SBML Model Report

Model name: "Aguda1999_CellCycle"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Harish Dharuri[1] at April third 2008 at 1:23 p. m. and last time modified at April thirteenth 2015 at 1:56 p. m. Table 1 shows an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	11
events	0	constraints	0
reactions	27	function definitions	3
global parameters	32	unit definitions	0
rules	0	initial assignments	0

Model Notes

The model reproduces the time profiles of p27, E2F and aE/cdk2 as depicted in Figure 5 c of the paper. Model was simulated on MathSBML.

[1]California Institute of Technology, hdharuri@cds.caltech.edu

commercially or not, in a restricted way or not.

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 which are all predefined by SBML and not mentioned in the model.

2.1 Unit `substance`

Notes Mole is the predefined SBML unit for `substance`.

Definition mol

2.2 Unit `volume`

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

Definition l

2.3 Unit `area`

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

Definition m^2

2.4 Unit `length`

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

Definition m

2.5 Unit `time`

Notes Second is the predefined SBML unit for `time`.

Definition s

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
cell_1	cell		3	1	litre	☑	

3.1 Compartment cell_1

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

Name cell

4 Species

This model contains eleven 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
Y3_1	pRB_E2F	cell_1	mol	⊟	⊟
Y4_1	E2F	cell_1	mol	⊟	⊟
Y11_1	pRB_P	cell_1	mol	⊟	⊟
Y2_1	i_cyclinE_CDK2	cell_1	mol	⊟	⊟
Y1_1	a_cyclinE_CDK2	cell_1	mol	⊟	⊟
Y5_1	pRB	cell_1	mol	⊟	⊟
Y6_1	CycD_CDK4	cell_1	mol	⊟	⊟
Y7_1	p27	cell_1	mol	⊟	⊟
Y8_1	cycE_CDK2_p27	cell_1	mol	⊟	⊟
Y10_1	p16	cell_1	mol	⊟	⊟
Y9_1	cycD_CDK4_p27	cell_1	mol	⊟	⊟

5 Parameters

This model contains 32 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1p_1	k1p		0.500		☑
k1pp_1	k1pp		0.500		☑
k1_1	k1		0.100		☑
k2_1	k2		0.100		☑
kminus2_1	kminus2		1.000		☑
k3_1	k3		1.420		☑
k3p_1	k3p		0.000		☑
k4_1	k4		10^{-6}		☑
kminus4_1	kminus4		0.016		☑
kminus1_1	kminus1		0.001		☑
k5_1	k5		0.020		☑
k6_1	k6		0.018		☑
kminus6_1	kminus6		5.000		☑
k7_1	k7		10^{-5}		☑
k8_1	k8		2.000		☑
k9_1	k9		2.000		☑
K10_1	K10		0.035		☑
k17_1	k17		3.500		☑
k18_1	k18		10^{-5}		☑
k19_1	k19		0.050		☑
k20_1	k20		0.010		☑
k21_1	k21		0.100		☑
k22_1	k22		0.001		☑
k23_1	k23		0.200		☑
k24_1	k24		0.100		☑
k25_1	k25		0.010		☑
k25p_1	k25p		0.020		☑
k26_1	k26		0.010		☑
k26p_1	k26p		0.100		☑
k27_1	k27		0.010		☑
k28_1	k28		0.010		☑
k29_1	k29		0.001		☑

6 Function definitions

This is an overview of three function definitions.

6.1 Function definition Mass_Action_1_1

Name Mass_Action_1

Arguments k1, S1

Mathematical Expression

$$k1 \cdot S1 \tag{1}$$

6.2 Function definition Mass_Action_2_1

Name Mass_Action_2

Arguments k1, S1, S2

Mathematical Expression

$$k1 \cdot S1 \cdot S2 \tag{2}$$

6.3 Function definition Mass_Action_0_1

Name Mass_Action_0

Argument k1

Mathematical Expression

$$k1 \tag{3}$$

7 Reactions

This model contains 27 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	_1	pRB/E2F complex deassociation	$Y3\_1 \xrightarrow{Y3\_1,\ Y1\_1,\ Y6\_1,\ Y9\_1} Y4\_1 + Y11\_1$	
2	pRBE2Fcomplexformation_1	pRB/E2F complex formation	$Y5\_1 + Y4\_1 \longrightarrow Y3\_1$	
3	cycECDK2activation_1	cycE/CDK2 activation	$Y2\_1 \longrightarrow Y1\_1$	
4	cycECDK2deactivation_1	cycE/CDK2 deactivation	$Y1\_1 \longrightarrow Y2\_1$	
5	cycECDK2synthesis_1	cycE/CDK2 synthesis	$\emptyset \xrightarrow{Y4\_1} Y2\_1$	
6	E2Fsynthesis_1	E2F synthesis	$\emptyset \longrightarrow Y4\_1$	
7	E2Fdegradation_1	E2F degradation	$Y4\_1 \longrightarrow \emptyset$	
8	cycECDK2degradation_1	cycE/CDK2 degradation	$Y2\_1 \longrightarrow \emptyset$	
9	cycDCDK4synthesis_1	cycD/CDK4 synthesis	$\emptyset \longrightarrow Y6\_1$	
10	cycDCDK4degradation_1	cycD/CDK4 degradation	$Y6\_1 \longrightarrow \emptyset$	
11	p27synthesis_1	p27 synthesis	$\emptyset \longrightarrow Y7\_1$	
12	p27degradationviacycECDK2_1	p27 degradation via cycE/CDK2	$Y7\_1 \xrightarrow{Y1\_1} \emptyset$	

№	Id	Name	Reaction Equation	SBO
13	cycECDK2p27complexformation_1	cycE/CDK2/p27 complex formation	$Y1\_1 + Y7\_1 \longrightarrow Y8\_1$	
14	cycECDK2p27deassociation_1	cycE/CDK2/p27 deassociation	$Y8\_1 \longrightarrow Y1\_1 + Y7\_1$	
15	cycDCDK4p16complexformation_1	cycD/CDK4/p16 complex formation	$Y6\_1 + Y10\_1 \longrightarrow \emptyset$	
16	E2Fautostimulation_1	E2F auto stimulation	$\emptyset \longrightarrow Y4\_1$	
17	cycDCDK4p27complexformation_1	cycD/CDK4/p27 complex formation	$Y7\_1 + Y6\_1 \longrightarrow Y9\_1$	
18	cycDCDK4p27complexdeassociation_1	cycD/CDK4/p27 complex deassociation	$Y9\_1 \longrightarrow Y7\_1 + Y6\_1$	
19	acycECDK2degradation_1	acycE/CDK2 degradation	$Y1\_1 \longrightarrow \emptyset$	
20	p27degradation_1	p27 degradation	$Y7\_1 \longrightarrow \emptyset$	
21	_20	p16 synthesis	$\emptyset \longrightarrow Y10\_1$	
22	p16degradation_1	p16 degradation	$Y10\_1 \longrightarrow \emptyset$	
23	p16synthesisinhibitedbypRB_1	p16 synthesis inhibited by pRB	$\emptyset \xrightarrow{Y5\_1} Y10\_1$	
24	pRBpdephosphorilationp16_1	pRB synthesis inhibited by p16	$\emptyset \xrightarrow{Y10\_1} Y5\_1$	
25	pRBsynthesis_1	pRB synthesis	$\emptyset \longrightarrow Y5\_1$	
26	pRBdegradation_1	pRB degradation	$Y5\_1 \longrightarrow \emptyset$	
27	pRBpdephosphorylationp16_1	pRB-p dephosphorylation	$Y11\_1 \longrightarrow Y5\_1$	

7.1 Reaction _1

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

Name pRB/E2F complex deassociation

Reaction equation

$$\mathrm{Y3\_1} \xrightarrow{\mathrm{Y3\_1,\ Y1\_1,\ Y6\_1,\ Y9\_1}} \mathrm{Y4\_1} + \mathrm{Y11\_1} \tag{4}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
Y3_1	pRB_E2F	

Modifiers

Table 7: Properties of each modifier.

Id	Name	SBO
Y3_1	pRB_E2F	
Y1_1	a_cyclinE_CDK2	
Y6_1	CycD_CDK4	
Y9_1	cycD_CDK4_p27	

Products

Table 8: Properties of each product.

Id	Name	SBO
Y4_1	E2F	
Y11_1	pRB_P	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \mathrm{k1p\_1} \cdot \mathrm{Y6\_1} \cdot \mathrm{Y3\_1} + \mathrm{k1pp\_1} \cdot \mathrm{Y9\_1} \cdot \mathrm{Y3\_1} + \mathrm{k1\_1} \cdot \mathrm{Y1\_1} \cdot \mathrm{Y3\_1} \tag{5}$$

7.2 Reaction pRBE2Fcomplexformation_1

This is an irreversible reaction of two reactants forming one product.

Name pRB/E2F complex formation

Reaction equation

$$\mathrm{Y5\_1} + \mathrm{Y4\_1} \longrightarrow \mathrm{Y3\_1} \tag{6}$$

Reactants

Table 9: Properties of each reactant.

Id	Name	SBO
Y5_1	pRB	
Y4_1	E2F	

Product

Table 10: Properties of each product.

Id	Name	SBO
Y3_1	pRB_E2F	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \mathrm{Mass\_Action\_2\_1}\left(\mathrm{kminus1\_1}, \mathrm{Y5\_1}, \mathrm{Y4\_1}\right) \tag{7}$$

$$\mathrm{Mass\_Action\_2\_1}\left(\mathrm{k1}, \mathrm{S1}, \mathrm{S2}\right) = \mathrm{k1} \cdot \mathrm{S1} \cdot \mathrm{S2} \tag{8}$$

7.3 Reaction cycECDK2activation_1

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

Name cycE/CDK2 activation

Reaction equation

$$\mathrm{Y2\_1} \longrightarrow \mathrm{Y1\_1} \tag{9}$$

Reactant

Table 11: Properties of each reactant.

Id	Name	SBO
Y2_1	i_cyclinE_CDK2	

Product

Table 12: Properties of each product.

Id	Name	SBO
Y1_1	a_cyclinE_CDK2	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \text{k2\_1} \cdot \text{Y1\_1} \cdot \text{Y2\_1} \tag{10}$$

7.4 Reaction cycECDK2deactivation_1

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

Name cycE/CDK2 deactivation

Reaction equation

$$\text{Y1\_1} \longrightarrow \text{Y2\_1} \tag{11}$$

Reactant

Table 13: Properties of each reactant.

Id	Name	SBO
Y1_1	a_cyclinE_CDK2	

Product

Table 14: Properties of each product.

Id	Name	SBO
Y2_1	i_cyclinE_CDK2	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{kminus2\_1} \cdot \text{Y1\_1} \tag{12}$$

7.5 Reaction cycECDK2synthesis_1

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

Name icycE/CDK2 synthesis

Reaction equation

$$\emptyset \xrightarrow{\text{Y4\_1}} \text{Y2\_1} \tag{13}$$

Modifier

Table 15: Properties of each modifier.

Id	Name	SBO
Y4_1	E2F	

Product

Table 16: Properties of each product.

Id	Name	SBO
Y2_1	i_cyclinE_CDK2	

Kinetic Law

Derived unit not available

$$v_5 = \text{k3\_1} \cdot \text{Y4\_1} + \text{k3p\_1} \tag{14}$$

7.6 Reaction E2Fsynthesis_1

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

Name E2F synthesis

Reaction equation

$$\emptyset \longrightarrow \text{Y4\_1} \tag{15}$$

Product

Table 17: Properties of each product.

Id	Name	SBO
Y4_1	E2F	

Kinetic Law

Derived unit not available

$$v_6 = \text{k4\_1} \tag{16}$$

7.7 Reaction E2Fdegradation_1

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

Name E2F degradation

Reaction equation

$$\text{Y4\_1} \longrightarrow \emptyset \tag{17}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
Y4_1	E2F	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \text{Mass\_Action\_1\_1}\,(\text{kminus4\_1}, \text{Y4\_1}) \tag{18}$$

$$\text{Mass\_Action\_1\_1}\,(\text{k1}, \text{S1}) = \text{k1} \cdot \text{S1} \tag{19}$$

7.8 Reaction cycECDK2degradation_1

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

Name icycE/CDK2 degradation

Reaction equation

$$\mathrm{Y2\_1} \longrightarrow \emptyset \tag{20}$$

Reactant

Table 19: Properties of each reactant.

Id	Name	SBO
Y2_1	i_cyclinE_CDK2	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \mathrm{Mass\_Action\_1\_1}\left(\mathrm{k5\_1}, \mathrm{Y2\_1}\right) \tag{21}$$

$$\mathrm{Mass\_Action\_1\_1}\left(\mathrm{k1}, \mathrm{S1}\right) = \mathrm{k1} \cdot \mathrm{S1} \tag{22}$$

7.9 Reaction cycDCDK4synthesis_1

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

Name cycD/CDK4 synthesis

Reaction equation

$$\emptyset \longrightarrow \mathrm{Y6\_1} \tag{23}$$

Product

Table 20: Properties of each product.

Id	Name	SBO
Y6_1	CycD_CDK4	

Kinetic Law

Derived unit not available

$$v_9 = \mathrm{Mass\_Action\_0\_1}\left(\mathrm{k6\_1}\right) \tag{24}$$

$$\mathrm{Mass\_Action\_0\_1}\left(\mathrm{k1}\right) = \mathrm{k1} \tag{25}$$

7.10 Reaction cycDCDK4degradation_1

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

Name cycD/CDK4 degradation

Reaction equation

$$\mathrm{Y6\_1} \longrightarrow \emptyset \tag{26}$$

Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
Y6_1	CycD_CDK4	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \mathrm{Mass\_Action\_1\_1}\left(\mathrm{kminus6\_1}, \mathrm{Y6\_1}\right) \tag{27}$$

$$\mathrm{Mass\_Action\_1\_1}\left(\mathrm{k1}, \mathrm{S1}\right) = \mathrm{k1} \cdot \mathrm{S1} \tag{28}$$

7.11 Reaction p27synthesis_1

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

Name p27 synthesis

Reaction equation

$$\emptyset \longrightarrow \mathrm{Y7\_1} \tag{29}$$

Product

Table 22: Properties of each product.

Id	Name	SBO
Y7_1	p27	

Kinetic Law

Derived unit not available

$$v_{11} = \text{Mass\_Action\_0\_1}\,(\text{k7\_1}) \tag{30}$$

$$\text{Mass\_Action\_0\_1}\,(\text{k1}) = \text{k1} \tag{31}$$

7.12 Reaction p27degradationviacycECDK2_1

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

Name p27 degradation via cycE/CDK2

Reaction equation

$$\text{Y7\_1} \xrightarrow{\text{Y1\_1}} \emptyset \tag{32}$$

Reactant

Table 23: Properties of each reactant.

Id	Name	SBO
Y7_1	p27	

Modifier

Table 24: Properties of each modifier.

Id	Name	SBO
Y1_1	a_cyclinE_CDK2	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{k8\_1} \cdot \text{Y7\_1} \cdot \text{Y1\_1} \tag{33}$$

7.13 Reaction cycECDK2p27complexformation_1

This is an irreversible reaction of two reactants forming one product.

Name cycE/CDK2/p27 complex formation

Reaction equation

$$\mathrm{Y1\_1} + \mathrm{Y7\_1} \longrightarrow \mathrm{Y8\_1} \tag{34}$$

Reactants

Table 25: Properties of each reactant.

Id	Name	SBO
Y1_1	a_cyclinE_CDK2	
Y7_1	p27	

Product

Table 26: Properties of each product.

Id	Name	SBO
Y8_1	cycE_CDK2_p27	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \mathrm{Mass\_Action\_2\_1}\left(\mathrm{k9\_1}, \mathrm{Y1\_1}, \mathrm{Y7\_1}\right) \tag{35}$$

$$\mathrm{Mass\_Action\_2\_1}\left(\mathrm{k1}, \mathrm{S1}, \mathrm{S2}\right) = \mathrm{k1} \cdot \mathrm{S1} \cdot \mathrm{S2} \tag{36}$$

7.14 Reaction cycECDK2p27deassociation_1

This is an irreversible reaction of one reactant forming two products.

Name cycE/CDK2/p27 deassociation

Reaction equation

$$\mathrm{Y8\_1} \longrightarrow \mathrm{Y1\_1} + \mathrm{Y7\_1} \tag{37}$$

Reactant

Table 27: Properties of each reactant.

Id	Name	SBO
Y8_1	cycE_CDK2_p27	

Products

Table 28: Properties of each product.

Id	Name	SBO
Y1_1	a_cyclinE_CDK2	
Y7_1	p27	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \text{Mass\_Action\_1\_1}\left(\text{K10\_1}, \text{Y8\_1}\right) \tag{38}$$

$$\text{Mass\_Action\_1\_1}\left(\text{k1}, \text{S1}\right) = \text{k1} \cdot \text{S1} \tag{39}$$

7.15 Reaction cycDCDK4p16complexformation_1

This is an irreversible reaction of two reactants forming no product.

Name cycD/CDK4/p16 complex formation

Reaction equation

$$\text{Y6\_1} + \text{Y10\_1} \longrightarrow \emptyset \tag{40}$$

Reactants

Table 29: Properties of each reactant.

Id	Name	SBO
Y6_1	CycD_CDK4	
Y10_1	p16	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \text{Mass\_Action\_2\_1}\,(\text{k17\_1}, \text{Y6\_1}, \text{Y10\_1}) \tag{41}$$

$$\text{Mass\_Action\_2\_1}\,(\text{k1}, \text{S1}, \text{S2}) = \text{k1} \cdot \text{S1} \cdot \text{S2} \tag{42}$$

7.16 Reaction E2Fautostimulation_1

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

Name E2F auto stimulation

Reaction equation

$$\emptyset \longrightarrow \text{Y4\_1} \tag{43}$$

Product

Table 30: Properties of each product.

Id	Name	SBO
Y4_1	E2F	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \text{k18\_1} \cdot \text{Y4\_1} \tag{44}$$

7.17 Reaction cycDCDK4p27complexformation_1

This is an irreversible reaction of two reactants forming one product.

Name cycD/CDK4/p27 complex formation

Reaction equation

$$\text{Y7\_1} + \text{Y6\_1} \longrightarrow \text{Y9\_1} \tag{45}$$

Reactants

Table 31: Properties of each reactant.

Id	Name	SBO
Y7_1	p27	
Y6_1	CycD_CDK4	

Product

Table 32: Properties of each product.

Id	Name	SBO
Y9_1	cycD_CDK4_p27	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \text{Mass\_Action\_2\_1}\,(\text{k19\_1}, \text{Y7\_1}, \text{Y6\_1}) \tag{46}$$

$$\text{Mass\_Action\_2\_1}\,(\text{k1}, \text{S1}, \text{S2}) = \text{k1} \cdot \text{S1} \cdot \text{S2} \tag{47}$$

7.18 Reaction cycDCDK4p27complexdeassociation_1

This is an irreversible reaction of one reactant forming two products.

Name cycD/CDK4/p27 complex deassociation

Reaction equation

$$\text{Y9\_1} \longrightarrow \text{Y7\_1} + \text{Y6\_1} \tag{48}$$

Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
Y9_1	cycD_CDK4_p27	

Products

Table 34: Properties of each product.

Id	Name	SBO
Y7_1	p27	
Y6_1	CycD_CDK4	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \text{Mass\_Action\_1\_1}\,(\text{k20\_1}, \text{Y9\_1}) \tag{49}$$

$$\text{Mass\_Action\_1\_1}\,(\text{k1}, \text{S1}) = \text{k1} \cdot \text{S1} \tag{50}$$

7.19 Reaction `acycECDK2degradation_1`

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

Name acycE/CDK2 degradation

Reaction equation

$$\text{Y1\_1} \longrightarrow \emptyset \tag{51}$$

Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
`Y1_1`	a_cyclinE_CDK2	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \text{k21\_1} \cdot \text{Y1\_1} \cdot \text{Y1\_1} \tag{52}$$

7.20 Reaction `p27degradation_1`

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

Name p27 degradation

Reaction equation

$$\text{Y7\_1} \longrightarrow \emptyset \tag{53}$$

Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
Y7_1	p27	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \text{Mass\_Action\_1\_1}\,(\text{k22\_1}, \text{Y7\_1}) \tag{54}$$

$$\text{Mass\_Action\_1\_1}\,(\text{k1}, \text{S1}) = \text{k1} \cdot \text{S1} \tag{55}$$

7.21 Reaction _20

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

Name p16 synthesis

Reaction equation

$$\emptyset \longrightarrow \text{Y10\_1} \tag{56}$$

Product

Table 37: Properties of each product.

Id	Name	SBO
Y10_1	p16	

Kinetic Law

Derived unit not available

$$v_{21} = \text{Mass\_Action\_0\_1}\,(\text{k23\_1}) \tag{57}$$

$$\text{Mass\_Action\_0\_1}\,(\text{k1}) = \text{k1} \tag{58}$$

7.22 Reaction p16degradation_1

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

Name p16 degradation

Reaction equation

$$\mathrm{Y10\_1} \longrightarrow \emptyset \tag{59}$$

Reactant

Table 38: Properties of each reactant.

Id	Name	SBO
Y10_1	p16	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \mathrm{Mass\_Action\_1\_1}\left(\mathrm{k24\_1}, \mathrm{Y10\_1}\right) \tag{60}$$

$$\mathrm{Mass\_Action\_1\_1}\left(\mathrm{k1}, \mathrm{S1}\right) = \mathrm{k1} \cdot \mathrm{S1} \tag{61}$$

7.23 Reaction p16synthesisinhibitedbypRB_1

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

Name p16 synthesis inhibited by pRB

Reaction equation

$$\emptyset \xrightarrow{\mathrm{Y5\_1}} \mathrm{Y10\_1} \tag{62}$$

Modifier

Table 39: Properties of each modifier.

Id	Name	SBO
Y5_1	pRB	

Product

Table 40: Properties of each product.

Id	Name	SBO
Y10_1	p16	

Id	Name	SBO

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \frac{\text{k25\_1}}{1 + \text{k25p\_1} \cdot \text{Y5\_1}} \tag{63}$$

7.24 Reaction pRBpdephosphorilation_1

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

Name pRB synthesis inhibited by p16

Reaction equation

$$\emptyset \xrightarrow{\text{Y10\_1}} \text{Y5\_1} \tag{64}$$

Modifier

Table 41: Properties of each modifier.

Id	Name	SBO
Y10_1	p16	

Product

Table 42: Properties of each product.

Id	Name	SBO
Y5_1	pRB	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \frac{\text{k26\_1}}{1 + \text{k26p\_1} \cdot \text{Y10\_1}} \tag{65}$$

7.25 Reaction pRBsynthesis_1

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

Name pRB synthesis

Reaction equation

$$\emptyset \longrightarrow \text{Y5\_1} \tag{66}$$

Product

Table 43: Properties of each product.

Id	Name	SBO
Y5_1	pRB	

Kinetic Law

Derived unit not available

$$v_{25} = \text{Mass\_Action\_0\_1}\,(\text{k27\_1}) \tag{67}$$

$$\text{Mass\_Action\_0\_1}\,(\text{k1}) = \text{k1} \tag{68}$$

7.26 Reaction pRBdegradation_1

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

Name pRB degradation

Reaction equation

$$\text{Y5\_1} \longrightarrow \emptyset \tag{69}$$

Reactant

Table 44: Properties of each reactant.

Id	Name	SBO
Y5_1	pRB	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \text{Mass\_Action\_1\_1}\,(\text{k28\_1}, \text{Y5\_1}) \tag{70}$$

$$\text{Mass\_Action\_1\_1}\,(\text{k1}, \text{S1}) = \text{k1} \cdot \text{S1} \tag{71}$$

7.27 Reaction `pRBpdephosphorylation_1`

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

Name pRB-p dephosphorylation

Reaction equation

$$\text{Y11\_1} \longrightarrow \text{Y5\_1} \tag{72}$$

Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
`Y11_1`	pRB_P	

Product

Table 46: Properties of each product.

Id	Name	SBO
`Y5_1`	pRB	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{Mass\_Action\_1\_1}\,(\text{k29\_1}, \text{Y11\_1}) \tag{73}$$

$$\text{Mass\_Action\_1\_1}\,(\text{k1}, \text{S1}) = \text{k1} \cdot \text{S1} \tag{74}$$

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 Y3_1

Name pRB_E2F

Initial amount 1.95 mol

This species takes part in three reactions (as a reactant in _1 and as a product in pRBE2Fcomplexformation_1 and as a modifier in _1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y3\_1} = v_2 - v_1 \tag{75}$$

8.2 Species Y4_1

Name E2F

Initial amount 0 mol

This species takes part in six reactions (as a reactant in pRBE2Fcomplexformation_1, E2Fdegradation_1 and as a product in _1, E2Fsynthesis_1, E2Fautostimulation_1 and as a modifier in cycECDK2synthesis_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y4\_1} = v_1 + v_6 + v_{16} - v_2 - v_7 \tag{76}$$

8.3 Species Y11_1

Name pRB_P

Initial amount 0.01 mol

This species takes part in two reactions (as a reactant in pRBpdephosphorylation_1 and as a product in _1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y11\_1} = v_1 - v_{27} \tag{77}$$

8.4 Species Y2_1

Name i_cyclinE_CDK2

Initial amount 0.01 mol

This species takes part in four reactions (as a reactant in cycECDK2activation_1, cycECDK2degradation_1 and as a product in cycECDK2deactivation_1, cycECDK2synthesis_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y2\_1} = v_4 + v_5 - v_3 - v_8 \tag{78}$$

8.5 Species Y1_1

Name a_cyclinE_CDK2

Initial amount 0 mol

This species takes part in seven reactions (as a reactant in cycECDK2deactivation_1, cycECDK2p27complexforma_1, acycECDK2degradation_1 and as a product in cycECDK2activation_1, cycECDK2p27deassociation_1 and as a modifier in _1, p27degradationviacycECDK2_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y1\_1} = v_3 + v_{14} - v_4 - v_{13} - v_{19} \tag{79}$$

8.6 Species Y5_1

Name pRB

Initial amount 0.05 mol

This species takes part in six reactions (as a reactant in pRBE2Fcomplexformation_1, pRBdegradation_1 and as a product in pRBpdephosphorilation_1, pRBsynthesis_1, pRBpdephosphorylation_1 and as a modifier in p16synthesisinhibitedbypRB_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y5\_1} = v_{24} + v_{25} + v_{27} - v_2 - v_{26} \tag{80}$$

8.7 Species Y6_1

Name CycD_CDK4

Initial amount 0 mol

This species takes part in six reactions (as a reactant in cycDCDK4degradation_1, cycDCDK4p16complexformatio_1, cycDCDK4p27complexformation_1 and as a product in cycDCDK4synthesis_1, cycDCDK4p27complexdeass_1 and as a modifier in _1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y6\_1} = v_9 + v_{18} - v_{10} - v_{15} - v_{17} \tag{81}$$

8.8 Species Y7_1

Name p27

Initial amount 15 mol

This species takes part in seven reactions (as a reactant in p27degradationviacycECDK2_1, cycECDK2p27complexformation_1, cycDCDK4p27complexformation_1, p27degradation_1 and as a product in p27synthesis_1, cycECDK2p27deassociation_1, cycDCDK4p27complexdeassociation_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y7\_1} = v_{11} + v_{14} + v_{18} - v_{12} - v_{13} - v_{17} - v_{20} \tag{82}$$

8.9 Species Y8_1

Name cycE_CDK2_p27

Initial amount 1 mol

This species takes part in two reactions (as a reactant in cycECDK2p27deassociation_1 and as a product in cycECDK2p27complexformation_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y8\_1} = v_{13} - v_{14} \tag{83}$$

8.10 Species Y10_1

Name p16

Initial amount 5 mol

This species takes part in five reactions (as a reactant in cycDCDK4p16complexformation_1, p16degradation_1 and as a product in _20, p16synthesisinhibitedbypRB_1 and as a modifier in pRBpdephosphorilation_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y10\_1} = v_{21} + v_{23} - v_{15} - v_{22} \tag{84}$$

8.11 Species Y9_1

Name cycD_CDK4_p27

Initial amount 0 mol

This species takes part in three reactions (as a reactant in cycDCDK4p27complexdeassociation_1 and as a product in cycDCDK4p27complexformation_1 and as a modifier in _1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y9\_1} = v_{17} - v_{18} \tag{85}$$

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

[a]Center for Bioinformatics Tübingen (ZBIT), Germany
[b]California Institute of Technology, Beckman Institute BNMC, Pasadena, United States
[c]European Bioinformatics Institute, Wellcome Trust Genome Campus, Hinxton, United Kingdom
[d]EML Research gGmbH, Heidelberg, Germany