SBML Model Report

Model name: "Keizer1996_Ryanodine-_receptor_adaptation"

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1 General Overview

This is a document in SBML Level 2 Version 3 format. This model was created by the following two authors: Harish Dharuri[1] and Lukas Endler[2] at October first 2008 at 5:41 p. m. and last time modified at April sixth 2014 at 9:39 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	4
events	0	constraints	0
reactions	3	function definitions	0
global parameters	1	unit definitions	5
rules	1	initial assignments	0

Model Notes

The model reproduces the time profile of Open probability of the ryanodine receptor as shown in Fig 2A and 2B of the paper. The model was successfully tested on MathSBML and Jarnac.

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2 Unit Definitions

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

2.1 Unit `per_microM4sec`

Name microM-4sec-1

Definition $\mu\text{mol}^{-4} \cdot \text{s}^{-1} \cdot \text{l}^{4}$

2.2 Unit `per_microM3sec`

Name microM-3sec-1

Definition $\mu\text{mol}^{-3} \cdot \text{s}^{-1} \cdot \text{l}^{3}$

2.3 Unit `per_second`

Name per_second

Definition s^{-1}

2.4 Unit `microM`

Name microM

Definition $\mu\text{mol} \cdot \text{l}^{-1}$

2.5 Unit `substance`

Name normalized substance

Definition dimensionless

2.6 Unit volume

Notes Litre is the predefined SBML unit for volume.

Definition l

2.7 Unit area

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

Definition m^2

2.8 Unit length

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

Definition m

2.9 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
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 four 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
Pc1		compartment	dimensionless	⊟	⊟
Po2		compartment	dimensionless	⊟	⊟
Po1	Po1	compartment	dimensionless	⊟	⊟
Pc2	Pc2	compartment	dimensionless	⊟	⊟

5 Parameter

This model contains one global parameter.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Open_probability			0.0	dimensionless	⊟

6 Rule

This is an overview of one rule.

6.1 Rule Open_probability

Rule Open_probability is an assignment rule for parameter Open_probability:

$$\text{Open\_probability} = \text{Po1} + \text{Po2} \tag{1}$$

Derived unit dimensionless

7 Reactions

This model contains three 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	`Closed_state_1`		$\mathrm{Po1} \overset{\mathrm{Po1}}{\rightleftharpoons} \mathrm{Pc1}$	
2	`Open_state_2`		$\mathrm{Po1} \overset{\mathrm{Po1}}{\rightleftharpoons} \mathrm{Po2}$	
3	`Closed_State_2`	Closed State 2	$\mathrm{Po1} \overset{\mathrm{Po1}}{\rightleftharpoons} \mathrm{Pc2}$	

7.1 Reaction Closed_state_1

This is a reversible reaction of one reactant forming one product influenced by one modifier.

Reaction equation

$$\mathrm{Po1} \overset{\mathrm{Po1}}{\rightleftharpoons} \mathrm{Pc1} \tag{2}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
Po1	Po1	

Modifier

Table 7: Properties of each modifier.

Id	Name	SBO
Po1	Po1	

Product

Table 8: Properties of each product.

Id	Name	SBO
Pc1		

Kinetic Law

Derived unit s^{-1}

$$v_1 = \mathrm{ka\_minus} \cdot \mathrm{Po1} - \mathrm{ka\_plus} \cdot \mathrm{Ca}^{\mathrm{n}} \cdot \mathrm{Pc1} \tag{3}$$

Table 9: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
ka_minus			28.8	s^{-1}	☑
ka_plus			1500.0	$\mu\mathrm{mol}^{-4} \cdot \mathrm{s}^{-1} \cdot \mathrm{l}^{4}$	☑
Ca			0.9	$\mu\mathrm{mol} \cdot \mathrm{l}^{-1}$	☑

Id	Name	SBO	Value	Unit	Constant
n			4.0	dimensionless	☑

7.2 Reaction Open_state_2

This is a reversible reaction of one reactant forming one product influenced by one modifier.

Reaction equation

$$\mathrm{Po1} \overset{\mathrm{Po1}}{\rightleftharpoons} \mathrm{Po2} \tag{4}$$

Reactant

Table 10: Properties of each reactant.

Id	Name	SBO
Po1	Po1	

Modifier

Table 11: Properties of each modifier.

Id	Name	SBO
Po1	Po1	

Product

Table 12: Properties of each product.

Id	Name	SBO
Po2		

Kinetic Law

Derived unit s^{-1}

$$v_2 = \mathrm{kb\_plus} \cdot \mathrm{Ca}^{\mathrm{m}} \cdot \mathrm{Po1} - \mathrm{kb\_minus} \cdot \mathrm{Po2} \tag{5}$$

Table 13: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kb_plus			1500.0	$\mu mol^{-3} \cdot s^{-1} \cdot l^{3}$	☑
Ca			0.9	$\mu mol \cdot l^{-1}$	☑
m			3.0	dimensionless	☑
kb_minus			385.9	s^{-1}	☑

7.3 Reaction Closed_State_2

This is a reversible reaction of one reactant forming one product influenced by one modifier.

Name Closed State 2

Reaction equation

$$\mathrm{Po1} \underset{}{\overset{\mathrm{Po1}}{\rightleftharpoons}} \mathrm{Pc2} \tag{6}$$

Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
Po1	Po1	

Modifier

Table 15: Properties of each modifier.

Id	Name	SBO
Po1	Po1	

Product

Table 16: Properties of each product.

Id	Name	SBO
Pc2	Pc2	

Kinetic Law

Derived unit s^{-1}

$$v_3 = \mathrm{kc\_plus} \cdot \mathrm{Po1} - \mathrm{kc\_minus} \cdot \mathrm{Pc2} \tag{7}$$

Table 17: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
`kc_plus`	kc_plus		1.75	s^{-1}	☑
`kc_minus`	kc_minus		0.10	s^{-1}	☑

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 `Pc1`

Initial amount 0.963 dimensionless

This species takes part in one reaction (as a product in `Closed_state_1`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Pc1} = v_1 \tag{8}$$

8.2 Species `Po2`

Initial amount 0 dimensionless

This species takes part in one reaction (as a product in `Open_state_2`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Po2} = v_2 \tag{9}$$

8.3 Species Po1

Name Po1

Initial amount 0 dimensionless

This species takes part in six reactions (as a reactant in Closed_state_1, Open_state_2, Closed_State_2 and as a modifier in Closed_state_1, Open_state_2, Closed_State_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Po1} = -v_1 - v_2 - v_3 \tag{10}$$

8.4 Species Pc2

Name Pc2

Initial amount 0.037 dimensionless

This species takes part in one reaction (as a product in Closed_State_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Pc2} = v_3 \tag{11}$$

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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