SBML Model Report

Model name: “Marwan2003 - Genetics, regulatory hierarchy between genes”

May 5, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Nicolas Le Novre[1] at July seventh 2005 at 4:16 p. m. and last time modified at July eleventh 2012 at 5:34 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	12
events	0	constraints	0
reactions	12	function definitions	0
global parameters	0	unit definitions	1
rules	0	initial assignments	0

Model Notes

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

2.1 Unit `time`

Name hour

Definition 3600 s

2.2 Unit `substance`

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

Definition mol

2.3 Unit `volume`

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

Definition l

2.4 Unit `area`

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

Definition m^2

2.5 Unit `length`

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

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
`compartment`			3	1	litre	☑	

3.1 Compartment `compartment`

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

4 Species

This model contains twelve 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 6 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Pfr		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Pr		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Xi		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Xa		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
prepreS		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
preS		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Ya		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
S		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Gluc		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	☑
Yi		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
V		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Pi		compartment	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Reactions

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

Table 4: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	Photoreceptor_activation		$\mathrm{Pfr} \longrightarrow \mathrm{Pr}$	
2	Photoreceptor_inactivation		$\mathrm{Pr} \longrightarrow \mathrm{Pfr}$	
3	Transducer_activation		$\mathrm{Xi} \xrightarrow{\mathrm{Pr}} \mathrm{Xa}$	
4	Transducer_inactivation		$\mathrm{Xa} \longrightarrow \mathrm{Xi}$	
5	preS_formation		$\mathrm{prepreS} \xrightarrow{\mathrm{Xa}} \mathrm{preS}$	
6	S_generation		$\mathrm{preS} \xrightarrow{\mathrm{Ya}} \mathrm{S}$	
7	Glucose_sensor_inactivation		$\mathrm{Ya} + \mathrm{Gluc} \longrightarrow \mathrm{Yi}$	
8	S_formation		$\emptyset \xrightarrow{\mathrm{V}} \mathrm{S}$	
9	V_formation		$\emptyset \xrightarrow{\mathrm{S}} \mathrm{V}$	
10	S_degradation		$\mathrm{S} \longrightarrow \emptyset$	
11	V_degradation		$\mathrm{V} \longrightarrow \emptyset$	
12	Photoreceptor_decay		$\mathrm{Pr} \longrightarrow \mathrm{Pi}$	

5.1 Reaction `Photoreceptor_activation`

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

Reaction equation

$$\text{Pfr} \longrightarrow \text{Pr} \tag{1}$$

Reactant

Table 5: Properties of each reactant.

Id	Name	SBO
`Pfr`		

Product

Table 6: Properties of each product.

Id	Name	SBO
`Pr`		

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \text{vol}\left(\text{compartment}\right) \cdot [\text{Pfr}] \cdot \text{IfrSfrPfr} \tag{2}$$

Table 7: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`IfrSfrPfr`			0.1		☑

5.2 Reaction `Photoreceptor_inactivation`

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

Reaction equation

$$\text{Pr} \longrightarrow \text{Pfr} \tag{3}$$

Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
Pr		

Product

Table 9: Properties of each product.

Id	Name	SBO
Pfr		

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \mathrm{IrSrPr} \cdot [\mathrm{Pr}] \cdot \mathrm{vol}\,(\mathrm{compartment}) \tag{4}$$

Table 10: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
IrSrPr			0.0		☑

5.3 Reaction Transducer_activation

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

Reaction equation

$$\mathrm{Xi} \xrightarrow{\mathrm{Pr}} \mathrm{Xa} \tag{5}$$

Reactant

Table 11: Properties of each reactant.

Id	Name	SBO
Xi		

Modifier

Table 12: Properties of each modifier.

Id	Name	SBO
Pr		

Product

Table 13: Properties of each product.

Id	Name	SBO
Xa		

Kinetic Law

Derived unit contains undeclared units

$$v_3 = [\mathrm{Xi}] \cdot \mathrm{kia} \cdot [\mathrm{Pr}] \cdot \mathrm{vol}\,(\mathrm{compartment}) \tag{6}$$

Table 14: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kia			0.1		☑

5.4 Reaction Transducer_inactivation

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

Reaction equation

$$\mathrm{Xa} \longrightarrow \mathrm{Xi} \tag{7}$$

Reactant

Table 15: Properties of each reactant.

Id	Name	SBO
Xa		

Product

Table 16: Properties of each product.

Id	Name	SBO
Xi		

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{kai} \cdot [\text{Xa}] \cdot \text{vol}\,(\text{compartment}) \tag{8}$$

Table 17: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kai			0.8		☑

5.5 Reaction preS_formation

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

Reaction equation

$$\text{prepreS} \xrightarrow{\text{Xa}} \text{preS} \tag{9}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
prepreS		

Modifier

Table 19: Properties of each modifier.

Id	Name	SBO
Xa		

Product

Table 20: Properties of each product.

Id	Name	SBO
preS		

Kinetic Law

Derived unit contains undeclared units

$$v_5 = [\text{prepreS}] \cdot \text{kx} \cdot [\text{Xa}] \cdot \text{vol}\,(\text{compartment}) \tag{10}$$

Table 21: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kx			0.2		☑

5.6 Reaction S_generation

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

Reaction equation

$$\text{preS} \xrightarrow{\text{Ya}} \text{S} \tag{11}$$

Reactant

Table 22: Properties of each reactant.

Id	Name	SBO
preS		

Modifier

Table 23: Properties of each modifier.

Id	Name	SBO
Ya		

Product

Table 24: Properties of each product.

Id	Name	SBO
S		

Kinetic Law

Derived unit contains undeclared units

$$v_6 = [\text{preS}] \cdot \text{ky} \cdot [\text{Ya}] \cdot \text{vol}\,(\text{compartment}) \tag{12}$$

Table 25: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
ky			1.0		☑

5.7 Reaction Glucose_sensor_inactivation

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

Reaction equation

$$\text{Ya} + \text{Gluc} \longrightarrow \text{Yi} \tag{13}$$

Reactants

Table 26: Properties of each reactant.

Id	Name	SBO
Ya		
Gluc		

Product

Table 27: Properties of each product.

Id	Name	SBO
Yi		

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{kG} \cdot [\mathrm{Ya}] \cdot [\mathrm{Gluc}] \cdot \mathrm{vol}\,(\mathrm{compartment}) \tag{14}$$

Table 28: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kG			0.1		☑

5.8 Reaction S_formation

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

Reaction equation

$$\emptyset \xrightarrow{\mathrm{V}} \mathrm{S} \tag{15}$$

Modifier

Table 29: Properties of each modifier.

Id	Name	SBO
V		

Product

Table 30: Properties of each product.

Id	Name	SBO
S		

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \mathrm{vol}\,(\mathrm{compartment}) \cdot \frac{\mathrm{alpha1}}{1 + [\mathrm{V}]^3} \tag{16}$$

Table 31: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
alpha1			30.0		☑

5.9 Reaction V_formation

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

Reaction equation

$$\emptyset \xrightarrow{\mathrm{S}} \mathrm{V} \tag{17}$$

Modifier

Table 32: Properties of each modifier.

Id	Name	SBO
S		

Product

Table 33: Properties of each product.

Id	Name	SBO
V		

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \mathrm{vol}\,(\mathrm{compartment}) \cdot \frac{\mathrm{alpha2}}{1 + [\mathrm{S}]^3} \tag{18}$$

Table 34: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
alpha2			50.0		☑

5.10 Reaction S_degradation

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

Reaction equation

$$\mathrm{S} \longrightarrow \emptyset \tag{19}$$

Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
S		

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \mathrm{kd\_s} \cdot [\mathrm{S}] \cdot \mathrm{vol}\,(\mathrm{compartment}) \tag{20}$$

Table 36: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kd_s			1.0		☑

5.11 Reaction V_degradation

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

Reaction equation

$$\mathrm{V} \longrightarrow \emptyset \tag{21}$$

Reactant

Table 37: Properties of each reactant.

Id	Name	SBO
V		

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \mathrm{vol}\,(\mathrm{compartment}) \cdot [\mathrm{V}] \cdot \mathrm{kd\_v} \tag{22}$$

Table 38: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kd_v			1.0		☑

5.12 Reaction Photoreceptor_decay

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

Reaction equation

$$\mathrm{Pr} \longrightarrow \mathrm{Pi} \tag{23}$$

Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
Pr		

Product

Table 40: Properties of each product.

Id	Name	SBO
Pi		

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \mathrm{vol}\,(\mathrm{compartment}) \cdot \mathrm{kd} \cdot [\mathrm{Pr}] \tag{24}$$

Table 41: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kd			0.1		☑

6 Derived Rate Equations

When interpreted as an ordinary differential equation framework, this model implies the following set of equations for the rates of change of each species.

Identifiers for kinetic laws highlighted in gray cannot be verified to evaluate to units of SBML substance per time. As a result, some SBML interpreters may not be able to verify the consistency of the units on quantities in the model. Please check if

- parameters without an unit definition are involved or
- volume correction is necessary because the hasOnlySubstanceUnits flag may be set to false and spacialDimensions> 0 for certain species.

6.1 Species Pfr

Initial amount 10 mol

This species takes part in two reactions (as a reactant in Photoreceptor_activation and as a product in Photoreceptor_inactivation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Pfr} = v_2 - v_1 \tag{25}$$

6.2 Species Pr

Initial amount 0 mol

This species takes part in four reactions (as a reactant in Photoreceptor_inactivation, Photoreceptor_decay and as a product in Photoreceptor_activation and as a modifier in Transducer_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Pr} = v_1 - v_2 - v_{12} \tag{26}$$

6.3 Species Xi

Initial amount 6 mol

This species takes part in two reactions (as a reactant in Transducer_activation and as a product in Transducer_inactivation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xi} = v_4 - v_3 \tag{27}$$

6.4 Species Xa

Initial amount 0 mol

This species takes part in three reactions (as a reactant in Transducer_inactivation and as a product in Transducer_activation and as a modifier in preS_formation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xa} = v_3 - v_4 \tag{28}$$

6.5 Species prepreS

Initial amount 200 mol

This species takes part in one reaction (as a reactant in preS_formation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{prepreS} = -v_5 \tag{29}$$

6.6 Species preS

Initial amount 0 mol

This species takes part in two reactions (as a reactant in S_generation and as a product in preS_formation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{preS} = v_5 - v_6 \tag{30}$$

6.7 Species Ya

Initial amount 0.9 mol

This species takes part in two reactions (as a reactant in Glucose_sensor_inactivation and as a modifier in S_generation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ya} = -v_7 \tag{31}$$

6.8 Species S

Initial amount 0 mol

This species takes part in four reactions (as a reactant in S_degradation and as a product in S_generation, S_formation and as a modifier in V_formation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{S} = v_6 + v_8 - v_{10} \tag{32}$$

6.9 Species Gluc

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Gluc} = 0 \tag{33}$$

6.10 Species Yi

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Yi} = v_7 \tag{34}$$

6.11 Species V

Initial amount 30 mol

This species takes part in three reactions (as a reactant in V_degradation and as a product in V_formation and as a modifier in S_formation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{V} = v_9 - v_{11} \tag{35}$$

6.12 Species Pi

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Pi} = v_{12} \tag{36}$$

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.

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