

## SBML Model Report

**Model name: “Smolen2004\_CircClock”**



May 6, 2016

### 1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Nicolas Le Novre<sup>1</sup> at June 24<sup>th</sup> 2005 at 12:05 a. m. and last time modified at February 25<sup>th</sup> 2015 at 1:17 p. m. Table 1 gives an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	2
species types	0	species	9
events	0	constraints	0
reactions	22	function definitions	0
global parameters	45	unit definitions	2
rules	6	initial assignments	0

### Model Notes

No initial conditions are specified in the paper. Because there is a basal rate of transcription for each gene, it doesn't matter much. With the agreement of Paul Smolen, I put all the initial concentration at 0.001 nanomoles. N Le Novre.

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## 2 Unit Definitions

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

### 2.1 Unit time

**Name** hour

**Definition** 3600 s

### 2.2 Unit substance

**Name** nanomole

**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<sup>2</sup>

### 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 two compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
compartment_0000002	cytoplasm		3	1	litre	<input checked="" type="checkbox"/>	
compartment_0000001	nucleus		3	1	litre	<input checked="" type="checkbox"/>	compartment_0000002

### 3.1 Compartment [compartment\\_0000002](#)

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

**Name** cytoplasm

### 3.2 Compartment [compartment\\_0000001](#)

This is a three dimensional compartment with a constant size of one litre, which is surrounded by compartment\_0000002 (cytoplasm).

**Name** nucleus

## 4 Species

This model contains nine species. Section 8 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_0000001	P0nuc	compartment_0000001	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000002	P1nuc	compartment_0000001	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000003	P2nuc	compartment_0000001	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000004	P0cyt	compartment_0000002	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000005	P1cyt	compartment_0000002	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000006	P2cyt	compartment_0000002	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000007	VRI	compartment_0000001	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000008	CLK	compartment_0000001	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_0000009	PDP	compartment_0000001	$\text{nmol} \cdot \text{l}^{-1}$	$\square$	$\square$

## 5 Parameters

This model contains 45 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
parameter-_0000001	ACvri		0.000		<input type="checkbox"/>
parameter-_0000002	ACper		0.000		<input type="checkbox"/>
parameter-_0000003	ACpdp		0.000		<input type="checkbox"/>
parameter-_0000005	Kpv		0.200		<input checked="" type="checkbox"/>
parameter-_0000006	Kpp		0.240		<input checked="" type="checkbox"/>
parameter-_0000007	Kppd		0.100		<input checked="" type="checkbox"/>
parameter-_0000008	Kvc		0.540		<input checked="" type="checkbox"/>
parameter-_0000010	Kpdc		0.540		<input checked="" type="checkbox"/>
parameter-_0000011	Kcv		0.083		<input checked="" type="checkbox"/>
parameter-_0000012	Kcp		0.134		<input checked="" type="checkbox"/>
parameter-_0000013	Kcpd		0.248		<input checked="" type="checkbox"/>
parameter-_0000014	Kvdeac		0.212		<input checked="" type="checkbox"/>
parameter-_0000015	Kpdeac		0.212		<input checked="" type="checkbox"/>
parameter-_0000016	Kpddeac		0.212		<input checked="" type="checkbox"/>
parameter-_0000017	Fv		1.062		<input checked="" type="checkbox"/>
parameter-_0000018	Fp		1.062		<input checked="" type="checkbox"/>
parameter-_0000019	Fpd		1.062		<input checked="" type="checkbox"/>
parameter-_0000020	OPvri		0.000		<input type="checkbox"/>

Id	Name	SBO	Value	Unit	Constant
parameter- _0000021	OPper		0.000		<input type="checkbox"/>
parameter- _0000022	OPpdp		0.000		<input type="checkbox"/>
parameter- _0000023	Tvriop		2.825		<input checked="" type="checkbox"/>
parameter- _0000024	Tperop		2.825		<input checked="" type="checkbox"/>
parameter- _0000025	Tpdpop		2.825		<input checked="" type="checkbox"/>
parameter- _0000026	N		5.000		<input checked="" type="checkbox"/>
parameter- _0000027	Vper		10.620		<input checked="" type="checkbox"/>
parameter- _0000028	Vvri		76.464		<input checked="" type="checkbox"/>
parameter- _0000029	Vpdp		344.090		<input checked="" type="checkbox"/>
parameter- _0000030	Vclk		1.062		<input checked="" type="checkbox"/>
parameter- _0000031	Rpbas		0.021		<input checked="" type="checkbox"/>
parameter- _0000032	Rvbas		0.191		<input checked="" type="checkbox"/>
parameter- _0000033	Rcbas		0.001		<input checked="" type="checkbox"/>
parameter- _0000034	Rpdbas		0.382		<input checked="" type="checkbox"/>
parameter- _0000036	Vdclk		0.212		<input checked="" type="checkbox"/>
parameter- _0000037	vdvri		0.743		<input checked="" type="checkbox"/>
parameter- _0000038	vdpdp		0.690		<input checked="" type="checkbox"/>
parameter- _0000039	Tdelay		2.825		<input checked="" type="checkbox"/>
parameter- _0000040	Vpcyt		1.699		<input checked="" type="checkbox"/>
parameter- _0000041	Kpcyt		0.250		<input checked="" type="checkbox"/>
parameter- _0000042	Vpnuc		0.319		<input checked="" type="checkbox"/>

Id	Name	SBO	Value	Unit	Constant
parameter- _0000043	Kpnuc		0.001		✓
parameter- _0000044	Vtrans		1.699		✓
parameter- _0000045	Ktrans		0.250		✓
parameter- _0000046	Vdegp		5.310		✓
parameter- _0000047	Kdegp		0.010		✓
parameter- _0000048	kd		0.005		✓

## 6 Rules

This is an overview of six rules.

### 6.1 Rule `parameter_0000001`

Rule `parameter_0000001` is a rate rule for parameter `parameter_0000001`:

$$\begin{aligned}
 & \frac{d}{dt} \text{parameter\_0000001} \\
 &= \text{parameter\_0000017} \cdot \frac{[\text{species\_0000008}]}{[\text{species\_0000008}] + \text{parameter\_0000011}} \\
 & \quad \cdot \frac{\text{parameter\_0000005}}{\text{parameter\_0000005} + [\text{species\_0000001}] + [\text{species\_0000002}] + [\text{species\_0000003}]} \\
 & \quad \cdot (1 - \text{parameter\_0000001}) - \text{parameter\_0000014} \cdot \text{parameter\_0000001}
 \end{aligned} \tag{1}$$

### 6.2 Rule `parameter_0000002`

Rule `parameter_0000002` is a rate rule for parameter `parameter_0000002`:

$$\begin{aligned}
 & \frac{d}{dt} \text{parameter\_0000002} \\
 &= \text{parameter\_0000018} \cdot \frac{[\text{species\_0000008}]}{[\text{species\_0000008}] + \text{parameter\_0000012}} \\
 & \quad \cdot \frac{\text{parameter\_0000006}}{\text{parameter\_0000006} + [\text{species\_0000001}] + [\text{species\_0000002}] + [\text{species\_0000003}]} \\
 & \quad \cdot (1 - \text{parameter\_0000002}) - \text{parameter\_0000015} \cdot \text{parameter\_0000002}
 \end{aligned} \tag{2}$$



### 6.3 Rule parameter\_0000003

Rule parameter\_0000003 is a rate rule for parameter parameter\_0000003:

$$\begin{aligned} \frac{d}{dt} \text{parameter\_0000003} &= \text{parameter\_0000019} \cdot \frac{[\text{species\_0000008}]}{[\text{species\_0000008}] + \text{parameter\_0000013}} \\ &\cdot \frac{\text{parameter\_0000007}}{\text{parameter\_0000007} + [\text{species\_0000001}] + [\text{species\_0000002}] + [\text{species\_0000003}]} \\ &\cdot (1 - \text{parameter\_0000003}) - \text{parameter\_0000016} \cdot \text{parameter\_0000003} \end{aligned} \quad (3)$$

### 6.4 Rule parameter\_0000020

Rule parameter\_0000020 is a rate rule for parameter parameter\_0000020:

$$\frac{d}{dt} \text{parameter\_0000020} = \frac{\text{parameter\_0000001} \text{parameter\_0000026} - \text{parameter\_0000020}}{\text{parameter\_0000023}} \quad (4)$$

### 6.5 Rule parameter\_0000021

Rule parameter\_0000021 is a rate rule for parameter parameter\_0000021:

$$\frac{d}{dt} \text{parameter\_0000021} = \frac{\text{parameter\_0000002} \text{parameter\_0000026} - \text{parameter\_0000021}}{\text{parameter\_0000024}} \quad (5)$$

### 6.6 Rule parameter\_0000022

Rule parameter\_0000022 is a rate rule for parameter parameter\_0000022:

$$\frac{d}{dt} \text{parameter\_0000022} = \frac{\text{parameter\_0000003} \text{parameter\_0000026} - \text{parameter\_0000022}}{\text{parameter\_0000025}} \quad (6)$$

## 7 Reactions

This model contains 22 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

Nº	Id	Name	Reaction Equation	SBO
1	reaction- _0000001	Per production	$\emptyset \longrightarrow \text{species\_0000004}$	
2	reaction- _0000002	Vri production	$\emptyset \longrightarrow \text{species\_0000007}$	
3	reaction- _0000003	Pdp production	$\emptyset \longrightarrow \text{species\_0000009}$	
4	reaction- _0000004	Clk production	$\emptyset \xrightarrow{\text{species\_0000009, species\_0000007}} \text{species\_0000008}$	
5	reaction- _0000005	Clk specific degradation	$\text{species\_0000008} \longrightarrow \emptyset$	
6	reaction- _0000006	Pdp specific degradation	$\text{species\_0000009} \longrightarrow \emptyset$	
7	reaction- _0000007	Vri specific degradation	$\text{species\_0000007} \longrightarrow \emptyset$	
8	reaction- _0000008	first cytoplasmic Per phosphorylation	$\text{species\_0000004} \longrightarrow \text{species\_0000005}$	
9	reaction- _0000009	second cytoplasmic Per phosphorylation	$\text{species\_0000005} \longrightarrow \text{species\_0000006}$	
10	reaction- _0000010	Per nuclear transport	$\text{species\_0000006} \longrightarrow \text{species\_0000001}$	
11	reaction- _0000011	first nuclear Per phosphorylation	$\text{species\_0000001} \longrightarrow \text{species\_0000002}$	

Nº	Id	Name	Reaction Equation	SBO
12	reaction- _0000012	second nuclear Rer phosphorylation	species_0000002 $\longrightarrow$ species_0000003	
13	reaction- _0000013	Per specific degradation	species_0000003 $\longrightarrow \emptyset$	
14	reaction- _0000014	Clk aspecific degradation	species_0000008 $\longrightarrow \emptyset$	
15	reaction- _0000015	Pdp aspecific degradation	species_0000009 $\longrightarrow \emptyset$	
16	reaction- _0000016	Vri aspecific degradation	species_0000007 $\longrightarrow \emptyset$	
17	reaction- _0000017	Per_cyt aspecific degradation	species_0000004 $\longrightarrow \emptyset$	
18	reaction- _0000018	Per-P_cyt aspecific degradation	species_0000005 $\longrightarrow \emptyset$	
19	reaction- _0000019	Per-PP_cyt aspecific degradation	species_0000006 $\longrightarrow \emptyset$	
20	reaction- _0000020	Per_nuc aspecific degradation	species_0000001 $\longrightarrow \emptyset$	
21	reaction- _0000021	Per-P_nuc aspecific degradation	species_0000002 $\longrightarrow \emptyset$	
22	reaction- _0000022	Per-PP_nuc aspecific degradation	species_0000003 $\longrightarrow \emptyset$	

### 7.1 Reaction [reaction\\_0000001](#)

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

**Name** Per production

#### Reaction equation



#### Product

Table 6: Properties of each product.

Id	Name	SBO
species_0000004	P0cyt	

#### Kinetic Law

**Derived unit** contains undeclared units

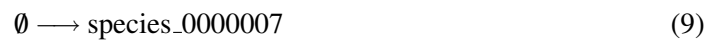
$$v_1 = \text{vol}(\text{compartment\_0000002}) \cdot (\text{parameter\_0000027} \cdot \text{parameter\_0000021} + \text{parameter\_0000031}) \quad (8)$$

### 7.2 Reaction [reaction\\_0000002](#)

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

**Name** Vri production

#### Reaction equation



#### Product

Table 7: Properties of each product.

Id	Name	SBO
species_0000007	VRI	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_2 = \text{vol}(\text{compartment\_0000001}) \cdot (\text{parameter\_0000028} \cdot \text{parameter\_0000020} + \text{parameter\_0000032}) \quad (10)$$

### 7.3 Reaction `reaction_0000003`

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

**Name** Pdp production

#### Reaction equation



#### Product

Table 8: Properties of each product.		
Id	Name	SBO
species_0000009	PDP	

### Kinetic Law

**Derived unit** contains undeclared units

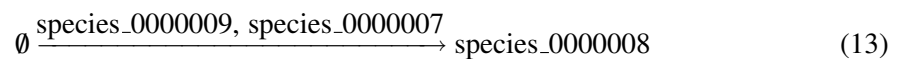
$$v_3 = \text{vol}(\text{compartment\_0000001}) \cdot \text{delay} \quad (12)$$

### 7.4 Reaction `reaction_0000004`

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

**Name** Clk production

#### Reaction equation



#### Modifiers

Table 9: Properties of each modifier.

Id	Name	SBO
species_0000009	PDP	
species_0000007	VRI	

## Product

Table 10: Properties of each product.

Id	Name	SBO
species_0000008	CLK	

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_4 = & \text{vol}(\text{compartment\_0000001}) \\
 & \cdot \left( \text{parameter\_0000030} \cdot \frac{[\text{species\_0000009}]^2}{[\text{species\_0000009}]^2 + \text{parameter\_0000010}^2} \right. \\
 & \left. \cdot \frac{\text{parameter\_0000008}^2}{[\text{species\_0000007}]^2 + \text{parameter\_0000008}^2} + \text{parameter\_0000033} \right) \quad (14)
 \end{aligned}$$

## 7.5 Reaction [reaction\\_0000005](#)

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

**Name** Clk specific degradation

## Reaction equation



## Reactant

Table 11: Properties of each reactant.

Id	Name	SBO
species_0000008	CLK	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_5 = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000036} \cdot [\text{species\_0000008}] \quad (16)$$

### 7.6 Reaction `reaction_0000006`

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

**Name** Pdp specific degradation

#### Reaction equation



#### Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
species_0000009	PDP	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_6 = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000038} \cdot [\text{species\_0000009}] \quad (18)$$

### 7.7 Reaction `reaction_0000007`

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

**Name** Vri specific degradation

#### Reaction equation



#### Reactant

Table 13: Properties of each reactant.

Id	Name	SBO
species_0000007	VRI	

### Kinetic Law

**Derived unit** contains undeclared units

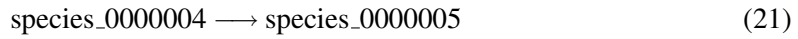
$$v_7 = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000037} \cdot [\text{species\_0000007}] \quad (20)$$

## 7.8 Reaction reaction\_0000008

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

**Name** first cytoplasmic Per phosphorylation

### Reaction equation



### Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
species_0000004	P0cyt	

### Product

Table 15: Properties of each product.

Id	Name	SBO
species_0000005	P1cyt	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_8 = \text{vol}(\text{compartment\_0000002}) \cdot \frac{\text{parameter\_0000040} \cdot [\text{species\_0000004}]}{\text{parameter\_0000041} + [\text{species\_0000004}]} \quad (22)$$

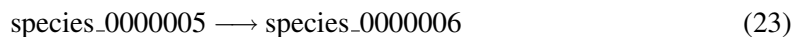


## 7.9 Reaction [reaction\\_0000009](#)

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

**Name** second cytoplasmic Per phosphorylation

### Reaction equation



### Reactant

Table 16: Properties of each reactant.

Id	Name	SBO
species_0000005	P1cyt	

### Product

Table 17: Properties of each product.

Id	Name	SBO
species_0000006	P2cyt	

### Kinetic Law

**Derived unit** contains undeclared units

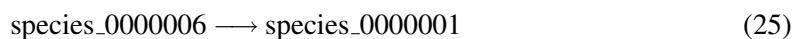
$$v_9 = \text{vol}(\text{compartment\_0000002}) \cdot \frac{\text{parameter\_0000040} \cdot [\text{species\_0000005}]}{\text{parameter\_0000041} + [\text{species\_0000005}]} \quad (24)$$

## 7.10 Reaction [reaction\\_0000010](#)

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

**Name** Per nuclear transport

### Reaction equation



### Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
species_0000006	P2cyt	

## Product

Table 19: Properties of each product.

Id	Name	SBO
species_0000001	P0nuc	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{10} = \text{vol}(\text{compartment\_0000002}) \cdot \frac{\text{parameter\_0000044} \cdot [\text{species\_0000006}]}{\text{parameter\_0000045} + [\text{species\_0000006}]} \quad (26)$$

## 7.11 Reaction `reaction_0000011`

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

**Name** first nuclear Per phosphorylation

## Reaction equation



## Reactant

Table 20: Properties of each reactant.

Id	Name	SBO
species_0000001	P0nuc	

## Product

Table 21: Properties of each product.

Id	Name	SBO
species_0000002	P1nuc	

Id	Name	SBO
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### Kinetic Law

**Derived unit** contains undeclared units

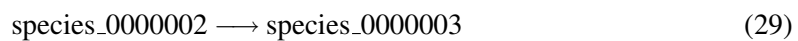
$$v_{11} = \text{vol}(\text{compartment\_0000001}) \cdot \frac{\text{parameter\_0000042} \cdot [\text{species\_0000001}]}{\text{parameter\_0000043} + [\text{species\_0000001}]} \quad (28)$$

### 7.12 Reaction [reaction\\_0000012](#)

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

**Name** second nuclear Rer phosphorylation

### Reaction equation



### Reactant

Table 22: Properties of each reactant.

Id	Name	SBO
species_0000002	P1nuc	

### Product

Table 23: Properties of each product.

Id	Name	SBO
species_0000003	P2nuc	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{12} = \text{vol}(\text{compartment\_0000001}) \cdot \frac{\text{parameter\_0000042} \cdot [\text{species\_0000002}]}{\text{parameter\_0000043} + [\text{species\_0000002}]} \quad (30)$$

### 7.13 Reaction [reaction\\_0000013](#)

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

**Name** Per specific degradation

### Reaction equation



### Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
species_0000003	P2nuc	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{13} = \text{vol}(\text{compartment\_0000001}) \cdot \frac{\text{parameter\_0000046} \cdot [\text{species\_0000003}]}{\text{parameter\_0000047} + [\text{species\_0000003}]} \quad (32)$$

## 7.14 Reaction reaction\_0000014

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

**Name** Clk aspecific degradation

### Reaction equation



### Reactant

Table 25: Properties of each reactant.

Id	Name	SBO
species_0000008	CLK	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{14} = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000008}] \quad (34)$$

### 7.15 Reaction `reaction_0000015`

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

**Name** Pdp aspecific degradation

#### Reaction equation



#### Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
species_0000009	PDP	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{15} = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000009}] \quad (36)$$

### 7.16 Reaction `reaction_0000016`

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

**Name** Vri aspecific degradation

#### Reaction equation



#### Reactant

Table 27: Properties of each reactant.

Id	Name	SBO
species_0000007	VRI	

#### Kinetic Law

**Derived unit** contains undeclared units

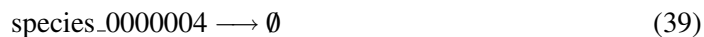
$$v_{16} = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000007}] \quad (38)$$

### 7.17 Reaction [reaction\\_0000017](#)

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

**Name** Per\_cyt aspecific degradation

#### Reaction equation



#### Reactant

Table 28: Properties of each reactant.

Id	Name	SBO
species_0000004	P0cyt	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{17} = \text{vol}(\text{compartment\_0000002}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000004}] \quad (40)$$

### 7.18 Reaction [reaction\\_0000018](#)

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

**Name** Per-P\_cyt aspecific degradation

#### Reaction equation



#### Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
species_0000005	P1cyt	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{18} = \text{vol}(\text{compartment\_0000002}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000005}] \quad (42)$$

### 7.19 Reaction [reaction\\_0000019](#)

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

**Name** Per-PP\_cyt aspecific degradation

#### Reaction equation



#### Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
species_0000006	P2cyt	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{19} = \text{vol}(\text{compartment\_0000002}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000006}] \quad (44)$$

### 7.20 Reaction [reaction\\_0000020](#)

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

**Name** Per\_nuc aspecific degradation

#### Reaction equation



#### Reactant

Table 31: Properties of each reactant.

Id	Name	SBO
species_0000001	P0nuc	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{20} = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000001}] \quad (46)$$

### 7.21 Reaction `reaction_0000021`

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

**Name** Per-P\_nuc aspecific degradation

#### Reaction equation



#### Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
species_0000002	P1nuc	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{21} = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000002}] \quad (48)$$

### 7.22 Reaction `reaction_0000022`

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

**Name** Per-PP\_nuc aspecific degradation

#### Reaction equation



#### Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
species_0000003	P2nuc	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{22} = \text{vol}(\text{compartment\_0000001}) \cdot \text{parameter\_0000048} \cdot [\text{species\_0000003}] \quad (50)$$



## 8 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.

### 8.1 Species `species_0000001`

**Name** P0nuc

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_0000011](#), [reaction\\_0000020](#) and as a product in [reaction\\_0000010](#)).

$$\frac{d}{dt}\text{species\_0000001} = v_{10} - v_{11} - v_{20} \quad (51)$$

### 8.2 Species `species_0000002`

**Name** P1nuc

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_0000012](#), [reaction\\_0000021](#) and as a product in [reaction\\_0000011](#)).

$$\frac{d}{dt}\text{species\_0000002} = v_{11} - v_{12} - v_{21} \quad (52)$$

### 8.3 Species `species_0000003`

**Name** P2nuc

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_0000013](#), [reaction\\_0000022](#) and as a product in [reaction\\_0000012](#)).

$$\frac{d}{dt}\text{species\_0000003} = v_{12} - v_{13} - v_{22} \quad (53)$$

#### 8.4 Species `species_0000004`

**Name** P0cyt

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_0000008](#), [reaction\\_0000017](#) and as a product in [reaction\\_0000001](#)).

$$\frac{d}{dt}\text{species\_0000004} = v_1 - v_8 - v_{17} \quad (54)$$

#### 8.5 Species `species_0000005`

**Name** P1cyt

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_0000009](#), [reaction\\_0000018](#) and as a product in [reaction\\_0000008](#)).

$$\frac{d}{dt}\text{species\_0000005} = v_8 - v_9 - v_{18} \quad (55)$$

#### 8.6 Species `species_0000006`

**Name** P2cyt

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_0000010](#), [reaction\\_0000019](#) and as a product in [reaction\\_0000009](#)).

$$\frac{d}{dt}\text{species\_0000006} = v_9 - v_{10} - v_{19} \quad (56)$$

#### 8.7 Species `species_0000007`

**Name** VRI

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in [reaction\\_0000007](#), [reaction\\_0000016](#) and as a product in [reaction\\_0000002](#) and as a modifier in [reaction\\_0000004](#)).

$$\frac{d}{dt}\text{species\_0000007} = v_2 - v_7 - v_{16} \quad (57)$$

## 8.8 Species `species_0000008`

**Name** CLK

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in `reaction_0000005`, `reaction_0000014` and as a product in `reaction_0000004`).

$$\frac{d}{dt}\text{species\_0000008} = v_4 - v_5 - v_{14} \quad (58)$$

## 8.9 Species `species_0000009`

**Name** PDP

**Initial concentration**  $0.0010 \text{ nmol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in `reaction_0000006`, `reaction_0000015` and as a product in `reaction_0000003` and as a modifier in `reaction_0000004`).

$$\frac{d}{dt}\text{species\_0000009} = v_3 - v_6 - v_{15} \quad (59)$$

SBML2<sup>AT</sup>EX was developed by Andreas Dräger<sup>a</sup>, Hannes Planatscher<sup>a</sup>, Dieudonné M Wouamba<sup>a</sup>, Adrian Schröder<sup>a</sup>, Michael Hucka<sup>b</sup>, Lukas Endler<sup>c</sup>, Martin Golebiewski<sup>d</sup> and Andreas Zell<sup>a</sup>. Please see <http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX> for more information.

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