

SBML Model Report

Model name: “Proctor2006_telomere”



May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Carole Proctor¹ at October 16th 2006 at 10:54 a. m. and last time modified at July fifth 2012 at 2:40 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	55
events	9	constraints	0
reactions	43	function definitions	0
global parameters	1	unit definitions	1
rules	0	initial assignments	0

Model Notes

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

2 Unit Definitions

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

2.1 Unit `substance`

Definition `item`

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 `m2`

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 Compartments

This model contains two compartments.

Table 2: Properties of all compartments.

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

3.1 Compartment `cellMembrane`

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

3.2 Compartment `nucleus`

This is a three dimensional compartment with a constant size of one litre, which is surrounded by `cellMembrane`.

4 Species

This model contains 55 species. The boundary condition of one of these species is set to `true` so that this species' amount cannot be changed by any reaction. 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 Condi- tion
Ctelo		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Utelo		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Cdc13		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Rad17Utelo		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Rad17		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Rad24		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
RPA		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Mec1		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
ssDNA		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
RPAssDNA		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
RPAssDNA1		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
RPAssDNA2		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Mec1RPAssDNA		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
ExoXI		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
ExoXA		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Exo1I		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Exo1A		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Rad9I		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Rad9A		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Rad53I		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
Rad53A		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
Chk1I		nucleus	item	\square	\square
Chk1A		nucleus	item	\square	\square
Dun1I		nucleus	item	\square	\square
Dun1A		nucleus	item	\square	\square
ATP		nucleus	item	\square	\square
ADP		nucleus	item	\square	\square
Rad9Kin		nucleus	item	\square	\square
recovery		nucleus	item	\square	\square
G1		nucleus	item	\square	\square
S		nucleus	item	\square	\square
G2		nucleus	item	\square	\square
M		nucleus	item	\square	\square
G1cyclin		nucleus	item	\square	\square
Scyclin		nucleus	item	\square	\square
G2cyclin		nucleus	item	\square	\square
Mcyclin		nucleus	item	\square	\square
G1CdkI		nucleus	item	\square	\square
G1CdkA		nucleus	item	\square	\square
SCdkI		nucleus	item	\square	\square
SCdkA		nucleus	item	\square	\square
G2CdkI		nucleus	item	\square	\square
G2CdkA		nucleus	item	\square	\square
MCdkI		nucleus	item	\square	\square
MCdkA		nucleus	item	\square	\square
G1Soff		nucleus	item	\square	\square
G1Son		nucleus	item	\square	\square
SG2off		nucleus	item	\square	\square

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
SG2on		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
G2Moff		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
G2Mon		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
MG1off		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
MG1on		nucleus	item	<input type="checkbox"/>	<input type="checkbox"/>
sink		nucleus	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>
budscar		cellMembrane	item	<input type="checkbox"/>	<input type="checkbox"/>

5 Parameter

This model contains one global parameter.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kalive			1.0		<input type="checkbox"/>

6 Events

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

6.1 Event `Rad9KinaseActivation`

Name Rad9KinaseActivation

Trigger condition

$$\text{Mec1RPAssDNA} \geq 800 \quad (1)$$

Assignment

$$[\text{Rad9Kin}] = 1 \quad (2)$$

6.2 Event `ssDNAremoval`

Name ssDNAremoval

Trigger condition

$$\text{Mec1RPAssDNA} + \text{RPAssDNA} + \text{ssDNA} \leq 1 \quad (3)$$

Assignments

$$[\text{recovery}] = 1 \quad (4)$$

$$[\text{Mec1RPAssDNA}] = 0 \quad (5)$$

$$[\text{RPAssDNA}] = 0 \quad (6)$$

$$[\text{ssDNA}] = 0 \quad (7)$$

6.3 Event G2MRecoveryCompleted

Name G2MRecoveryCompleted

Trigger condition

$$(G2 = 1) \wedge (\text{Rad17Utelo} = 0) \quad (8)$$

Assignments

$$[G2Mon] = 1 \quad (9)$$

$$[G2Moff] = 0 \quad (10)$$

$$[\text{recovery}] = 0 \quad (11)$$

$$[\text{Rad9A}] = 0 \quad (12)$$

$$[\text{Rad9I}] = 20 \quad (13)$$

$$[\text{Chk1A}] = 0 \quad (14)$$

$$[\text{Chk1I}] = 60 \quad (15)$$

$$[\text{Dun1A}] = 0 \quad (16)$$

$$[\text{Dun1I}] = 3000 \quad (17)$$

$$[\text{Exo1A}] = 0 \quad (18)$$

$$[\text{Exo1I}] = 670 \quad (19)$$

$$[\text{ExoXA}] = 0 \quad (20)$$

$$[\text{ExoXI}] = 70 \quad (21)$$

$$[\text{Rad53I}] = 6900 \quad (22)$$

$$[\text{Rad53A}] = 0 \quad (23)$$

6.4 Event SphaseRecoveryCompleted

Name SphaseRecoveryCompleted

Trigger condition

$$\text{Rad17Utelo} = 0 \quad (24)$$

Assignment

$$[\text{recovery}] = 0 \quad (25)$$

6.5 Event G1CdkActivation

Name G1CdkActivation

Trigger condition

$$G1cyclin > 100 \quad (26)$$

Assignments

$$[G1CdkA] = 1 \quad (27)$$

$$[G1CdkI] = 0 \quad (28)$$

6.6 Event SCdkActivation

Name SCdkActivation

Trigger condition $\text{Scyclin} > 100$ (29)

Assignments

$[\text{SCdkA}] = 1$ (30)

$[\text{SCdkI}] = 0$ (31)

6.7 Event G2CdkActivation

Name G2CdkActivation

Trigger condition $\text{G2cyclin} > 100$ (32)

Assignments

$[\text{G2CdkA}] = 1$ (33)

$[\text{G2CdkI}] = 0$ (34)

6.8 Event MCdkActivation

Name MCdkActivation

Trigger condition $\text{Mcyclin} > 100$ (35)

Assignments

$[\text{MCdkA}] = 1$ (36)

$[\text{MCdkI}] = 0$ (37)

6.9 Event CellDeath

Name CellDeath

Trigger condition $\text{Mec1RPAssDNA} + \text{RPAssDNA} + \text{ssDNA} \geq 2000$ (38)

Assignment $\text{kalive} = 0$ (39)

7 Reactions

This model contains 43 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	Capping	Capping	$\text{Cdc13} + \text{Utelo} \longrightarrow \text{Ctelo}$	
2	Uncapping	Uncapping	$\text{Ctelo} \longrightarrow \text{Cdc13} + \text{Utelo}$	
3	Rad17binding	Rad17binding	$\text{Utelo} + \text{Rad17} + \text{Rad24} + \text{ATP} \longrightarrow \text{Rad17Utelo} + \text{Rad24} + \text{ADP}$	
4	ExoXactivation	ExoXactivation	$\text{ExoXI} + \text{Rad17Utelo} \longrightarrow \text{ExoXA} + \text{Rad17Utelo}$	
5	ExoXactivity	ExoXactivity	$\text{ExoXA} + \text{Rad17Utelo} \longrightarrow \text{ExoXA} + \text{Rad17Utelo} + \text{ssDNA}$	
6	Exo1activation	Rad24independentExo1Activation	$\text{ExoII} \longrightarrow \text{Exo1A}$	
7	Exo1Rad24dependent	Rad24dependentExo1Activation	$\text{ExoII} + \text{Rad24} \longrightarrow \text{Exo1A} + \text{Rad24}$	
8	Exo1Rad17independent	Rad17independentExo1Activity	$\text{Utelo} + \text{Exo1A} \longrightarrow \text{Utelo} + \text{Exo1A} + \text{ssDNA}$	
9	Exo1Rad17dependent	Rad17dependentExo1Activity	$\text{Rad17Utelo} + \text{Exo1A} \longrightarrow \text{Rad17Utelo} + \text{Exo1A} + \text{ssDNA}$	
10	RPAbinding1	RPAbinding-stage1	$\text{ssDNA} + \text{RPA} \longrightarrow \text{RPAssDNA1}$	
11	RPAbinding2	RPAbinding-stage2	$\text{ssDNA} + \text{RPAssDNA1} \longrightarrow \text{RPAssDNA2}$	
12	RPAbinding	RPAbinding-completed	$\text{ssDNA} + \text{RPAssDNA2} \longrightarrow \text{RPAssDNA}$	
13	Mec1binding	Mec1binding	$\text{RPAssDNA} + \text{Mec1} \longrightarrow \text{Mec1RPAssDNA}$	
14	Rad9activation	Rad9activation	$\text{Rad9Kin} + \text{Rad9I} \longrightarrow \text{Rad9Kin} + \text{Rad9A}$	
15	ExoXinhibition	ExoXinhibition	$\text{ExoXA} + \text{Rad9A} \longrightarrow \text{ExoXI} + \text{Rad9A}$	
16	ExoXinhibition2	ExoXinhibition2	$\text{ExoXA} + \text{Rad9I} \longrightarrow \text{ExoXI} + \text{Rad9I}$	
17	Rad53activation	Rad53activation	$\text{Rad53I} + \text{Rad9A} \longrightarrow \text{Rad53A} + \text{Rad9A}$	
18	Chk1Activation	Chk1Activation	$\text{Chk1I} + \text{Rad9A} \longrightarrow \text{Chk1A} + \text{Rad9A}$	
19	Exo1inhibition	Exo1inhibition	$\text{Exo1A} + \text{Rad53A} \longrightarrow \text{Exo1I} + \text{Rad53A}$	
20	Dun1activation	Dun1activation	$\text{Dun1I} + \text{Rad53A} \longrightarrow \text{Dun1A} + \text{Rad53A}$	

Nº	Id	Name	Reaction Equation	SBO
21	Chk1cellArrest	Chk1cellArrest	$\text{Chk1A} + \text{G2Mon} \longrightarrow \text{Chk1A} + \text{G2Moff}$	
22	Dun1cellArrest	Dun1cellArrest	$\text{Dun1A} + \text{G2Mon} \longrightarrow \text{Dun1A} + \text{G2Moff}$	
23	SDNArepair1	SDNArepair1	$\text{Mec1RPAssDNA} + \text{S} \longrightarrow \text{Mec1} + \text{RPA} + \text{S} + 3 \text{ ssDNA}$	
24	G2DNArepair1	G2DNArepair1	$\text{G2} + \text{G2Moff} + \text{Mec1RPAssDNA} \longrightarrow \text{G2} + \text{G2Moff} + \text{Mec1} + \text{RPA} + 3 \text{ ssDNA}$	
25	SDNArepair2	SDNArepair2	$\text{S} + \text{ssDNA} \longrightarrow \text{S}$	
26	G2DNArepair2	G2DNArepair2	$\text{G2} + \text{G2Moff} + \text{ssDNA} \longrightarrow \text{G2} + \text{G2Moff}$	
27	Recovery	Recovery	$\text{Cdc13} + \text{Rad17Utelo} + \text{recovery} \longrightarrow \text{Ctelo} + \text{Rad17} + \text{recovery}$	
28	G1cyclinSynthesis	G1cyclinSynthesis	$\text{G1} \longrightarrow \text{G1cyclin} + \text{G1}$	
29	ScyclinSynthesis	ScyclinSynthesis	$\text{S} \longrightarrow \text{Scyclin} + \text{S}$	
30	G2cyclinSynthesis	G2cyclinSynthesis	$\text{G2} \longrightarrow \text{G2cyclin} + \text{G2}$	
31	McyclinSynthesis	McyclinSynthesis	$\text{M} \longrightarrow \text{Mcyclin} + \text{M}$	
32	G1toSGenesOn	G1toSGenesOn	$\text{G1Soff} + \text{G1} + \text{G1CdkA} \longrightarrow \text{G1Son} + \text{G1} + \text{G1CdkA}$	
33	StoG2GenesOn	StoG2GenesOn	$\text{SG2off} + \text{S} + \text{SCdkA} \longrightarrow \text{SG2on} + \text{S} + \text{SCdkA}$	
34	G2toMGenesOn	G2toMGenesOn	$\text{G2Moff} + \text{G2} + \text{G2CdkA} \longrightarrow \text{G2Mon} + \text{G2} + \text{G2CdkA}$	
35	MtoG1GenesOn	MtoG1GenesOn	$\text{MG1off} + \text{M} + \text{MCdkA} \longrightarrow \text{MG1on} + \text{M} + \text{MCdkA}$	
36	G1cyclinDegradation	G1cyclinDegradation	$\text{G1cyclin} \longrightarrow \text{sink}$	
37	ScyclinDegradation	ScyclinDegradation	$\text{Scyclin} \longrightarrow \text{sink}$	
38	G2cyclinDegradation	G2cyclinDegradation	$\text{G2cyclin} \longrightarrow \text{sink}$	
39	McyclinDegradation	McyclinDegradation	$\text{Mcyclin} \longrightarrow \text{sink}$	
40	G1toSProgression	G1toSProgression	$\text{G1} + \text{G1CdkA} + \text{G1Son} \longrightarrow \text{G1CdkI} + \text{G1Soff} + \text{S}$	
41	StoG2Progression	StoG2Progression	$\text{S} + \text{SCdkA} + \text{SG2on} \longrightarrow \text{G2} + \text{SCdkI} + \text{SG2off}$	
42	G2toMProgression	G2toMProgression	$\text{G2} + \text{G2CdkA} + \text{G2Mon} \longrightarrow \text{G2CdkI} + \text{G2Moff} + \text{M}$	

Nº	Id	Name	Reaction Equation	SBO
43	MtoG1Progression	MtoG1Progression	$M + MCdkA + MG1on \longrightarrow budscar + G1 + MCdkI + MG1off$	

7.1 Reaction Capping

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

Name Capping

Reaction equation



Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
Cdc13		
Utelo		

Product

Table 7: Properties of each product.

Id	Name	SBO
Ctelo		

Kinetic Law

Derived unit contains undeclared units

$$v_1 = k1 \cdot \text{Cdc13} \cdot \text{Utelo} \cdot \text{kalive} \quad (41)$$

Table 8: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1			$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

7.2 Reaction Uncapping

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

Name Uncapping

Reaction equation



Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
Ctelo		

Products

Table 10: Properties of each product.

Id	Name	SBO
Cdc13		
Utelo		

Kinetic Law

Derived unit contains undeclared units

$$v_2 = k_2 \cdot \text{Ctelo} \cdot \text{kalive} \quad (43)$$

Table 11: Properties of each parameter.

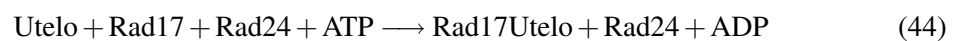
Id	Name	SBO	Value	Unit	Constant
k2			$3.85 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

7.3 Reaction Rad17binding

This is an irreversible reaction of four reactants forming three products.

Name Rad17binding

Reaction equation



Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
Utelo		
Rad17		
Rad24		
ATP		

Products

Table 13: Properties of each product.

Id	Name	SBO
Rad17Utelo		
Rad24		
ADP		

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \frac{k3 \cdot \text{Utelo} \cdot \text{Rad17} \cdot \text{Rad24} \cdot \text{ATP} \cdot \text{kalive}}{5000 + \text{ATP}} \quad (45)$$

Table 14: Properties of each parameter.

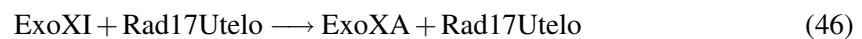
Id	Name	SBO	Value	Unit	Constant
k3			$1.5 \cdot 10^{-8}$		<input checked="" type="checkbox"/>

7.4 Reaction ExoXactivation

This is an irreversible reaction of two reactants forming two products.

Name ExoXactivation

Reaction equation



Reactants

Table 15: Properties of each reactant.

Id	Name	SBO
ExoXI		
Rad17Utelo		

Products

Table 16: Properties of each product.

Id	Name	SBO
ExoXA		
Rad17Utelo		

Kinetic Law

Derived unit contains undeclared units

$$v_4 = k_4 \cdot \text{ExoXI} \cdot \text{Rad17Utelo} \cdot \text{kalive} \quad (47)$$

Table 17: Properties of each parameter.

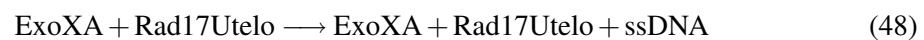
Id	Name	SBO	Value	Unit	Constant
k4			0.01		<input checked="" type="checkbox"/>

7.5 Reaction ExoXactivity

This is an irreversible reaction of two reactants forming three products.

Name ExoXactivity

Reaction equation



Reactants

Table 18: Properties of each reactant.

Id	Name	SBO
ExoXA		

Id	Name	SBO
Rad17Utelo		

Products

Table 19: Properties of each product.

Id	Name	SBO
ExoXA		
Rad17Utelo		
ssDNA		

Kinetic Law

Derived unit contains undeclared units

$$v_5 = k_5 \cdot \text{ExoXA} \cdot \text{Rad17Utelo} \cdot \text{kalive} \quad (49)$$

Table 20: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k5			$3 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

7.6 Reaction Exo1activation

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

Name Rad24independentExo1Activation

Reaction equation



Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
Exo1I		

Product

Table 22: Properties of each product.

Id	Name	SBO
Exo1A		

Kinetic Law

Derived unit contains undeclared units

$$v_6 = k6a \cdot \text{Exo1I} \cdot \text{kalive} \quad (51)$$

Table 23: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k6a			$5 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

7.7 Reaction `Exo1Rad24dependentActivation`

This is an irreversible reaction of two reactants forming two products.

Name `Rad24dependentExo1Activation`

Reaction equation



Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
Exo1I		
Rad24		

Products

Table 25: Properties of each product.

Id	Name	SBO
Exo1A		
Rad24		

Kinetic Law

Derived unit contains undeclared units

$$v_7 = k6b \cdot \text{Exo1I} \cdot \text{Rad24} \cdot \text{kalive} \quad (53)$$

Table 26: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k6b			$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

7.8 Reaction Exo1Rad17independentActivity

This is an irreversible reaction of two reactants forming three products.

Name Rad17independentExo1Activity

Reaction equation



Reactants

Table 27: Properties of each reactant.

Id	Name	SBO
Utelo		
Exo1A		

Products

Table 28: Properties of each product.

Id	Name	SBO
Utelo		

Id	Name	SBO
Exo1A		
ssDNA		

Kinetic Law

Derived unit contains undeclared units

$$v_8 = k7a \cdot Utelo \cdot Exo1A \cdot kalive \quad (55)$$

Table 29: Properties of each parameter.

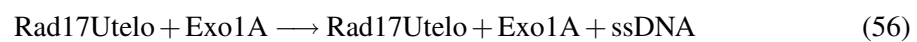
Id	Name	SBO	Value	Unit	Constant
k7a			$3 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

7.9 Reaction Exo1Rad17dependentActivity

This is an irreversible reaction of two reactants forming three products.

Name Rad17dependentExo1Activity

Reaction equation



Reactants

Table 30: Properties of each reactant.

Id	Name	SBO
Rad17Utelo		
Exo1A		

Products

Table 31: Properties of each product.

Id	Name	SBO
Rad17Utelo		
Exo1A		
ssDNA		

Kinetic Law

Derived unit contains undeclared units

$$v_9 = k7b \cdot \text{Rad17Utelo} \cdot \text{Exo1A} \cdot \text{kalive} \quad (57)$$

Table 32: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k7b			$3 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

7.10 Reaction `RPAbinding1`

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

Name `RPAbinding-stage1`

Reaction equation



Reactants

Table 33: Properties of each reactant.

Id	Name	SBO
	ssDNA	
	RPA	

Product

Table 34: Properties of each product.

Id	Name	SBO
	RPAssDNA1	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = k8a \cdot \text{RPA} \cdot \text{ssDNA} \cdot \text{kalive} \quad (59)$$

Table 35: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k8a			0.001		<input checked="" type="checkbox"/>

7.11 Reaction `RPAbinding2`

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

Name `RPAbinding-stage2`

Reaction equation



Reactants

Table 36: Properties of each reactant.

Id	Name	SBO
	<code>ssDNA</code>	
	<code>RPAssDNA1</code>	

Product

Table 37: Properties of each product.

Id	Name	SBO
	<code>RPAssDNA2</code>	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = k8b \cdot \text{RPAssDNA1} \cdot \text{ssDNA} \cdot \text{kalive} \quad (61)$$

Table 38: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k8b			100.0		<input checked="" type="checkbox"/>

7.12 Reaction *RPA*binding

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

Name *RPA*binding-completed

Reaction equation



Reactants

Table 39: Properties of each reactant.

Id	Name	SBO
ssDNA		
RPAssDNA2		

Product

Table 40: Properties of each product.

Id	Name	SBO
RPAssDNA		

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = k8c \cdot \text{RPAssDNA2} \cdot \text{ssDNA} \cdot \text{kalive} \quad (63)$$

Table 41: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k8c			100.0		<input checked="" type="checkbox"/>

7.13 Reaction *Mec1*binding

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

Name *Mec1*binding

Reaction equation



Reactants

Table 42: Properties of each reactant.

Id	Name	SBO
	RPAssDNA	
	Mec1	

Product

Table 43: Properties of each product.

Id	Name	SBO
	Mec1RPAssDNA	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = k8d \cdot \text{RPAssDNA} \cdot \text{Mec1} \cdot \text{kalive} \quad (65)$$

Table 44: Properties of each parameter.

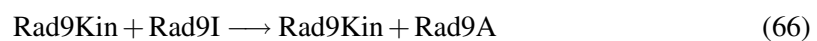
Id	Name	SBO	Value	Unit	Constant
k8d			0.004		<input checked="" type="checkbox"/>

7.14 Reaction Rad9activation

This is an irreversible reaction of two reactants forming two products.

Name Rad9activation

Reaction equation



Reactants

Table 45: Properties of each reactant.

Id	Name	SBO
Rad9Kin		
Rad9I		

Products

Table 46: Properties of each product.

Id	Name	SBO
Rad9Kin		
Rad9A		

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = k9 \cdot \text{Rad9Kin} \cdot \text{Rad9I} \cdot \text{kalive} \quad (67)$$

Table 47: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k9			100.0		<input checked="" type="checkbox"/>

7.15 Reaction `ExoXinhibition`

This is an irreversible reaction of two reactants forming two products.

Name `ExoXinhibition`

Reaction equation



Reactants

Table 48: Properties of each reactant.

Id	Name	SBO
ExoXA		

Id	Name	SBO
Rad9A		

Products

Table 49: Properties of each product.

Id	Name	SBO
ExoXI		
Rad9A		

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \text{ExoXA} \cdot k_{10a} \cdot \text{Rad9A} \cdot \text{kalive} \quad (69)$$

Table 50: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k10a			0.05		<input checked="" type="checkbox"/>

7.16 Reaction [ExoXinhibition2](#)

This is an irreversible reaction of two reactants forming two products.

Name ExoXinhibition2

Reaction equation



Reactants

Table 51: Properties of each reactant.

Id	Name	SBO
ExoXA		
Rad9I		

Products

Table 52: Properties of each product.

Id	Name	SBO
ExoXI		
Rad9I		

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \text{ExoXA} \cdot \text{k10b} \cdot \text{Rad9I} \cdot \text{kalive} \quad (71)$$

Table 53: Properties of each parameter.

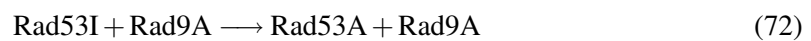
Id	Name	SBO	Value	Unit	Constant
k10b			0.05		<input checked="" type="checkbox"/>

7.17 Reaction [Rad53activation](#)

This is an irreversible reaction of two reactants forming two products.

Name Rad53activation

Reaction equation



Reactants

Table 54: Properties of each reactant.

Id	Name	SBO
Rad53I		
Rad9A		

Products

Table 55: Properties of each product.

Id	Name	SBO
	Rad53A	
	Rad9A	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = k_{11} \cdot \text{Rad53I} \cdot \text{Rad9A} \cdot \text{kalive} \quad (73)$$

Table 56: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k11			10^{-5}		<input checked="" type="checkbox"/>

7.18 Reaction Chk1Activation

This is an irreversible reaction of two reactants forming two products.

Name Chk1Activation

Reaction equation



Reactants

Table 57: Properties of each reactant.

Id	Name	SBO
	Chk1I	
	Rad9A	

Products

Table 58: Properties of each product.

Id	Name	SBO
	Chk1A	

Id	Name	SBO
Rad9A		

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \text{Chk1I} \cdot k_{12} \cdot \text{Rad9A} \cdot \text{kalive} \quad (75)$$

Table 59: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k12			$1.7 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

7.19 Reaction [Exo1inhibition](#)

This is an irreversible reaction of two reactants forming two products.

Name Exo1inhibition

Reaction equation



Reactants

Table 60: Properties of each reactant.

Id	Name	SBO
Exo1A		
Rad53A		

Products

Table 61: Properties of each product.

Id	Name	SBO
Exo1I		
Rad53A		

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \text{Exo1A} \cdot k_{13} \cdot \text{Rad53A} \cdot \text{kalive} \quad (77)$$

Table 62: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k13			1.0		<input checked="" type="checkbox"/>

7.20 Reaction `Dun1activation`

This is an irreversible reaction of two reactants forming two products.

Name `Dun1activation`

Reaction equation



Reactants

Table 63: Properties of each reactant.

Id	Name	SBO
Dun1I		
Rad53A		

Products

Table 64: Properties of each product.

Id	Name	SBO
Dun1A		
Rad53A		

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \text{Dun1I} \cdot k_{14} \cdot \text{Rad53A} \cdot \text{kalive} \quad (79)$$

Table 65: Properties of each parameter.

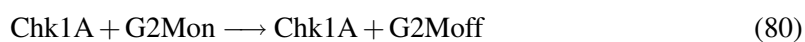
Id	Name	SBO	Value	Unit	Constant
k14			$3.3 \cdot 10^{-6}$		<input checked="" type="checkbox"/>

7.21 Reaction Chk1cellArrest

This is an irreversible reaction of two reactants forming two products.

Name Chk1cellArrest

Reaction equation



Reactants

Table 66: Properties of each reactant.

Id	Name	SBO
	Chk1A	
	G2Mon	

Products

Table 67: Properties of each product.

Id	Name	SBO
	Chk1A	
	G2Moff	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \text{Chk1A} \cdot \text{G2Mon} \cdot k15 \cdot \text{kalive} \quad (81)$$

Table 68: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k15			0.2		<input checked="" type="checkbox"/>

7.22 Reaction `Dun1cellArrest`

This is an irreversible reaction of two reactants forming two products.

Name `Dun1cellArrest`

Reaction equation



Reactants

Table 69: Properties of each reactant.

Id	Name	SBO
Dun1A		
G2Mon		

Products

Table 70: Properties of each product.

Id	Name	SBO
Dun1A		
G2Moff		

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \text{Dun1A} \cdot \text{G2Mon} \cdot k16 \cdot k_{\text{alive}} \quad (83)$$

Table 71: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k16			0.1		<input checked="" type="checkbox"/>

7.23 Reaction `SDNArepair1`

This is an irreversible reaction of two reactants forming four products.

Name `SDNArepair1`

Reaction equation



Reactants

Table 72: Properties of each reactant.

Id	Name	SBO
Mec1RPAssDNA		
S		

Products

Table 73: Properties of each product.

Id	Name	SBO
Mec1		
RPA		
S		
ssDNA		

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = k17a \cdot \text{Mec1RPAssDNA} \cdot \text{S} \cdot \text{kalive} \quad (85)$$

Table 74: Properties of each parameter.

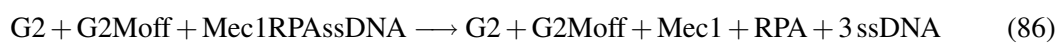
Id	Name	SBO	Value	Unit	Constant
k17a			0.05		<input checked="" type="checkbox"/>

7.24 Reaction G2DNArepair1

This is an irreversible reaction of three reactants forming five products.

Name G2DNArepair1

Reaction equation



Reactants

Table 75: Properties of each reactant.

Id	Name	SBO
G2		
G2Moff		
Mec1RPAssDNA		

Products

Table 76: Properties of each product.

Id	Name	SBO
G2		
G2Moff		
Mec1		
RPA		
ssDNA		

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = G2 \cdot G2Moff \cdot k17b \cdot Mec1RPAssDNA \cdot kalive \quad (87)$$

Table 77: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k17b			0.05		<input checked="" type="checkbox"/>

7.25 Reaction `SDNArepair2`

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

Name `SDNArepair2`

Reaction equation



Reactants

Table 78: Properties of each reactant.

Id	Name	SBO
S		
ssDNA		

Product

Table 79: Properties of each product.

Id	Name	SBO
S		

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = k18a \cdot S \cdot ssDNA \cdot kalive \quad (89)$$

Table 80: Properties of each parameter.

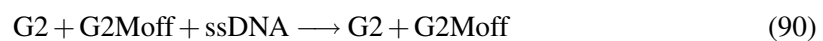
Id	Name	SBO	Value	Unit	Constant
k18a			0.001		<input checked="" type="checkbox"/>

7.26 Reaction `G2DNArepair2`

This is an irreversible reaction of three reactants forming two products.

Name `G2DNArepair2`

Reaction equation



Reactants

Table 81: Properties of each reactant.

Id	Name	SBO
G2		
G2Moff		
ssDNA		

Products

Table 82: Properties of each product.

Id	Name	SBO
G2		
G2Moff		

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = G2 \cdot G2Moff \cdot k18b \cdot ssDNA \cdot kalive \quad (91)$$

Table 83: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k18b			10^{-5}		<input checked="" type="checkbox"/>

7.27 Reaction Recovery

This is an irreversible reaction of three reactants forming three products.

Name Recovery

Reaction equation



Reactants

Table 84: Properties of each reactant.

Id	Name	SBO
Cdc13		
Rad17Utelo		
recovery		

Products

Table 85: Properties of each product.

Id	Name	SBO
Ctelo		
Rad17		
recovery		

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{Cdc13} \cdot k_{19} \cdot \text{Rad17Utelo} \cdot \text{recovery} \cdot \text{kalive} \quad (93)$$

Table 86: Properties of each parameter.

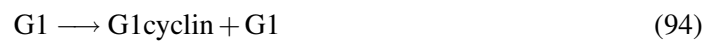
Id	Name	SBO	Value	Unit	Constant
k19			0.001		<input checked="" type="checkbox"/>

7.28 Reaction G1cyclinSynthesis

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

Name G1cyclinSynthesis

Reaction equation



Reactant

Table 87: Properties of each reactant.

Id	Name	SBO
G1		

Products

Table 88: Properties of each product.

Id	Name	SBO
G1cyclin		
G1		

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = G1 \cdot kc1 \cdot kalive \quad (95)$$

Table 89: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc1			0.16		<input checked="" type="checkbox"/>

7.29 Reaction ScyclinSynthesis

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

Name ScyclinSynthesis

Reaction equation



Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
S		

Products

Table 91: Properties of each product.

Id	Name	SBO
	Scyclin	
	S	

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = kc1 \cdot S \cdot kalive \quad (97)$$

Table 92: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc1			0.16		<input checked="" type="checkbox"/>

7.30 Reaction G2cyclinSynthesis

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

Name G2cyclinSynthesis

Reaction equation



Reactant

Table 93: Properties of each reactant.

Id	Name	SBO
	G2	

Products

Table 94: Properties of each product.

Id	Name	SBO
G2cyclin		
G2		

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = G2 \cdot kc1 \cdot kalive \quad (99)$$

Table 95: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc1			0.16		<input checked="" type="checkbox"/>

7.31 Reaction McyclinSynthesis

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

Name McyclinSynthesis

Reaction equation



Reactant

Table 96: Properties of each reactant.

Id	Name	SBO
M		

Products

Table 97: Properties of each product.

Id	Name	SBO
Mcyclin		
M		

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = kc1 \cdot M \cdot kalive \quad (101)$$

Table 98: Properties of each parameter.

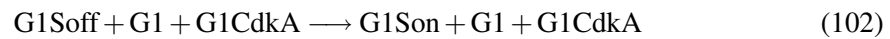
Id	Name	SBO	Value	Unit	Constant
kc1			0.16		<input checked="" type="checkbox"/>

7.32 Reaction G1toSGenesOn

This is an irreversible reaction of three reactants forming three products.

Name G1toSGenesOn

Reaction equation



Reactants

Table 99: Properties of each reactant.

Id	Name	SBO
G1Soff		
G1		
G1CdkA		

Products

Table 100: Properties of each product.

Id	Name	SBO
G1Son		
G1		
G1CdkA		

Kinetic Law

Derived unit contains undeclared units

$$v_{32} = G1 \cdot G1CdkA \cdot G1Soff \cdot kc2 \cdot kalive \quad (103)$$

Table 101: Properties of each parameter.

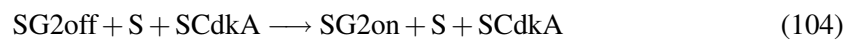
Id	Name	SBO	Value	Unit	Constant
kc2			0.01		<input checked="" type="checkbox"/>

7.33 Reaction StoG2GenesOn

This is an irreversible reaction of three reactants forming three products.

Name StoG2GenesOn

Reaction equation



Reactants

Table 102: Properties of each reactant.

Id	Name	SBO
SG2off		
S		
SCdkA		

Products

Table 103: Properties of each product.

Id	Name	SBO
SG2on		
S		
SCdkA		

Kinetic Law

Derived unit contains undeclared units

$$v_{33} = kc2 \cdot S \cdot SCdkA \cdot SG2off \cdot kalive \quad (105)$$

Table 104: Properties of each parameter.

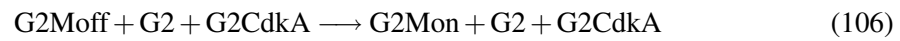
Id	Name	SBO	Value	Unit	Constant
kc2			0.01		<input checked="" type="checkbox"/>

7.34 Reaction G2toMGenesOn

This is an irreversible reaction of three reactants forming three products.

Name G2toMGenesOn

Reaction equation



Reactants

Table 105: Properties of each reactant.

Id	Name	SBO
G2Moff		
G2		
G2CdkA		

Products

Table 106: Properties of each product.

Id	Name	SBO
G2Mon		
G2		
G2CdkA		

Kinetic Law

Derived unit contains undeclared units

$$v_{34} = \text{G2} \cdot \text{G2CdkA} \cdot \text{G2Moff} \cdot \text{kc2} \cdot \text{kalive} \quad (107)$$

Table 107: Properties of each parameter.

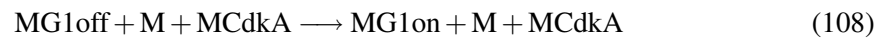
Id	Name	SBO	Value	Unit	Constant
kc2			0.01		<input checked="" type="checkbox"/>

7.35 Reaction MtoG1GenesOn

This is an irreversible reaction of three reactants forming three products.

Name MtoG1GenesOn

Reaction equation



Reactants

Table 108: Properties of each reactant.

Id	Name	SBO
MG1off		
M		
MCdkA		

Products

Table 109: Properties of each product.

Id	Name	SBO
MG1on		
M		
MCdkA		

Kinetic Law

Derived unit contains undeclared units

$$v_{35} = \text{kc2} \cdot \text{M} \cdot \text{MCdkA} \cdot \text{MG1off} \cdot \text{kalive} \quad (109)$$

Table 110: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc2			0.01		<input checked="" type="checkbox"/>

7.36 Reaction G1cyclinDegradation

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

Name G1cyclinDegradation

Reaction equation



Reactant

Table 111: Properties of each reactant.

Id	Name	SBO
G1cyclin		

Product

Table 112: Properties of each product.

Id	Name	SBO
sink		

Kinetic Law

Derived unit contains undeclared units

$$v_{36} = \text{G1cyclin} \cdot \text{kc3} \cdot \text{kalive} \quad (111)$$

Table 113: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc3			0.001		<input checked="" type="checkbox"/>

7.37 Reaction ScyclinDegradation

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

Name ScyclinDegradation

Reaction equation



Reactant

Table 114: Properties of each reactant.

Id	Name	SBO
	Scyclin	

Product

Table 115: Properties of each product.

Id	Name	SBO
	sink	

Kinetic Law

Derived unit contains undeclared units

$$v_{37} = \text{kc3} \cdot \text{Scyclin} \cdot \text{kalive} \quad (113)$$

Table 116: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc3			0.001		<input checked="" type="checkbox"/>

7.38 Reaction G2cyclinDegradation

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

Name G2cyclinDegradation

Reaction equation



Reactant

Table 117: Properties of each reactant.

Id	Name	SBO
G2cyclin		

Product

Table 118: Properties of each product.

Id	Name	SBO
sink		

Kinetic Law

Derived unit contains undeclared units

$$v_{38} = \text{G2cyclin} \cdot \text{kc3} \cdot \text{kalive} \quad (115)$$

Table 119: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc3			0.001		<input checked="" type="checkbox"/>

7.39 Reaction `McyclinDegradation`

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

Name `McyclinDegradation`

Reaction equation



Reactant

Table 120: Properties of each reactant.

Id	Name	SBO
Mcyclin		

Product

Table 121: Properties of each product.

Id	Name	SBO
sink		

Kinetic Law

Derived unit contains undeclared units

$$v_{39} = kc3 \cdot \text{Mcyclin} \cdot \text{kalive} \quad (117)$$

Table 122: Properties of each parameter.

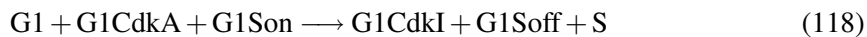
Id	Name	SBO	Value	Unit	Constant
kc3			0.001		<input checked="" type="checkbox"/>

7.40 Reaction G1toSProgression

This is an irreversible reaction of three reactants forming three products.

Name G1toSProgression

Reaction equation



Reactants

Table 123: Properties of each reactant.

Id	Name	SBO
G1		
G1CdkA		
G1Son		

Products

Table 124: Properties of each product.

Id	Name	SBO
G1CdkI		
G1Soff		
S		

Kinetic Law

Derived unit contains undeclared units

$$v_{40} = G1 \cdot G1CdkA \cdot G1Son \cdot kc4 \cdot kalive \quad (119)$$

Table 125: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc4			0.01		<input checked="" type="checkbox"/>

7.41 Reaction `StoG2Progression`

This is an irreversible reaction of three reactants forming three products.

Name `StoG2Progression`

Reaction equation



Reactants

Table 126: Properties of each reactant.

Id	Name	SBO
S		
SCdkA		
SG2on		

Products

Table 127: Properties of each product.

Id	Name	SBO
G2		
SCdkI		
SG2off		

Kinetic Law

Derived unit contains undeclared units

$$v_{41} = kc4 \cdot S \cdot SCdkA \cdot SG2on \cdot kalive \quad (121)$$

Table 128: Properties of each parameter.

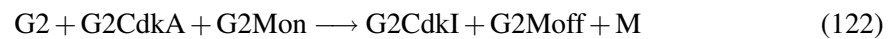
Id	Name	SBO	Value	Unit	Constant
kc4			0.01		<input checked="" type="checkbox"/>

7.42 Reaction G2toMProgression

This is an irreversible reaction of three reactants forming three products.

Name G2toMProgression

Reaction equation



Reactants

Table 129: Properties of each reactant.

Id	Name	SBO
G2		
G2CdkA		
G2Mon		

Products

Table 130: Properties of each product.

Id	Name	SBO
G2CdkI		
G2Moff		
M		

Kinetic Law

Derived unit contains undeclared units

$$v_{42} = G2 \cdot G2CdkA \cdot G2Mon \cdot kc4 \cdot kalive \quad (123)$$

Table 131: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc4			0.01		<input checked="" type="checkbox"/>

7.43 Reaction MtoG1Progression

This is an irreversible reaction of three reactants forming four products.

Name MtoG1Progression

Reaction equation



Reactants

Table 132: Properties of each reactant.

Id	Name	SBO
M		
MCdkA		
MG1on		

Products

Table 133: Properties of each product.

Id	Name	SBO
budscar		
G1		
MCdkI		
MG1off		

Kinetic Law

Derived unit contains undeclared units

$$v_{43} = kc4 \cdot M \cdot MCdkA \cdot MG1on \cdot kalive \quad (125)$$

Table 134: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kc4			0.01		<input checked="" type="checkbox"/>

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 Ctelo

Initial amount 64 item

This species takes part in three reactions (as a reactant in [Uncapping](#) and as a product in [Capping](#), [Recovery](#)).

$$\frac{d}{dt}Ctelo = v_1 + v_{27} - v_2 \quad (126)$$

8.2 Species Utelo

Initial amount 0 item

This species takes part in five reactions (as a reactant in [Capping](#), [Rad17binding](#), [Exo1Rad17independentActivity](#) and as a product in [Uncapping](#), [Exo1Rad17independentActivity](#)).

$$\frac{d}{dt} \text{Utelo} = v_2 + v_8 - v_1 - v_3 - v_8 \quad (127)$$

8.3 Species Cdc13

Initial amount 300 item

This species takes part in three reactions (as a reactant in [Capping](#), [Recovery](#) and as a product in [Uncapping](#)).

$$\frac{d}{dt} \text{Cdc13} = v_2 - v_1 - v_{27} \quad (128)$$

8.4 Species Rad17Utelo

Initial amount 0 item

This species takes part in eight reactions (as a reactant in [ExoXactivation](#), [ExoXactivity](#), [Exo1Rad17dependentActivity](#), [Recovery](#) and as a product in [Rad17binding](#), [ExoXactivation](#), [ExoXactivity](#), [Exo1Rad17dependentActivity](#)).

$$\frac{d}{dt} \text{Rad17Utelo} = v_3 + v_4 + v_5 + v_9 - v_4 - v_5 - v_9 - v_{27} \quad (129)$$

8.5 Species Rad17

Initial amount 70 item

This species takes part in two reactions (as a reactant in [Rad17binding](#) and as a product in [Recovery](#)).

$$\frac{d}{dt} \text{Rad17} = v_{27} - v_3 \quad (130)$$

8.6 Species Rad24

Initial amount 70 item

This species takes part in four reactions (as a reactant in [Rad17binding](#), [Exo1Rad24dependentActivation](#) and as a product in [Rad17binding](#), [Exo1Rad24dependentActivation](#)).

$$\frac{d}{dt} \text{Rad24} = v_3 + v_7 - v_3 - v_7 \quad (131)$$

8.7 Species RPA

Initial amount 4000 item

This species takes part in three reactions (as a reactant in [RPAbinding1](#) and as a product in [SDNArepair1](#), [G2DNArepair1](#)).

$$\frac{d}{dt}RPA = v_{23} + v_{24} - v_{10} \quad (132)$$

8.8 Species Mec1

Initial amount 4000 item

This species takes part in three reactions (as a reactant in [Mec1binding](#) and as a product in [SDNArepair1](#), [G2DNArepair1](#)).

$$\frac{d}{dt}Mec1 = v_{23} + v_{24} - v_{13} \quad (133)$$

8.9 Species ssDNA

Initial amount 0 item

Involved in event [ssDNAremoval](#)

This species takes part in ten reactions (as a reactant in [RPAbinding1](#), [RPAbinding2](#), [RPAbinding](#), [SDNArepair2](#), [G2DNArepair2](#) and as a product in [ExoXactivity](#), [Exo1Rad17independentActivity](#), [Exo1Rad17dependentActivity](#), [SDNArepair1](#), [G2DNArepair1](#)).

$$\frac{d}{dt}ssDNA = v_5 + v_8 + v_9 + 3 v_{23} + 3 v_{24} - v_{10} - v_{11} - v_{12} - v_{25} - v_{26} \quad (134)$$

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

8.10 Species RPAssDNA

Initial amount 0 item

Involved in event [ssDNAremoval](#)

This species takes part in two reactions (as a reactant in [Mec1binding](#) and as a product in [RPAbinding](#)).

$$\frac{d}{dt}RPAssDNA = v_{12} - v_{13} \quad (135)$$

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

8.11 Species `RPAssDNA1`

Initial amount 0 item

This species takes part in two reactions (as a reactant in `RPAbinding2` and as a product in `RPAbinding1`).

$$\frac{d}{dt} \text{RPAssDNA1} = v_{10} - v_{11} \quad (136)$$

8.12 Species `RPAssDNA2`

Initial amount 0 item

This species takes part in two reactions (as a reactant in `RPAbinding` and as a product in `RPAbinding2`).

$$\frac{d}{dt} \text{RPAssDNA2} = v_{11} - v_{12} \quad (137)$$

8.13 Species `Mec1RPAssDNA`

Initial amount 0 item

Involved in event `ssDNAremoval`

This species takes part in three reactions (as a reactant in `SDNArepair1`, `G2DNArepair1` and as a product in `Mec1binding`).

$$\frac{d}{dt} \text{Mec1RPAssDNA} = v_{13} - v_{23} - v_{24} \quad (138)$$

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

8.14 Species `ExoXI`

Initial amount 70 item

Involved in event `G2MRecoveryCompleted`

This species takes part in three reactions (as a reactant in `ExoXactivation` and as a product in `ExoXinhibition`, `ExoXinhibition2`).

$$\frac{d}{dt} \text{ExoXI} = v_{15} + v_{16} - v_4 \quad (139)$$

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

8.15 Species [ExoXA](#)

Initial amount 0 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in five reactions (as a reactant in [ExoXactivity](#), [ExoXinhibition](#), [ExoXinhibition2](#) and as a product in [ExoXactivation](#), [ExoXactivity](#)).

$$\frac{d}{dt}\text{ExoXA} = v_4 + v_5 - v_5 - v_{15} - v_{16} \quad (140)$$

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

8.16 Species [Exo1I](#)

Initial amount 670 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in three reactions (as a reactant in [Exo1activation](#), [Exo1Rad24dependentActivation](#) and as a product in [Exo1inhibition](#)).

$$\frac{d}{dt}\text{Exo1I} = v_{19} - v_6 - v_7 \quad (141)$$

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

8.17 Species [Exo1A](#)

Initial amount 0 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in seven reactions (as a reactant in [Exo1Rad17independentActivity](#), [Exo1Rad17dependentActivity](#), [Exo1inhibition](#) and as a product in [Exo1activation](#), [Exo1Rad24dependentActivation](#), [Exo1Rad17independentActivity](#), [Exo1Rad17dependentActivity](#)).

$$\frac{d}{dt}\text{Exo1A} = v_6 + v_7 + v_8 + v_9 - v_8 - v_9 - v_{19} \quad (142)$$

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

8.18 Species [Rad9I](#)

Initial amount 20 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in three reactions (as a reactant in [Rad9activation](#), [ExoXinhibition2](#) and as a product in [ExoXinhibition2](#)).

$$\frac{d}{dt}\text{Rad9I} = v_{16} - v_{14} - v_{16} \quad (143)$$

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

8.19 Species Rad9A

Initial amount 0 item

Involved in event G2MRecoveryCompleted

This species takes part in seven reactions (as a reactant in [ExoXinhibition](#), [Rad53activation](#), [Chk1Activation](#) and as a product in [Rad9activation](#), [ExoXinhibition](#), [Rad53activation](#), [Chk1Activation](#)).

$$\frac{d}{dt}\text{Rad9A} = v_{14} + v_{15} + v_{17} + v_{18} - v_{15} - v_{17} - v_{18} \quad (144)$$

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

8.20 Species Rad53I

Initial amount 6900 item

Involved in event G2MRecoveryCompleted

This species takes part in one reaction (as a reactant in [Rad53activation](#)).

$$\frac{d}{dt}\text{Rad53I} = -v_{17} \quad (145)$$

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

8.21 Species Rad53A

Initial amount 0 item

Involved in event G2MRecoveryCompleted

This species takes part in five reactions (as a reactant in [Exo1inhibition](#), [Dun1activation](#) and as a product in [Rad53activation](#), [Exo1inhibition](#), [Dun1activation](#)).

$$\frac{d}{dt}\text{Rad53A} = v_{17} + v_{19} + v_{20} - v_{19} - v_{20} \quad (146)$$

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

8.22 Species Chk1I

Initial amount 60 item

Involved in event G2MRecoveryCompleted

This species takes part in one reaction (as a reactant in [Chk1Activation](#)).

$$\frac{d}{dt}\text{Chk1I} = -v_{18} \quad (147)$$

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

8.23 Species Chk1A

Initial amount 0 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in three reactions (as a reactant in [Chk1cellArrest](#) and as a product in [Chk1Activation](#), [Chk1cellArrest](#)).

$$\frac{d}{dt}\text{Chk1A} = v_{18} + v_{21} - v_{21} \quad (148)$$

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

8.24 Species Dun1I

Initial amount 3000 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in one reaction (as a reactant in [Dun1activation](#)).

$$\frac{d}{dt}\text{Dun1I} = -v_{20} \quad (149)$$

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

8.25 Species Dun1A

Initial amount 0 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in three reactions (as a reactant in [Dun1cellArrest](#) and as a product in [Dun1activation](#), [Dun1cellArrest](#)).

$$\frac{d}{dt}\text{Dun1A} = v_{20} + v_{22} - v_{22} \quad (150)$$

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

8.26 Species ATP

Initial amount 10000 item

This species takes part in one reaction (as a reactant in [Rad17binding](#)).

$$\frac{d}{dt}\text{ATP} = -v_3 \quad (151)$$

8.27 Species ADP

Initial amount 1000 item

This species takes part in one reaction (as a product in [Rad17binding](#)).

$$\frac{d}{dt}\text{ADP} = v_3 \quad (152)$$

8.28 Species Rad9Kin

Initial amount 0 item

Involved in event [Rad9KinaseActivation](#)

This species takes part in two reactions (as a reactant in [Rad9activation](#) and as a product in [Rad9activation](#)).

$$\frac{d}{dt}\text{Rad9Kin} = v_{14} - v_{14} \quad (153)$$

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

8.29 Species recovery

Initial amount 0 item

Involved in events [ssDNAremoval](#), [G2MRecoveryCompleted](#), [SphaseRecoveryCompleted](#)

This species takes part in two reactions (as a reactant in [Recovery](#) and as a product in [Recovery](#)).

$$\frac{d}{dt}\text{recovery} = v_{27} - v_{27} \quad (154)$$

Furthermore, three events influence this species' rate of change.

8.30 Species G1

Initial amount 1 item

This species takes part in six reactions (as a reactant in [G1cyclinSynthesis](#), [G1toSGenesOn](#), [G1toSProgression](#) and as a product in [G1cyclinSynthesis](#), [G1toSGenesOn](#), [MtoG1Progression](#)).

$$\frac{d}{dt}\text{G1} = v_{28} + v_{32} + v_{43} - v_{28} - v_{32} - v_{40} \quad (155)$$

8.31 Species S

Initial amount 0 item

This species takes part in ten reactions (as a reactant in [SDNArepair1](#), [SDNArepair2](#), [ScyclinSynthesis](#), [StoG2GenesOn](#), [StoG2Progeession](#) and as a product in [SDNArepair1](#), [SDNArepair2](#), [ScyclinSynthesis](#), [StoG2GenesOn](#), [G1toSProgeession](#)).

$$\frac{d}{dt}S = v_{23} + v_{25} + v_{29} + v_{33} + v_{40} - v_{23} - v_{25} - v_{29} - v_{33} - v_{41} \quad (156)$$

8.32 Species G2

Initial amount 0 item

This species takes part in ten reactions (as a reactant in [G2DNArepair1](#), [G2DNArepair2](#), [G2cyclinSynthesis](#), [G2toMGenesOn](#), [G2toMProgeession](#) and as a product in [G2DNArepair1](#), [G2DNArepair2](#), [G2cyclinSynthesis](#), [G2toMGenesOn](#), [StoG2Progeession](#)).

$$\frac{d}{dt}G2 = v_{24} + v_{26} + v_{30} + v_{34} + v_{41} - v_{24} - v_{26} - v_{30} - v_{34} - v_{42} \quad (157)$$

8.33 Species M

Initial amount 0 item

This species takes part in six reactions (as a reactant in [McyclinSynthesis](#), [MtoG1GenesOn](#), [MtoG1Progeession](#) and as a product in [McyclinSynthesis](#), [MtoG1GenesOn](#), [G2toMProgeession](#)).

$$\frac{d}{dt}M = v_{31} + v_{35} + v_{42} - v_{31} - v_{35} - v_{43} \quad (158)$$

8.34 Species G1cyclin

Initial amount 0 item

This species takes part in two reactions (as a reactant in [G1cyclinDegradation](#) and as a product in [G1cyclinSynthesis](#)).

$$\frac{d}{dt}G1cyclin = v_{28} - v_{36} \quad (159)$$

8.35 Species Scyclin

Initial amount 0 item

This species takes part in two reactions (as a reactant in [ScyclinDegradation](#) and as a product in [ScyclinSynthesis](#)).

$$\frac{d}{dt}Scyclin = v_{29} - v_{37} \quad (160)$$

8.36 Species G2cyclin

Initial amount 0 item

This species takes part in two reactions (as a reactant in [G2cyclinDegradation](#) and as a product in [G2cyclinSynthesis](#)).

$$\frac{d}{dt}G2cyclin = v_{30} - v_{38} \quad (161)$$

8.37 Species Mcyclin

Initial amount 0 item

This species takes part in two reactions (as a reactant in [McyclinDegradation](#) and as a product in [McyclinSynthesis](#)).

$$\frac{d}{dt}Mcyclin = v_{31} - v_{39} \quad (162)$$

8.38 Species G1CdkI

Initial amount 1 item

Involved in event [G1CdkActivation](#)

This species takes part in one reaction (as a product in [G1toSProgression](#)).

$$\frac{d}{dt}G1CdkI = v_{40} \quad (163)$$

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

8.39 Species G1CdkA

Initial amount 0 item

Involved in event [G1CdkActivation](#)

This species takes part in three reactions (as a reactant in [G1toSGenesOn](#), [G1toSProgression](#) and as a product in [G1toSGenesOn](#)).

$$\frac{d}{dt}G1CdkA = v_{32} - v_{32} - v_{40} \quad (164)$$

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

8.40 Species SCdkI

Initial amount 1 item

Involved in event SCdkActivation

This species takes part in one reaction (as a product in StoG2Progection).

$$\frac{d}{dt} \text{SCdkI} = v_{41} \quad (165)$$

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

8.41 Species SCdkA

Initial amount 0 item

Involved in event SCdkActivation

This species takes part in three reactions (as a reactant in StoG2GenesOn, StoG2Progection and as a product in StoG2GenesOn).

$$\frac{d}{dt} \text{SCdkA} = v_{33} - v_{33} - v_{41} \quad (166)$$

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

8.42 Species G2CdkI

Initial amount 1 item

Involved in event G2CdkActivation

This species takes part in one reaction (as a product in G2toMProgection).

$$\frac{d}{dt} \text{G2CdkI} = v_{42} \quad (167)$$

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

8.43 Species G2CdkA

Initial amount 0 item

Involved in event G2CdkActivation

This species takes part in three reactions (as a reactant in G2toMGenesOn, G2toMProgection and as a product in G2toMGenesOn).

$$\frac{d}{dt} \text{G2CdkA} = v_{34} - v_{34} - v_{42} \quad (168)$$

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

8.44 Species MCdkI

Initial amount 1 item

Involved in event MCdkActivation

This species takes part in one reaction (as a product in MtoG1Progression).

$$\frac{d}{dt}MCdkI = v_{43} \quad (169)$$

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

8.45 Species MCdkA

Initial amount 0 item

Involved in event MCdkActivation

This species takes part in three reactions (as a reactant in MtoG1GenesOn, MtoG1Progression and as a product in MtoG1GenesOn).

$$\frac{d}{dt}MCdkA = v_{35} - v_{35} - v_{43} \quad (170)$$

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

8.46 Species G1Soff

Initial amount 1 item

This species takes part in two reactions (as a reactant in G1toSGenesOn and as a product in G1toSProgression).

$$\frac{d}{dt}G1Soff = v_{40} - v_{32} \quad (171)$$

8.47 Species G1Son

Initial amount 0 item

This species takes part in two reactions (as a reactant in G1toSProgression and as a product in G1toSGenesOn).

$$\frac{d}{dt}G1Son = v_{32} - v_{40} \quad (172)$$

8.48 Species [SG2off](#)

Initial amount 1 item

This species takes part in two reactions (as a reactant in [StoG2GenesOn](#) and as a product in [StoG2Progression](#)).

$$\frac{d}{dt}SG2off = v_{41} - v_{33} \quad (173)$$

8.49 Species [SG2on](#)

Initial amount 0 item

This species takes part in two reactions (as a reactant in [StoG2Progression](#) and as a product in [StoG2GenesOn](#)).

$$\frac{d}{dt}SG2on = v_{33} - v_{41} \quad (174)$$

8.50 Species [G2Moff](#)

Initial amount 1 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in eight reactions (as a reactant in [G2DNArepair1](#), [G2DNArepair2](#), [G2toMGenesOn](#) and as a product in [Chk1cellArrest](#), [Dun1cellArrest](#), [G2DNArepair1](#), [G2DNArepair2](#), [G2toMProgression](#)).

$$\frac{d}{dt}G2Moff = v_{21} + v_{22} + v_{24} + v_{26} + v_{42} - v_{24} - v_{26} - v_{34} \quad (175)$$

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

8.51 Species [G2Mon](#)

Initial amount 0 item

Involved in event [G2MRecoveryCompleted](#)

This species takes part in four reactions (as a reactant in [Chk1cellArrest](#), [Dun1cellArrest](#), [G2toMProgression](#) and as a product in [G2toMGenesOn](#)).

$$\frac{d}{dt}G2Mon = v_{34} - v_{21} - v_{22} - v_{42} \quad (176)$$

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

8.52 Species MG1off

Initial amount 1 item

This species takes part in two reactions (as a reactant in [MtoG1GenesOn](#) and as a product in [MtoG1Progression](#)).

$$\frac{d}{dt} \text{MG1off} = v_{43} - v_{35} \quad (177)$$

8.53 Species MG1on

Initial amount 0 item

This species takes part in two reactions (as a reactant in [MtoG1Progression](#) and as a product in [MtoG1GenesOn](#)).

$$\frac{d}{dt} \text{MG1on} = v_{35} - v_{43} \quad (178)$$

8.54 Species sink

Initial amount 0 item

This species takes part in four reactions (as a product in [G1cyclinDegradation](#), [ScyclinDegradation](#), [G2cyclinDegradation](#), [McyclinDegradation](#)), which do not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt} \text{sink} = 0 \quad (179)$$

8.55 Species budscar

Initial amount 0 item

This species takes part in one reaction (as a product in [MtoG1Progression](#)).

$$\frac{d}{dt} \text{budscar} = v_{43} \quad (180)$$

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