}, [\mathrm{species\_2}], \mathrm{Km}\right) \tag{112}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{113}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{114}$$

Table 91: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdbc		3.0		☑
Km	Kd		0.3		☑

6.37 Reaction reaction_36

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

Name Bn phospholation

Reaction equation

$$\mathrm{species\_3} \longrightarrow \mathrm{species\_13} \tag{115}$$

Reactant

Table 92: Properties of each reactant.

Id	Name	SBO
species_3	Bn	

Product

Table 93: Properties of each product.

Id	Name	SBO
species_13	Bnp	

Kinetic Law

Derived unit contains undeclared units

$$v_{37} = \text{vol}\,(\text{compartment\_0}) \cdot \text{function\_2}\,(\text{V}, [\text{species\_3}], \text{Km}) \tag{116}$$

$$\text{function\_2}\,(\text{V}, \text{substrate}, \text{Km}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{117}$$

$$\text{function\_2}\,(\text{V}, \text{substrate}, \text{Km}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{118}$$

Table 94: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V3b		1.400		☑
Km	Kp		1.006		☑

6.38 Reaction reaction_37

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

Name Bnp specific degradation

Reaction equation

$$\text{species\_13} \longrightarrow \emptyset \tag{119}$$

Reactant

Table 95: Properties of each reactant.

Id	Name	SBO
species_13	Bnp	

Kinetic Law

Derived unit contains undeclared units

$$v_{38} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_2}\,(\mathrm{V}, [\mathrm{species\_13}], \mathrm{Km}) \tag{120}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{121}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{122}$$

Table 96: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdbn		3.0		☑
Km	Kd		0.3		☑

6.39 Reaction reaction_38

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

Name In nonspecific degration

Reaction equation

$$\mathrm{species\_15} \longrightarrow \emptyset \tag{123}$$

Reactant

Table 97: Properties of each reactant.

Id	Name	SBO
species_15	In	

Kinetic Law

Derived unit contains undeclared units

$$v_{39} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_15}] \tag{124}$$

Table 98: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.40 Reaction reaction_39

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

Name In specific degradation

Reaction equation

$$\text{species\_15} \longrightarrow \emptyset \tag{125}$$

Reactant

Table 99: Properties of each reactant.

Id	Name	SBO
species_15	In	

Kinetic Law

Derived unit contains undeclared units

$$v_{40} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_15}], \text{Km}\right) \tag{126}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{127}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{128}$$

Table 100: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdin		1.6		☑
Km	Kd		0.3		☑

6.41 Reaction reaction_40

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

Name Bn nonspecific degradation

Reaction equation

$$\text{species\_3} \longrightarrow \emptyset \tag{129}$$

Reactant

Table 101: Properties of each reactant.

Id	Name	SBO
species_3	Bn	

Kinetic Law

Derived unit contains undeclared units

$$v_{41} = \text{vol}(\text{compartment\_0}) \cdot \text{k1} \cdot [\text{species\_3}] \tag{130}$$

Table 102: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.42 Reaction reaction_41

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

Name Bcp dephospholation

Reaction equation

$$\text{species\_2} \longrightarrow \text{species\_1} \tag{131}$$

Reactant

Table 103: Properties of each reactant.

Id	Name	SBO
species_2	Bcp	

Product

Table 104: Properties of each product.

Id	Name	SBO
species_1	Bc	

Kinetic Law

Derived unit contains undeclared units

$$v_{42} = \mathrm{vol}\left(\mathrm{compartment\_0}\right) \cdot \mathrm{function\_2}\left(\mathrm{V}, [\mathrm{species\_2}], \mathrm{Km}\right) \tag{132}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{133}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{134}$$

Table 105: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V2b		0.2		☑
Km	Kdp		0.1		☑

6.43 Reaction reaction_42

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

Name Bnp dephospholation

Reaction equation

$$\mathrm{species\_13} \longrightarrow \mathrm{species\_3} \tag{135}$$

Reactant

Table 106: Properties of each reactant.

Id	Name	SBO
species_13	Bnp	

Product

Table 107: Properties of each product.

Id	Name	SBO
species_3	Bn	

Kinetic Law

Derived unit contains undeclared units

$$v_{43} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_13}], \text{Km}\right) \tag{136}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{137}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{138}$$

Table 108: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V4b		0.4		☑
Km	Kdp		0.1		☑

6.44 Reaction reaction_43

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

Name Ccp dephospholation

Reaction equation

$$\text{species\_6} \longrightarrow \text{species\_4} \tag{139}$$

Reactant

Table 109: Properties of each reactant.

Id	Name	SBO
species_6	Ccp	

Product

Table 110: Properties of each product.

Id	Name	SBO
species_4	Cc	

Kinetic Law

Derived unit contains undeclared units

$$v_{44} = \mathrm{vol}\left(\mathrm{compartment\_0}\right) \cdot \mathrm{function\_2}\left(\mathrm{V}, [\mathrm{species\_6}], \mathrm{Km}\right) \tag{140}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{141}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{142}$$

Table 111: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V2c		0.2		☑
Km	Kdp		0.1		☑

6.45 Reaction reaction_44

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

Name Pcp dephospholation

Reaction equation

$$\mathrm{species\_9} \longrightarrow \mathrm{species\_8} \tag{143}$$

Reactant

Table 112: Properties of each reactant.

Id	Name	SBO
species_9	Pcp	

Product

Table 113: Properties of each product.

Id	Name	SBO
species_8	Pc	

Kinetic Law

Derived unit contains undeclared units

$$v_{45} = \mathrm{vol}\left(\mathrm{compartment\_0}\right) \cdot \mathrm{function\_2}\left(\mathrm{V}, [\mathrm{species\_9}], \mathrm{Km}\right) \tag{144}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{145}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{146}$$

Table 114: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V2p		0.6		☑
Km	Kdp		0.1		☑

6.46 Reaction reaction_45

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

Name PCnp dephospholation

Reaction equation

$$\mathrm{species\_14} \longrightarrow \mathrm{species\_12} \tag{147}$$

Reactant

Table 115: Properties of each reactant.

Id	Name	SBO
species_14	PCnp	

Product

Table 116: Properties of each product.

Id	Name	SBO
species_12	PCn	

Kinetic Law

Derived unit contains undeclared units

$$v_{46} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_2}\,(\mathrm{V}, [\mathrm{species\_14}], \mathrm{Km}) \tag{148}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{149}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{150}$$

Table 117: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V4pc		0.2		☑
Km	Kdp		0.1		☑

6.47 Reaction reaction_46

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

Name PCn nonspecific degradation

Reaction equation

$$\mathrm{species\_12} \longrightarrow \emptyset \tag{151}$$

Reactant

Table 118: Properties of each reactant.

Id	Name	SBO
species_12	PCn	

Kinetic Law

Derived unit contains undeclared units

$$v_{47} = \mathrm{vol}(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_12}] \tag{152}$$

Table 119: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.48 Reaction reaction_47

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

Name PCcp dephospholation

Reaction equation

$$\mathrm{species\_11} \longrightarrow \mathrm{species\_10} \tag{153}$$

Reactant

Table 120: Properties of each reactant.

Id	Name	SBO
species_11	PCcp	

Product

Table 121: Properties of each product.

Id	Name	SBO
species_10	PCc	

Id	Name	SBO

Kinetic Law

Derived unit contains undeclared units

$$v_{48} = \mathrm{vol}\left(\mathrm{compartment\_0}\right) \cdot \mathrm{function\_2}\left(\mathrm{V}, [\mathrm{species\_11}], \mathrm{Km}\right) \tag{154}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{155}$$

$$\mathrm{function\_2}\left(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}\right) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{156}$$

Table 122: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	V2pc		0.2		☑
Km	Kdp		0.1		☑

6.49 Reaction reaction_48

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

Name Mr synthesized

Reaction equation

$$\emptyset \xrightarrow{\mathrm{species\_3}} \mathrm{species\_16} \tag{157}$$

Modifier

Table 123: Properties of each modifier.

Id	Name	SBO
species_3	Bn	

Product

Table 124: Properties of each product.

Id	Name	SBO
species_16	Mr	

Kinetic Law

Derived unit contains undeclared units

$$v_{49} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_3}\,(\mathrm{Vs}, [\mathrm{species\_3}], \mathrm{n}, \mathrm{K}) \tag{158}$$

$$\mathrm{function\_3}\,(\mathrm{Vs}, \mathrm{B}, \mathrm{n}, \mathrm{K}) = \frac{\mathrm{Vs} \cdot \mathrm{B}^{\mathrm{n}}}{\mathrm{K}^{\mathrm{n}} + \mathrm{B}^{\mathrm{n}}} \tag{159}$$

$$\mathrm{function\_3}\,(\mathrm{Vs}, \mathrm{B}, \mathrm{n}, \mathrm{K}) = \frac{\mathrm{Vs} \cdot \mathrm{B}^{\mathrm{n}}}{\mathrm{K}^{\mathrm{n}} + \mathrm{B}^{\mathrm{n}}} \tag{160}$$

Table 125: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Vs	vsr		1.6		☑
n			2.0		☑
K	Kar		0.6		☑

6.50 Reaction reaction_49

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

Name Mr nonspecific degradation

Reaction equation

$$\mathrm{species\_16} \longrightarrow \emptyset \tag{161}$$

Reactant

Table 126: Properties of each reactant.

Id	Name	SBO
species_16	Mr	

Kinetic Law

Derived unit contains undeclared units

$$v_{50} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_16}] \tag{162}$$

Table 127: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdmr		0.02		☑

6.51 Reaction reaction_50

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

Name Mr specific degradation

Reaction equation

$$\mathrm{species\_16} \longrightarrow \emptyset \tag{163}$$

Reactant

Table 128: Properties of each reactant.

Id	Name	SBO
species_16	Mr	

Kinetic Law

Derived unit contains undeclared units

$$v_{51} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_2}\,(\mathrm{V}, [\mathrm{species\_16}], \mathrm{Km}) \tag{164}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{165}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{166}$$

Table 129: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vmr		1.6		☑
Km	Kmr		0.4		☑

6.52 Reaction reaction_51

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

Name Mr translated into protein

Reaction equation

$$\emptyset \xrightarrow{\text{species\_16}} \text{species\_17} \tag{167}$$

Modifier

Table 130: Properties of each modifier.

Id	Name	SBO
species_16	Mr	

Product

Table 131: Properties of each product.

Id	Name	SBO
species_17	Rc	

Kinetic Law

Derived unit contains undeclared units

$$v_{52} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_1}\left(\text{k}, [\text{species\_16}]\right) \tag{168}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{169}$$

$$\text{function\_1}\left(\text{k}, \text{mRNA}\right) = \text{k} \cdot \text{mRNA} \tag{170}$$

Table 132: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	ksr		1.7		☑

6.53 Reaction reaction_52

This is a reversible reaction of one reactant forming one product.

Name Rc transfered into nuclear

Reaction equation

$$\text{species\_17} \rightleftharpoons \text{species\_18} \tag{171}$$

Reactant

Table 133: Properties of each reactant.

Id	Name	SBO
species_17	Rc	

Product

Table 134: Properties of each product.

Id	Name	SBO
species_18	Rn	

Kinetic Law

Derived unit contains undeclared units

$$v_{53} = \text{vol}\,(\text{compartment\_0}) \cdot (\text{k1} \cdot [\text{species\_17}] - \text{k2} \cdot [\text{species\_18}]) \tag{172}$$

Table 135: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k9		0.8		☑
k2	k10		0.4		☑

6.54 Reaction reaction_53

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

Name Rc specific degradation

Reaction equation

$$\text{species\_17} \longrightarrow \emptyset \tag{173}$$

Reactant

Table 136: Properties of each reactant.

Id	Name	SBO
species_17	Rc	

Kinetic Law

Derived unit contains undeclared units

$$v_{54} = \text{vol}\left(\text{compartment\_0}\right) \cdot \text{function\_2}\left(\text{V}, [\text{species\_17}], \text{Km}\right) \tag{174}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{175}$$

$$\text{function\_2}\left(\text{V}, \text{substrate}, \text{Km}\right) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \tag{176}$$

Table 137: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdrc		4.4		☑
Km	Kd		0.3		☑

6.55 Reaction reaction_54

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

Name Rc nonspecific degradation

Reaction equation

$$\text{species\_17} \longrightarrow \emptyset \tag{177}$$

Reactant

Table 138: Properties of each reactant.

Id	Name	SBO
species_17	Rc	

Kinetic Law

Derived unit contains undeclared units

$$v_{55} = \text{vol}(\text{compartment\_0}) \cdot \text{k1} \cdot [\text{species\_17}] \tag{178}$$

Table 139: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

6.56 Reaction reaction_55

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

Name Rn specific degradation

Reaction equation

$$\text{species\_18} \longrightarrow \emptyset \tag{179}$$

Reactant

Table 140: Properties of each reactant.

Id	Name	SBO
species_18	Rn	

Kinetic Law

Derived unit contains undeclared units

$$v_{56} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{function\_2}\,(\mathrm{V}, [\mathrm{species\_18}], \mathrm{Km}) \tag{180}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{181}$$

$$\mathrm{function\_2}\,(\mathrm{V}, \mathrm{substrate}, \mathrm{Km}) = \frac{\mathrm{V} \cdot \mathrm{substrate}}{\mathrm{Km} + \mathrm{substrate}} \tag{182}$$

Table 141: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
V	vdrn		0.8		☑
Km	Kd		0.3		☑

6.57 Reaction reaction_56

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

Name Rn nonspecific degradation

Reaction equation

$$\mathrm{species\_18} \longrightarrow \emptyset \tag{183}$$

Reactant

Table 142: Properties of each reactant.

Id	Name	SBO
species_18	Rn	

Kinetic Law

Derived unit contains undeclared units

$$v_{57} = \mathrm{vol}\,(\mathrm{compartment\_0}) \cdot \mathrm{k1} \cdot [\mathrm{species\_18}] \tag{184}$$

Table 143: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	kdn		0.02		☑

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 species_0

Name Mb

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_2, reaction_24 and as a product in reaction_0 and as a modifier in reaction_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_0} = v_1 - v_3 - v_{25} \tag{185}$$

7.2 Species species_1

Name Bc

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_3, reaction_4, reaction_34 and as a product in reaction_1, reaction_41).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_1} = v_2 + v_{42} - v_4 - v_5 - v_{35} \tag{186}$$

7.3 Species species_2

Name Bcp

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_18, reaction_35, reaction_41 and as a product in reaction_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_2} = v_4 - v_{19} - v_{36} - v_{42} \tag{187}$$

7.4 Species species_3

Name Bn

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eight reactions (as a reactant in reaction_23, reaction_36, reaction_40 and as a product in reaction_4, reaction_42 and as a modifier in reaction_9, reaction_20, reaction_48).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_3} = v_5 + v_{43} - v_{24} - v_{37} - v_{41} \tag{188}$$

7.5 Species species_4

Name Cc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_7, reaction_13, reaction_28 and as a product in reaction_5, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_4} = v_6 + v_{44} - v_8 - v_{14} - v_{29} \tag{189}$$

7.6 Species species_5

Name Mc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_6, reaction_25 and as a product in reaction_20 and as a modifier in reaction_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_5} = v_{21} - v_7 - v_{26} \tag{190}$$

7.7 Species species_6

Name Ccp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_8, reaction_30, reaction_43 and as a product in reaction_7).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_6} = v_8 - v_9 - v_{31} - v_{44} \tag{191}$$

7.8 Species species_7

Name Mp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_22, reaction_26 and as a product in reaction_9 and as a modifier in reaction_10).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_7} = v_{10} - v_{23} - v_{27} \tag{192}$$

7.9 Species species_8

Name Pc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_12, reaction_13, reaction_27 and as a product in reaction_10, reaction_44).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_8} = v_{11} + v_{45} - v_{13} - v_{14} - v_{28} \tag{193}$$

7.10 Species species_9

Name Pcp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_11, reaction_29, reaction_44 and as a product in reaction_12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_9} = v_{13} - v_{12} - v_{30} - v_{45} \tag{194}$$

7.11 Species species_10

Name PCc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_14, reaction_16, reaction_32 and as a product in reaction_13, reaction_47).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_10} = v_{14} + v_{48} - v_{15} - v_{17} - v_{33} \tag{195}$$

7.12 Species species_11

Name PCcp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_15, reaction_31, reaction_47 and as a product in reaction_14).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_11} = v_{15} - v_{16} - v_{32} - v_{48} \tag{196}$$

7.13 Species species_12

Name PCn

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_21, reaction_23, reaction_46 and as a product in reaction_16, reaction_45).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_12} = v_{17} + v_{46} - v_{22} - v_{24} - v_{47} \tag{197}$$

7.14 Species species_13

Name Bnp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_19, reaction_37, reaction_42 and as a product in reaction_36).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_13} = v_{37} - v_{20} - v_{38} - v_{43} \tag{198}$$

7.15 Species species_14

Name PCnp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_17, reaction_33, reaction_45 and as a product in reaction_21).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_14} = v_{22} - v_{18} - v_{34} - v_{46} \tag{199}$$

7.16 Species species_15

Name In

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_38, reaction_39 and as a product in reaction_23).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_15} = v_{24} - v_{39} - v_{40} \tag{200}$$

7.17 Species species_16

Name Mr

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_49, reaction_50 and as a product in reaction_48 and as a modifier in reaction_51).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_16} = v_{49} - v_{50} - v_{51} \tag{201}$$

7.18 Species species_17

Name Rc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_52, reaction_53, reaction_54 and as a product in reaction_51).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_17} = v_{52} - v_{53} - v_{54} - v_{55} \tag{202}$$

7.19 Species species_18

Name Rn

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_55, reaction_56 and as a product in reaction_52 and as a modifier in reaction_0).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_18} = v_{53} - v_{56} - v_{57} \tag{203}$$

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