

## SBML Model Report

### Model name: “Hernjak2005\_Calcium\_Signaling”



May 6, 2016

## 1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Harish Dharuri<sup>1</sup> at January 28<sup>th</sup> 2008 at 11:44 a. m. and last time modified at February 20<sup>th</sup> 2014 at 5:06 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	5
species types	0	species	32
events	0	constraints	0
reactions	45	function definitions	0
global parameters	28	unit definitions	23
rules	3	initial assignments	0

## Model Notes

The model reproduces the time profiles of Calcium in the spine and dendrites as depicted in Fig 8 and Fig 9 of the paper for CF activation.

The model was reproduced using MathSBML.

Please note that the units of volume species is molecules/micrometer cubed as against the units of microMolar given in the paper. To convert the units to microMolar multiply the species

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concentration by the conversion factor 1/602.

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## 2 Unit Definitions

This is an overview of 25 unit definitions of which two are predefined by SBML and not mentioned in the model.

### 2.1 Unit `substance`

**Definition** `item`

### 2.2 Unit `volume`

**Definition**  $\mu\text{m}^3$

### 2.3 Unit `area`

**Definition**  $\mu\text{m}^2$

### 2.4 Unit `molecules`

**Definition** `item`

### 2.5 Unit `umol_um3_litre_1`

**Definition**  $10^{-21} \text{ mol}$

### 2.6 Unit `um2`

**Definition**  $\mu\text{m}^2$

### 2.7 Unit `uM_um3_molecules_1`

**Definition**  $10^{-21} \text{ dimensionless} \cdot \text{item}^{-1} \cdot \text{mol}$

## 2.8 Unit `uM_s_1`

**Definition**  $0.0010 \text{ dimensionless} \cdot \text{m}^{-3} \cdot \text{mol} \cdot \text{s}^{-1}$

## 2.9 Unit `uM_1_s_1`

**Definition**  $1000 \text{ dimensionless} \cdot \text{m}^3 \cdot \text{mol}^{-1} \cdot \text{s}^{-1}$

## 2.10 Unit `s_1`

**Definition**  $\text{s}^{-1}$

## 2.11 Unit `um2_s_1`

**Definition**  $10^{-12} \text{ dimensionless} \cdot \text{m}^2 \cdot \text{s}^{-1}$

## 2.12 Unit `um`

**Definition**  $\mu\text{m}$

## 2.13 Unit `uM`

**Definition**  $0.0010 \text{ dimensionless} \cdot \text{m}^{-3} \cdot \text{mol}$

## 2.14 Unit `molecules_um_2_s_1`

**Definition**  $10^{12} \text{ dimensionless} \cdot \text{item} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$

## 2.15 Unit `pA_um_2`

**Definition**  $\text{dimensionless} \cdot \text{A} \cdot \text{m}^{-2}$

## 2.16 Unit `molecules_um_2_uM_1_s_1`

**Definition**  $10^{15} \text{ dimensionless} \cdot \text{item} \cdot \text{m} \cdot \text{mol}^{-1} \cdot \text{s}^{-1}$

## 2.17 Unit `um_1`

**Definition**  $\mu\text{m}^{-1}$

## 2.18 Unit `uM_um_s_1`

**Definition**  $10^{-9} \text{ dimensionless} \cdot \text{m}^{-2} \cdot \text{mol} \cdot \text{s}^{-1}$

## 2.19 Unit `_one_`

**Definition**  $\text{dimensionless}$

## 2.20 Unit s

**Definition** s

## 2.21 Unit uM\_um3\_molecules\_1\_s\_1

**Definition**  $10^{-21} \text{ dimensionless} \cdot \text{item}^{-1} \cdot \text{mol} \cdot \text{s}^{-1}$

## 2.22 Unit \_one\_\_0E\_57\_item\_4\_m6\_mol\_s\_1

**Definition**  $10^{-57} \text{ dimensionless} \cdot \text{item}^{-4} \cdot \text{m}^6 \cdot \text{mol} \cdot \text{s}^{-1}$

## 2.23 Unit um\_s\_1

**Definition**  $\mu\text{m} \cdot \text{s}^{-1}$

## 2.24 Unit length

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

**Definition** m

## 2.25 Unit time

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

**Definition** s

# 3 Compartments

This model contains five compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
Extracellular	Extracellular		3	1	$\mu\text{m}^3$	✓	
Cytosol	Cytosol		3	14169.5000044198	$\mu\text{m}^3$	✓	PM
ER	ER		3	2500	$\mu\text{m}^3$	✓	ERM
PM	PM		2	16669.5000051998	$\mu\text{m}^2$	✓	Extracellular
ERM	ERM		2	50000	$\mu\text{m}^2$	✓	Cytosol

## 3.1 Compartment Extracellular

This is a three dimensional compartment with a constant size of one  $\mu\text{m}^3$ .

**Name** Extracellular

### 3.2 Compartment Cytosol

This is a three dimensional compartment with a constant size of  $14169.5000044198 \mu\text{m}^3$ , which is surrounded by PM (PM).

**Name** Cytosol

### 3.3 Compartment ER

This is a three dimensional compartment with a constant size of  $2500 \mu\text{m}^3$ , which is surrounded by ERM (ERM).

**Name** ER

### 3.4 Compartment PM

This is a two dimensional compartment with a constant size of  $16669.5000051998 \mu\text{m}^2$ , which is surrounded by Extracellular (Extracellular).

**Name** PM

### 3.5 Compartment ERM

This is a two dimensional compartment with a constant size of  $50000 \mu\text{m}^2$ , which is surrounded by Cytosol (Cytosol).

**Name** ERM

## 4 Species

This model contains 32 species. The boundary condition of eight of these species is set to `true` so that these 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 Condition
ERDensity_ERM		ERM	$\text{item} \cdot \mu\text{m}^{-2}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
PA_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
PABCa_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
Ca_D_ER		ER	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
h_D_ERM		ERM	$\text{item} \cdot \mu\text{m}^{-2}$	<input type="checkbox"/>	<input type="checkbox"/>
PABMg_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
ERDensity_D_ERM		ERM	$\text{item} \cdot \mu\text{m}^{-2}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
CG_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
D28kB_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
PA_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
CG_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
PABCa_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
Mg_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
D28k_high_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
D28k_high_D- _Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
Ca_ER		ER	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
D28kB_high_D- _Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
CGB_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
Ca_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
CGB_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
D28k_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
D28kB_high- _Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
PABMg_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
IP3_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
Ca_Extracellular		Extracellular	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
D28k_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
IP3_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
Mg_D_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ca_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>
h_ERM		ERM	$\text{item} \cdot \mu\text{m}^{-2}$	<input type="checkbox"/>	<input type="checkbox"/>
Ca_D- _Extracellular		Extracellular	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
D28kB_Cytosol		Cytosol	$\text{item} \cdot \mu\text{m}^{-3}$	<input type="checkbox"/>	<input type="checkbox"/>

## 5 Parameters

This model contains 28 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
KMOLE			0.002	$10^{-21}$ dimensionless · item <sup>-1</sup> · mol	<input checked="" type="checkbox"/>
pulses0			0.000		<input type="checkbox"/>
p0			1.000		<input checked="" type="checkbox"/>
delta			0.000		<input checked="" type="checkbox"/>
tau			0.012		<input checked="" type="checkbox"/>
Ks			1.188		<input checked="" type="checkbox"/>
A1			1.000		<input checked="" type="checkbox"/>
B1			2.000		<input checked="" type="checkbox"/>
flux0_ar			0.000		<input type="checkbox"/>
Jch			13.250		<input checked="" type="checkbox"/>
t1			0.100		<input checked="" type="checkbox"/>
t2			0.105		<input checked="" type="checkbox"/>
flux1_ar			0.000		<input type="checkbox"/>
JchD			6.250		<input checked="" type="checkbox"/>
pulses_ar			0.000		<input type="checkbox"/>
p1			1.000		<input checked="" type="checkbox"/>
p2			1.000		<input checked="" type="checkbox"/>
p3			1.000		<input checked="" type="checkbox"/>
p4			1.000		<input checked="" type="checkbox"/>
p5			1.000		<input checked="" type="checkbox"/>
p6			1.000		<input checked="" type="checkbox"/>
p7			1.000		<input checked="" type="checkbox"/>
p8			1.000		<input checked="" type="checkbox"/>
p9			1.000		<input checked="" type="checkbox"/>
p10			1.000		<input checked="" type="checkbox"/>
p11			1.000		<input checked="" type="checkbox"/>
p12			1.000		<input checked="" type="checkbox"/>
p13			1.000		<input checked="" type="checkbox"/>

## 6 Rules

This is an overview of three rules.



## 6.1 Rule `pulses_ar`

Rule `pulses_ar` is an assignment rule for parameter `pulses_ar`:

$$\begin{aligned}
 \text{pulses\_ar} = & \begin{cases} p0 \cdot \exp(((t + (\text{delta})) \cdot Ks)) & \text{if } t > \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p1 \cdot \exp(((t + ((\text{tau} + \text{delta}))) \cdot Ks)) & \text{if } t > \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p2 \cdot \exp((Ks \cdot (t + ((2 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 2 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p3 \cdot \exp((Ks \cdot (t + ((3 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 3 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p4 \cdot \exp((Ks \cdot (t + ((4 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 4 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p5 \cdot \exp((Ks \cdot (t + ((5 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 5 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p6 \cdot \exp((Ks \cdot (t + ((6 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 6 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p7 \cdot \exp((Ks \cdot (t + ((7 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 7 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p8 \cdot \exp((Ks \cdot (t + ((8 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 8 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p9 \cdot \exp((Ks \cdot (t + ((9 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 9 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p10 \cdot \exp((Ks \cdot (t + ((10 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 10 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases} \\
 & + \begin{cases} p11 \cdot \exp((Ks \cdot (t + ((11 \cdot \text{tau} + \text{delta})))))) & \text{if } t > 11 \cdot \text{tau} + \text{delta} \\ 0 & \text{otherwise} \end{cases}
 \end{aligned} \tag{1}$$

## 6.2 Rule `flux0_ar`

Rule `flux0_ar` is an assignment rule for parameter `flux0_ar`:

$$\begin{aligned}
 & \text{flux0\_ar} & (2) \\
 = & \begin{cases} Jch \cdot (0.0016611295681 \cdot [\text{Ca\_Extracellular}] + ((0.0016611295681 \cdot [\text{Ca\_Cytosol}]))) & \text{if } (t > t1) \wedge (t < t2) \\ 0 & \text{otherwise} \end{cases}
 \end{aligned}$$

### 6.3 Rule `flux1_ar`

Rule `flux1_ar` is an assignment rule for parameter `flux1_ar`:

$$\begin{aligned} & \text{flux1\_ar} & (3) \\ = & \begin{cases} \text{JchD} \cdot (0.0016611295681 \cdot [\text{Ca\_D\_Extracellular}] + ((0.0016611295681 \cdot [\text{Ca\_D\_Cytosol}]))) & \text{if } (t > t1) \wedge (t < t2) \\ 0 & \text{otherwise} \end{cases} \end{aligned}$$

## 7 Reactions

This model contains 45 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	CD28k- _highDbinding	CD28k_highDbinding	$\text{Ca\_D.Cytosol} + \text{D28k\_high\_D.Cytosol} \rightleftharpoons \text{D28kB\_high\_D.Cytosol}$	
2	PA_Dbinding	PA_Dbinding	$\text{PA\_D.Cytosol} + \text{Ca\_D.Cytosol} \rightleftharpoons \text{PABCa\_D.Cytosol}$	
3	CG_deg	CG_deg	$\text{CG\_D.Cytosol} \xrightarrow{\text{CG.Cytosol}} \emptyset$	
4	IP3deg	IP3deg	$\text{IP3\_D.Cytosol} \xrightarrow{\text{IP3.Cytosol}} \emptyset$	
5	D28kB_deg	D28kB_deg	$\text{D28kB\_D.Cytosol} \xrightarrow{\text{D28kB.Cytosol}} \emptyset$	
6	D28k_deg	D28k_deg	$\text{D28k\_D.Cytosol} \xrightarrow{\text{D28k.Cytosol}} \emptyset$	
7	PA_MgD	PA_MgD	$\text{Mg\_D.Cytosol} + \text{PA\_D.Cytosol} \rightleftharpoons \text{PABMg\_D.Cytosol}$	
8	PA_Ca	PA_Ca	$\text{PA\_Cytosol} + \text{Ca\_Cytosol} \rightleftharpoons \text{PABCa\_Cytosol}$	
9	PABMg_deg	PABMg_deg	$\text{PABMg\_D.Cytosol} \xrightarrow{\text{PABMg.Cytosol}} \emptyset$	
10	D28k_high_deg	D28k_high_deg	$\text{D28k\_high\_D.Cytosol} \xrightarrow{\text{D28k\_high.Cytosol}} \emptyset$	
11	Ca_d	Ca_d	$\text{Ca\_Cytosol} \xrightarrow{\text{Ca\_D.Cytosol}} \emptyset$	
12	D28kB_high_deg	D28kB_high_deg	$\text{D28kB\_high\_D.Cytosol} \xrightarrow{\text{D28kB\_high.Cytosol}} \emptyset$	
13	CG_d	CG_d	$\text{CG\_Cytosol} \xrightarrow{\text{CG\_D.Cytosol}} \emptyset$	
14	D28kB_d	D28kB_d	$\text{D28kB\_Cytosol} \xrightarrow{\text{D28kB\_D.Cytosol}} \emptyset$	
15	reaction1	reaction1	$\text{h\_D.ERM} \xrightarrow{\text{Ca\_D.Cytosol}} \emptyset$	
16	CGbinding	CGbinding	$\text{Ca\_Cytosol} + \text{CG\_Cytosol} \rightleftharpoons \text{CGB\_Cytosol}$	

Nº	Id	Name	Reaction Equation	SBO
17	CaD28k_med	CaD28k_med	$\text{D28k\_Cytosol} + \text{Ca\_Cytosol} \rightleftharpoons \text{D28kB\_Cytosol}$	
18	PABCa_deg	PABCa_deg	$\text{PABCa\_D\_Cytosol} \xrightleftharpoons{\text{PABCa\_Cytosol}} \emptyset$	
19	IP3_d	IP3_d	$\text{IP3\_Cytosol} \xrightleftharpoons{\text{IP3\_D\_Cytosol}} \emptyset$	
20	D28k_high_d	D28k_high_d	$\text{D28k\_high\_Cytosol} \xrightleftharpoons{\text{D28k\_high\_D\_Cytosol}} \emptyset$	
21	reaction0	reaction0	$\text{h\_ERM} \xrightleftharpoons{\text{Ca\_Cytosol}} \emptyset$	
22	PABMg_d	PABMg_d	$\text{PABMg\_Cytosol} \xrightleftharpoons{\text{PABMg\_D\_Cytosol}} \emptyset$	
23	CD28k_high	CD28k_high	$\text{Ca\_Cytosol} + \text{D28k\_high\_Cytosol} \rightleftharpoons \text{D28kB\_high\_Cytosol}$	
24	D28kBDbinding	D28kBDbinding	$\text{D28k\_D\_Cytosol} + \text{Ca\_D\_Cytosol} \rightleftharpoons \text{D28kB\_D\_Cytosol}$	
25	PABCa_d	PABCa_d	$\text{PABCa\_Cytosol} \xrightleftharpoons{\text{PABCa\_D\_Cytosol}} \emptyset$	
26	PA_d	PA_d	$\text{PA\_Cytosol} \xrightleftharpoons{\text{PA\_D\_Cytosol}} \emptyset$	
27	CGB_deg	CGB_deg	$\text{CGB\_D\_Cytosol} \xrightleftharpoons{\text{CGB\_Cytosol}} \emptyset$	
28	PA_Mg	PA_Mg	$\text{PA\_Cytosol} + \text{Mg\_Cytosol} \rightleftharpoons \text{PABMg\_Cytosol}$	
29	PA_deg	PA_deg	$\text{PA\_D\_Cytosol} \xrightleftharpoons{\text{PA\_Cytosol}} \emptyset$	
30	IP3_degr	IP3_degr	$\text{IP3\_Cytosol} \rightleftharpoons \emptyset$	
31	D28kB_high_d	D28kB_high_d	$\text{D28kB\_high\_Cytosol} \xrightleftharpoons{\text{D28kB\_high\_D\_Cytosol}} \emptyset$	
32	D28k_d	D28k_d	$\text{D28k\_Cytosol} \xrightleftharpoons{\text{D28k\_D\_Cytosol}} \emptyset$	
33	CGB_d	CGB_d	$\text{CGB\_Cytosol} \xrightleftharpoons{\text{CGB\_D\_Cytosol}} \emptyset$	
34	CG_Dbinding	CG_Dbinding	$\text{Ca\_D\_Cytosol} + \text{CG\_D\_Cytosol} \rightleftharpoons \text{CGB\_D\_Cytosol}$	
35	IP3_degr1	IP3_degr1	$\text{IP3\_D\_Cytosol} \rightleftharpoons \emptyset$	
36	Ca_deg	Ca_deg	$\text{Ca\_D\_Cytosol} \xrightleftharpoons{\text{Ca\_Cytosol}} \emptyset$	
37	pulses	pulses	$\emptyset \rightleftharpoons \text{IP3\_Cytosol}$	

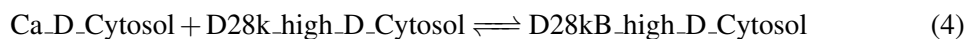
Nº	Id	Name	Reaction Equation	SBO
38	ER_leak_flux	ER_leak_flux	$\text{Ca\_Cytosol} \xrightleftharpoons{\text{ERDensity\_ERM}} \text{Ca\_ER}$	
39	SERCA_fluxD	SERCA_fluxD	$\text{Ca\_D\_Cytosol} \xrightleftharpoons{\text{ERDensity\_D\_ERM}} \text{Ca\_D\_ER}$	
40	IP3R_fluxD	IP3R_fluxD	$\text{Ca\_D\_Cytosol} \xrightleftharpoons{\text{IP3\_D\_Cytosol, ERDensity\_D\_ERM, h\_D\_ERM}} \text{Ca\_D\_ER}$	
41	SERCA_flux	SERCA_flux	$\text{Ca\_Cytosol} \xrightleftharpoons{\text{ERDensity\_ERM}} \text{Ca\_ER}$	
42	flux0	flux0	$\text{Ca\_Extracellular} \rightleftharpoons \text{Ca\_Cytosol}$	
43	IP3R_flux	IP3R_flux	$\text{Ca\_Cytosol} \xrightleftharpoons{\text{IP3\_Cytosol, h\_ERM, ERDensity\_ERM}} \text{Ca\_ER}$	
44	flux1	flux1	$\text{Ca\_D\_Extracellular} \rightleftharpoons \text{Ca\_D\_Cytosol}$	
45	ER_leak_fluxD	ER_leak_fluxD	$\text{Ca\_D\_Cytosol} \xrightleftharpoons{\text{ERDensity\_D\_ERM}} \text{Ca\_D\_ER}$	

## 7.1 Reaction CD28k\_highDbinding

This is a reversible reaction of two reactants forming one product.

**Name** CD28k\_highDbinding

### Reaction equation



### Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
Ca_D_Cytosol		
D28k_high_D_Cytosol		

### Product

Table 7: Properties of each product.

Id	Name	SBO
D28kB_high_D_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$v_1 = (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] \cdot 0.00166112956810631 \\ \cdot [\text{D28k\_high\_D\_Cytosol}] + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{D28kB\_high\_D\_Cytosol}]))) \\ \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (5)$$

Table 8: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Kf			5.5	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	✓
Kr			2.6	s <sup>-1</sup>	✓

## 7.2 Reaction PA\_Dbinding

This is a reversible reaction of two reactants forming one product.

**Name** PA\_Dbinding

### Reaction equation



### Reactants

Table 9: Properties of each reactant.

Id	Name	SBO
PA_D_Cytosol		
Ca_D_Cytosol		

### Product

Table 10: Properties of each product.

Id	Name	SBO
PABCa_D_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$v_2 = (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{PA\_D\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{PABCa\_D\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (7)$$

Table 11: Properties of each parameter.

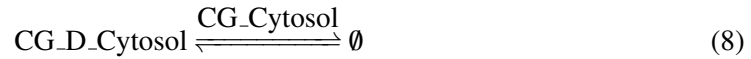
Id	Name	SBO	Value	Unit	Constant
Kf			107.00	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	✓
Kr			0.95	s <sup>-1</sup>	✓

### 7.3 Reaction CG\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** CG\_deg

#### Reaction equation



#### Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
CG_D_Cytosol		

#### Modifier

Table 13: Properties of each modifier.

Id	Name	SBO
CG_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_3 = \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [\text{CG\_D\_Cytosol}] + ((0.00166112956810631 \cdot [\text{CG\_Cytosol}]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_d^2} \cdot \frac{1}{l_{\text{star}}} + D \cdot (0.00166112956810631 \cdot [\text{CG\_D\_Cytosol}] + (\text{CG\_F})) \cdot \frac{1}{l_{\text{star}}} \cdot \frac{1}{l_c} \right) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (9)$$

Table 14: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			15.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓



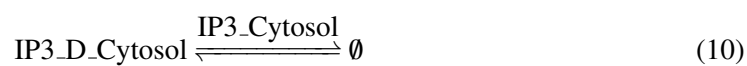
Id	Name	SBO	Value	Unit	Constant
r_n			0.100	μm	✓
l_n			0.660	μm	✓
r_d			1.000	μm	✓
l_star			27.981	μm	✓
CG_F			140.476	0.0010 dimensionless · m <sup>-3</sup> · mol	✓
lc			5.627	μm	✓

## 7.4 Reaction IP3deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** IP3deg

### Reaction equation



### Reactant

Table 15: Properties of each reactant.

Id	Name	SBO
	IP3_D_Cytosol	

### Modifier

Table 16: Properties of each modifier.

Id	Name	SBO
	IP3_Cytosol	

### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
v_4 = & \left( D \cdot r_n^2 \right. \\
& \cdot (0.00166112956810631 \cdot [\text{IP3\_D\_Cytosol}] + ((0.00166112956810631 \cdot [\text{IP3\_Cytosol}]))) \\
& \cdot \frac{1}{l_n} \cdot \frac{1}{r_d^2} \cdot \frac{1}{l_{\text{star}}} + D \cdot (0.00166112956810631 \cdot [\text{IP3\_D\_Cytosol}] + (\text{IP3\_F})) \cdot \frac{1}{l_{\text{star}}} \cdot \frac{1}{l_c} \Big) \\
& \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
\end{aligned} \tag{11}$$

Table 17: Properties of each parameter.

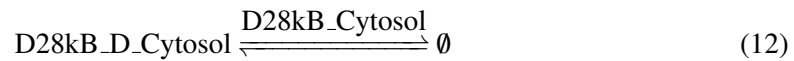
Id	Name	SBO	Value	Unit	Constant
D			283.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_n			0.100	$\mu\text{m}$	✓
l_n			0.660	$\mu\text{m}$	✓
r_d			1.000	$\mu\text{m}$	✓
l_star			27.981	$\mu\text{m}$	✓
IP3_F			0.160	0.0010 dimensionless · $\text{m}^{-3} \cdot \text{mol}$	✓
lc			5.627	$\mu\text{m}$	✓

## 7.5 Reaction D28kB\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** D28kB\_deg

### Reaction equation



### Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
	D28kB_D_Cytosol	

### Modifier

Table 19: Properties of each modifier.

Id	Name	SBO
	D28kB_Cytosol	

### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_5 = & \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [D28kB\_D\_Cytosol] \right. \\
 & + ((0.00166112956810631 \cdot [D28kB\_Cytosol]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_D^2} \cdot \frac{1}{l_{star}} + D \\
 & \cdot (0.00166112956810631 \cdot [D28kB\_D\_Cytosol] + (D28kB\_F)) \cdot \frac{1}{l_{star}} \cdot \frac{1}{l_c} \Big) \\
 & \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned} \quad (13)$$

Table 20: Properties of each parameter.

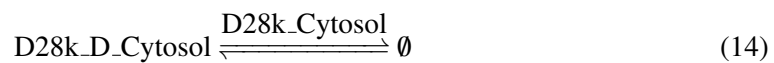
Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_n			0.100	$\mu\text{m}$	✓
l_n			0.660	$\mu\text{m}$	✓
r_D			1.000	$\mu\text{m}$	✓
l_star			27.981	$\mu\text{m}$	✓
D28kB_F			4.170	0.0010 dimensionless · $\text{m}^{-3} \cdot \text{mol}$	✓
l_c			5.627	$\mu\text{m}$	✓

### 7.6 Reaction D28k\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** D28k\_deg

### Reaction equation



## Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
D28k_D_Cytosol		

## Modifier

Table 22: Properties of each modifier.

Id	Name	SBO
D28k_Cytosol		

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_6 = & \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [D28k\_D\_Cytosol] \right. \\
 & + ((0.00166112956810631 \cdot [D28k\_Cytosol]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r\_D^2} \cdot \frac{1}{l\_star} + D \\
 & \cdot (0.00166112956810631 \cdot [D28k\_D\_Cytosol] + (D28k\_F)) \cdot \frac{1}{l\_star} \cdot \frac{1}{lc} \Big) \\
 & \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned} \tag{15}$$

Table 23: Properties of each parameter.

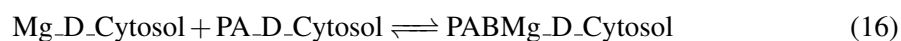
Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12} \text{ dimensionless} \cdot \text{m}^2 \cdot \text{s}^{-1}$	✓
r_n			0.100	$\mu\text{m}$	✓
l_n			0.660	$\mu\text{m}$	✓
r_D			1.000	$\mu\text{m}$	✓
l_star			27.981	$\mu\text{m}$	✓
D28k_F			75.830	$0.0010 \text{ dimensionless} \cdot \text{m}^{-3} \cdot \text{mol}$	✓
lc			5.627	$\mu\text{m}$	✓

## 7.7 Reaction PA\_MgD

This is a reversible reaction of two reactants forming one product.

**Name** PA\_MgD

### Reaction equation



### Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
Mg_D_Cytosol		
PA_D_Cytosol		

### Product

Table 25: Properties of each product.

Id	Name	SBO
PABMg_D_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$v_7 = (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{Mg\_D\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{PA\_D\_Cytosol}] + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{PABMg\_D\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (17)$$

Table 26: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Kf			0.8	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	✓
Kr			25.0	s <sup>-1</sup>	✓

## 7.8 Reaction PA\_Ca

This is a reversible reaction of two reactants forming one product.

**Name** PA\_Ca

### Reaction equation



### Reactants

Table 27: Properties of each reactant.

Id	Name	SBO
PA_Cytosol		
Ca_Cytosol		

### Product

Table 28: Properties of each product.

Id	Name	SBO
PABCa_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$v_8 = (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{PA\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{PABCa\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (19)$$

Table 29: Properties of each parameter.

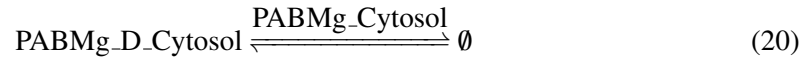
Id	Name	SBO	Value	Unit	Constant
Kf			107.00	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	<input checked="" type="checkbox"/>
Kr			0.95	s <sup>-1</sup>	<input checked="" type="checkbox"/>

## 7.9 Reaction PABMg\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** PABMg\_deg

### Reaction equation



### Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
PABMg_D_Cytosol		

### Modifier

Table 31: Properties of each modifier.

Id	Name	SBO
PABMg_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_9 = & \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [\text{PABMg\_D\_Cytosol}] \right. \\
 & + ((0.00166112956810631 \cdot [\text{PABMg\_Cytosol}]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_d^2} \cdot \frac{1}{l_{\text{star}}} + D \\
 & \cdot (0.00166112956810631 \cdot [\text{PABMg\_D\_Cytosol}] + (\text{PABMg\_F})) \cdot \frac{1}{l_{\text{star}}} \cdot \frac{1}{l_c} \Big) \\
 & \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned} \quad (21)$$

Table 32: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			43.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	<input checked="" type="checkbox"/>
r_n			0.100	$\mu\text{m}$	<input checked="" type="checkbox"/>
l_n			0.660	$\mu\text{m}$	<input checked="" type="checkbox"/>
r_d			1.000	$\mu\text{m}$	<input checked="" type="checkbox"/>
l_star			27.981	$\mu\text{m}$	<input checked="" type="checkbox"/>
PABMg_F			60.472	0.0010 dimensionless · $\text{m}^{-3} \cdot \text{mol}$	<input checked="" type="checkbox"/>
lc			5.627	$\mu\text{m}$	<input checked="" type="checkbox"/>

### 7.10 Reaction `D28k_high_deg`

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** `D28k_high_deg`

#### Reaction equation



#### Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
D28k_high_D_Cytosol		

#### Modifier

Table 34: Properties of each modifier.

Id	Name	SBO
D28k_high_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units



$$\begin{aligned}
v_{10} = & \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [D28k\_high\_D\_Cytosol] \right. \\
& + ((0.00166112956810631 \cdot [D28k\_high\_Cytosol]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_D^2} \cdot \frac{1}{l_{star}} + D \\
& \cdot (0.00166112956810631 \cdot [D28k\_high\_D\_Cytosol] + (D28k\_high\_F)) \cdot \frac{1}{l_{star}} \cdot \frac{1}{lc} \Big) \\
& \cdot vol(Cytosol) \cdot 1 \cdot \frac{1}{KMOLE}
\end{aligned} \tag{23}$$

Table 35: Properties of each parameter.

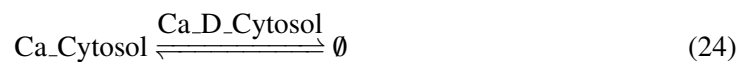
Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12}$ dimensionless · $m^2 \cdot s^{-1}$	✓
r_n			0.100	$\mu m$	✓
l_n			0.660	$\mu m$	✓
r_D			1.000	$\mu m$	✓
l_star			27.981	$\mu m$	✓
D28k_high_F			73.011	0.0010 dimensionless · $m^{-3} \cdot mol$	✓
lc			5.627	$\mu m$	✓

### 7.11 Reaction Ca\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** Ca\_d

#### Reaction equation



#### Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
Ca_Cytosol		

#### Modifier

Table 37: Properties of each modifier.

Id	Name	SBO
	Ca_D_Cytosol	

### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{11} = & 0.75 \cdot D \\
 & \cdot (0.00166112956810631 \cdot [\text{Ca\_Cytosol}] + ((0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}]))) \\
 & \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned}
 \tag{25}$$

Table 38: Properties of each parameter.

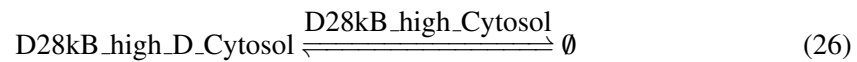
Id	Name	SBO	Value	Unit	Constant
D			223.000	$10^{-12} \text{ dimensionless} \cdot \text{m}^2 \cdot \text{s}^{-1}$	✓
r_neck			0.100	$\mu\text{m}$	✓
l			0.660	$\mu\text{m}$	✓
r_spine			0.288	$\mu\text{m}$	✓

### 7.12 Reaction D28kB\_high\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** D28kB\_high\_deg

#### Reaction equation



#### Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
	D28kB_high_D_Cytosol	

## Modifier

Table 40: Properties of each modifier.

Id	Name	SBO
	D28kB_high_Cytosol	

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{12} = & \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [\text{D28kB\_high\_D\_Cytosol}] \right. \\
 & + ((0.00166112956810631 \cdot [\text{D28kB\_high\_Cytosol}]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_D^2} \cdot \frac{1}{l_{\text{star}}} + D \\
 & \cdot (0.00166112956810631 \cdot [\text{D28kB\_high\_D\_Cytosol}] + (\text{D28kB\_high\_F})) \cdot \frac{1}{l_{\text{star}}} \cdot \frac{1}{l_c} \Big) \\
 & \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned}
 \tag{27}$$

Table 41: Properties of each parameter.

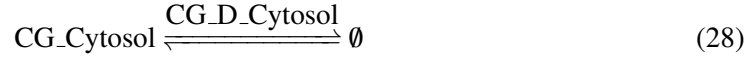
Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_n			0.100	$\mu\text{m}$	✓
l_n			0.660	$\mu\text{m}$	✓
r_D			1.000	$\mu\text{m}$	✓
l_star			27.981	$\mu\text{m}$	✓
D28kB_high_F			6.989	0.0010 dimensionless · $\text{m}^{-3} \cdot \text{mol}$	✓
l_c			5.627	$\mu\text{m}$	✓

## 7.13 Reaction CG\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** CG\_d

## Reaction equation



## Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
CG_Cytosol		

## Modifier

Table 43: Properties of each modifier.

Id	Name	SBO
CG_D_Cytosol		

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{13} = 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{CG\_Cytosol}] + ((0.00166112956810631 \cdot [\text{CG\_D\_Cytosol}]))) \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (29)$$

Table 44: Properties of each parameter.

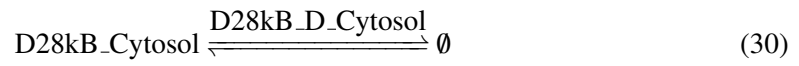
Id	Name	SBO	Value	Unit	Constant
D			15.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_neck			0.100	$\mu\text{m}$	✓
l			0.660	$\mu\text{m}$	✓
r_spine			0.288	$\mu\text{m}$	✓

## 7.14 Reaction D28kB\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** D28kB\_d

### Reaction equation



### Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
D28kB_Cytosol		

### Modifier

Table 46: Properties of each modifier.

Id	Name	SBO
D28kB_D_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{14} = 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{D28kB\_Cytosol}] + ((0.00166112956810631 \cdot [\text{D28kB\_Cytosol}]))) \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (31)$$

Table 47: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_neck			0.100	$\mu\text{m}$	✓
l			0.660	$\mu\text{m}$	✓
r_spine			0.288	$\mu\text{m}$	✓

## 7.15 Reaction `reaction1`

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** `reaction1`

### Reaction equation



### Reactant

Table 48: Properties of each reactant.

Id	Name	SBO
h_D_ERM		

### Modifier

Table 49: Properties of each modifier.

Id	Name	SBO
Ca_D_Cytosol		

### Kinetic Law

**Derived unit** `item · s-1`

$$v_{15} = ((\text{Kinh} + (((0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] + \text{Kinh}) \cdot [\text{h\_D\_ERM}]))) \cdot \text{Kon}) \cdot \text{area(ERM)} \quad (33)$$

Table 50: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
I			0.0	dimensionless · A · m <sup>-2</sup>	✓
Kinh			0.2	0.0010 dimensionless · m <sup>-3</sup> · mol	✓
Kon			2.7	10 <sup>15</sup> dimensionless · item · m · mol <sup>-1</sup> · s <sup>-1</sup>	✓

## 7.16 Reaction CGbinding

This is a reversible reaction of two reactants forming one product.

**Name** CGbinding

### Reaction equation



### Reactants

Table 51: Properties of each reactant.

Id	Name	SBO
Ca_Cytosol		
CG_Cytosol		

### Product

Table 52: Properties of each product.

Id	Name	SBO
CGB_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned} v_{16} = & (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{CG\_Cytosol}] \\ & + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{CGB\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \end{aligned} \quad (35)$$

Table 53: Properties of each parameter.

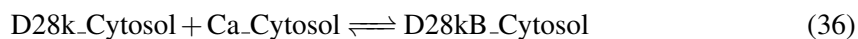
Id	Name	SBO	Value	Unit	Constant
Kf			430.0	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	✓
Kr			140.0	s <sup>-1</sup>	✓

### 7.17 Reaction CaD28k\_med

This is a reversible reaction of two reactants forming one product.

**Name** CaD28k\_med

#### Reaction equation



#### Reactants

Table 54: Properties of each reactant.

Id	Name	SBO
D28k_Cytosol		
Ca_Cytosol		

#### Product

Table 55: Properties of each product.

Id	Name	SBO
D28kB_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{17} = (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{D28k\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{D28kB\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (37)$$

Table 56: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Kf			43.5	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	✓
Kr			35.8	s <sup>-1</sup>	✓

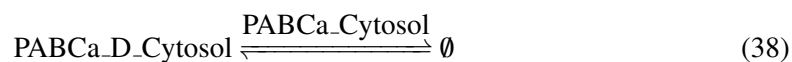


## 7.18 Reaction PABCa\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** PABCa\_deg

### Reaction equation



### Reactant

Table 57: Properties of each reactant.

Id	Name	SBO
PABCa_D_Cytosol		

### Modifier

Table 58: Properties of each modifier.

Id	Name	SBO
PABCa_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{18} = & \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [\text{PABCa\_D\_Cytosol}] \right. \\
 & + ((0.00166112956810631 \cdot [\text{PABCa\_Cytosol}]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_d^2} \cdot \frac{1}{l_{\text{star}}} + D \\
 & \cdot (0.00166112956810631 \cdot [\text{PABCa\_D\_Cytosol}] + (\text{PABCa\_F})) \cdot \frac{1}{l_{\text{star}}} \cdot \frac{1}{l_c} \Big) \\
 & \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned} \quad (39)$$

Table 59: Properties of each parameter.

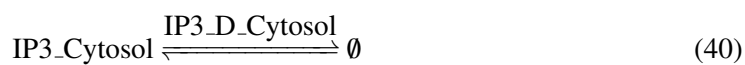
Id	Name	SBO	Value	Unit	Constant
D			43.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_n			0.100	$\mu\text{m}$	✓
l_n			0.660	$\mu\text{m}$	✓
r_d			1.000	$\mu\text{m}$	✓
l_star			27.981	$\mu\text{m}$	✓
PABCa_F			16.325	0.0010 dimensionless · $\text{m}^{-3} \cdot \text{mol}$	✓
lc			5.627	$\mu\text{m}$	✓

### 7.19 Reaction IP3\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** IP3\_d

#### Reaction equation



#### Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
IP3_Cytosol		

#### Modifier

Table 61: Properties of each modifier.

Id	Name	SBO
IP3_D_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
v_{19} = & 0.75 \cdot D \\
& \cdot (0.00166112956810631 \cdot [\text{IP3\_Cytosol}] + ((0.00166112956810631 \cdot [\text{IP3\_D\_Cytosol}]))) \\
& \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
\end{aligned}
\tag{41}$$

Table 62: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			283.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_neck			0.100	$\mu\text{m}$	✓
l			0.660	$\mu\text{m}$	✓
r_spine			0.288	$\mu\text{m}$	✓

## 7.20 Reaction D28k\_high\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** D28k\_high\_d

### Reaction equation



### Reactant

Table 63: Properties of each reactant.

Id	Name	SBO
D28k_high_Cytosol		

### Modifier

Table 64: Properties of each modifier.

Id	Name	SBO
D28k_high_D_Cytosol		

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{20} = 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{D28k\_high\_Cytosol}] + ((0.00166112956810631 \cdot [\text{D28k\_high\_D\_Cytosol}]))) \cdot r_{\text{neck}}^2 \cdot \frac{1}{1} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (43)$$

Table 65: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	<input checked="" type="checkbox"/>
r_neck			0.100	$\mu\text{m}$	<input checked="" type="checkbox"/>
l			0.660	$\mu\text{m}$	<input checked="" type="checkbox"/>
r_spine			0.288	$\mu\text{m}$	<input checked="" type="checkbox"/>

## 7.21 Reaction reaction0

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** reaction0

### Reaction equation



### Reactant

Table 66: Properties of each reactant.

Id	Name	SBO
h_ERM		

### Modifier

Table 67: Properties of each modifier.

Id	Name	SBO
Ca_Cytosol		

Id	Name	SBO
----	------	-----

## Kinetic Law

**Derived unit**  $\text{item} \cdot \text{s}^{-1}$

$$v_{21} = ((\text{Kinh} + (((0.00166112956810631 \cdot [\text{Ca\_Cytosol}] + \text{Kinh}) \cdot [\text{h\_ERM}]))) \cdot \text{Kon}) \cdot \text{area}(\text{ERM}) \quad (45)$$

Table 68: Properties of each parameter.

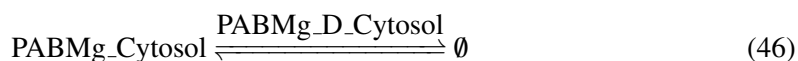
Id	Name	SBO	Value	Unit	Constant
I			0.0	dimensionless · A · m <sup>-2</sup>	✓
Kinh			0.2	0.0010 dimensionless · m <sup>-3</sup> · mol	✓
Kon			2.7	10 <sup>15</sup> dimensionless · item · m · mol <sup>-1</sup> · s <sup>-1</sup>	✓

## 7.22 Reaction PABMg\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** PABMg\_d

## Reaction equation



## Reactant

Table 69: Properties of each reactant.

Id	Name	SBO
PABMg_Cytosol		

## Modifier

Table 70: Properties of each modifier.

Id	Name	SBO
	PABMg_D_Cytosol	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{22} = 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{PABMg\_Cytosol}] + ((0.00166112956810631 \cdot [\text{PABMg\_D\_Cytosol}]))) \cdot r_{\text{neck}}^2 \cdot \frac{1}{1} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (47)$$

Table 71: Properties of each parameter.

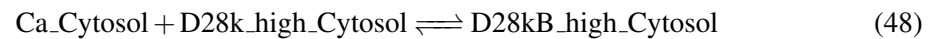
Id	Name	SBO	Value	Unit	Constant
D			43.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_neck			0.100	$\mu\text{m}$	✓
l			0.660	$\mu\text{m}$	✓
r_spine			0.288	$\mu\text{m}$	✓

### 7.23 Reaction CD28k\_high

This is a reversible reaction of two reactants forming one product.

**Name** CD28k\_high

### Reaction equation



### Reactants

Table 72: Properties of each reactant.

Id	Name	SBO
	Ca_Cytosol	
	D28k_high_Cytosol	

## Product

Table 73: Properties of each product.

Id	Name	SBO
D28kB_high_Cytosol		

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{23} = (K_f \cdot 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{D28k\_high\_Cytosol}] + ((K_r \cdot 0.00166112956810631 \cdot [\text{D28kB\_high\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (49)$$

Table 74: Properties of each parameter.

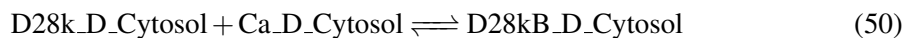
Id	Name	SBO	Value	Unit	Constant
Kf			5.5	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	<input checked="" type="checkbox"/>
Kr			2.6	s <sup>-1</sup>	<input checked="" type="checkbox"/>

## 7.24 Reaction D28kBDbinding

This is a reversible reaction of two reactants forming one product.

**Name** D28kBDbinding

### Reaction equation



## Reactants

Table 75: Properties of each reactant.

Id	Name	SBO
D28k_D_Cytosol		
Ca_D_Cytosol		

## Product

Table 76: Properties of each product.

Id	Name	SBO
	D28kB_D_Cytosol	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{24} = (K_f \cdot 0.00166112956810631 \cdot [\text{D28k\_D\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] + ((K_r \cdot 0.00166112956810631 \cdot [\text{D28kB\_D\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (51)$$

Table 77: Properties of each parameter.

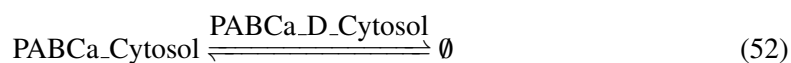
Id	Name	SBO	Value	Unit	Constant
Kf			43.5	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	<input checked="" type="checkbox"/>
Kr			35.8	s <sup>-1</sup>	<input checked="" type="checkbox"/>

### 7.25 Reaction PABCa\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** PABCa\_d

## Reaction equation



## Reactant

Table 78: Properties of each reactant.

Id	Name	SBO
	PABCa_Cytosol	



## Modifier

Table 79: Properties of each modifier.

Id	Name	SBO
	PABCa_D_Cytosol	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{25} = 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{PABCa\_Cytosol}] + ((0.00166112956810631 \cdot [\text{PABCa\_D\_Cytosol}]))) \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (53)$$

Table 80: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			43.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_neck			0.100	$\mu\text{m}$	✓
l			0.660	$\mu\text{m}$	✓
r_spine			0.288	$\mu\text{m}$	✓

## 7.26 Reaction PA\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** PA\_d

## Reaction equation



## Reactant

Table 81: Properties of each reactant.

Id	Name	SBO
	PA_Cytosol	

Id	Name	SBO
----	------	-----

## Modifier

Table 82: Properties of each modifier.

Id	Name	SBO
	PA_D_Cytosol	

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{26} = & 0.75 \cdot D \\
 & \cdot (0.00166112956810631 \cdot [\text{PA\_Cytosol}] + ((0.00166112956810631 \cdot [\text{PA\_D\_Cytosol}]))) \\
 & \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned}
 \tag{55}$$

Table 83: Properties of each parameter.

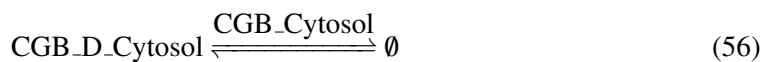
Id	Name	SBO	Value	Unit	Constant
D			43.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	<input checked="" type="checkbox"/>
r_neck			0.100	$\mu\text{m}$	<input checked="" type="checkbox"/>
l			0.660	$\mu\text{m}$	<input checked="" type="checkbox"/>
r_spine			0.288	$\mu\text{m}$	<input checked="" type="checkbox"/>

## 7.27 Reaction CGB\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** CGB\_deg

### Reaction equation



### Reactant

Table 84: Properties of each reactant.

Id	Name	SBO
CGB_D_Cytosol		

## Modifier

Table 85: Properties of each modifier.

Id	Name	SBO
CGB_Cytosol		

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{27} = & \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [CGB\_D\_Cytosol] \right. \\
 & + ((0.00166112956810631 \cdot [CGB\_Cytosol]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_d^2} \cdot \frac{1}{l_{star}} + D \\
 & \cdot (0.00166112956810631 \cdot [CGB\_D\_Cytosol] + (CGB\_F)) \cdot \frac{1}{l_{star}} \cdot \frac{1}{l_c} \Big) \\
 & \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned} \tag{57}$$

Table 86: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			15.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_n			0.100	$\mu\text{m}$	✓
l_n			0.660	$\mu\text{m}$	✓
r_d			1.000	$\mu\text{m}$	✓
l_star			27.981	$\mu\text{m}$	✓
CGB_F			19.524	0.0010 dimensionless · $\text{m}^{-3} \cdot \text{mol}$	✓
l_c			5.627	$\mu\text{m}$	✓

## 7.28 Reaction PA\_Mg

This is a reversible reaction of two reactants forming one product.

**Name** PA\_Mg

### Reaction equation



### Reactants

Table 87: Properties of each reactant.

Id	Name	SBO
PA_Cytosol		
Mg_Cytosol		

### Product

Table 88: Properties of each product.

Id	Name	SBO
PABMg_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{28} = (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{PA\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Mg\_Cytosol}] + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{PABMg\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (59)$$

Table 89: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Kf			0.8	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	✓
Kr			25.0	s <sup>-1</sup>	✓

## 7.29 Reaction PA\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** PA\_deg

### Reaction equation



### Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
PA_D_Cytosol		

### Modifier

Table 91: Properties of each modifier.

Id	Name	SBO
PA_Cytosol		

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{29} = \left( D \cdot r_n^2 \cdot (0.00166112956810631 \cdot [\text{PA\_D\_Cytosol}] + ((0.00166112956810631 \cdot [\text{PA\_Cytosol}]))) \cdot \frac{1}{l_n} \cdot \frac{1}{r_d^2} \cdot \frac{1}{l_{\text{star}}} + D \cdot (0.00166112956810631 \cdot [\text{PA\_D\_Cytosol}] + (\text{PA\_F})) \cdot \frac{1}{l_{\text{star}}} \cdot \frac{1}{l_c} \right) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (61)$$

Table 92: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			43.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓

Id	Name	SBO	Value	Unit	Constant
r_n			0.100	μm	✓
l_n			0.660	μm	✓
r_d			1.000	μm	✓
l_star			27.981	μm	✓
PA_F			3.203	0.0010 dimensionless · m <sup>-3</sup> · mol	✓
lc			5.627	μm	✓

### 7.30 Reaction IP3\_degr

This is a reversible reaction of one reactant forming no product.

**Name** IP3\_degr

#### Reaction equation



#### Reactant

Table 93: Properties of each reactant.

Id	Name	SBO
IP3_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{30} = K_{\text{degr}} \cdot (0.00166112956810631 \cdot [\text{IP3\_Cytosol}] + (\text{IP3\_CytosolS})) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (63)$$

Table 94: Properties of each parameter.

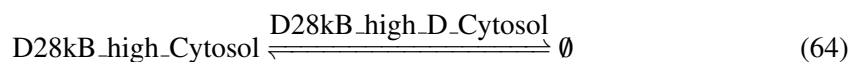
Id	Name	SBO	Value	Unit	Constant
Kdegr			0.14	s <sup>-1</sup>	✓
IP3_CytosolS			0.16	0.0010 dimensionless · m <sup>-3</sup> · mol	✓

### 7.31 Reaction D28kB\_high\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** D28kB\_high\_d

#### Reaction equation



#### Reactant

Table 95: Properties of each reactant.

Id	Name	SBO
D28kB_high_Cytosol		

#### Modifier

Table 96: Properties of each modifier.

Id	Name	SBO
D28kB_high_D_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned} v_{31} = & 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{D28kB\_high\_Cytosol}] \\ & + ((0.00166112956810631 \cdot [\text{D28kB\_high\_D\_Cytosol}]))) \quad (65) \\ & \cdot r_{\text{neck}}^2 \cdot \frac{1}{1} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \end{aligned}$$

Table 97: Properties of each parameter.

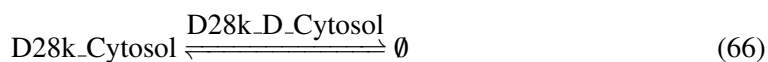
Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_neck			0.100	$\mu\text{m}$	✓
l			0.660	$\mu\text{m}$	✓
r_spine			0.288	$\mu\text{m}$	✓

### 7.32 Reaction D28k\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** D28k\_d

#### Reaction equation



#### Reactant

Table 98: Properties of each reactant.

Id	Name	SBO
	D28k_Cytosol	

#### Modifier

Table 99: Properties of each modifier.

Id	Name	SBO
	D28k_D_Cytosol	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{32} = 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{D28k\_Cytosol}] + ((0.00166112956810631 \cdot [\text{D28k\_D\_Cytosol}]))) \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (67)$$

Table 100: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			28.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	<input checked="" type="checkbox"/>
r_neck			0.100	$\mu\text{m}$	<input checked="" type="checkbox"/>
l			0.660	$\mu\text{m}$	<input checked="" type="checkbox"/>
r_spine			0.288	$\mu\text{m}$	<input checked="" type="checkbox"/>

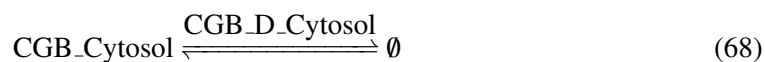


### 7.33 Reaction CGB\_d

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** CGB\_d

#### Reaction equation



#### Reactant

Table 101: Properties of each reactant.

Id	Name	SBO
CGB_Cytosol		

#### Modifier

Table 102: Properties of each modifier.

Id	Name	SBO
CGB_D_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{33} = 0.75 \cdot D \cdot (0.00166112956810631 \cdot [\text{CGB\_Cytosol}] + ((0.00166112956810631 \cdot [\text{CGB\_D\_Cytosol}]))) \cdot r_{\text{neck}}^2 \cdot \frac{1}{l} \cdot \frac{1}{r_{\text{spine}}^3} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (69)$$

Table 103: Properties of each parameter.

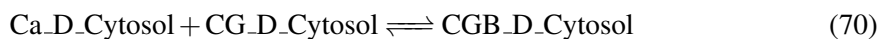
Id	Name	SBO	Value	Unit	Constant
D			15.000	$10^{-12} \text{ dimensionless} \cdot \text{m}^2 \cdot \text{s}^{-1}$	<input checked="" type="checkbox"/>
r_neck			0.100	$\mu\text{m}$	<input checked="" type="checkbox"/>
l			0.660	$\mu\text{m}$	<input checked="" type="checkbox"/>
r_spine			0.288	$\mu\text{m}$	<input checked="" type="checkbox"/>

### 7.34 Reaction CG\_Dbinding

This is a reversible reaction of two reactants forming one product.

**Name** CG\_Dbinding

#### Reaction equation



#### Reactants

Table 104: Properties of each reactant.

Id	Name	SBO
Ca_D_Cytosol		
CG_D_Cytosol		

#### Product

Table 105: Properties of each product.

Id	Name	SBO
CGB_D_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{34} = (\text{Kf} \cdot 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{CG\_D\_Cytosol}] + ((\text{Kr} \cdot 0.00166112956810631 \cdot [\text{CGB\_D\_Cytosol}]))) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (71)$$

Table 106: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Kf			430.0	1000 dimensionless · m <sup>3</sup> · mol <sup>-1</sup> · s <sup>-1</sup>	✓
Kr			140.0	s <sup>-1</sup>	✓

### 7.35 Reaction IP3\_degr1

This is a reversible reaction of one reactant forming no product.

**Name** IP3\_degr1

#### Reaction equation



#### Reactant

Table 107: Properties of each reactant.

Id	Name	SBO
IP3_D_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{35} = K_{\text{degr}} \cdot (0.00166112956810631 \cdot [\text{IP3\_D\_Cytosol}] + (\text{IP3\_CytosolD})) \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (73)$$

Table 108: Properties of each parameter.

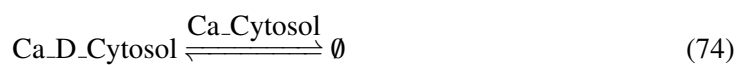
Id	Name	SBO	Value	Unit	Constant
Kdegr			0.14	s <sup>-1</sup>	✓
IP3_CytosolD			0.16	0.0010 dimensionless · m <sup>-3</sup> · mol	✓

### 7.36 Reaction Ca\_deg

This is a reversible reaction of one reactant forming no product influenced by one modifier.

**Name** Ca\_deg

#### Reaction equation



## Reactant

Table 109: Properties of each reactant.

Id	Name	SBO
Ca_D_Cytosol		

## Modifier

Table 110: Properties of each modifier.

Id	Name	SBO
Ca_Cytosol		

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{36} = & \left( D \cdot r_n^2 \right. \\
 & \cdot (0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] + ((0.00166112956810631 \cdot [\text{Ca\_Cytosol}]))) \\
 & \cdot \frac{1}{l_n} \cdot \frac{1}{r_D^2} \cdot \frac{1}{l_{\text{star}}} + D \cdot (0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] + (\text{Ca\_F})) \cdot \frac{1}{l_{\text{star}}} \cdot \frac{1}{lc} \Big) \\
 & \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned}
 \tag{75}$$

Table 111: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
D			223.000	$10^{-12}$ dimensionless · $\text{m}^2 \cdot \text{s}^{-1}$	✓
r_n			0.100	$\mu\text{m}$	✓
l_n			0.660	$\mu\text{m}$	✓
r_D			1.000	$\mu\text{m}$	✓
l_star			27.981	$\mu\text{m}$	✓
Ca_F			0.045	0.0010 dimensionless · $\text{m}^{-3} \cdot \text{mol}$	✓
lc			5.627	$\mu\text{m}$	✓

### 7.37 Reaction pulses

This is a reversible reaction of no reactant forming one product.

**Name** pulses

#### Reaction equation



#### Product

Table 112: Properties of each product.

Id	Name	SBO
IP3_Cytosol		

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{37} = \text{SVR} \cdot \text{Js} \cdot \text{pulses\_ar} \cdot \frac{1}{\text{Rs}} \cdot \text{vol}(\text{Cytosol}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (77)$$

Table 113: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
SVR			3.000	$\mu\text{m}^{-1}$	<input checked="" type="checkbox"/>
Js			0.000	$10^{-9} \text{ dimensionless} \cdot \text{m}^{-2} \cdot \text{mol} \cdot \text{s}^{-1}$	<input checked="" type="checkbox"/>
Rs			0.288	dimensionless	<input checked="" type="checkbox"/>

### 7.38 Reaction ER\_leak\_flux

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

**Name** ER\_leak\_flux

#### Reaction equation



## Reactant

Table 114: Properties of each reactant.

Id	Name	SBO
Ca_Cytosol		

## Modifier

Table 115: Properties of each modifier.

Id	Name	SBO
ERDensity_ERM		

## Product

Table 116: Properties of each product.

Id	Name	SBO
Ca_ER		

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{38} = & \left( [\text{ERDensity\_ERM}] \cdot vL \cdot \left( 1 \right. \right. \\
 & + \left( \left( 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] \cdot \frac{1}{0.00166112956810631 \cdot [\text{Ca\_ER}]} \right) \right) \right) \\
 & \cdot \text{area}(\text{ERM}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned}
 \tag{79}$$

Table 117: Properties of each parameter.

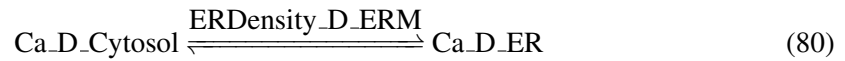
Id	Name	SBO	Value	Unit	Constant
I			0.000	dimensionless · A · m <sup>-2</sup>	✓
vL			0.124	10 <sup>-21</sup> dimensionless · item <sup>-1</sup> · mol · s <sup>-1</sup>	✓

### 7.39 Reaction `SERCA_fluxD`

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

**Name** `SERCA_fluxD`

#### Reaction equation



#### Reactant

Table 118: Properties of each reactant.

Id	Name	SBO
Ca_D_Cytosol		

#### Modifier

Table 119: Properties of each modifier.

Id	Name	SBO
ERDensity_D_ERM		

#### Product

Table 120: Properties of each product.

Id	Name	SBO
Ca_D_ER		

#### Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned} v_{39} = & [\text{ERDensity\_D\_ERM}] \cdot vP \cdot 0.00166112956810631 \\ & \cdot [\text{Ca\_D\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] \\ & \cdot \frac{1}{\text{kP} \cdot \text{kP} + 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}]} \\ & \cdot \text{area}(\text{ERM}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \end{aligned} \quad (81)$$

Table 121: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
I			0.00	dimensionless · A · m <sup>-2</sup>	✓
vP			3.75	10 <sup>-21</sup> dimensionless · item <sup>-1</sup> · mol · s <sup>-1</sup>	✓
kP			0.27		✓

#### 7.40 Reaction IP3R\_fluxD

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

**Name** IP3R\_fluxD

#### Reaction equation



#### Reactant

Table 122: Properties of each reactant.

Id	Name	SBO
	Ca_D_Cytosol	

#### Modifiers

Table 123: Properties of each modifier.

Id	Name	SBO
	IP3_D_Cytosol	
	ERDensity_D_ERM	
	h_D_ERM	

#### Product

Table 124: Properties of each product.

Id	Name	SBO
	Ca_D_ER	



## Kinetic Law

**Derived unit** contains undeclared units

$$v_{40} = \left( [\text{ERDensity\_D\_ERM}] \cdot \text{Jmax2} \cdot \left( 1 + \left( \left( 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] \cdot \frac{1}{0.00166112956810631 \cdot [\text{Ca\_D\_ER}]} \right) \right) \cdot \left( [\text{h\_D\_ERM}] \cdot 0.00166112956810631 \cdot [\text{IP3\_D\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] \cdot \frac{1}{0.00166112956810631 \cdot [\text{IP3\_D\_Cytosol}] + \text{dI}} \cdot \frac{1}{0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] + \text{Kact}} \right)^3 \right) \cdot \text{area(ERM)} \cdot 1 \cdot \frac{1}{\text{KMOLE}} \right) \quad (83)$$

Table 125: Properties of each parameter.

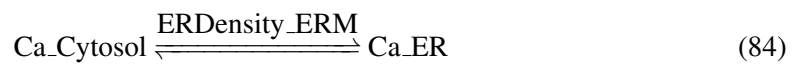
Id	Name	SBO	Value	Unit	Constant
I			0.0	dimensionless · A · m <sup>-2</sup>	✓
Jmax2			21000.0	10 <sup>-57</sup> dimensionless · item <sup>-4</sup> · m <sup>6</sup> · mol · s <sup>-1</sup>	✓
dI			20.0	0.0010 dimensionless · m <sup>-3</sup> · mol	✓
Kact			0.3	0.0010 dimensionless · m <sup>-3</sup> · mol	✓

## 7.41 Reaction SERCA\_flux

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

**Name** SERCA\_flux

### Reaction equation



### Reactant

Table 126: Properties of each reactant.

Id	Name	SBO
Ca_Cytosol		

## Modifier

Table 127: Properties of each modifier.

Id	Name	SBO
ERDensity_ERM		

## Product

Table 128: Properties of each product.

Id	Name	SBO
Ca_ER		

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{41} = & [\text{ERDensity\_ERM}] \cdot vP \cdot 0.00166112956810631 \\
 & \cdot [\text{Ca\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] \\
 & \cdot \frac{1}{kP \cdot kP + 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] \cdot 0.00166112956810631 \cdot [\text{Ca\_Cytosol}]} \\
 & \cdot \text{area(ERM)} \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned}
 \tag{85}$$

Table 129: Properties of each parameter.

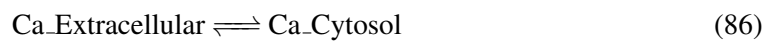
Id	Name	SBO	Value	Unit	Constant
I			0.00	dimensionless · A · m <sup>-2</sup>	✓
vP			3.75	10 <sup>-21</sup> dimensionless · item <sup>-1</sup> · mol · s <sup>-1</sup>	✓
kP			0.27		✓

## 7.42 Reaction `flux0`

This is a reversible reaction of one reactant forming one product.

**Name** `flux0`

### Reaction equation



### Reactant

Table 130: Properties of each reactant.

Id	Name	SBO
	Ca_Extracellular	

### Product

Table 131: Properties of each product.

Id	Name	SBO
	Ca_Cytosol	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{42} = \text{flux0\_ar} \cdot \text{area (PM)} \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (87)$$

Table 132: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
I			0.0	dimensionless · A · m <sup>-2</sup>	<input checked="" type="checkbox"/>

## 7.43 Reaction `IP3R_flux`

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

**Name** `IP3R_flux`

## Reaction equation



## Reactant

Table 133: Properties of each reactant.

Id	Name	SBO
Ca_Cytosol		

## Modifiers

Table 134: Properties of each modifier.

Id	Name	SBO
IP3_Cytosol		
h_ERM		
ERDensity_ERM		

## Product

Table 135: Properties of each product.

Id	Name	SBO
Ca_ER		

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
v_{43} = & \left( [\text{ERDensity\_ERM}] \cdot \text{Jmax2} \right. \\
& \cdot \left( 1 + \left( \left( 0.00166112956810631 \cdot [\text{Ca\_Cytosol}] \cdot \frac{1}{0.00166112956810631 \cdot [\text{Ca\_ER}]} \right) \right) \right) \\
& \cdot \left( [\text{h\_ERM}] \cdot 0.00166112956810631 \cdot [\text{IP3\_Cytosol}] \cdot 0.00166112956810631 \right. \\
& \quad \cdot [\text{Ca\_Cytosol}] \cdot \frac{1}{0.00166112956810631 \cdot [\text{IP3\_Cytosol}] + \text{dI}} \\
& \quad \cdot \left. \left. \frac{1}{0.00166112956810631 \cdot [\text{Ca\_Cytosol}] + \text{Kact}} \right)^3 \right) \cdot \text{area(ERM)} \cdot 1 \cdot \frac{1}{\text{KMOLE}} \\
& \quad (89)
\end{aligned}$$

Table 136: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
I			0.0	dimensionless · A · m <sup>-2</sup>	✓
Jmax2			21000.0	10 <sup>-57</sup> dimensionless · item <sup>-4</sup> · m <sup>6</sup> · mol · s <sup>-1</sup>	✓
dI			20.0	0.0010 dimensionless · m <sup>-3</sup> · mol	✓
Kact			0.3	0.0010 dimensionless · m <sup>-3</sup> · mol	✓

#### 7.44 Reaction flux1

This is a reversible reaction of one reactant forming one product.

**Name** flux1

#### Reaction equation



#### Reactant

Table 137: Properties of each reactant.

Id	Name	SBO
	Ca_D_Extracellular	

## Product

Table 138: Properties of each product.

Id	Name	SBO
	Ca_D_Cytosol	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{44} = \text{flux1\_ar} \cdot \text{area}(\text{PM}) \cdot 1 \cdot \frac{1}{\text{KMOLE}} \quad (91)$$

Table 139: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
I			0.0	dimensionless · A · m <sup>-2</sup>	<input checked="" type="checkbox"/>

### 7.45 Reaction ER\_leak\_fluxD

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

**Name** ER\_leak\_fluxD

## Reaction equation



## Reactant

Table 140: Properties of each reactant.

Id	Name	SBO
	Ca_D_Cytosol	

## Modifier

Table 141: Properties of each modifier.

Id	Name	SBO
	ERDensity_D_ERM	

## Product

Table 142: Properties of each product.

Id	Name	SBO
	Ca_D_ER	

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{45} &= \left( [\text{ERDensity\_D\_ERM}] \cdot vL \cdot \left( 1 \right. \right. \\
 &\quad \left. \left. + \left( \left( 0.00166112956810631 \cdot [\text{Ca\_D\_Cytosol}] \cdot \frac{1}{0.00166112956810631 \cdot [\text{Ca\_D\_ER}]} \right) \right) \right) \right) \\
 &\quad \cdot \text{area}(\text{ERM}) \cdot 1 \cdot \frac{1}{\text{KMOLE}}
 \end{aligned}
 \tag{93}$$

Table 143: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
I			0.000	dimensionless · A · m <sup>-2</sup>	✓
vL			0.124	10 <sup>-21</sup> dimensionless · item <sup>-1</sup> · mol · s <sup>-1</sup>	✓

## 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 `ERDensity_ERM`

**Initial concentration**  $1 \text{ item} \cdot \mu\text{m}^{-2}$

This species takes part in three reactions (as a modifier in `ER_leak_flux`, `SERCA_flux`, `IP3R_flux`), which do not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt} \text{ERDensity\_ERM} = 0 \quad (94)$$

### 8.2 Species `PA_D_Cytosol`

**Initial concentration**  $1928.19396 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in four reactions (as a reactant in `PA_Dbinding`, `PA_MgD`, `PA_deg` and as a modifier in `PA_d`).

$$\frac{d}{dt} \text{PA\_D\_Cytosol} = -v_2 - v_7 - v_{29} \quad (95)$$

### 8.3 Species `PABCa_D_Cytosol`

**Initial concentration**  $9827.53562 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in three reactions (as a reactant in `PABCa_deg` and as a product in `PA_Dbinding` and as a modifier in `PABCa_d`).

$$\frac{d}{dt} \text{PABCa\_D\_Cytosol} = v_2 - v_{18} \quad (96)$$

### 8.4 Species `Ca_D_ER`

**Initial concentration**  $240800 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in three reactions (as a product in `SERCA_fluxD`, `IP3R_fluxD`, `ER_leak_fluxD`), which do not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt} \text{Ca\_D\_ER} = 0 \quad (97)$$



### 8.5 Species `h_D_ERM`

**Initial concentration**  $0.8 \text{ item} \cdot \mu\text{m}^{-2}$

This species takes part in two reactions (as a reactant in `reaction1` and as a modifier in `IP3R_fluxD`).

$$\frac{d}{dt}h\_D\_ERM = -v_{15} \quad (98)$$

### 8.6 Species `PABMg_D_Cytosol`

**Initial concentration**  $36404.27644 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in three reactions (as a reactant in `PABMg_deg` and as a product in `PA_MgD` and as a modifier in `PABMg_d`).

$$\frac{d}{dt}PABMg\_D\_Cytosol = v_7 - v_9 \quad (99)$$

### 8.7 Species `ERDensity_D_ERM`

**Initial concentration**  $1 \text{ item} \cdot \mu\text{m}^{-2}$

This species takes part in three reactions (as a modifier in `SERCA_fluxD`, `IP3R_fluxD`, `ER_leak_fluxD`), which do not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt}ERDensity\_D\_ERM = 0 \quad (100)$$

### 8.8 Species `CG_D_Cytosol`

**Initial concentration**  $84566.35334 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in three reactions (as a reactant in `CG_deg`, `CG_Dbinding` and as a modifier in `CG_d`).

$$\frac{d}{dt}CG\_D\_Cytosol = -v_3 - v_{34} \quad (101)$$

### 8.9 Species `D28kB_D_Cytosol`

**Initial concentration**  $2510.04502 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in three reactions (as a reactant in `D28kB_deg` and as a product in `D28kBDbinding` and as a modifier in `D28kB_d`).

$$\frac{d}{dt}D28kB\_D\_Cytosol = v_{24} - v_5 \quad (102)$$

### 8.10 Species PA\_Cytosol

**Initial concentration** 1928.19396 item · μm<sup>-3</sup>

This species takes part in four reactions (as a reactant in PA\_Ca, PA\_d, PA\_Mg and as a modifier in PA\_deg).

$$\frac{d}{dt} \text{PA\_Cytosol} = -v_8 - v_{26} - v_{28} \quad (103)$$

### 8.11 Species CG\_Cytosol

**Initial concentration** 84566.35334 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in CG\_d, CGbinding and as a modifier in CG\_deg).

$$\frac{d}{dt} \text{CG\_Cytosol} = -v_{13} - v_{16} \quad (104)$$

### 8.12 Species PABCa\_Cytosol

**Initial concentration** 9827.53562 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in PABCa\_d and as a product in PA\_Ca and as a modifier in PABCa\_deg).

$$\frac{d}{dt} \text{PABCa\_Cytosol} = v_8 - v_{25} \quad (105)$$

### 8.13 Species Mg\_Cytosol

**Initial concentration** 355180 item · μm<sup>-3</sup>

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

$$\frac{d}{dt} \text{Mg\_Cytosol} = 0 \quad (106)$$

### 8.14 Species D28k\_high\_Cytosol

**Initial concentration** 43952.64608 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in D28k\_high\_d, CD28k\_high and as a modifier in D28k\_high\_deg).

$$\frac{d}{dt} \text{D28k\_high\_Cytosol} = -v_{20} - v_{23} \quad (107)$$

### 8.15 Species [D28k\\_high\\_D\\_Cytosol](#)

**Initial concentration** 43952.64608 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [CD28k\\_highDbinding](#), [D28k\\_high\\_deg](#) and as a modifier in [D28k\\_high\\_d](#)).

$$\frac{d}{dt} \text{D28k\_high\_D\_Cytosol} = -v_1 - v_{10} \quad (108)$$

### 8.16 Species [Ca\\_ER](#)

**Initial concentration** 240800 item · μm<sup>-3</sup>

This species takes part in three reactions (as a product in [ER\\_leak\\_flux](#), [SERCA\\_flux](#), [IP3R\\_flux](#)), which do not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt} \text{Ca\_ER} = 0 \quad (109)$$

### 8.17 Species [D28kB\\_high\\_D\\_Cytosol](#)

**Initial concentration** 4207.35392 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [D28kB\\_high\\_deg](#) and as a product in [CD28k\\_highDbinding](#) and as a modifier in [D28kB\\_high\\_d](#)).

$$\frac{d}{dt} \text{D28kB\_high\_D\_Cytosol} = v_1 - v_{12} \quad (110)$$

### 8.18 Species [CGB\\_D\\_Cytosol](#)

**Initial concentration** 11753.6286 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [CGB\\_deg](#) and as a product in [CG\\_Dbinding](#) and as a modifier in [CGB\\_d](#)).

$$\frac{d}{dt} \text{CGB\_D\_Cytosol} = v_{34} - v_{27} \quad (111)$$

### 8.19 Species [Ca\\_D\\_Cytosol](#)

**Initial concentration** 27.09 item · μm<sup>-3</sup>

This species takes part in eleven reactions (as a reactant in [CD28k\\_highDbinding](#), [PA\\_Dbinding](#), [D28kBDbinding](#), [CG\\_Dbinding](#), [Ca\\_deg](#), [SERCA\\_fluxD](#), [IP3R\\_fluxD](#), [ER\\_leak\\_fluxD](#) and as a product in [flux1](#) and as a modifier in [Ca\\_d\\_reaction1](#)).

$$\frac{d}{dt} \text{Ca\_D\_Cytosol} = v_{44} - v_1 - v_2 - v_{24} - v_{34} - v_{36} - v_{39} - v_{40} - v_{45} \quad (112)$$

### 8.20 Species CGB\_Cytosol

**Initial concentration** 11753.6286 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [CGB\\_d](#) and as a product in [CGbinding](#) and as a modifier in [CGB\\_deg](#)).

$$\frac{d}{dt} \text{CGB\_Cytosol} = v_{16} - v_{33} \quad (113)$$

### 8.21 Species D28k\_Cytosol

**Initial concentration** 45649.95498 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [CaD28k\\_med](#), [D28k\\_d](#) and as a modifier in [D28k\\_deg](#)).

$$\frac{d}{dt} \text{D28k\_Cytosol} = -v_{17} - v_{32} \quad (114)$$

### 8.22 Species D28kB\_high\_Cytosol

**Initial concentration** 4207.35392 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [D28kB\\_high\\_d](#) and as a product in [CD28k\\_high](#) and as a modifier in [D28kB\\_high\\_deg](#)).

$$\frac{d}{dt} \text{D28kB\_high\_Cytosol} = v_{23} - v_{31} \quad (115)$$

### 8.23 Species PABMg\_Cytosol

**Initial concentration** 36404.27644 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [PABMg\\_d](#) and as a product in [PA\\_Mg](#) and as a modifier in [PABMg\\_deg](#)).

$$\frac{d}{dt} \text{PABMg\_Cytosol} = v_{28} - v_{22} \quad (116)$$

### 8.24 Species IP3\_Cytosol

**Initial concentration** 96.32 item · μm<sup>-3</sup>

This species takes part in five reactions (as a reactant in [IP3\\_d](#), [IP3\\_degr](#) and as a product in [pulses](#) and as a modifier in [IP3deg](#), [IP3R\\_flux](#)).

$$\frac{d}{dt} \text{IP3\_Cytosol} = v_{37} - v_{19} - v_{30} \quad (117)$$

### 8.25 Species [Ca\\_Extracellular](#)

**Initial concentration** 602000 item · μm<sup>-3</sup>

This species takes part in one reaction (as a reactant in [flux0](#)), which does not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{Ca\_Extracellular} = 0 \quad (118)$$

### 8.26 Species [D28k\\_D\\_Cytosol](#)

**Initial concentration** 45649.95498 item · μm<sup>-3</sup>

This species takes part in three reactions (as a reactant in [D28k\\_deg](#), [D28kBDbinding](#) and as a modifier in [D28k\\_d](#)).

$$\frac{d}{dt}\text{D28k\_D\_Cytosol} = -v_6 - v_{24} \quad (119)$$

### 8.27 Species [IP3\\_D\\_Cytosol](#)

**Initial concentration** 96.32 item · μm<sup>-3</sup>

This species takes part in four reactions (as a reactant in [IP3deg](#), [IP3\\_degr1](#) and as a modifier in [IP3\\_d](#), [IP3R\\_fluxD](#)).

$$\frac{d}{dt}\text{IP3\_D\_Cytosol} = -v_4 - v_{35} \quad (120)$$

### 8.28 Species [Mg\\_D\\_Cytosol](#)

**Initial concentration** 355180 item · μm<sup>-3</sup>

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

$$\frac{d}{dt}\text{Mg\_D\_Cytosol} = 0 \quad (121)$$

### 8.29 Species [Ca\\_Cytosol](#)

**Initial concentration** 27.09 item · μm<sup>-3</sup>

This species takes part in eleven reactions (as a reactant in [PA\\_Ca](#), [Ca\\_d](#), [CGbinding](#), [CaD28k-med](#), [CD28k\\_high](#), [ER\\_leak\\_flux](#), [SERCA\\_flux](#), [IP3R\\_flux](#) and as a product in [flux0](#) and as a modifier in [reaction0](#), [Ca\\_deg](#)).

$$\frac{d}{dt}\text{Ca\_Cytosol} = v_{42} - v_8 - v_{11} - v_{16} - v_{17} - v_{23} - v_{38} - v_{41} - v_{43} \quad (122)$$

### 8.30 Species `h_ERM`

**Initial concentration**  $0.8 \text{ item} \cdot \mu\text{m}^{-2}$

This species takes part in two reactions (as a reactant in `reaction0` and as a modifier in `IP3R-flux`).

$$\frac{d}{dt} h\_ERM = -v_{21} \quad (123)$$

### 8.31 Species `Ca_D_Extracellular`

**Initial concentration**  $602000 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in one reaction (as a reactant in `flux1`), which does not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt} \text{Ca\_D\_Extracellular} = 0 \quad (124)$$

### 8.32 Species `D28kB_Cytosol`

**Initial concentration**  $2510.04502 \text{ item} \cdot \mu\text{m}^{-3}$

This species takes part in three reactions (as a reactant in `D28kB_d` and as a product in `CaD28k-med` and as a modifier in `D28kB_deg`).

$$\frac{d}{dt} \text{D28kB\_Cytosol} = v_{17} - v_{14} \quad (125)$$

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

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