SBML Model Report

Model name: “Invergo2014 - Phototransduction cascade in mouse rod cells”

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Vijayalakshmi Chelliah[1] and Brandon Invergo[2] at August sixth 2015 at 3:33 p. m. and last time modified at August sixth 2015 at 4:33 p. m. Table 1 provides 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	76
events	0	constraints	0
reactions	96	function definitions	0
global parameters	103	unit definitions	0
rules	37	initial assignments	0

Model Notes

Invergo2014 - Phototransduction cascade inmouse rod cells

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This model is described in the article:A comprehensive model of the phototransduction cascade in mouse rod cells.Invergo BM, Dell'Orco D, Montanucci L, Koch KW, Bertranpetit J.Mol Biosyst 2014 Jun; 10(6): 1481-1489

Abstract:

Vertebrate visual phototransduction is perhaps the most well-studied G-protein signaling pathway. A wealth of available biochemical and electrophysiological data has resulted in a rich history of mathematical modeling of the system. However, while the most comprehensive models have relied upon amphibian biochemical and electrophysiological data, modern research typically employs mammalian species, particularly mice, which exhibit significantly faster signaling dynamics. In this work, we present an adaptation of a previously published, comprehensive model of amphibian phototransduction that can produce quantitatively accurate simulations of the murine photoresponse. We demonstrate the ability of the model to predict responses to a wide range of stimuli and under a variety of mutant conditions. Finally, we employ the model to highlight a likely unknown mechanism related to the interaction between rhodopsin and rhodopsin kinase.

This model is hosted on BioModels Database and identified by: BIOMD0000000578.

To cite BioModels Database, please use: BioModels Database: An enhanced, curated and annotated resource for published quantitative kinetic models.

2 Unit Definitions

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

2.1 Unit `substance`

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

Definition mol

2.2 Unit `volume`

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

Definition l

2.3 Unit `area`

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

Definition m^2

2.4 Unit `length`

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

Definition m

2.5 Unit `time`

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

Definition s

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
`cytosol`	cytosol	0000290	3	0.03916	l	☑	

3.1 Compartment `cytosol`

This is a three dimensional compartment with a constant size of 0.03916 litre.

Name cytosol

SBO:0000290 physical compartment

4 Species

This model contains 76 species. The boundary condition of one of these species is set to `true` so that this species' amount cannot be changed by any reaction. Section 8 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Arr	Arr	cytosol	mol	⊟	⊟
Arr_di	Arr_di	cytosol	mol	⊟	⊟
Arr_tetra	Arr_tetra	cytosol	mol	⊟	⊟
Ca2_buff	Ca2_buff	cytosol	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Ca2_free	Ca2_free	cytosol	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	☑
G_GTP	G_GTP	cytosol	mol	⊟	⊟
Ga_GDP	Ga_GDP	cytosol	mol	⊟	⊟
Ga_GTP	Ga_GTP	cytosol	mol	⊟	⊟
Ga_GTP_PDE_a_Ga_GTP	Ga_GTP_PDE_a_Ga_GTP	cytosol	mol	⊟	⊟
Ga_GTP_a_PDE_a_Ga_GTP	Ga_GTP_a_PDE_a_Ga_GTP	cytosol	mol	⊟	⊟
Gbg	Gbg	cytosol	mol	⊟	⊟
Gt	Gt	cytosol	mol	⊟	⊟
Ops	Ops	cytosol	mol	⊟	⊟
Ops_G	Ops_G	cytosol	mol	⊟	⊟
Ops_G_GTP	Ops_G_GTP	cytosol	mol	⊟	⊟
Ops_Gt	Ops_Gt	cytosol	mol	⊟	⊟
PDE	PDE	cytosol	mol	⊟	⊟
PDE_Ga_GTP	PDE_Ga_GTP	cytosol	mol	⊟	⊟
PDE_a_Ga_GTP	PDE_a_Ga_GTP	cytosol	mol	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
R	R	cytosol	mol	⊟	⊟
R0	R0	cytosol	mol	⊟	⊟
R0_G	R0_G	cytosol	mol	⊟	⊟
R0_G_GTP	R0_G_GTP	cytosol	mol	⊟	⊟
R0_Gt	R0_Gt	cytosol	mol	⊟	⊟
R0_RKpre	R0_RKpre	cytosol	mol	⊟	⊟
R1	R1	cytosol	mol	⊟	⊟
R1_Arr	R1_Arr	cytosol	mol	⊟	⊟
R1_G	R1_G	cytosol	mol	⊟	⊟
R1_G_GTP	R1_G_GTP	cytosol	mol	⊟	⊟
R1_Gt	R1_Gt	cytosol	mol	⊟	⊟
R1_RKpost	R1_RKpost	cytosol	mol	⊟	⊟
R1_RKpre	R1_RKpre	cytosol	mol	⊟	⊟
R2	R2	cytosol	mol	⊟	⊟
R2_Arr	R2_Arr	cytosol	mol	⊟	⊟
R2_G	R2_G	cytosol	mol	⊟	⊟
R2_G_GTP	R2_G_GTP	cytosol	mol	⊟	⊟
R2_Gt	R2_Gt	cytosol	mol	⊟	⊟
R2_RKpost	R2_RKpost	cytosol	mol	⊟	⊟
R2_RKpre	R2_RKpre	cytosol	mol	⊟	⊟
R3	R3	cytosol	mol	⊟	⊟
R3_Arr	R3_Arr	cytosol	mol	⊟	⊟
R3_G	R3_G	cytosol	mol	⊟	⊟
R3_G_GTP	R3_G_GTP	cytosol	mol	⊟	⊟
R3_Gt	R3_Gt	cytosol	mol	⊟	⊟
R3_RKpost	R3_RKpost	cytosol	mol	⊟	⊟
R3_RKpre	R3_RKpre	cytosol	mol	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
R4	R4	cytosol	mol	⊟	⊟
R4_Arr	R4_Arr	cytosol	mol	⊟	⊟
R4_G	R4_G	cytosol	mol	⊟	⊟
R4_G_GTP	R4_G_GTP	cytosol	mol	⊟	⊟
R4_Gt	R4_Gt	cytosol	mol	⊟	⊟
R4_RKpost	R4_RKpost	cytosol	mol	⊟	⊟
R4_RKpre	R4_RKpre	cytosol	mol	⊟	⊟
R5	R5	cytosol	mol	⊟	⊟
R5_Arr	R5_Arr	cytosol	mol	⊟	⊟
R5_G	R5_G	cytosol	mol	⊟	⊟
R5_G_GTP	R5_G_GTP	cytosol	mol	⊟	⊟
R5_Gt	R5_Gt	cytosol	mol	⊟	⊟
R5_RKpost	R5_RKpost	cytosol	mol	⊟	⊟
R5_RKpre	R5_RKpre	cytosol	mol	⊟	⊟
R6	R6	cytosol	mol	⊟	⊟
R6_Arr	R6_Arr	cytosol	mol	⊟	⊟
R6_G	R6_G	cytosol	mol	⊟	⊟
R6_G_GTP	R6_G_GTP	cytosol	mol	⊟	⊟
R6_Gt	R6_Gt	cytosol	mol	⊟	⊟
R6_RKpost	R6_RKpost	cytosol	mol	⊟	⊟
R6_RKpre	R6_RKpre	cytosol	mol	⊟	⊟
RGS	RGS	cytosol	mol	⊟	⊟
RGS_Ga_GTP_a_PDE_a_Ga_GTP	RGS_Ga_GTP_a_PDE_a_Ga_GTP	cytosol	mol	⊟	⊟
RGS_PDE_a_Ga_GTP	RGS_PDE_a_Ga_GTP	cytosol	mol	⊟	⊟
RK	RK	cytosol	mol	⊟	⊟
R_Gt	R_Gt	cytosol	mol	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
RecR_Ca	RecR_Ca	cytosol	mol	⊟	⊟
RecR_Ca_RK	RecR_Ca_RK	cytosol	mol	⊟	⊟
RecT	RecT	cytosol	mol	⊟	⊟
cGMP	cGMP	cytosol	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Parameters

This model contains 103 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Rtot	Rtot		10^{8}		☑
PDEtot	PDEtot		2000000.000		☑
Gtot	Gtot		10^{7}		☑
RGStot	RGStot		100000.000		☑
ArrTot	ArrTot		7074600.000		☑
flashBG	flashBG		0.000		☑
flash0Dur	flash0Dur		0.001		☑
flash0Mag	flash0Mag		0.000		☑
flashDel	flashDel		0.000		☑
flashDur	flashDur		0.001		☑
flashMag	flashMag		0.000		☑
otherstimulus	otherstimulus		0.000		☑
kRK1_0	kRK1_0		0.172		☑
omega	omega		2.500		☑
kRK2	kRK2		250.000		☑
kRK3_ATP	kRK3_ATP		4000.000		☑
kRK4	kRK4		250.000		☑
kArr	kArr		$9.9147 \cdot 10^{-6}$		☑
kA2	kA2		0.026		☑
m_Arr	m_Arr		$9.5475 \cdot 10^{-6}$		☑
kA3	kA3		1.165		☑
kA4	kA4		$2.9965 \cdot 10^{-7}$		☑
kA5	kA5		0.424		☑
kOps	kOps		$6.1172 \cdot 10^{-13}$		☑
kRrecyc	kRrecyc		$7 \cdot 10^{-4}$		☑
omega_G	omega_G		0.600		☑
kG1_0	kG1_0		0.001		☑
kG2	kG2		2200.000		☑
kG3	kG3		8500.000		☑
kG4_GDP	kG4_GDP		400.000		☑
kG5_GTP	kG5_GTP		3500.000		☑
kG6	kG6		8500.000		☑
kG7	kG7		200.000		☑
kGrecyc	kGrecyc		2.000		☑
kGshutoff	kGshutoff		0.050		☑
kP1	kP1		0.055		☑
kP1_rev	kP1_rev		0.000		☑

Id	Name	SBO	Value	Unit	Constant
kP2	kP2		940.700		☑
kP3	kP3		$1.4983 \cdot 10^{-9}$		☑
kP4	kP4		21.088		☑
kPDEshutoff	kPDEshutoff		0.100		☑
kRGS1	kRGS1		$4.8182 \cdot 10^{-5}$		☑
kRGS2	kRGS2		98.000		☑
kRec1	kRec1		0.011		☑
kRec2	kRec2		0.050		☑
kRec3	kRec3		$4.1081 \cdot 10^{-4}$		☑
kRec4	kRec4		0.610		☑
Vcyto	Vcyto		0.039		☑
Kc1	Kc1		0.171		☑
Kc2	Kc2		0.059		☑
m1	m1		3.000		☑
m2	m2		1.500		☑
alfamax	alfamax		60.000		☑
betadark	betadark		3.190		☑
betasub	betasub		0.002		☑
fCa	fCa		0.120		☑
Jdark	Jdark		14.870		☑
F	F		96485.340		☑
cGMPdark	cGMPdark		6.494		☑
ncg	ncg		3.800		☑
gammaCa	gammaCa		981.356		☑
Ca2dark	Ca2dark		0.250		☑
Ca2_0	Ca2_0		0.023		☑
k1	k1		9.371		☑
k2	k2		46.412		☑
eT	eT		400.000		☑
ktherm	ktherm		0.024		☑
background	background		0.000		⊟
premag	premag		0.000		⊟
mag	mag		0.000		⊟
predur	predur		0.000		⊟
dur	dur		0.000		⊟
del	del		0.000		⊟
preflash	preflash		0.000		⊟
testflash	testflash		0.000		⊟
stimulus	stimulus		0.000		⊟
numConcFactor	numConcFactor		0.000		⊟
kRK1_1	kRK1_1		0.000		⊟
kRK1_2	kRK1_2		0.000		⊟

Id	Name	SBO	Value	Unit	Constant
kRK1_3	kRK1_3		0.000		⊟
kRK1_4	kRK1_4		0.000		⊟
kRK1_5	kRK1_5		0.000		⊟
kRK1_6	kRK1_6		0.000		⊟
kA1_1	kA1_1		0.000		⊟
kA1_2	kA1_2		0.000		⊟
kA1_3	kA1_3		0.000		⊟
kA1_4	kA1_4		0.000		⊟
kA1_5	kA1_5		0.000		⊟
kA1_6	kA1_6		0.000		⊟
kGpre1	kGpre1		0.000		⊟
kGpre2	kGpre2		0.000		⊟
kG1ops	kG1ops		0.000		⊟
kG2ops	kG2ops		0.000		⊟
kG1_1	kG1_1		0.000		⊟
kG1_2	kG1_2		0.000		⊟
kG1_3	kG1_3		0.000		⊟
kG1_4	kG1_4		0.000		⊟
kG1_5	kG1_5		0.000		⊟
kG1_6	kG1_6		0.000		⊟
E	E		0.000		⊟
Ca2_frac	Ca2_frac		0.000		⊟
J	J		0.000		⊟
deltaJ	deltaJ		0.000		⊟

6 Rules

This is an overview of 37 rules.

6.1 Rule background

Rule background is an assignment rule for parameter background:

$$\text{background} = \text{flashBG} \tag{1}$$

6.2 Rule premag

Rule premag is an assignment rule for parameter premag:

$$\text{premag} = \frac{\text{flash0Mag}}{\text{flash0Dur}} \tag{2}$$

6.3 Rule `mag`

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

$$\text{mag} = \frac{\text{flashMag}}{\text{flashDur}} \tag{3}$$

6.4 Rule `predur`

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

$$\text{predur} = \text{flash0Dur} \tag{4}$$

6.5 Rule `dur`

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

$$\text{dur} = \text{flashDur} \tag{5}$$

6.6 Rule `del`

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

$$\text{del} = \text{flashDel} \tag{6}$$

6.7 Rule `preflash`

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

$$\text{preflash} = \begin{cases} \text{premag} & \text{if time} \leq \text{predur} \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

6.8 Rule `testflash`

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

$$\text{testflash} = \begin{cases} \text{mag} & \text{if } (\text{time} \geq \text{del}) \wedge (\text{time} \leq \text{del} + \text{dur}) \\ 0 & \text{otherwise} \end{cases} \tag{8}$$

6.9 Rule `stimulus`

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

$$\text{stimulus} = \text{background} + \text{preflash} + \text{testflash} + \text{otherstimulus} \tag{9}$$

6.10 Rule `numConcFactor`

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

$$\text{numConcFactor} = \frac{1}{602200.0 \cdot \text{Vcyto}} \tag{10}$$

6.11 Rule kRK1_1

Rule kRK1_1 is an assignment rule for parameter kRK1_1:

$$\mathrm{kRK1\_1} = \mathrm{kRK1\_0} \cdot \exp(\mathrm{omega}) \tag{11}$$

6.12 Rule kRK1_2

Rule kRK1_2 is an assignment rule for parameter kRK1_2:

$$\mathrm{kRK1\_2} = \mathrm{kRK1\_0} \cdot \exp(\mathrm{omega} \cdot 2) \tag{12}$$

6.13 Rule kRK1_3

Rule kRK1_3 is an assignment rule for parameter kRK1_3:

$$\mathrm{kRK1\_3} = \mathrm{kRK1\_0} \cdot \exp(\mathrm{omega} \cdot 3) \tag{13}$$

6.14 Rule kRK1_4

Rule kRK1_4 is an assignment rule for parameter kRK1_4:

$$\mathrm{kRK1\_4} = \mathrm{kRK1\_0} \cdot \exp(\mathrm{omega} \cdot 4) \tag{14}$$

6.15 Rule kRK1_5

Rule kRK1_5 is an assignment rule for parameter kRK1_5:

$$\mathrm{kRK1\_5} = \mathrm{kRK1\_0} \cdot \exp(\mathrm{omega} \cdot 5) \tag{15}$$

6.16 Rule kRK1_6

Rule kRK1_6 is an assignment rule for parameter kRK1_6:

$$\mathrm{kRK1\_6} = 0 \tag{16}$$

6.17 Rule kA1_1

Rule kA1_1 is an assignment rule for parameter kA1_1:

$$\mathrm{kA1\_1} = \mathrm{kArr} \tag{17}$$

6.18 Rule kA1_2

Rule kA1_2 is an assignment rule for parameter kA1_2:

$$\mathrm{kA1\_2} = \mathrm{kArr} + 1 \cdot \mathrm{m\_Arr} \tag{18}$$

6.19 Rule kA1_3

Rule kA1_3 is an assignment rule for parameter kA1_3:

$$\text{kA1\_3} = \text{kArr} + 2 \cdot \text{m\_Arr} \tag{19}$$

6.20 Rule kA1_4

Rule kA1_4 is an assignment rule for parameter kA1_4:

$$\text{kA1\_4} = \text{kArr} + 3 \cdot \text{m\_Arr} \tag{20}$$

6.21 Rule kA1_5

Rule kA1_5 is an assignment rule for parameter kA1_5:

$$\text{kA1\_5} = \text{kArr} + 3 \cdot \text{m\_Arr} \tag{21}$$

6.22 Rule kA1_6

Rule kA1_6 is an assignment rule for parameter kA1_6:

$$\text{kA1\_6} = \text{kArr} + 3 \cdot \text{m\_Arr} \tag{22}$$

6.23 Rule kGpre1

Rule kGpre1 is an assignment rule for parameter kGpre1:

$$\text{kGpre1} = \text{kG1\_0} \cdot 1.6 \tag{23}$$

6.24 Rule kGpre2

Rule kGpre2 is an assignment rule for parameter kGpre2:

$$\text{kGpre2} = \text{kG2} \cdot 315 \tag{24}$$

6.25 Rule kG1ops

Rule kG1ops is an assignment rule for parameter kG1ops:

$$\text{kG1ops} = \text{kG1\_0} \cdot 1.9 \tag{25}$$

6.26 Rule kG2ops

Rule kG2ops is an assignment rule for parameter kG2ops:

$$\text{kG2ops} = \text{kG2} \cdot 3 \tag{26}$$

6.27 Rule kG1_1

Rule kG1_1 is an assignment rule for parameter kG1_1:

$$\text{kG1\_1} = \text{kG1\_0} \cdot \exp(\text{omega\_G}) \tag{27}$$

6.28 Rule kG1_2

Rule kG1_2 is an assignment rule for parameter kG1_2:

$$\text{kG1\_2} = \text{kG1\_0} \cdot \exp(\text{omega\_G} \cdot 2) \tag{28}$$

6.29 Rule kG1_3

Rule kG1_3 is an assignment rule for parameter kG1_3:

$$\text{kG1\_3} = \text{kG1\_0} \cdot \exp(\text{omega\_G} \cdot 3) \tag{29}$$

6.30 Rule kG1_4

Rule kG1_4 is an assignment rule for parameter kG1_4:

$$\text{kG1\_4} = \text{kG1\_0} \cdot \exp(\text{omega\_G} \cdot 4) \tag{30}$$

6.31 Rule kG1_5

Rule kG1_5 is an assignment rule for parameter kG1_5:

$$\text{kG1\_5} = \text{kG1\_0} \cdot \exp(\text{omega\_G} \cdot 5) \tag{31}$$

6.32 Rule kG1_6

Rule kG1_6 is an assignment rule for parameter kG1_6:

$$\text{kG1\_6} = \text{kG1\_0} \cdot \exp(\text{omega\_G} \cdot 6) \tag{32}$$

6.33 Rule E

Rule E is an assignment rule for parameter E:

$$\text{E} = \text{PDE\_a\_Ga\_GTP} + 2 \cdot \text{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} + \text{Ga\_GTP\_PDE\_a\_Ga\_GTP} \tag{33}$$

6.34 Rule Ca2_frac

Rule Ca2_frac is an assignment rule for parameter Ca2_frac:

$$\text{Ca2\_frac} = \frac{[\text{Ca2\_free}] - \text{Ca2\_0}}{\text{Ca2dark} - \text{Ca2\_0}} \tag{34}$$

6.35 Rule J

Rule J is an assignment rule for parameter J:

$$\mathrm{J} = \frac{2}{2 + \mathrm{fCa}} \cdot \left(\frac{[\mathrm{cGMP}]}{\mathrm{cGMPdark}} \right)^{\mathrm{ncg}} \cdot \mathrm{Jdark} + \frac{\mathrm{fCa}}{\mathrm{fCa} + 2} \cdot \mathrm{Ca2\_frac} \cdot \mathrm{Jdark} \tag{35}$$

6.36 Rule deltaJ

Rule deltaJ is an assignment rule for parameter deltaJ:

$$\mathrm{deltaJ} = \mathrm{Jdark} - \mathrm{J} \tag{36}$$

6.37 Rule Ca2_free

Rule Ca2_free is a rate rule for species Ca2_free:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ca2\_free} = \mathrm{v\_r33} - \mathrm{v\_r34} + \mathrm{v\_r35} - 2 \cdot \mathrm{v\_r30} \cdot \mathrm{numConcFactor} \tag{37}$$

7 Reactions

This model contains 96 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	v_r1	v_r1	$R \longrightarrow R0$	
2	v_rstprec	v_rstprec	$R\_Gt \longrightarrow R0\_Gt$	
3	v_r2_0	v_r2_0	$R0 + RK \rightleftharpoons R0\_RKpre$	
4	v_r2_1	v_r2_1	$R1 + RK \rightleftharpoons R1\_RKpre$	
5	v_r2_2	v_r2_2	$R2 + RK \rightleftharpoons R2\_RKpre$	
6	v_r2_3	v_r2_3	$R3 + RK \rightleftharpoons R3\_RKpre$	
7	v_r2_4	v_r2_4	$R4 + RK \rightleftharpoons R4\_RKpre$	
8	v_r2_5	v_r2_5	$R5 + RK \rightleftharpoons R5\_RKpre$	
9	v_r2_6	v_r2_6	$R6 + RK \rightleftharpoons R6\_RKpre$	
10	v_r3_0	v_r3_0	$R0\_RKpre \longrightarrow R1\_RKpost$	
11	v_r3_1	v_r3_1	$R1\_RKpre \longrightarrow R2\_RKpost$	
12	v_r3_2	v_r3_2	$R2\_RKpre \longrightarrow R3\_RKpost$	
13	v_r3_3	v_r3_3	$R3\_RKpre \longrightarrow R4\_RKpost$	
14	v_r3_4	v_r3_4	$R4\_RKpre \longrightarrow R5\_RKpost$	
15	v_r3_5	v_r3_5	$R5\_RKpre \longrightarrow R6\_RKpost$	
16	v_r4_1	v_r4_1	$R1\_RKpost \longrightarrow R1 + RK$	
17	v_r4_2	v_r4_2	$R2\_RKpost \longrightarrow R2 + RK$	
18	v_r4_3	v_r4_3	$R3\_RKpost \longrightarrow R3 + RK$	
19	v_r4_4	v_r4_4	$R4\_RKpost \longrightarrow R4 + RK$	
20	v_r4_5	v_r4_5	$R5\_RKpost \longrightarrow R5 + RK$	
21	v_r4_6	v_r4_6	$R6\_RKpost \longrightarrow R6 + RK$	
22	v_r5_1	v_r5_1	$Arr + R1 \rightleftharpoons R1\_Arr$	
23	v_r5_2	v_r5_2	$Arr + R2 \rightleftharpoons R2\_Arr$	

№	Id	Name	Reaction Equation	SBO
24	v_r5_3	v_r5_3	$\mathrm{Arr} + \mathrm{R3} \rightleftharpoons \mathrm{R3\_Arr}$	
25	v_r5_4	v_r5_4	$\mathrm{Arr} + \mathrm{R4} \rightleftharpoons \mathrm{R4\_Arr}$	
26	v_r5_5	v_r5_5	$\mathrm{Arr} + \mathrm{R5} \rightleftharpoons \mathrm{R5\_Arr}$	
27	v_r5_6	v_r5_6	$\mathrm{Arr} + \mathrm{R6} \rightleftharpoons \mathrm{R6\_Arr}$	
28	v_r6_1	v_r6_1	$\mathrm{R1\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops}$	
29	v_r6_2	v_r6_2	$\mathrm{R2\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops}$	
30	v_r6_3	v_r6_3	$\mathrm{R3\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops}$	
31	v_r6_4	v_r6_4	$\mathrm{R4\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops}$	
32	v_r6_5	v_r6_5	$\mathrm{R5\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops}$	
33	v_r6_6	v_r6_6	$\mathrm{R6\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops}$	
34	v_r7_0	v_r7_0	$\mathrm{R0} \longrightarrow \mathrm{Ops}$	
35	v_r7_1	v_r7_1	$\mathrm{R1} \longrightarrow \mathrm{Ops}$	
36	v_r7_2	v_r7_2	$\mathrm{R2} \longrightarrow \mathrm{Ops}$	
37	v_r7_3	v_r7_3	$\mathrm{R3} \longrightarrow \mathrm{Ops}$	
38	v_r7_4	v_r7_4	$\mathrm{R4} \longrightarrow \mathrm{Ops}$	
39	v_r7_5	v_r7_5	$\mathrm{R5} \longrightarrow \mathrm{Ops}$	
40	v_r7_6	v_r7_6	$\mathrm{R6} \longrightarrow \mathrm{Ops}$	
41	v_r8	v_r8	$\mathrm{Gt} + \mathrm{Ops} \rightleftharpoons \mathrm{Ops\_Gt}$	
42	v_r9	v_r9	$\mathrm{Ops\_Gt} \rightleftharpoons \mathrm{Ops\_G}$	
43	v_r10	v_r10	$\mathrm{Ops\_G} \longrightarrow \mathrm{Ops\_G\_GTP}$	
44	v_r11	v_r11	$\mathrm{Ops\_G\_GTP} \longrightarrow \mathrm{G\_GTP} + \mathrm{Ops}$	
45	v_r12	v_r12	$\mathrm{Ops} \longrightarrow \mathrm{R}$	
46	v_GtRpre	v_GtRpre	$\mathrm{Gt} + \mathrm{R} \rightleftharpoons \mathrm{R\_Gt}$	
47	v_r13_0	v_r13_0	$\mathrm{Gt} + \mathrm{R0} \rightleftharpoons \mathrm{R0\_Gt}$	
48	v_r13_1	v_r13_1	$\mathrm{Gt} + \mathrm{R1} \rightleftharpoons \mathrm{R1\_Gt}$	
49	v_r13_2	v_r13_2	$\mathrm{Gt} + \mathrm{R2} \rightleftharpoons \mathrm{R2\_Gt}$	
50	v_r13_3	v_r13_3	$\mathrm{Gt} + \mathrm{R3} \rightleftharpoons \mathrm{R3\_Gt}$	
51	v_r13_4	v_r13_4	$\mathrm{Gt} + \mathrm{R4} \rightleftharpoons \mathrm{R4\_Gt}$	
52	v_r13_5	v_r13_5	$\mathrm{Gt} + \mathrm{R5} \rightleftharpoons \mathrm{R5\_Gt}$	

№	Id	Name	Reaction Equation	SBO
53	v_r13_6	v_r13_6	$Gt + R6 \rightleftharpoons R6\_Gt$	
54	v_r14_0	v_r14_0	$R0\_Gt \rightleftharpoons R0\_G$	
55	v_r14_1	v_r14_1	$R1\_Gt \rightleftharpoons R1\_G$	
56	v_r14_2	v_r14_2	$R2\_Gt \rightleftharpoons R2\_G$	
57	v_r14_3	v_r14_3	$R3\_Gt \rightleftharpoons R3\_G$	
58	v_r14_4	v_r14_4	$R4\_Gt \rightleftharpoons R4\_G$	
59	v_r14_5	v_r14_5	$R5\_Gt \rightleftharpoons R5\_G$	
60	v_r14_6	v_r14_6	$R6\_Gt \rightleftharpoons R6\_G$	
61	v_r15_0	v_r15_0	$R0\_G \longrightarrow R0\_G\_GTP$	
62	v_r15_1	v_r15_1	$R1\_G \longrightarrow R1\_G\_GTP$	
63	v_r15_2	v_r15_2	$R2\_G \longrightarrow R2\_G\_GTP$	
64	v_r15_3	v_r15_3	$R3\_G \longrightarrow R3\_G\_GTP$	
65	v_r15_4	v_r15_4	$R4\_G \longrightarrow R4\_G\_GTP$	
66	v_r15_5	v_r15_5	$R5\_G \longrightarrow R5\_G\_GTP$	
67	v_r15_6	v_r15_6	$R6\_G \longrightarrow R6\_G\_GTP$	
68	v_r16_0	v_r16_0	$R0\_G\_GTP \longrightarrow G\_GTP + R0$	
69	v_r16_1	v_r16_1	$R1\_G\_GTP \longrightarrow G\_GTP + R1$	
70	v_r16_2	v_r16_2	$R2\_G\_GTP \longrightarrow G\_GTP + R2$	
71	v_r16_3	v_r16_3	$R3\_G\_GTP \longrightarrow G\_GTP + R3$	
72	v_r16_4	v_r16_4	$R4\_G\_GTP \longrightarrow G\_GTP + R4$	
73	v_r16_5	v_r16_5	$R5\_G\_GTP \longrightarrow G\_GTP + R5$	
74	v_r16_6	v_r16_6	$R6\_G\_GTP \longrightarrow G\_GTP + R6$	
75	v_r17	v_r17	$G\_GTP \longrightarrow Ga\_GTP + Gbg$	
76	v_r18	v_r18	$Ga\_GTP + PDE \rightleftharpoons PDE\_Ga\_GTP$	
77	v_r19	v_r19	$PDE\_Ga\_GTP \longrightarrow PDE\_a\_Ga\_GTP$	
78	v_r20	v_r20	$Ga\_GTP + PDE\_a\_Ga\_GTP \longrightarrow Ga\_GTP\_PDE\_a\_Ga\_GTP$	
79	v_r21	v_r21	$Ga\_GTP\_PDE\_a\_Ga\_GTP \longrightarrow Ga\_GTP\_a\_PDE\_a\_Ga\_GTP$	
80	v_r22	v_r22	$Ga\_GTP\_a\_PDE\_a\_Ga\_GTP + RGS \longrightarrow RGS\_Ga\_GTP\_a\_PDE\_a\_Ga\_GTP$	

№	Id	Name	Reaction Equation	SBO
81	v_r23	v_r23	$\mathrm{RGS\_Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \longrightarrow \mathrm{Ga\_GDP} + \mathrm{PDE\_a\_Ga\_GTP} + \mathrm{RGS}$	
82	v_r24	v_r24	$\mathrm{PDE\_a\_Ga\_GTP} + \mathrm{RGS} \longrightarrow \mathrm{RGS\_PDE\_a\_Ga\_GTP}$	
83	v_r25	v_r25	$\mathrm{RGS\_PDE\_a\_Ga\_GTP} \longrightarrow \mathrm{Ga\_GDP} + \mathrm{PDE} + \mathrm{RGS}$	
84	v_r26	v_r26	$\mathrm{PDE\_a\_Ga\_GTP} \longrightarrow \mathrm{Ga\_GDP} + \mathrm{PDE}$	
85	v_r27	v_r27	$\mathrm{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \longrightarrow \mathrm{Ga\_GDP} + \mathrm{PDE\_a\_Ga\_GTP}$	
86	v_r28	v_r28	$\mathrm{Ga\_GTP} \longrightarrow \mathrm{Ga\_GDP}$	
87	v_r29	v_r29	$\mathrm{Ga\_GDP} + \mathrm{Gbg} \longrightarrow \mathrm{Gt}$	
88	v_r30	v_r30	$\mathrm{RecT} + \mathrm{Ca2\_free} \rightleftharpoons \mathrm{RecR\_Ca}$	
89	v_r31	v_r31	$\mathrm{RK} + \mathrm{RecR\_Ca} \rightleftharpoons \mathrm{RecR\_Ca\_RK}$	
90	v_r_diarr	v_r_diarr	$2\,\mathrm{Arr} \rightleftharpoons \mathrm{Arr\_di}$	
91	v_r_tetraarr	v_r_tetraarr	$2\,\mathrm{Arr\_di} \rightleftharpoons \mathrm{Arr\_tetra}$	
92	v_r33	v_r33	$\mathrm{Ca2\_free} \rightleftharpoons \mathrm{Ca2\_buff}$	
93	v_r34	v_r34	$\mathrm{Ca2\_free} \longrightarrow \emptyset$	
94	v_r35	v_r35	$\emptyset \xrightarrow{\mathrm{cGMP}} \mathrm{Ca2\_free}$	
95	v_r36	v_r36	$\emptyset \xrightarrow{\mathrm{Ca2\_free}} \mathrm{cGMP}$	
96	v_r37	v_r37	$\mathrm{cGMP} \xrightarrow{\mathrm{Ga\_GTP\_PDE\_a\_Ga\_GTP,\ Ga\_GTP\_a\_PDE\_a\_Ga\_GTP,\ PDE\_a\_Ga\_GTP}} \emptyset$	

7.1 Reaction v_r1

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

Name v_r1

Notes Photoactivation of unphosphorylated R

Reaction equation

$$\mathrm{R} \longrightarrow \mathrm{R0} \tag{38}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
R	R	

Product

Table 7: Properties of each product.

Id	Name	SBO
R0	R0	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \frac{\text{stimulus} \cdot \mathrm{R}}{\mathrm{Rtot}} \tag{39}$$

7.2 Reaction v_rstprec

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

Name v_rstprec

Notes Photoactivation of pre-coupled R-Gt

Reaction equation

$$\mathrm{R\_Gt} \longrightarrow \mathrm{R0\_Gt} \tag{40}$$

Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
R_Gt	R_Gt	

Product

Table 9: Properties of each product.

Id	Name	SBO
R0_Gt	R0_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \frac{\text{stimulus} \cdot \text{R\_Gt}}{\text{Rtot}} \tag{41}$$

7.3 Reaction v_r2_0

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

Name v_r2_0

Notes Binding of R0 and RK. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\text{R0} + \text{RK} \rightleftharpoons \text{R0\_RKpre} \tag{42}$$

Reactants

Table 10: Properties of each reactant.

Id	Name	SBO
R0	R0	
RK	RK	

Product

Table 11: Properties of each product.

Id	Name	SBO
R0_RKpre	R0_RKpre	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{kRK1\_0} \cdot \mathrm{RK} \cdot \mathrm{R0} - \mathrm{kRK2} \cdot \mathrm{R0\_RKpre} \tag{43}$$

7.4 Reaction v_r2_1

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

Name v_r2_1

Notes Binding of R1 and RK. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{R1} + \mathrm{RK} \rightleftharpoons \mathrm{R1\_RKpre} \tag{44}$$

Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
R1	R1	
RK	RK	

Product

Table 13: Properties of each product.

Id	Name	SBO
R1_RKpre	R1_RKpre	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{kRK1\_1} \cdot \text{RK} \cdot \text{R1} - \text{kRK2} \cdot \text{R1\_RKpre} \tag{45}$$

7.5 Reaction v_r2_2

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

Name v_r2_2

Notes Binding of R2 and RK. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\text{R2} + \text{RK} \rightleftharpoons \text{R2\_RKpre} \tag{46}$$

Reactants

Table 14: Properties of each reactant.

Id	Name	SBO
R2	R2	
RK	RK	

Product

Table 15: Properties of each product.

Id	Name	SBO
R2_RKpre	R2_RKpre	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \text{kRK1\_2} \cdot \text{RK} \cdot \text{R2} - \text{kRK2} \cdot \text{R2\_RKpre} \tag{47}$$

7.6 Reaction v_r2_3

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

Name v_r2_3

Notes Binding of R3 and RK. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{R3} + \mathrm{RK} \rightleftharpoons \mathrm{R3\_RKpre} \tag{48}$$

Reactants

Table 16: Properties of each reactant.

Id	Name	SBO
R3	R3	
RK	RK	

Product

Table 17: Properties of each product.

Id	Name	SBO
R3_RKpre	R3_RKpre	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \mathrm{kRK1\_3} \cdot \mathrm{RK} \cdot \mathrm{R3} - \mathrm{kRK2} \cdot \mathrm{R3\_RKpre} \tag{49}$$

7.7 Reaction v_r2_4

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

Name v_r2_4

Notes Binding of R4 and RK. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{R4} + \mathrm{RK} \rightleftharpoons \mathrm{R4\_RKpre} \tag{50}$$

Reactants

Table 18: Properties of each reactant.

Id	Name	SBO
R4	R4	
RK	RK	

Product

Table 19: Properties of each product.

Id	Name	SBO
R4_RKpre	R4_RKpre	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \text{kRK1\_4} \cdot \text{RK} \cdot \text{R4} - \text{kRK2} \cdot \text{R4\_RKpre} \tag{51}$$

7.8 Reaction v_r2_5

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

Name v_r2_5

Notes Binding of R5 and RK. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\text{R5} + \text{RK} \rightleftharpoons \text{R5\_RKpre} \tag{52}$$

Reactants

Table 20: Properties of each reactant.

Id	Name	SBO
R5	R5	
RK	RK	

Product

Table 21: Properties of each product.

Id	Name	SBO
R5_RKpre	R5_RKpre	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \text{kRK1\_5} \cdot \text{RK} \cdot \text{R5} - \text{kRK2} \cdot \text{R5\_RKpre} \tag{53}$$

7.9 Reaction v_r2_6

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

Name v_r2_6

Notes Binding of R6 and RK. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\text{R6} + \text{RK} \rightleftharpoons \text{R6\_RKpre} \tag{54}$$

Reactants

Table 22: Properties of each reactant.

Id	Name	SBO
R6	R6	
RK	RK	

Product

Table 23: Properties of each product.

Id	Name	SBO
R6_RKpre	R6_RKpre	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \text{kRK1\_6} \cdot \text{RK} \cdot \text{R6} - \text{kRK2} \cdot \text{R6\_RKpre} \tag{55}$$

7.10 Reaction v_r3_0

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

Name v_r3_0

Notes Phosphorylation of R0 to give R1

Reaction equation

$$\text{R0\_RKpre} \longrightarrow \text{R1\_RKpost} \tag{56}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
R0_RKpre	R0_RKpre	

Product

Table 25: Properties of each product.

Id	Name	SBO
R1_RKpost	R1_RKpost	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \text{kRK3\_ATP} \cdot \text{R0\_RKpre} \tag{57}$$

7.11 Reaction v_r3_1

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

Name v_r3_1

Notes Phosphorylation of R1 to give R2

Reaction equation

$$\text{R1\_RKpre} \longrightarrow \text{R2\_RKpost} \tag{58}$$

Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
R1_RKpre	R1_RKpre	

Product

Table 27: Properties of each product.

Id	Name	SBO
R2_RKpost	R2_RKpost	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \text{kRK3\_ATP} \cdot \text{R1\_RKpre} \tag{59}$$

7.12 Reaction v_r3_2

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

Name v_r3_2

Notes Phosphorylation of R2 to give R3

Reaction equation

$$\text{R2\_RKpre} \longrightarrow \text{R3\_RKpost} \tag{60}$$

Reactant

Table 28: Properties of each reactant.

Id	Name	SBO
R2_RKpre	R2_RKpre	

Product

Table 29: Properties of each product.

Id	Name	SBO
R3_RKpost	R3_RKpost	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{kRK3\_ATP} \cdot \text{R2\_RKpre} \tag{61}$$

7.13 Reaction v_r3_3

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

Name v_r3_3

Notes Phosphorylation of R3 to give R4

Reaction equation

$$\text{R3\_RKpre} \longrightarrow \text{R4\_RKpost} \tag{62}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
R3_RKpre	R3_RKpre	

Product

Table 31: Properties of each product.

Id	Name	SBO
R4_RKpost	R4_RKpost	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \text{kRK3\_ATP} \cdot \text{R3\_RKpre} \tag{63}$$

7.14 Reaction v_r3_4

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

Name v_r3_4

Notes Phosphorylation of R4 to give R5

Reaction equation

$$\text{R4\_RKpre} \longrightarrow \text{R5\_RKpost} \tag{64}$$

Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
R4_RKpre	R4_RKpre	

Product

Table 33: Properties of each product.

Id	Name	SBO
R5_RKpost	R5_RKpost	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \text{kRK3\_ATP} \cdot \text{R4\_RKpre} \tag{65}$$

7.15 Reaction v_r3_5

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

Name v_r3_5

Notes Phosphorylation of R5 to give R6

Reaction equation

$$\text{R5\_RKpre} \longrightarrow \text{R6\_RKpost} \tag{66}$$

Reactant

Table 34: Properties of each reactant.

Id	Name	SBO
R5_RKpre	R5_RKpre	

Product

Table 35: Properties of each product.

Id	Name	SBO
R6_RKpost	R6_RKpost	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \text{kRK3\_ATP} \cdot \text{R5\_RKpre} \tag{67}$$

7.16 Reaction v_r4_1

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

Name v_r4_1

Notes Dissociation of the R1-RK complex

Reaction equation

$$\text{R1\_RKpost} \longrightarrow \text{R1} + \text{RK} \tag{68}$$

Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
R1_RKpost	R1_RKpost	

Products

Table 37: Properties of each product.

Id	Name	SBO
R1	R1	
RK	RK	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \text{kRK4} \cdot \text{R1\_RKpost} \tag{69}$$

7.17 Reaction v_r4_2

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

Name v_r4_2

Notes Dissociation of the R2-RK complex

Reaction equation

$$\text{R2\_RKpost} \longrightarrow \text{R2} + \text{RK} \tag{70}$$

Reactant

Table 38: Properties of each reactant.

Id	Name	SBO
R2_RKpost	R2_RKpost	

Products

Table 39: Properties of each product.

Id	Name	SBO
R2	R2	
RK	RK	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \text{kRK4} \cdot \text{R2\_RKpost} \tag{71}$$

7.18 Reaction v_r4_3

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

Name v_r4_3

Notes Dissociation of the R3-RK complex

Reaction equation

$$\text{R3\_RKpost} \longrightarrow \text{R3} + \text{RK} \tag{72}$$

Reactant

Table 40: Properties of each reactant.

Id	Name	SBO
R3_RKpost	R3_RKpost	

Products

Table 41: Properties of each product.

Id	Name	SBO
R3	R3	
RK	RK	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \text{kRK4} \cdot \text{R3\_RKpost} \tag{73}$$

7.19 Reaction v_r4_4

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

Name v_r4_4

Notes Dissociation of the R4-RK complex

Reaction equation

$$\text{R4\_RKpost} \longrightarrow \text{R4} + \text{RK} \tag{74}$$

Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
R4_RKpost	R4_RKpost	

Products

Table 43: Properties of each product.

Id	Name	SBO
R4	R4	
RK	RK	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \text{kRK4} \cdot \text{R4\_RKpost} \tag{75}$$

7.20 Reaction v_r4_5

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

Name v_r4_5

Notes Dissociation of the R5-RK complex

Reaction equation

$$\text{R5\_RKpost} \longrightarrow \text{R5} + \text{RK} \tag{76}$$

Reactant

Table 44: Properties of each reactant.

Id	Name	SBO
R5_RKpost	R5_RKpost	

Products

Table 45: Properties of each product.

Id	Name	SBO
R5	R5	
RK	RK	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \text{kRK4} \cdot \text{R5\_RKpost} \tag{77}$$

7.21 Reaction v_r4_6

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

Name v_r4_6

Notes Dissociation of the R6-RK complex

Reaction equation

$$\text{R6\_RKpost} \longrightarrow \text{R6} + \text{RK} \tag{78}$$

Reactant

Table 46: Properties of each reactant.

Id	Name	SBO
R6_RKpost	R6_RKpost	

Products

Table 47: Properties of each product.

Id	Name	SBO
R6	R6	
RK	RK	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \text{kRK4} \cdot \text{R6\_RKpost} \tag{79}$$

7.22 Reaction v_r5_1

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

Name v_r5_1

Notes Binding of R1 and Arr. The association rate constant increases linearly with the first four phosphorylations.

Reaction equation

$$\text{Arr} + \text{R1} \rightleftharpoons \text{R1\_Arr} \tag{80}$$

Reactants

Table 48: Properties of each reactant.

Id	Name	SBO
Arr	Arr	
R1	R1	

Product

Table 49: Properties of each product.

Id	Name	SBO
R1_Arr	R1_Arr	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \text{kA1\_1} \cdot \text{Arr} \cdot \text{R1} - \text{kA2} \cdot \text{R1\_Arr} \tag{81}$$

7.23 Reaction v_r5_2

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

Name v_r5_2

Notes Binding of R2 and Arr. The association rate constant increases linearly with the first four phosphorylations.

Reaction equation

$$\text{Arr} + \text{R2} \rightleftharpoons \text{R2\_Arr} \tag{82}$$

Reactants

Table 50: Properties of each reactant.

Id	Name	SBO
Arr	Arr	
R2	R2	

Product

Table 51: Properties of each product.

Id	Name	SBO
R2_Arr	R2_Arr	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \text{kA1\_2} \cdot \text{Arr} \cdot \text{R2} - \text{kA2} \cdot \text{R2\_Arr} \tag{83}$$

7.24 Reaction v_r5_3

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

Name v_r5_3

Notes Binding of R3 and Arr. The association rate constant increases linearly with the first four phosphorylations.

Reaction equation

$$\text{Arr} + \text{R3} \rightleftharpoons \text{R3\_Arr} \tag{84}$$

Reactants

Table 52: Properties of each reactant.

Id	Name	SBO
Arr	Arr	
R3	R3	

Product

Table 53: Properties of each product.

Id	Name	SBO
R3_Arr	R3_Arr	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \mathrm{kA1\_3} \cdot \mathrm{Arr} \cdot \mathrm{R3} - \mathrm{kA2} \cdot \mathrm{R3\_Arr} \tag{85}$$

7.25 Reaction v_r5_4

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

Name v_r5_4

Notes Binding of R4 and Arr. The association rate constant increases linearly with the first four phosphorylations.

Reaction equation

$$\mathrm{Arr} + \mathrm{R4} \rightleftharpoons \mathrm{R4\_Arr} \tag{86}$$

Reactants

Table 54: Properties of each reactant.

Id	Name	SBO
Arr	Arr	
R4	R4	

Product

Table 55: Properties of each product.

Id	Name	SBO
R4_Arr	R4_Arr	

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \text{kA1\_4} \cdot \text{Arr} \cdot \text{R4} - \text{kA2} \cdot \text{R4\_Arr} \tag{87}$$

7.26 Reaction v_r5_5

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

Name v_r5_5

Notes Binding of R5 and Arr. The association rate constant increases linearly with the first four phosphorylations.

Reaction equation

$$\text{Arr} + \text{R5} \rightleftharpoons \text{R5\_Arr} \tag{88}$$

Reactants

Table 56: Properties of each reactant.

Id	Name	SBO
Arr	Arr	
R5	R5	

Product

Table 57: Properties of each product.

Id	Name	SBO
R5_Arr	R5_Arr	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \text{kA1\_5} \cdot \text{Arr} \cdot \text{R5} - \text{kA2} \cdot \text{R5\_Arr} \tag{89}$$

7.27 Reaction v_r5_6

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

Name v_r5_6

Notes Binding of R6 and Arr. The association rate constant increases linearly with the first four phosphorylations.

Reaction equation

$$\text{Arr} + \text{R6} \rightleftharpoons \text{R6\_Arr} \tag{90}$$

Reactants

Table 58: Properties of each reactant.

Id	Name	SBO
Arr	Arr	
R6	R6	

Product

Table 59: Properties of each product.

Id	Name	SBO
R6_Arr	R6_Arr	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{kA1\_6} \cdot \text{Arr} \cdot \text{R6} - \text{kA2} \cdot \text{R6\_Arr} \tag{91}$$

7.28 Reaction v_r6_1

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

Name v_r6_1

Notes Arr-mediated inactivation of R1.

Reaction equation

$$\mathrm{R1\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops} \tag{92}$$

Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
R1_Arr	R1_Arr	

Products

Table 61: Properties of each product.

Id	Name	SBO
Arr	Arr	
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \mathrm{kA3} \cdot \mathrm{R1\_Arr} \tag{93}$$

7.29 Reaction v_r6_2

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

Name v_r6_2

Notes Arr-mediated inactivation of R2.

Reaction equation

$$\mathrm{R2\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops} \tag{94}$$

Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
R2_Arr	R2_Arr	

Products

Table 63: Properties of each product.

Id	Name	SBO
`Arr`	Arr	
`Ops`	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = \mathrm{kA3} \cdot \mathrm{R2\_Arr} \tag{95}$$

7.30 Reaction `v_r6_3`

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

Name v_r6_3

Notes Arr-mediated inactivation of R3.

Reaction equation

$$\mathrm{R3\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops} \tag{96}$$

Reactant

Table 64: Properties of each reactant.

Id	Name	SBO
`R3_Arr`	R3_Arr	

Products

Table 65: Properties of each product.

Id	Name	SBO
`Arr`	Arr	
`Ops`	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = \mathrm{kA3} \cdot \mathrm{R3\_Arr} \tag{97}$$

7.31 Reaction v_r6_4

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

Name v_r6_4

Notes Arr-mediated inactivation of R4.

Reaction equation

$$\mathrm{R4\_Arr} \longrightarrow \mathrm{Arr} + \mathrm{Ops} \tag{98}$$

Reactant

Table 66: Properties of each reactant.

Id	Name	SBO
R4_Arr	R4_Arr	

Products

Table 67: Properties of each product.

Id	Name	SBO
Arr	Arr	
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = \mathrm{kA3} \cdot \mathrm{R4\_Arr} \tag{99}$$

7.32 Reaction v_r6_5

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

Name v_r6_5

Notes Arr-mediated inactivation of R5.

Reaction equation

$$\text{R5\_Arr} \longrightarrow \text{Arr} + \text{Ops} \tag{100}$$

Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
R5_Arr	R5_Arr	

Products

Table 69: Properties of each product.

Id	Name	SBO
Arr	Arr	
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{32} = \text{kA3} \cdot \text{R5\_Arr} \tag{101}$$

7.33 Reaction v_r6_6

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

Name v_r6_6

Notes Arr-mediated inactivation of R6.

Reaction equation

$$\text{R6\_Arr} \longrightarrow \text{Arr} + \text{Ops} \tag{102}$$

Reactant

Table 70: Properties of each reactant.

Id	Name	SBO
R6_Arr	R6_Arr	

Products

Table 71: Properties of each product.

Id	Name	SBO
Arr	Arr	
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{33} = \mathrm{kA3} \cdot \mathrm{R6\_Arr} \tag{103}$$

7.34 Reaction v_r7_0

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

Name v_r7_0

Notes Thermal decay of catalytic active form of R0 to give Ops.

Reaction equation

$$\mathrm{R0} \longrightarrow \mathrm{Ops} \tag{104}$$

Reactant

Table 72: Properties of each reactant.

Id	Name	SBO
R0	R0	

Product

Table 73: Properties of each product.

Id	Name	SBO
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{34} = \text{ktherm} \cdot \text{R0} \tag{105}$$

7.35 Reaction v_r7_1

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

Name v_r7_1

Notes Thermal decay of catalytic active form of R1 to give Ops.

Reaction equation

$$\text{R1} \longrightarrow \text{Ops} \tag{106}$$

Reactant

Table 74: Properties of each reactant.

Id	Name	SBO
R1	R1	

Product

Table 75: Properties of each product.

Id	Name	SBO
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{35} = \text{ktherm} \cdot \text{R1} \tag{107}$$

7.36 Reaction v_r7_2

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

Name v_r7_2

Notes Thermal decay of catalytic active form of R2 to give Ops.

Reaction equation

$$\text{R2} \longrightarrow \text{Ops} \tag{108}$$

Reactant

Table 76: Properties of each reactant.

Id	Name	SBO
R2	R2	

Product

Table 77: Properties of each product.

Id	Name	SBO
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{36} = \text{ktherm} \cdot \text{R2} \tag{109}$$

7.37 Reaction v_r7_3

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

Name v_r7_3

Notes Thermal decay of catalytic active form of R3 to give Ops.

Reaction equation

$$\text{R3} \longrightarrow \text{Ops} \tag{110}$$

Reactant

Table 78: Properties of each reactant.

Id	Name	SBO
R3	R3	

Product

Table 79: Properties of each product.

Id	Name	SBO
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{37} = \text{ktherm} \cdot \text{R3} \tag{111}$$

7.38 Reaction v_r7_4

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

Name v_r7_4

Notes Thermal decay of catalytic active form of R4 to give Ops.

Reaction equation

$$\text{R4} \longrightarrow \text{Ops} \tag{112}$$

Reactant

Table 80: Properties of each reactant.

Id	Name	SBO
R4	R4	

Product

Table 81: Properties of each product.

Id	Name	SBO
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{38} = \text{ktherm} \cdot \text{R4} \tag{113}$$

7.39 Reaction v_r7_5

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

Name v_r7_5

Notes Thermal decay of catalytic active form of R5 to give Ops.

Reaction equation

$$\mathrm{R5} \longrightarrow \mathrm{Ops} \tag{114}$$

Reactant

Table 82: Properties of each reactant.

Id	Name	SBO
R5	R5	

Product

Table 83: Properties of each product.

Id	Name	SBO
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{39} = \mathrm{ktherm} \cdot \mathrm{R5} \tag{115}$$

7.40 Reaction v_r7_6

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

Name v_r7_6

Notes Thermal decay of catalytic active form of R6 to give Ops.

Reaction equation

$$\mathrm{R6} \longrightarrow \mathrm{Ops} \tag{116}$$

Reactant

Table 84: Properties of each reactant.

Id	Name	SBO
R6	R6	

Product

Table 85: Properties of each product.

Id	Name	SBO
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{40} = \text{ktherm} \cdot \text{R6} \tag{117}$$

7.41 Reaction v_r8

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

Name v_r8

Notes Spontaneous Ops activity.

Reaction equation

$$\text{Gt} + \text{Ops} \rightleftharpoons \text{Ops\_Gt} \tag{118}$$

Reactants

Table 86: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
Ops	Ops	

Product

Table 87: Properties of each product.

Id	Name	SBO
Ops_Gt	Ops_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{41} = \text{kG1ops} \cdot \text{Ops} \cdot \text{Gt} - \text{kG2ops} \cdot \text{Ops\_Gt} \tag{119}$$

7.42 Reaction v_r9

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

Name v_r9

Notes GDP dissociation from the Ops-Gt complex.

Reaction equation

$$\text{Ops\_Gt} \rightleftharpoons \text{Ops\_G} \tag{120}$$

Reactant

Table 88: Properties of each reactant.

Id	Name	SBO
Ops_Gt	Ops_Gt	

Product

Table 89: Properties of each product.

Id	Name	SBO
Ops_G	Ops_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{42} = \text{kOps} \cdot \text{Ops\_Gt} - \text{kG4\_GDP} \cdot \text{Ops\_G} \tag{121}$$

7.43 Reaction v_r10

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

Name v_r10

Notes GTP binding to the Ops-Gt complex.

Reaction equation

$$\text{Ops\_G} \longrightarrow \text{Ops\_G\_GTP} \tag{122}$$

Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
Ops_G	Ops_G	

Product

Table 91: Properties of each product.

Id	Name	SBO
Ops_G_GTP	Ops_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{43} = \text{kG5\_GTP} \cdot \text{Ops\_G} \tag{123}$$

7.44 Reaction v_r11

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

Name v_r11

Notes Dissociation of the Ops-G_GTP complex

Reaction equation

$$\text{Ops\_G\_GTP} \longrightarrow \text{G\_GTP} + \text{Ops} \tag{124}$$

Reactant

Table 92: Properties of each reactant.

Id	Name	SBO
Ops_G_GTP	Ops_G_GTP	

Products

Table 93: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
Ops	Ops	

Kinetic Law

Derived unit contains undeclared units

$$v_{44} = \text{kG6} \cdot \text{Ops\_G\_GTP} \tag{125}$$

7.45 Reaction v_r12

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

Name v_r12

Notes Chromophore regeneration by 11-cis retinal binding to Ops.

Reaction equation

$$\text{Ops} \longrightarrow \text{R} \tag{126}$$

Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
Ops	Ops	

Product

Table 95: Properties of each product.

Id	Name	SBO
R	R	

Kinetic Law

Derived unit contains undeclared units

$$v_{45} = \text{kRrecyc} \cdot \text{Ops} \tag{127}$$

7.46 Reaction v_GtRpre

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

Name v_GtRpre

Notes Pre-coupling of inactive R to Gt

Reaction equation

$$\text{Gt} + \text{R} \rightleftharpoons \text{R\_Gt} \tag{128}$$

Reactants

Table 96: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R	R	

Product

Table 97: Properties of each product.

Id	Name	SBO
R_Gt	R_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{46} = \text{kGpre1} \cdot \text{Gt} \cdot \text{R} - \text{kGpre2} \cdot \text{R\_Gt} \tag{129}$$

7.47 Reaction v_r13_0

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

Name v_r13_0

Notes Binding of R0 and Gt. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{Gt} + \mathrm{R0} \rightleftharpoons \mathrm{R0\_Gt} \tag{130}$$

Reactants

Table 98: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R0	R0	

Product

Table 99: Properties of each product.

Id	Name	SBO
R0_Gt	R0_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{47} = \mathrm{kG1\_0} \cdot \mathrm{Gt} \cdot \mathrm{R0} - \mathrm{kG2} \cdot \mathrm{R0\_Gt} \tag{131}$$

7.48 Reaction v_r13_1

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

Name v_r13_1

Notes Binding of R1 and Gt. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{Gt} + \mathrm{R1} \rightleftharpoons \mathrm{R1\_Gt} \tag{132}$$

Reactants

Table 100: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R1	R1	

Product

Table 101: Properties of each product.

Id	Name	SBO
R1_Gt	R1_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{48} = \mathrm{kG1\_1} \cdot \mathrm{Gt} \cdot \mathrm{R1} - \mathrm{kG2} \cdot \mathrm{R1\_Gt} \tag{133}$$

7.49 Reaction v_r13_2

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

Name v_r13_2

Notes Binding of R2 and Gt. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{Gt} + \mathrm{R2} \rightleftharpoons \mathrm{R2\_Gt} \tag{134}$$

Reactants

Table 102: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R2	R2	

Product

Table 103: Properties of each product.

Id	Name	SBO
R2_Gt	R2_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{49} = \text{kG1\_2} \cdot \text{Gt} \cdot \text{R2} - \text{kG2} \cdot \text{R2\_Gt} \tag{135}$$

7.50 Reaction v_r13_3

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

Name v_r13_3

Notes Binding of R3 and Gt. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\text{Gt} + \text{R3} \rightleftharpoons \text{R3\_Gt} \tag{136}$$

Reactants

Table 104: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R3	R3	

Product

Table 105: Properties of each product.

Id	Name	SBO
R3_Gt	R3_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{50} = \text{kG1\_3} \cdot \text{Gt} \cdot \text{R3} - \text{kG2} \cdot \text{R3\_Gt} \tag{137}$$

7.51 Reaction v_r13_4

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

Name v_r13_4

Notes Binding of R4 and Gt. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\text{Gt} + \text{R4} \rightleftharpoons \text{R4\_Gt} \tag{138}$$

Reactants

Table 106: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R4	R4	

Product

Table 107: Properties of each product.

Id	Name	SBO
R4_Gt	R4_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{51} = \text{kG1\_4} \cdot \text{Gt} \cdot \text{R4} - \text{kG2} \cdot \text{R4\_Gt} \tag{139}$$

7.52 Reaction v_r13_5

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

Name v_r13_5

Notes Binding of R5 and Gt. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{Gt} + \mathrm{R5} \rightleftharpoons \mathrm{R5\_Gt} \tag{140}$$

Reactants

Table 108: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R5	R5	

Product

Table 109: Properties of each product.

Id	Name	SBO
R5_Gt	R5_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{52} = \mathrm{kG1\_5} \cdot \mathrm{Gt} \cdot \mathrm{R5} - \mathrm{kG2} \cdot \mathrm{R5\_Gt} \tag{141}$$

7.53 Reaction v_r13_6

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

Name v_r13_6

Notes Binding of R6 and Gt. The association rate constant is assumed to decrease exponentially with increasing phosphorylations.

Reaction equation

$$\mathrm{Gt} + \mathrm{R6} \rightleftharpoons \mathrm{R6\_Gt} \tag{142}$$

Reactants

Table 110: Properties of each reactant.

Id	Name	SBO
Gt	Gt	
R6	R6	

Product

Table 111: Properties of each product.

Id	Name	SBO
R6_Gt	R6_Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{53} = \text{kG1\_6} \cdot \text{Gt} \cdot \text{R6} - \text{kG2} \cdot \text{R6\_Gt} \tag{143}$$

7.54 Reaction v_r14_0

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

Name v_r14_0

Notes GDP dissociation from the R0-Gt complex.

Reaction equation

$$\text{R0\_Gt} \rightleftharpoons \text{R0\_G} \tag{144}$$

Reactant

Table 112: Properties of each reactant.

Id	Name	SBO
R0_Gt	R0_Gt	

Product

Table 113: Properties of each product.

Id	Name	SBO
R0_G	R0_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{54} = \text{kG3} \cdot \text{R0\_Gt} - \text{kG4\_GDP} \cdot \text{R0\_G} \tag{145}$$

7.55 Reaction v_r14_1

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

Name v_r14_1

Notes GDP dissociation from the R1-Gt complex.

Reaction equation

$$\text{R1\_Gt} \rightleftharpoons \text{R1\_G} \tag{146}$$

Reactant

Table 114: Properties of each reactant.

Id	Name	SBO
R1_Gt	R1_Gt	

Product

Table 115: Properties of each product.

Id	Name	SBO
R1_G	R1_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{55} = \text{kG3} \cdot \text{R1\_Gt} - \text{kG4\_GDP} \cdot \text{R1\_G} \tag{147}$$

7.56 Reaction v_r14_2

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

Name v_r14_2

Notes GDP dissociation from the R2-Gt complex.

Reaction equation

$$\text{R2\_Gt} \rightleftharpoons \text{R2\_G} \tag{148}$$

Reactant

Table 116: Properties of each reactant.

Id	Name	SBO
R2_Gt	R2_Gt	

Product

Table 117: Properties of each product.

Id	Name	SBO
R2_G	R2_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{56} = \text{kG3} \cdot \text{R2\_Gt} - \text{kG4\_GDP} \cdot \text{R2\_G} \tag{149}$$

7.57 Reaction v_r14_3

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

Name v_r14_3

Notes GDP dissociation from the R3-Gt complex.

Reaction equation

$$\text{R3\_Gt} \rightleftharpoons \text{R3\_G} \tag{150}$$

Reactant

Table 118: Properties of each reactant.

Id	Name	SBO
R3_Gt	R3_Gt	

Product

Table 119: Properties of each product.

Id	Name	SBO
R3_G	R3_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{57} = \text{kG3} \cdot \text{R3\_Gt} - \text{kG4\_GDP} \cdot \text{R3\_G} \tag{151}$$

7.58 Reaction v_r14_4

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

Name v_r14_4

Notes GDP dissociation from the R4-Gt complex.

Reaction equation

$$\text{R4\_Gt} \rightleftharpoons \text{R4\_G} \tag{152}$$

Reactant

Table 120: Properties of each reactant.

Id	Name	SBO
R4_Gt	R4_Gt	

Product

Table 121: Properties of each product.

Id	Name	SBO
R4_G	R4_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{58} = \text{kG3} \cdot \text{R4\_Gt} - \text{kG4\_GDP} \cdot \text{R4\_G} \tag{153}$$

7.59 Reaction v_r14_5

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

Name v_r14_5

Notes GDP dissociation from the R5-Gt complex.

Reaction equation

$$\text{R5\_Gt} \rightleftharpoons \text{R5\_G} \tag{154}$$

Reactant

Table 122: Properties of each reactant.

Id	Name	SBO
R5_Gt	R5_Gt	

Product

Table 123: Properties of each product.

Id	Name	SBO
R5_G	R5_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{59} = \text{kG3} \cdot \text{R5\_Gt} - \text{kG4\_GDP} \cdot \text{R5\_G} \tag{155}$$

7.60 Reaction v_r14_6

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

Name v_r14_6

Notes GDP dissociation from the R6-Gt complex.

Reaction equation

$$\text{R6\_Gt} \rightleftharpoons \text{R6\_G} \tag{156}$$

Reactant

Table 124: Properties of each reactant.

Id	Name	SBO
R6_Gt	R6_Gt	

Product

Table 125: Properties of each product.

Id	Name	SBO
R6_G	R6_G	

Kinetic Law

Derived unit contains undeclared units

$$v_{60} = \text{kG3} \cdot \text{R6\_Gt} - \text{kG4\_GDP} \cdot \text{R6\_G} \tag{157}$$

7.61 Reaction v_r15_0

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

Name v_r15_0

Notes GTP binding to the R0-Gt complex.

Reaction equation

$$\text{R0\_G} \longrightarrow \text{R0\_G\_GTP} \tag{158}$$

Reactant

Table 126: Properties of each reactant.

Id	Name	SBO
R0_G	R0_G	

Product

Table 127: Properties of each product.

Id	Name	SBO
R0_G_GTP	R0_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{61} = \text{kG5\_GTP} \cdot \text{R0\_G} \tag{159}$$

7.62 Reaction v_r15_1

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

Name v_r15_1

Notes GTP binding to the R1-Gt complex.

Reaction equation

$$\text{R1\_G} \longrightarrow \text{R1\_G\_GTP} \tag{160}$$

Reactant

Table 128: Properties of each reactant.

Id	Name	SBO
R1_G	R1_G	

Product

Table 129: Properties of each product.

Id	Name	SBO
R1_G_GTP	R1_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{62} = \text{kG5\_GTP} \cdot \text{R1\_G} \tag{161}$$

7.63 Reaction v_r15_2

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

Name v_r15_2

Notes GTP binding to the R2-Gt complex.

Reaction equation

$$\text{R2\_G} \longrightarrow \text{R2\_G\_GTP} \tag{162}$$

Reactant

Table 130: Properties of each reactant.

Id	Name	SBO
R2_G	R2_G	

Product

Table 131: Properties of each product.

Id	Name	SBO
R2_G_GTP	R2_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{63} = \text{kG5\_GTP} \cdot \text{R2\_G} \tag{163}$$

7.64 Reaction v_r15_3

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

Name v_r15_3

Notes GTP binding to the R3-Gt complex.

Reaction equation

$$\text{R3\_G} \longrightarrow \text{R3\_G\_GTP} \tag{164}$$

Reactant

Table 132: Properties of each reactant.

Id	Name	SBO
R3_G	R3_G	

Product

Table 133: Properties of each product.

Id	Name	SBO
R3_G_GTP	R3_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{64} = \text{kG5\_GTP} \cdot \text{R3\_G} \tag{165}$$

7.65 Reaction v_r15_4

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

Name v_r15_4

Notes GTP binding to the R4-Gt complex.

Reaction equation

$$\text{R4\_G} \longrightarrow \text{R4\_G\_GTP} \tag{166}$$

Reactant

Table 134: Properties of each reactant.

Id	Name	SBO
R4_G	R4_G	

Product

Table 135: Properties of each product.

Id	Name	SBO
R4_G_GTP	R4_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{65} = \text{kG5\_GTP} \cdot \text{R4\_G} \tag{167}$$

7.66 Reaction v_r15_5

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

Name v_r15_5

Notes GTP binding to the R5-Gt complex.

Reaction equation

$$\text{R5\_G} \longrightarrow \text{R5\_G\_GTP} \tag{168}$$

Reactant

Table 136: Properties of each reactant.

Id	Name	SBO
R5_G	R5_G	

Product

Table 137: Properties of each product.

Id	Name	SBO
R5_G_GTP	R5_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{66} = \text{kG5\_GTP} \cdot \text{R5\_G} \tag{169}$$

7.67 Reaction v_r15_6

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

Name v_r15_6

Notes GTP binding to the R6-Gt complex.

Reaction equation

$$\text{R6\_G} \longrightarrow \text{R6\_G\_GTP} \tag{170}$$

Reactant

Table 138: Properties of each reactant.

Id	Name	SBO
R6_G	R6_G	

Product

Table 139: Properties of each product.

Id	Name	SBO
R6_G_GTP	R6_G_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{67} = \text{kG5\_GTP} \cdot \text{R6\_G} \tag{171}$$

7.68 Reaction v_r16_0

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

Name v_r16_0

Notes Dissociation of the R0-G_GTP complex.

Reaction equation

$$\text{R0\_G\_GTP} \longrightarrow \text{G\_GTP} + \text{R0} \tag{172}$$

Reactant

Table 140: Properties of each reactant.

Id	Name	SBO
R0_G_GTP	R0_G_GTP	

Products

Table 141: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
R0	R0	

Kinetic Law

Derived unit contains undeclared units

$$v_{68} = \text{kG6} \cdot \text{R0\_G\_GTP} \tag{173}$$

7.69 Reaction v_r16_1

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

Name v_r16_1

Notes Dissociation of the R1-G_GTP complex.

Reaction equation

$$\text{R1\_G\_GTP} \longrightarrow \text{G\_GTP} + \text{R1} \tag{174}$$

Reactant

Table 142: Properties of each reactant.

Id	Name	SBO
R1_G_GTP	R1_G_GTP	

Products

Table 143: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
R1	R1	

Kinetic Law

Derived unit contains undeclared units

$$v_{69} = \mathrm{kG6} \cdot \mathrm{R1\_G\_GTP} \tag{175}$$

7.70 Reaction v_r16_2

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

Name v_r16_2

Notes Dissociation of the R2-G_GTP complex.

Reaction equation

$$\mathrm{R2\_G\_GTP} \longrightarrow \mathrm{G\_GTP} + \mathrm{R2} \tag{176}$$

Reactant

Table 144: Properties of each reactant.

Id	Name	SBO
R2_G_GTP	R2_G_GTP	

Products

Table 145: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
R2	R2	

Kinetic Law

Derived unit contains undeclared units

$$v_{70} = \text{kG6} \cdot \text{R2\_G\_GTP} \tag{177}$$

7.71 Reaction v_r16_3

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

Name v_r16_3

Notes Dissociation of the R3-G_GTP complex.

Reaction equation

$$\text{R3\_G\_GTP} \longrightarrow \text{G\_GTP} + \text{R3} \tag{178}$$

Reactant

Table 146: Properties of each reactant.

Id	Name	SBO
R3_G_GTP	R3_G_GTP	

Products

Table 147: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
R3	R3	

Kinetic Law

Derived unit contains undeclared units

$$v_{71} = \text{kG6} \cdot \text{R3\_G\_GTP} \tag{179}$$

7.72 Reaction v_r16_4

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

Name v_r16_4

Notes Dissociation of the R4-G_GTP complex.

Reaction equation

$$\text{R4\_G\_GTP} \longrightarrow \text{G\_GTP} + \text{R4} \tag{180}$$

Reactant

Table 148: Properties of each reactant.

Id	Name	SBO
R4_G_GTP	R4_G_GTP	

Products

Table 149: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
R4	R4	

Kinetic Law

Derived unit contains undeclared units

$$v_{72} = \text{kG6} \cdot \text{R4\_G\_GTP} \tag{181}$$

7.73 Reaction v_r16_5

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

Name v_r16_5

Notes Dissociation of the R5-G_GTP complex.

Reaction equation

$$\text{R5\_G\_GTP} \longrightarrow \text{G\_GTP} + \text{R5} \tag{182}$$

Reactant

Table 150: Properties of each reactant.

Id	Name	SBO
R5_G_GTP	R5_G_GTP	

Products

Table 151: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
R5	R5	

Kinetic Law

Derived unit contains undeclared units

$$v_{73} = \text{kG6} \cdot \text{R5\_G\_GTP} \tag{183}$$

7.74 Reaction v_r16_6

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

Name v_r16_6

Notes Dissociation of the R6-G_GTP complex.

Reaction equation

$$\text{R6\_G\_GTP} \longrightarrow \text{G\_GTP} + \text{R6} \tag{184}$$

Reactant

Table 152: Properties of each reactant.

Id	Name	SBO
R6_G_GTP	R6_G_GTP	

Products

Table 153: Properties of each product.

Id	Name	SBO
G_GTP	G_GTP	
R6	R6	

Kinetic Law

Derived unit contains undeclared units

$$v_{74} = \text{kG6} \cdot \text{R6\_G\_GTP} \tag{185}$$

7.75 Reaction v_r17

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

Name v_r17

Notes Dissociation of trimeric Gt into and subunits.

Reaction equation

$$\text{G\_GTP} \longrightarrow \text{Ga\_GTP} + \text{Gbg} \tag{186}$$

Reactant

Table 154: Properties of each reactant.

Id	Name	SBO
G_GTP	G_GTP	

Products

Table 155: Properties of each product.

Id	Name	SBO
Ga_GTP	Ga_GTP	
Gbg	Gbg	

Kinetic Law

Derived unit contains undeclared units

$$v_{75} = \text{kG7} \cdot \text{G\_GTP} \tag{187}$$

7.76 Reaction v_r18

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

Name v_r18

Notes Binding of G__GTP to one PDE inactive subunit.

Reaction equation

$$\text{Ga\_GTP} + \text{PDE} \rightleftharpoons \text{PDE\_Ga\_GTP} \tag{188}$$

Reactants

Table 156: Properties of each reactant.

Id	Name	SBO
Ga_GTP	Ga_GTP	
PDE	PDE	

Product

Table 157: Properties of each product.

Id	Name	SBO
PDE_Ga_GTP	PDE_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{76} = \text{kP1} \cdot \text{PDE} \cdot \text{Ga\_GTP} - \text{kP1\_rev} \cdot \text{PDE\_Ga\_GTP} \tag{189}$$

7.77 Reaction v_r19

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

Name v_r19

Notes Activation of the PDE-G__GTP complex.

Reaction equation

$$\text{PDE\_Ga\_GTP} \longrightarrow \text{PDE\_a\_Ga\_GTP} \tag{190}$$

Reactant

Table 158: Properties of each reactant.

Id	Name	SBO
PDE_Ga_GTP	PDE_Ga_GTP	

Product

Table 159: Properties of each product.

Id	Name	SBO
PDE_a_Ga_GTP	PDE_a_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{77} = \text{kP2} \cdot \text{PDE\_Ga\_GTP} \tag{191}$$

7.78 Reaction v_r20

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

Name v_r20

Notes Binding of G__GTP to singly active PDE.

Reaction equation

$$\text{Ga\_GTP} + \text{PDE\_a\_Ga\_GTP} \longrightarrow \text{Ga\_GTP\_PDE\_a\_Ga\_GTP} \tag{192}$$

Reactants

Table 160: Properties of each reactant.

Id	Name	SBO
Ga_GTP	Ga_GTP	
PDE_a_Ga_GTP	PDE_a_Ga_GTP	

Product

Table 161: Properties of each product.

Id	Name	SBO
Ga_GTP_PDE_a_Ga_GTP	Ga_GTP_PDE_a_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{78} = \text{kP3} \cdot \text{PDE\_a\_Ga\_GTP} \cdot \text{Ga\_GTP} \tag{193}$$

7.79 Reaction v_r21

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

Name v_r21

Notes Activation of the second G__GTP-bound PDE subunit.

Reaction equation

$$\text{Ga\_GTP\_PDE\_a\_Ga\_GTP} \longrightarrow \text{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \tag{194}$$

Reactant

Table 162: Properties of each reactant.

Id	Name	SBO
Ga_GTP_PDE_a_Ga_GTP	Ga_GTP_PDE_a_Ga_GTP	

Product

Table 163: Properties of each product.

Id	Name	SBO
Ga_GTP_a_PDE_a_Ga_GTP	Ga_GTP_a_PDE_a_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{79} = \text{kP4} \cdot \text{Ga\_GTP\_PDE\_a\_Ga\_GTP} \tag{195}$$

7.80 Reaction v_r22

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

Name v_r22

Notes Binding of RGS9-1 complex to a doubly-active PDE tetramer.

Reaction equation

$$\text{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} + \text{RGS} \longrightarrow \text{RGS\_Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \tag{196}$$

Reactants

Table 164: Properties of each reactant.

Id	Name	SBO
Ga_GTP_a_PDE_a_Ga_GTP	Ga_GTP_a_PDE_a_Ga_GTP	
RGS	RGS	

Product

Table 165: Properties of each product.

Id	Name	SBO
RGS_Ga_GTP_a_PDE_a_Ga_GTP	RGS_Ga_GTP_a_PDE_a_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{80} = \text{kRGS1} \cdot \text{RGS} \cdot \text{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \tag{197}$$

7.81 Reaction v_r23

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

Name v_r23

Notes RGS9-1-mediated deactivation of one of two PDE active subunits.

Reaction equation

$$\text{RGS\_Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \longrightarrow \text{Ga\_GDP} + \text{PDE\_a\_Ga\_GTP} + \text{RGS} \tag{198}$$

Reactant

Table 166: Properties of each reactant.

Id	Name	SBO
RGS_Ga_GTP_a_PDE_a_Ga_GTP	RGS_Ga_GTP_a_PDE_a_Ga_GTP	

Products

Table 167: Properties of each product.

Id	Name	SBO
Ga_GDP	Ga_GDP	
PDE_a_Ga_GTP	PDE_a_Ga_GTP	
RGS	RGS	

Kinetic Law

Derived unit contains undeclared units

$$v_{81} = \text{kRGS2} \cdot \text{RGS\_Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \tag{199}$$

7.82 Reaction v_r24

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

Name v_r24

Notes Binding of RGS9-1 complex to a singly-active PDE tetramer.

Reaction equation

$$\text{PDE\_a\_Ga\_GTP} + \text{RGS} \longrightarrow \text{RGS\_PDE\_a\_Ga\_GTP} \tag{200}$$

Reactants

Table 168: Properties of each reactant.

Id	Name	SBO
PDE_a_Ga_GTP	PDE_a_Ga_GTP	
RGS	RGS	

Product

Table 169: Properties of each product.

Id	Name	SBO
RGS_PDE_a_Ga_GTP	RGS_PDE_a_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{82} = \text{kRGS1} \cdot \text{RGS} \cdot \text{PDE\_a\_Ga\_GTP} \tag{201}$$

7.83 Reaction v_r25

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

Name v_r25

Notes RGS9-1-mediated deactivation of a singly active PDE.

Reaction equation

$$\text{RGS\_PDE\_a\_Ga\_GTP} \longrightarrow \text{Ga\_GDP} + \text{PDE} + \text{RGS} \tag{202}$$

Reactant

Table 170: Properties of each reactant.

Id	Name	SBO
RGS_PDE_a_Ga_GTP	RGS_PDE_a_Ga_GTP	

Products

Table 171: Properties of each product.

Id	Name	SBO
Ga_GDP	Ga_GDP	
PDE	PDE	
RGS	RGS	

Kinetic Law

Derived unit contains undeclared units

$$v_{83} = \text{kRGS2} \cdot \text{RGS\_PDE\_a\_Ga\_GTP} \tag{203}$$

7.84 Reaction v_r26

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

Name v_r26

Notes Inactivation of the PDE*-G__GTP complex by G__GTP's inate GTPase activity.

Reaction equation

$$\text{PDE\_a\_Ga\_GTP} \longrightarrow \text{Ga\_GDP} + \text{PDE} \tag{204}$$

Reactant

Table 172: Properties of each reactant.

Id	Name	SBO
PDE_a_Ga_GTP	PDE_a_Ga_GTP	

Products

Table 173: Properties of each product.

Id	Name	SBO
Ga_GDP	Ga_GDP	
PDE	PDE	

Kinetic Law

Derived unit contains undeclared units

$$v_{84} = \text{kPDEshutoff} \cdot \text{PDE\_a\_Ga\_GTP} \tag{205}$$

7.85 Reaction v_r27

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

Name v_r27

Notes Inactivation of one of the two active PDE subunits by G__GTP's inate GTPase activity.

Reaction equation

$$\text{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \longrightarrow \text{Ga\_GDP} + \text{PDE\_a\_Ga\_GTP} \tag{206}$$

Reactant

Table 174: Properties of each reactant.

Id	Name	SBO
Ga_GTP_a_PDE_a_Ga_GTP	Ga_GTP_a_PDE_a_Ga_GTP	

Products

Table 175: Properties of each product.

Id	Name	SBO
Ga_GDP	Ga_GDP	
PDE_a_Ga_GTP	PDE_a_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{85} = \text{kPDEshutoff} \cdot \text{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} \tag{207}$$

7.86 Reaction v_r28

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

Name v_r28

Notes G__GTP auto-catalytic GTPase activity

Reaction equation

$$\text{Ga\_GTP} \longrightarrow \text{Ga\_GDP} \tag{208}$$

Reactant

Table 176: Properties of each reactant.

Id	Name	SBO
Ga_GTP	Ga_GTP	

Product

Table 177: Properties of each product.

Id	Name	SBO
Ga_GDP	Ga_GDP	

Kinetic Law

Derived unit contains undeclared units

$$v_{86} = \text{kGshutoff} \cdot \text{Ga\_GTP} \tag{209}$$

7.87 Reaction v_r29

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

Name v_r29

Notes Reconstitution of Gt heterotrimer from inactive subunits

Reaction equation

$$\text{Ga\_GDP} + \text{Gbg} \longrightarrow \text{Gt} \tag{210}$$

Reactants

Table 178: Properties of each reactant.

Id	Name	SBO
Ga_GDP	Ga_GDP	
Gbg	Gbg	

Product

Table 179: Properties of each product.

Id	Name	SBO
Gt	Gt	

Kinetic Law

Derived unit contains undeclared units

$$v_{87} = \text{kGrecyc} \cdot \text{Gbg} \cdot \text{Ga\_GDP} \tag{211}$$

7.88 Reaction v_r30

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

Name v_r30

Notes Ca2+-induced Rec conformation change

Reaction equation

$$\text{RecT} + \text{Ca2\_free} \rightleftharpoons \text{RecR\_Ca} \tag{212}$$

Reactants

Table 180: Properties of each reactant.

Id	Name	SBO
RecT	RecT	
Ca2_free	Ca2_free	

Product

Table 181: Properties of each product.

Id	Name	SBO
RecR_Ca	RecR_Ca	

Kinetic Law

Derived unit contains undeclared units

$$v_{88} = \text{kRec1} \cdot \text{RecT} \cdot [\text{Ca2\_free}] - \text{kRec2} \cdot \text{RecR\_Ca} \tag{213}$$

7.89 Reaction v_r31

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

Name v_r31

Notes Binding of RK to Ca2+-bound Rec

Reaction equation

$$\text{RK} + \text{RecR\_Ca} \rightleftharpoons \text{RecR\_Ca\_RK} \tag{214}$$

Reactants

Table 182: Properties of each reactant.

Id	Name	SBO
RK	RK	
RecR_Ca	RecR_Ca	

Product

Table 183: Properties of each product.

Id	Name	SBO
RecR_Ca_RK	RecR_Ca_RK	

Kinetic Law

Derived unit contains undeclared units

$$v_{89} = \text{kRec3} \cdot \text{RecR\_Ca} \cdot \text{RK} - \text{kRec4} \cdot \text{RecR\_Ca\_RK} \tag{215}$$

7.90 Reaction v_r_diarr

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

Name v_r_diarr

Notes Arr homo-dimerization

Reaction equation

$$2\,\mathrm{Arr} \rightleftharpoons \mathrm{Arr\_di} \tag{216}$$

Reactant

Table 184: Properties of each reactant.

Id	Name	SBO
Arr	Arr	

Product

Table 185: Properties of each product.

Id	Name	SBO
Arr_di	Arr_di	

Kinetic Law

Derived unit contains undeclared units

$$v_{90} = \mathrm{kA4} \cdot \mathrm{Arr} \cdot \mathrm{Arr} - \mathrm{kA5} \cdot \mathrm{Arr\_di} \tag{217}$$

7.91 Reaction v_r_tetraarr

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

Name v_r_tetraarr

Notes Arr homo-tetramerization

Reaction equation

$$2\,\mathrm{Arr\_di} \rightleftharpoons \mathrm{Arr\_tetra} \tag{218}$$

Reactant

Table 186: Properties of each reactant.

Id	Name	SBO
Arr_di	Arr_di	

Product

Table 187: Properties of each product.

Id	Name	SBO
Arr_tetra	Arr_tetra	

Kinetic Law

Derived unit contains undeclared units

$$v_{91} = \text{kA4} \cdot \text{Arr\_di} \cdot \text{Arr\_di} - \text{kA5} \cdot \text{Arr\_tetra} \tag{219}$$

7.92 Reaction v_r33

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

Name v_r33

Notes Ca2+ association and dissociation from intracellular buffers with total concentration eT.

Reaction equation

$$\text{Ca2\_free} \rightleftharpoons \text{Ca2\_buff} \tag{220}$$

Reactant

Table 188: Properties of each reactant.

Id	Name	SBO
Ca2_free	Ca2_free	

Product

Table 189: Properties of each product.

Id	Name	SBO
Ca2_buff	Ca2_buff	

Kinetic Law

Derived unit contains undeclared units

$$v_{92} = \mathrm{k1} \cdot (\mathrm{eT} - [\mathrm{Ca2\_buff}]) \cdot [\mathrm{Ca2\_free}] - \mathrm{k2} \cdot [\mathrm{Ca2\_buff}] \tag{221}$$

7.93 Reaction v_r34

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

Name v_r34

Notes Intracellular Ca2+ efflux via the Na+/Ca2+-K+ exchanger.

Reaction equation

$$\mathrm{Ca2\_free} \longrightarrow \emptyset \tag{222}$$

Reactant

Table 190: Properties of each reactant.

Id	Name	SBO
Ca2_free	Ca2_free	

Kinetic Law

Derived unit not available

$$v_{93} = \mathrm{gammaCa} \cdot ([\mathrm{Ca2\_free}] - \mathrm{Ca2\_0}) \tag{223}$$

7.94 Reaction v_r35

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

Name v_r35

Notes Extracellular Ca2+ influx via the cGMP-gated cation channels.

Reaction equation

$$\emptyset \xrightarrow{\mathrm{cGMP}} \mathrm{Ca2\_free} \tag{224}$$

Modifier

Table 191: Properties of each modifier.

Id	Name	SBO
cGMP	cGMP	

Product

Table 192: Properties of each product.

Id	Name	SBO
Ca2_free	Ca2_free	

Kinetic Law

Derived unit contains undeclared units

$$v_{94} = \frac{1000000.0 \cdot \mathrm{fCa} \cdot \mathrm{Jdark}}{(2 + \mathrm{fCa}) \cdot \mathrm{F} \cdot \mathrm{Vcyto}} \cdot \left(\frac{[\mathrm{cGMP}]}{\mathrm{cGMPdark}} \right)^{\mathrm{ncg}} \tag{225}$$

7.95 Reaction v_r36

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

Name v_r36

Notes cGMP synthesis by guanylate cyclases.

Reaction equation

$$\emptyset \xrightarrow{\mathrm{Ca2\_free}} \mathrm{cGMP} \tag{226}$$

Modifier

Table 193: Properties of each modifier.

Id	Name	SBO
Ca2_free	Ca2_free	

Product

Table 194: Properties of each product.

Id	Name	SBO
cGMP	cGMP	

Kinetic Law

Derived unit contains undeclared units

$$v_{95} = \frac{\text{alfamax}}{1 + \left(\frac{[\text{Ca2\_free}]}{\text{Kc1}}\right)^{\text{m1}}} + \frac{\text{alfamax}}{1 + \left(\frac{[\text{Ca2\_free}]}{\text{Kc2}}\right)^{\text{m2}}} \tag{227}$$

7.96 Reaction v_r37

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

Name v_r37

Notes cGMP hydrolysis by PDE.

Reaction equation

$$\text{cGMP} \xrightarrow{\text{Ga\_GTP\_PDE\_a\_Ga\_GTP, Ga\_GTP\_a\_PDE\_a\_Ga\_GTP, PDE\_a\_Ga\_GTP}} \emptyset \tag{228}$$

Reactant

Table 195: Properties of each reactant.

Id	Name	SBO
cGMP	cGMP	

Modifiers

Table 196: Properties of each modifier.

Id	Name	SBO
Ga_GTP_PDE_a_Ga_GTP	Ga_GTP_PDE_a_Ga_GTP	
Ga_GTP_a_PDE_a_Ga_GTP	Ga_GTP_a_PDE_a_Ga_GTP	
PDE_a_Ga_GTP	PDE_a_Ga_GTP	

Kinetic Law

Derived unit contains undeclared units

$$v_{96} = (\text{betadark} + \text{betasub} \cdot \text{E}) \cdot [\text{cGMP}] \tag{229}$$

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 `Arr`

Name Arr

Initial amount 1260760 mol

This species takes part in 13 reactions (as a reactant in `v_r5_1`, `v_r5_2`, `v_r5_3`, `v_r5_4`, `v_r5_5`, `v_r5_6`, `v_r_diarr` and as a product in `v_r6_1`, `v_r6_2`, `v_r6_3`, `v_r6_4`, `v_r6_5`, `v_r6_6`).

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\text{Arr} = {} & v_{28} + v_{29} + v_{30} + v_{31} + v_{32} + v_{33} - v_{22} \\ & - v_{23} - v_{24} - v_{25} - v_{26} - v_{27} - 2\,v_{90}\end{aligned} \tag{230}$$

8.2 Species `Arr_di`

Name Arr_di

Initial amount 1123300 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Arr\_di} = v_{90} - 2\,v_{91} \tag{231}$$

8.3 Species Arr_tetra

Name Arr_tetra

Initial amount 891810 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Arr\_tetra} = v_{91} \tag{232}$$

8.4 Species Ca2_buff

Name Ca2_buff

Initial concentration $19.2199\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in v_r33).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ca2\_buff} = v_{92} \tag{233}$$

8.5 Species Ca2_free

Name Ca2_free

Initial concentration $0.25\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Involved in rule Ca2_free

This species takes part in five reactions (as a reactant in v_r30, v_r33, v_r34 and as a product in v_r35 and as a modifier in v_r36). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

8.6 Species G_GTP

Name G_GTP

Initial amount 0 mol

This species takes part in nine reactions (as a reactant in v_r17 and as a product in v_r11, v_r16_0, v_r16_1, v_r16_2, v_r16_3, v_r16_4, v_r16_5, v_r16_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{G\_GTP} = v_{44} + v_{68} + v_{69} + v_{70} + v_{71} + v_{72} + v_{73} + v_{74} - v_{75} \tag{234}$$

8.7 Species Ga_GDP

Name Ga_GDP

Initial amount 0 mol

This species takes part in six reactions (as a reactant in v_r29 and as a product in v_r23, v_r25, v_r26, v_r27, v_r28).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ga\_GDP} = v_{81} + v_{83} + v_{84} + v_{85} + v_{86} - v_{87} \tag{235}$$

8.8 Species Ga_GTP

Name Ga_GTP

Initial amount 0 mol

This species takes part in four reactions (as a reactant in v_r18, v_r20, v_r28 and as a product in v_r17).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ga\_GTP} = v_{75} - v_{76} - v_{78} - v_{86} \tag{236}$$

8.9 Species Ga_GTP_PDE_a_Ga_GTP

Name Ga_GTP_PDE_a_Ga_GTP

Initial amount 0 mol

This species takes part in three reactions (as a reactant in v_r21 and as a product in v_r20 and as a modifier in v_r37).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ga\_GTP\_PDE\_a\_Ga\_GTP} = v_{78} - v_{79} \tag{237}$$

8.10 Species Ga_GTP_a_PDE_a_Ga_GTP

Name Ga_GTP_a_PDE_a_Ga_GTP

Initial amount 0 mol

This species takes part in four reactions (as a reactant in v_r22, v_r27 and as a product in v_r21 and as a modifier in v_r37).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} = v_{79} - v_{80} - v_{85} \tag{238}$$

8.11 Species Gbg

Name Gbg

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r29 and as a product in v_r17).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Gbg} = v_{75} - v_{87} \tag{239}$$

8.12 Species Gt

Name Gt

Initial amount 8152500 mol

This species takes part in ten reactions (as a reactant in v_r8, v_GtRpre, v_r13_0, v_r13_1, v_r13_2, v_r13_3, v_r13_4, v_r13_5, v_r13_6 and as a product in v_r29).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Gt} = v_{87} - v_{41} - v_{46} - v_{47} - v_{48} - v_{49} - v_{50} - v_{51} - v_{52} - v_{53} \tag{240}$$

8.13 Species Ops

Name Ops

Initial amount 0 mol

This species takes part in 16 reactions (as a reactant in v_r8, v_r12 and as a product in v_r6_1, v_r6_2, v_r6_3, v_r6_4, v_r6_5, v_r6_6, v_r7_0, v_r7_1, v_r7_2, v_r7_3, v_r7_4, v_r7_5, v_r7_6, v_r11).

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ops} = {} & v_{28} + v_{29} + v_{30} + v_{31} + v_{32} + v_{33} + v_{34} + v_{35} \\ & + v_{36} + v_{37} + v_{38} + v_{39} + v_{40} + v_{44} - v_{41} - v_{45}\end{aligned} \tag{241}$$

8.14 Species Ops_G

Name Ops_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r10 and as a product in v_r9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ops\_G} = v_{42} - v_{43} \tag{242}$$

8.15 Species Ops_G_GTP

Name Ops_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r11 and as a product in v_r10).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ops\_G\_GTP} = v_{43} - v_{44} \tag{243}$$

8.16 Species Ops_Gt

Name Ops_Gt

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r9 and as a product in v_r8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ops\_Gt} = v_{41} - v_{42} \tag{244}$$

8.17 Species PDE

Name PDE

Initial amount 2000000 mol

This species takes part in three reactions (as a reactant in v_r18 and as a product in v_r25, v_r26).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PDE} = v_{83} + v_{84} - v_{76} \tag{245}$$

8.18 Species PDE_Ga_GTP

Name PDE_Ga_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r19 and as a product in v_r18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PDE\_Ga\_GTP} = v_{76} - v_{77} \tag{246}$$

8.19 Species PDE_a_Ga_GTP

Name PDE_a_Ga_GTP

Initial amount 0 mol

This species takes part in seven reactions (as a reactant in v_r20, v_r24, v_r26 and as a product in v_r19, v_r23, v_r27 and as a modifier in v_r37).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PDE\_a\_Ga\_GTP} = v_{77} + v_{81} + v_{85} - v_{78} - v_{82} - v_{84} \tag{247}$$

8.20 Species R

Name R

Initial amount $9.81525 \cdot 10^7$ mol

This species takes part in three reactions (as a reactant in v_r1, v_GtRpre and as a product in v_r12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R} = v_{45} - v_1 - v_{46} \tag{248}$$

8.21 Species R0

Name R0

Initial amount 0 mol

This species takes part in five reactions (as a reactant in v_r2_0, v_r7_0, v_r13_0 and as a product in v_r1, v_r16_0).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R0} = v_1 + v_{68} - v_3 - v_{34} - v_{47} \tag{249}$$

8.22 Species R0_G

Name R0_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r15_0 and as a product in v_r14_0).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R0\_G} = v_{54} - v_{61} \tag{250}$$

8.23 Species R0_G_GTP

Name R0_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r16_0 and as a product in v_r15_0).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R0\_G\_GTP} = v_{61} - v_{68} \tag{251}$$

8.24 Species R0_Gt

Name R0_Gt

Initial amount 0 mol

This species takes part in three reactions (as a reactant in v_r14_0 and as a product in v_rstprec, v_r13_0).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R0\_Gt} = v_{2} + v_{47} - v_{54} \tag{252}$$

8.25 Species R0_RKpre

Name R0_RKpre

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r3_0 and as a product in v_r2_0).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R0\_RKpre} = v_{3} - v_{10} \tag{253}$$

8.26 Species R1

Name R1

Initial amount 0 mol

This species takes part in six reactions (as a reactant in v_r2_1, v_r5_1, v_r7_1, v_r13_1 and as a product in v_r4_1, v_r16_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R1} = v_{16} + v_{69} - v_{4} - v_{22} - v_{35} - v_{48} \tag{254}$$

8.27 Species R1_Arr

Name R1_Arr

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r6_1 and as a product in v_r5_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R1\_Arr} = v_{22} - v_{28} \tag{255}$$

8.28 Species R1_G

Name R1_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r15_1 and as a product in v_r14_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R1\_G} = v_{55} - v_{62} \tag{256}$$

8.29 Species R1_G_GTP

Name R1_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r16_1 and as a product in v_r15_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R1\_G\_GTP} = v_{62} - v_{69} \tag{257}$$

8.30 Species R1_Gt

Name R1_Gt

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r14_1 and as a product in v_r13_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R1\_Gt} = v_{48} - v_{55} \tag{258}$$

8.31 Species R1_RKpost

Name R1_RKpost

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r4_1 and as a product in v_r3_0).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R1\_RKpost} = v_{10} - v_{16} \tag{259}$$

8.32 Species R1_RKpre

Name R1_RKpre

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r3_1 and as a product in v_r2_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R1\_RKpre} = v_4 - v_{11} \tag{260}$$

8.33 Species R2

Name R2

Initial amount 0 mol

This species takes part in six reactions (as a reactant in v_r2_2, v_r5_2, v_r7_2, v_r13_2 and as a product in v_r4_2, v_r16_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R2} = v_{17} + v_{70} - v_5 - v_{23} - v_{36} - v_{49} \tag{261}$$

8.34 Species R2_Arr

Name R2_Arr

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r6_2 and as a product in v_r5_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R2\_Arr} = v_{23} - v_{29} \tag{262}$$

8.35 Species R2_G

Name R2_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r15_2 and as a product in v_r14_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R2\_G} = v_{56} - v_{63} \tag{263}$$

8.36 Species R2_G_GTP

Name R2_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r16_2 and as a product in v_r15_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R2\_G\_GTP} = v_{63} - v_{70} \tag{264}$$

8.37 Species R2_Gt

Name R2_Gt

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r14_2 and as a product in v_r13_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R2\_Gt} = v_{49} - v_{56} \tag{265}$$

8.38 Species R2_RKpost

Name R2_RKpost

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r4_2 and as a product in v_r3_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R2\_RKpost} = v_{11} - v_{17} \tag{266}$$

8.39 Species R2_RKpre

Name R2_RKpre

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r3_2 and as a product in v_r2_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R2\_RKpre} = v_{5} - v_{12} \tag{267}$$

8.40 Species R3

Name R3

Initial amount 0 mol

This species takes part in six reactions (as a reactant in v_r2_3, v_r5_3, v_r7_3, v_r13_3 and as a product in v_r4_3, v_r16_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R3} = v_{18} + v_{71} - v_{6} - v_{24} - v_{37} - v_{50} \tag{268}$$

8.41 Species R3_Arr

Name R3_Arr

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r6_3 and as a product in v_r5_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R3\_Arr} = v_{24} - v_{30} \tag{269}$$

8.42 Species R3_G

Name R3_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r15_3 and as a product in v_r14_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R3\_G} = v_{57} - v_{64} \tag{270}$$

8.43 Species R3_G_GTP

Name R3_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r16_3 and as a product in v_r15_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R3\_G\_GTP} = v_{64} - v_{71} \tag{271}$$

8.44 Species R3_Gt

Name R3_Gt

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r14_3 and as a product in v_r13_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R3\_Gt} = v_{50} - v_{57} \tag{272}$$

8.45 Species R3_RKpost

Name R3_RKpost

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r4_3 and as a product in v_r3_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R3\_RKpost} = v_{12} - v_{18} \tag{273}$$

8.46 Species R3_RKpre

Name R3_RKpre

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r3_3 and as a product in v_r2_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R3\_RKpre} = v_{6} - v_{13} \tag{274}$$

8.47 Species R4

Name R4

Initial amount 0 mol

This species takes part in six reactions (as a reactant in v_r2_4, v_r5_4, v_r7_4, v_r13_4 and as a product in v_r4_4, v_r16_4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R4} = v_{19} + v_{72} - v_{7} - v_{25} - v_{38} - v_{51} \tag{275}$$

8.48 Species R4_Arr

Name R4_Arr

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r6_4 and as a product in v_r5_4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R4\_Arr} = v_{25} - v_{31} \tag{276}$$

8.49 Species R4_G

Name R4_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r15_4 and as a product in v_r14_4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R4\_G} = v_{58} - v_{65} \tag{277}$$

8.50 Species R4_G_GTP

Name R4_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r16_4 and as a product in v_r15_4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R4\_G\_GTP} = v_{65} - v_{72} \tag{278}$$

8.51 Species R4_Gt

Name R4_Gt

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r14_4 and as a product in v_r13_4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R4\_Gt} = v_{51} - v_{58} \tag{279}$$

8.52 Species R4_RKpost

Name R4_RKpost

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r4_4 and as a product in v_r3_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R4\_RKpost} = v_{13} - v_{19} \tag{280}$$

8.53 Species R4_RKpre

Name R4_RKpre

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r3_4 and as a product in v_r2_4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R4\_RKpre} = v_{7} - v_{14} \tag{281}$$

8.54 Species R5

Name R5

Initial amount 0 mol

This species takes part in six reactions (as a reactant in v_r2_5, v_r5_5, v_r7_5, v_r13_5 and as a product in v_r4_5, v_r16_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5} = v_{20} + v_{73} - v_{8} - v_{26} - v_{39} - v_{52} \tag{282}$$

8.55 Species R5_Arr

Name R5_Arr

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r6_5 and as a product in v_r5_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5\_Arr} = v_{26} - v_{32} \tag{283}$$

8.56 Species R5_G

Name R5_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r15_5 and as a product in v_r14_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5\_G} = v_{59} - v_{66} \tag{284}$$

8.57 Species R5_G_GTP

Name R5_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r16_5 and as a product in v_r15_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5\_G\_GTP} = v_{66} - v_{73} \tag{285}$$

8.58 Species R5_Gt

Name R5_Gt

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r14_5 and as a product in v_r13_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5\_Gt} = v_{52} - v_{59} \tag{286}$$

8.59 Species R5_RKpost

Name R5_RKpost

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r4_5 and as a product in v_r3_4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5\_RKpost} = v_{14} - v_{20} \tag{287}$$

8.60 Species R5_RKpre

Name R5_RKpre

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r3_5 and as a product in v_r2_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R5\_RKpre} = v_{8} - v_{15} \tag{288}$$

8.61 Species R6

Name R6

Initial amount 0 mol

This species takes part in six reactions (as a reactant in v_r2_6, v_r5_6, v_r7_6, v_r13_6 and as a product in v_r4_6, v_r16_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R6} = v_{21} + v_{74} - v_{9} - v_{27} - v_{40} - v_{53} \tag{289}$$

8.62 Species R6_Arr

Name R6_Arr

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r6_6 and as a product in v_r5_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R6\_Arr} = v_{27} - v_{33} \tag{290}$$

8.63 Species R6_G

Name R6_G

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r15_6 and as a product in v_r14_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R6\_G} = v_{60} - v_{67} \tag{291}$$

8.64 Species R6_G_GTP

Name R6_G_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r16_6 and as a product in v_r15_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R6\_G\_GTP} = v_{67} - v_{74} \tag{292}$$

8.65 Species R6_Gt

Name R6_Gt

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r14_6 and as a product in v_r13_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R6\_Gt} = v_{53} - v_{60} \tag{293}$$

8.66 Species R6_RKpost

Name R6_RKpost

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r4_6 and as a product in v_r3_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R6\_RKpost} = v_{15} - v_{21} \tag{294}$$

8.67 Species R6_RKpre

Name R6_RKpre

Initial amount 0 mol

This species takes part in one reaction (as a product in v_r2_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R6\_RKpre} = v_9 \tag{295}$$

8.68 Species RGS

Name RGS

Initial amount 100000 mol

This species takes part in four reactions (as a reactant in v_r22, v_r24 and as a product in v_r23, v_r25).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RGS} = v_{81} + v_{83} - v_{80} - v_{82} \tag{296}$$

8.69 Species RGS_Ga_GTP_a_PDE_a_Ga_GTP

Name RGS_Ga_GTP_a_PDE_a_Ga_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r23 and as a product in v_r22).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RGS\_Ga\_GTP\_a\_PDE\_a\_Ga\_GTP} = v_{80} - v_{81} \tag{297}$$

8.70 Species RGS_PDE_a_Ga_GTP

Name RGS_PDE_a_Ga_GTP

Initial amount 0 mol

This species takes part in two reactions (as a reactant in v_r25 and as a product in v_r24).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RGS\_PDE\_a\_Ga\_GTP} = v_{82} - v_{83} \tag{298}$$

8.71 Species RK

Name RK

Initial amount 580 mol

This species takes part in 14 reactions (as a reactant in v_r2_0, v_r2_1, v_r2_2, v_r2_3, v_r2_4, v_r2_5, v_r2_6, v_r31 and as a product in v_r4_1, v_r4_2, v_r4_3, v_r4_4, v_r4_5, v_r4_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RK} = v_{16} + v_{17} + v_{18} + v_{19} + v_{20} + v_{21} - v_3 - v_4 - v_5 - v_6 - v_7 - v_8 - v_9 - v_{89} \tag{299}$$

8.72 Species R_Gt

Name R_Gt

Initial amount 1847500 mol

This species takes part in two reactions (as a reactant in v_rstprec and as a product in v_GtRpre).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R\_Gt} = v_{46} - v_2 \tag{300}$$

8.73 Species RecR_Ca

Name RecR_Ca

Initial amount 510930 mol

This species takes part in two reactions (as a reactant in v_r31 and as a product in v_r30).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RecR\_Ca} = v_{88} - v_{89} \tag{301}$$

8.74 Species RecR_Ca_RK

Name RecR_Ca_RK

Initial amount 199420 mol

This species takes part in one reaction (as a product in v_r31).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RecR\_Ca\_RK} = v_{89} \tag{302}$$

8.75 Species RecT

Name RecT

Initial amount 9289650 mol

This species takes part in one reaction (as a reactant in v_r30).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RecT} = -v_{88} \tag{303}$$

8.76 Species cGMP

Name cGMP

Initial concentration 6.4944 $\mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in v_r37 and as a product in v_r36 and as a modifier in v_r35).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{cGMP} = v_{95} - v_{96} \tag{304}$$

A Glossary of Systems Biology Ontology Terms

SBO:0000290 physical compartment: Specific location of space, that can be bounded or not. A physical compartment can have 1, 2 or 3 dimensions

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