SBML Model Report

Model name: "Borisov2009_EGF_Insulin_Crosstalk"

May 5, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Lukas Endler[1] and Nikolay Borisov[2] at July nineth 2009 at eleven o' clock in the morning. and last time modified at May 28th 2014 at 0:41 a. m. Table 1 gives an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

Element	Quantity	Element	Quantity
compartment types	0	compartments	2
species types	0	species	86
events	0	constraints	0
reactions	109	function definitions	0
global parameters	162	unit definitions	7
rules	29	initial assignments	0

Model Notes

described in: **Systems-level interactions between insulin-EGF networks amplify mitogenic signaling.**
Borisov N, Aksamitiene E, Kiyatkin A, Legewie S, Berkhout J, Maiwald T, Kaimachnikov

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NP, Timmer J, Hoek JB, Kholodenko BN.;Mol Syst Biol. 2009;5:256. Epub 2009 Apr 7. PMID:19357636; doi:10.1038/msb.2009.19

Abstract:
Crosstalk mechanisms have not been studied as thoroughly as individual signaling pathways. We exploit experimental and computational approaches to reveal how a concordant interplay between the insulin and epidermal growth factor (EGF) signaling networks can potentiate mitogenic signaling. In HEK293 cells, insulin is a poor activator of the Ras/ERK (extracellular signal-regulated kinase) cascade, yet it enhances ERK activation by low EGF doses. We find that major crosstalk mechanisms that amplify ERK signaling are localized upstream of Ras and at the Ras/Raf level. Computational modeling unveils how critical network nodes, the adaptor proteins GAB1 and insulin receptor substrate (IRS), Src kinase, and phosphatase SHP2, convert insulin-induced increase in the phosphatidylinositol-3,4,5-triphosphate (PIP(3)) concentration into enhanced Ras/ERK activity. The model predicts and experiments confirm that insulin-induced amplification of mitogenic signaling is abolished by disrupting PIP(3)-mediated positive feedback via GAB1 and IRS. We demonstrate that GAB1 behaves as a non-linear amplifier of mitogenic responses and insulin endows EGF signaling with robustness to GAB1 suppression. Our results show the feasibility of using computational models to identify key target combinations and predict complex cellular responses to a mixture of external cues.

An extracellular compartment with 34 times the volume of the cell was added and the association rate as well as the dissociation constants for Insulin and EGF binding were altered (k_{on}'=34*k_{on}, K_D'=K_D/34). This was done to allow using the concentrations for those species given in the article and retaining the same dynamics and Ligand depletion as in the matlab file the SBML file was exported from.

SBML model exported from PottersWheel on 2008-10-14 16:26:44.

2 Unit Definitions

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

2.1 Unit `substance`

Name nanomole

Definition nmol

2.2 Unit time

Name seconds

Definition s

2.3 Unit nM

Name nM

Definition $\mathrm{nmol} \cdot \mathrm{l}^{-1}$

2.4 Unit per_nM

Name per_nM

Definition $\mathrm{nmol}^{-1} \cdot \mathrm{l}$

2.5 Unit per_sec

Name per second

Definition s^{-1}

2.6 Unit nM_per_s

Name nM per sec

Definition $\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot \mathrm{s}^{-1}$

2.7 Unit per_nMs

Name per nM per s

Definition $\mathrm{l} \cdot \mathrm{nmol}^{-1} \cdot \mathrm{s}^{-1}$

2.8 Unit volume

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

Definition l

2.9 Unit area

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

Definition m^2

2.10 Unit `length`

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

Definition m

3 Compartments

This model contains two compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
`cell`	cell		3	1	litre	☑	
`extra`	extracellular space		3	34	l	☑	

3.1 Compartment `cell`

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

Name cell

3.2 Compartment `extra`

This is a three dimensional compartment with a constant size of 34 litre.

Name extracellular space

4 Species

This model contains 86 species. Section 8 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
EGF		extra	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
I		extra	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
RE		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rd		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rp		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rp_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Shc		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rp_Shc		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rp_pShc		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
pShc		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rp_pShc_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PI3K		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rp_PI3K		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
RasGAP		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rp_RasGAP		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRL		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRp		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRp_PI3K		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRp_RasGAP		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRp_IRS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
IRp_IRSp		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
IRSp		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
iSrc		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mIRS		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mIRSp		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mIRSp_GS		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mIRSp_PI3K		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
SHP2		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mIRSp_SHP2		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
GAB		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mGAB		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mGABp		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mGABp_GS		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mGABp_PI3K		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mGABp_SHP2		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mGABp_pSHP2		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
PIP3		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
dRas		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
Raf		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
aRaf		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
Mek		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
Erk		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
pErk		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
PDK1		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
Akt		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
pAkt		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟
mTOR		cell	$\mathrm{nmol \cdot l^{-1}}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Null		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
aaRaf		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PKA		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
pShc_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
ppMek		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
mGABp_pSHP2_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
R		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
ppErk		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IR		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
mPDK1		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
tRas		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
tRas_PI3K		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
ppAkt		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
mGABp_RasGAP		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
amTOR		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
iGS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
imGAB		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
imIRS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
aSrc		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Ri		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRi		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
iPX		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
aPX		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
aPX_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRSp_PI3K		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRSp_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IRSp_SHP2		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
GABp		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GABp_PI3K		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GABp_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GABp_RasGAP		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GABp_SHP2		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GABp_pSHP2		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GABp_pSHP2_GS		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
imGABp		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
bRasGAP		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
phosphorylated_Akt		cell	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Parameters

This model contains 162 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
EGF_tot			3.400	$\mathrm{nmol \cdot l^{-1}}$	☐
k1			0.068	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd1			0.588	$\mathrm{nmol \cdot l^{-1}}$	☑
k2			0.033	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd2			15.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k3			0.400	$\mathrm{s^{-1}}$	☑
k4			$6.66 \cdot 10^{-4}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd4			10.000	$\mathrm{nmol \cdot l^{-1}}$	☑
Kd5			10.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k5			0.013	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
k6			0.333	$\mathrm{s^{-1}}$	☑
k7			$6.66 \cdot 10^{-4}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd7			400.000	$\mathrm{nmol \cdot l^{-1}}$	☑
V8			200.000	$\mathrm{nmol \cdot l^{-1} \cdot s^{-1}}$	☑
Km8			100.000	$\mathrm{nmol \cdot l^{-1}}$	☑
Kd9			10.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k9			0.007	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd10			400.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k10			$4 \cdot 10^{-4}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
k11			0.000	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☐
k12			0.009	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd12			12.450	$\mathrm{nmol \cdot l^{-1}}$	☑
k13			$6.66 \cdot 10^{-6}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd13			200.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k17			$1.85 \cdot 10^{-4}$	$\mathrm{s^{-1}}$	☑
k24			0.011	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd24			0.029	$\mathrm{nmol \cdot l^{-1}}$	☑
k25			1.660	$\mathrm{s^{-1}}$	☑
k26			0.009	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd26			124.500	$\mathrm{nmol \cdot l^{-1}}$	☑
k27			$6.66 \cdot 10^{-8}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd27			2000000.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k28			0.107	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd28			3.750	$\mathrm{nmol \cdot l^{-1}}$	☑
k29			0.660	$\mathrm{s^{-1}}$	☑
k30			0.007	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑

Id	Name	SBO	Value	Unit	Constant
Kd30			10.000	$\mathrm{nmol \cdot l^{-1}}$	☑
V31			333.000	$\mathrm{nmol \cdot l^{-1} \cdot s^{-1}}$	☑
Km31			143.300	$\mathrm{nmol \cdot l^{-1}}$	☑
kcat40			6.600	$\mathrm{s^{-1}}$	☑
Km40			110.000	$\mathrm{nmol \cdot l^{-1}}$	☑
alpha40			$2.5 \cdot 10^{-4}$	dimensionless	☑
V41			6.660	$\mathrm{nmol \cdot l^{-1} \cdot s^{-1}}$	☑
Km41			50.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k42			0.007	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd42			10.000	$\mathrm{nmol \cdot l^{-1}}$	☑
kcat43			33.300	$\mathrm{s^{-1}}$	☑
Km43			150.000	$\mathrm{nmol \cdot l^{-1}}$	☑
alpha43			0.050	dimensionless	☑
Kd45			100000.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k45			$6.66 \cdot 10^{-4}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
k46			0.007	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd46			1.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k47			$6.66 \cdot 10^{-4}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd47			1000.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k48			0.666	$\mathrm{s^{-1}}$	☑
k49			$6.66 \cdot 10^{-4}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd49			1.000	$\mathrm{nmol \cdot l^{-1}}$	☑
kcat50			3333.000	$\mathrm{s^{-1}}$	☑
alpha50			10^{-4}	dimensionless	☑
Km50			150.000	$\mathrm{nmol \cdot l^{-1}}$	☑
V51			333.000	$\mathrm{nmol \cdot l^{-1} \cdot s^{-1}}$	☑
Km51			130.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k52			0.002	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd52			1.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k53			0.013	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd53			2.500	$\mathrm{nmol \cdot l^{-1}}$	☑
k54			10^{-5}	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd54			66666.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k55			$6.66 \cdot 10^{-4}$	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd55			100.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k56			0.666	$\mathrm{s^{-1}}$	☑
kcat57			0.133	$\mathrm{s^{-1}}$	☑
Km57			150.000	$\mathrm{nmol \cdot l^{-1}}$	☑
V58			2.000	$\mathrm{nmol \cdot l^{-1} \cdot s^{-1}}$	☑
Km58			130.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k59			0.010	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
Kd59			20.000	$\mathrm{nmol \cdot l^{-1}}$	☑

Id	Name	SBO	Value	Unit	Constant
k60			4.660	s^{-1}	☑
k61			3.330	s^{-1}	☑
kcat62			5.330	s^{-1}	☑
Km62			50.000	$nmol \cdot l^{-1}$	☑
kcat63			20000.000	s^{-1}	☑
Km63			50.000	$nmol \cdot l^{-1}$	☑
k64			0.000	$l \cdot nmol^{-1} \cdot s^{-1}$	☑
k_64			2.500	s^{-1}	☑
kcat65			0.100	s^{-1}	☑
Km65			400.000	$nmol \cdot l^{-1}$	☑
kcat66			3.330	s^{-1}	☑
Km66			10.000	$nmol \cdot l^{-1}$	☑
kcat67			0.666	s^{-1}	☑
Km67			10000.000	$nmol \cdot l^{-1}$	☑
alpha67			10^{-6}	$l \cdot nmol^{-1} \cdot s^{-1}$	☑
beta67			2.000	dimensionless	☑
kcat68			0.133	s^{-1}	☑
Km68			50.000	$nmol \cdot l^{-1}$	☑
V69			16.600	$nmol \cdot l^{-1} \cdot s^{-1}$	☑
Km69			675.299	$nmol \cdot l^{-1}$	☑
kcat70			0.333	s^{-1}	☑
Km70			500.000	$nmol \cdot l^{-1}$	☑
kcat71			0.666	s^{-1}	☑
Km71			500.000	$nmol \cdot l^{-1}$	☑
V72			33.300	$nmol \cdot l^{-1} \cdot s^{-1}$	☑
Km72			500.000	$nmol \cdot l^{-1}$	☑
V73			23.330	$nmol \cdot l^{-1} \cdot s^{-1}$	☑
Km73			500.000	$nmol \cdot l^{-1}$	☑
k74			0.007	$l \cdot nmol^{-1} \cdot s^{-1}$	☑
Kd74			100.000	$nmol \cdot l^{-1}$	☑
kcat75			4.660	s^{-1}	☑
Km75			500.000	$nmol \cdot l^{-1}$	☑
V76			16.660	$nmol \cdot l^{-1} \cdot s^{-1}$	☑
Km76			1.000	$nmol \cdot l^{-1}$	☑
kcat77			0.666	s^{-1}	☑
alpha77			0.500	dimensionless	☑
Km77			100.000	$nmol \cdot l^{-1}$	☑
k_77			0.666	s^{-1}	☑
kcat78			0.666	s^{-1}	☑
Km78			100.000	$nmol \cdot l^{-1}$	☑
k_78			0.666	s^{-1}	☑
kcat79			0.047	s^{-1}	☑

Id	Name	SBO	Value	Unit	Constant
Km79			5000.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k_79			$6.66 \cdot 10^{-5}$	$\mathrm{s^{-1}}$	☑
kcat80			0.040	$\mathrm{s^{-1}}$	☑
Km80			700.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k_80			$6.66 \cdot 10^{-5}$	$\mathrm{s^{-1}}$	☑
kcat81			0.166	$\mathrm{s^{-1}}$	☑
Km81			300.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k_81			$6.66 \cdot 10^{-5}$	$\mathrm{s^{-1}}$	☑
V_82			133.000	$\mathrm{nmol \cdot l^{-1} \cdot s^{-1}}$	☑
Km82			50.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k83			0.017	$\mathrm{s^{-1}}$	☑
V_84			333.000	$\mathrm{nmol \cdot l^{-1} \cdot s^{-1}}$	☑
Km84			266.000	$\mathrm{nmol \cdot l^{-1}}$	☑
k85			0.017	$\mathrm{s^{-1}}$	☑
k111			0.013	$\mathrm{l \cdot nmol^{-1} \cdot s^{-1}}$	☑
k118			0.001	$\mathrm{s^{-1}}$	☑
k_1			0.000	$\mathrm{s^{-1}}$	⊟
k_2			0.000	$\mathrm{s^{-1}}$	⊟
k_4			0.000	$\mathrm{s^{-1}}$	⊟
k_5			0.000	$\mathrm{s^{-1}}$	⊟
k_7			0.000	$\mathrm{s^{-1}}$	⊟
k_9			0.000	$\mathrm{s^{-1}}$	⊟
k_10			0.000	$\mathrm{s^{-1}}$	⊟
k_11			0.000	$\mathrm{s^{-1}}$	⊟
k_12			0.000	$\mathrm{s^{-1}}$	⊟
k_13			0.000	$\mathrm{s^{-1}}$	⊟
k_24			0.000	$\mathrm{s^{-1}}$	⊟
k_26			0.000	$\mathrm{s^{-1}}$	⊟
k_27			0.000	$\mathrm{s^{-1}}$	⊟
k_28			0.000	$\mathrm{s^{-1}}$	⊟
k_30			0.000	$\mathrm{s^{-1}}$	⊟
k_42			0.000	$\mathrm{s^{-1}}$	⊟
k_45			0.000	$\mathrm{s^{-1}}$	⊟
k_46			0.000	$\mathrm{s^{-1}}$	⊟
k_47			0.000	$\mathrm{s^{-1}}$	⊟
k_49			0.000	$\mathrm{s^{-1}}$	⊟
k_52			0.000	$\mathrm{s^{-1}}$	⊟
k_53			0.000	$\mathrm{s^{-1}}$	⊟
k_54			0.000	$\mathrm{s^{-1}}$	⊟
k_55			0.000	$\mathrm{s^{-1}}$	⊟
k_59			0.000	$\mathrm{s^{-1}}$	⊟
k_74			0.000	$\mathrm{s^{-1}}$	⊟

Id	Name	SBO	Value	Unit	Constant

6 Rules

This is an overview of 29 rules.

6.1 Rule phosphorylated_Akt

Rule phosphorylated_Akt is an assignment rule for species phosphorylated_Akt:

$$\text{phosphorylated\_Akt} = [\text{pAkt}] + [\text{ppAkt}] \tag{1}$$

Derived unit $\text{nmol} \cdot \text{l}^{-1}$

6.2 Rule EGF_tot

Rule EGF_tot is an assignment rule for parameter EGF_tot:

$$\begin{aligned}\text{EGF\_tot} = [\text{EGF}] + ([\text{RE}] + 2 \cdot ([\text{Rd}] + [\text{Rp}] + [\text{Ri}] + [\text{Rp\_GS}] + [\text{Rp\_Shc}] + [\text{Rp\_pShc}] \\ + [\text{Rp\_pShc\_GS}] + [\text{Rp\_PI3K}] + [\text{Rp\_RasGAP}])) \cdot \frac{\text{vol}(\text{cell})}{\text{vol}(\text{extra})}\end{aligned} \tag{2}$$

6.3 Rule k_1

Rule k_1 is an assignment rule for parameter k_1:

$$\text{k\_1} = \text{Kd1} \cdot \text{k1} \tag{3}$$

Derived unit s^{-1}

6.4 Rule k_2

Rule k_2 is an assignment rule for parameter k_2:

$$\text{k\_2} = \text{Kd2} \cdot \text{k2} \tag{4}$$

Derived unit s^{-1}

6.5 Rule k_4

Rule k_4 is an assignment rule for parameter k_4:

$$\text{k\_4} = \text{Kd4} \cdot \text{k4} \tag{5}$$

Derived unit s^{-1}

6.6 Rule k_5

Rule k_5 is an assignment rule for parameter k_5:

$$\mathrm{k\_5} = \mathrm{Kd5} \cdot \mathrm{k5} \tag{6}$$

Derived unit s^{-1}

6.7 Rule k_7

Rule k_7 is an assignment rule for parameter k_7:

$$\mathrm{k\_7} = \mathrm{Kd7} \cdot \mathrm{k7} \tag{7}$$

Derived unit s^{-1}

6.8 Rule k_9

Rule k_9 is an assignment rule for parameter k_9:

$$\mathrm{k\_9} = \mathrm{Kd9} \cdot \mathrm{k9} \tag{8}$$

Derived unit s^{-1}

6.9 Rule k_10

Rule k_10 is an assignment rule for parameter k_10:

$$\mathrm{k\_10} = \mathrm{Kd10} \cdot \mathrm{k10} \tag{9}$$

Derived unit s^{-1}

6.10 Rule k_11

Rule k_11 is an assignment rule for parameter k_11:

$$\mathrm{k\_11} = \mathrm{k\_9} \tag{10}$$

Derived unit s^{-1}

6.11 Rule k11

Rule k11 is an assignment rule for parameter k11:

$$\mathrm{k11} = \mathrm{k9} \tag{11}$$

Derived unit $\mathrm{l} \cdot \mathrm{nmol}^{-1} \cdot \mathrm{s}^{-1}$

6.12 Rule k_12

Rule k_12 is an assignment rule for parameter k_12:

$$\mathrm{k\_12} = \mathrm{Kd12} \cdot \mathrm{k12} \tag{12}$$

Derived unit s^{-1}

6.13 Rule k_13

Rule k_13 is an assignment rule for parameter k_13:

$$\mathrm{k\_13} = \mathrm{Kd13} \cdot \mathrm{k13} \tag{13}$$

Derived unit s^{-1}

6.14 Rule k_24

Rule k_24 is an assignment rule for parameter k_24:

$$\mathrm{k\_24} = \mathrm{Kd24} \cdot \mathrm{k24} \tag{14}$$

Derived unit s^{-1}

6.15 Rule k_26

Rule k_26 is an assignment rule for parameter k_26:

$$\mathrm{k\_26} = \mathrm{Kd26} \cdot \mathrm{k26} \tag{15}$$

Derived unit s^{-1}

6.16 Rule k_27

Rule k_27 is an assignment rule for parameter k_27:

$$\mathrm{k\_27} = \mathrm{Kd27} \cdot \mathrm{k27} \tag{16}$$

Derived unit s^{-1}

6.17 Rule k_28

Rule k_28 is an assignment rule for parameter k_28:

$$\mathrm{k\_28} = \mathrm{Kd28} \cdot \mathrm{k28} \tag{17}$$

Derived unit s^{-1}

6.18 Rule k_30

Rule k_30 is an assignment rule for parameter k_30:

$$\mathrm{k\_30} = \mathrm{Kd30} \cdot \mathrm{k30} \tag{18}$$

Derived unit s^{-1}

6.19 Rule k_42

Rule k_42 is an assignment rule for parameter k_42:

$$\mathrm{k\_42} = \mathrm{Kd42} \cdot \mathrm{k42} \tag{19}$$

Derived unit s^{-1}

6.20 Rule k_45

Rule k_45 is an assignment rule for parameter k_45:

$$\mathrm{k\_45} = \mathrm{k45} \cdot \mathrm{Kd45} \tag{20}$$

Derived unit s^{-1}

6.21 Rule k_46

Rule k_46 is an assignment rule for parameter k_46:

$$\mathrm{k\_46} = \mathrm{Kd46} \cdot \mathrm{k46} \tag{21}$$

Derived unit s^{-1}

6.22 Rule k_47

Rule k_47 is an assignment rule for parameter k_47:

$$\mathrm{k\_47} = \mathrm{Kd47} \cdot \mathrm{k47} \tag{22}$$

Derived unit s^{-1}

6.23 Rule k_49

Rule k_49 is an assignment rule for parameter k_49:

$$\mathrm{k\_49} = \mathrm{Kd49} \cdot \mathrm{k49} \tag{23}$$

Derived unit s^{-1}

6.24 Rule k_52

Rule k_52 is an assignment rule for parameter k_52:

$$\mathrm{k\_52} = \mathrm{k52} \cdot \mathrm{Kd52} \tag{24}$$

Derived unit s^{-1}

6.25 Rule k_53

Rule k_53 is an assignment rule for parameter k_53:

$$\mathrm{k\_53} = \mathrm{Kd53} \cdot \mathrm{k53} \tag{25}$$

Derived unit s^{-1}

6.26 Rule k_54

Rule k_54 is an assignment rule for parameter k_54:

$$\mathrm{k\_54} = \mathrm{Kd54} \cdot \mathrm{k54} \tag{26}$$

Derived unit s^{-1}

6.27 Rule k_55

Rule k_55 is an assignment rule for parameter k_55:

$$\mathrm{k\_55} = \mathrm{Kd55} \cdot \mathrm{k55} \tag{27}$$

Derived unit s^{-1}

6.28 Rule k_59

Rule k_59 is an assignment rule for parameter k_59:

$$\mathrm{k\_59} = \mathrm{Kd59} \cdot \mathrm{k59} \tag{28}$$

Derived unit s^{-1}

6.29 Rule k_74

Rule k_74 is an assignment rule for parameter k_74:

$$\mathrm{k\_74} = \mathrm{k74} \cdot \mathrm{Kd74} \tag{29}$$

Derived unit s^{-1}

7 Reactions

This model contains 109 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	reaction_1		$R + EGF \rightleftharpoons RE$	
2	reaction_2		$2\,RE \rightleftharpoons Rd$	
3	reaction_3		$Rd \longrightarrow Rp$	
4	reaction_4		$Rp + GS \rightleftharpoons Rp\_GS$	
5	reaction_5		$Rp + Shc \rightleftharpoons Rp\_Shc$	
6	reaction_6		$Rp\_Shc \longrightarrow Rp\_pShc$	
7	reaction_7		$Rp\_pShc \rightleftharpoons Rp + pShc$	
8	reaction_8		$pShc \longrightarrow Shc$	
9	reaction_9		$GS + Rp\_pShc \rightleftharpoons Rp\_pShc\_GS$	
10	reaction_10		$Rp\_pShc\_GS \rightleftharpoons Rp + pShc\_GS$	
11	reaction_11		$pShc\_GS \rightleftharpoons GS + pShc$	
12	reaction_12		$Rp + PI3K \rightleftharpoons Rp\_PI3K$	
13	reaction_13		$Rp + RasGAP \rightleftharpoons Rp\_RasGAP$	
14	reaction_17		$Rp \longrightarrow Null$	
15	reaction_18		$Rp\_GS \longrightarrow GS$	
16	reaction_19		$Rp\_Shc \longrightarrow Shc$	
17	reaction_20		$Rp\_pShc \longrightarrow pShc$	
18	reaction_21		$Rp\_pShc\_GS \longrightarrow pShc\_GS$	
19	reaction_22		$Rp\_PI3K \longrightarrow PI3K$	
20	reaction_23		$Rp\_RasGAP \longrightarrow RasGAP$	
21	reaction_24		$I + IR \rightleftharpoons IRL$	
22	reaction_25		$IRL \longrightarrow IRp$	
23	reaction_26		$PI3K + IRp \rightleftharpoons IRp\_PI3K$	

№	Id	Name	Reaction Equation	SBO
24	reaction_27		$\mathrm{RasGAP} + \mathrm{IRp} \rightleftharpoons \mathrm{IRp\_RasGAP}$	
25	reaction_28		$\mathrm{IRp} + \mathrm{IRS} \rightleftharpoons \mathrm{IRp\_IRS}$	
26	reaction_29		$\mathrm{IRp\_IRS} \longrightarrow \mathrm{IRp\_IRSp}$	
27	reaction_30		$\mathrm{IRp\_IRSp} \rightleftharpoons \mathrm{IRp} + \mathrm{IRSp}$	
28	reaction_31		$\mathrm{IRSp} \longrightarrow \mathrm{IRS}$	
29	reaction_34		$\mathrm{IRp} \longrightarrow \mathrm{Null}$	
30	reaction_35		$\mathrm{IRp\_PI3K} \longrightarrow \mathrm{PI3K}$	
31	reaction_36		$\mathrm{IRp\_RasGAP} \longrightarrow \mathrm{RasGAP}$	
32	reaction_37		$\mathrm{IRp\_IRS} \longrightarrow \mathrm{IRS}$	
33	reaction_38		$\mathrm{IRp\_IRSp} \longrightarrow \mathrm{IRSp}$	
34	reaction_40		$\mathrm{iSrc} \xrightarrow{\mathrm{Rp,\ IRp}} \mathrm{aSrc}$	
35	reaction_41		$\mathrm{aSrc} \longrightarrow \mathrm{iSrc}$	
36	reaction_42		$\mathrm{IRS} + \mathrm{PIP3} \rightleftharpoons \mathrm{mIRS}$	
37	reaction_43		$\mathrm{mIRS} \xrightarrow{\mathrm{Rp,\ IRp}} \mathrm{mIRSp}$	
38	reaction_44		$\mathrm{mIRSp} \longrightarrow \mathrm{mIRS}$	
39	reaction_45		$\mathrm{GS} + \mathrm{mIRSp} \rightleftharpoons \mathrm{mIRSp\_GS}$	
40	reaction_46		$\mathrm{PI3K} + \mathrm{mIRSp} \rightleftharpoons \mathrm{mIRSp\_PI3K}$	
41	reaction_47		$\mathrm{mIRSp} + \mathrm{SHP2} \rightleftharpoons \mathrm{mIRSp\_SHP2}$	
42	reaction_48		$\mathrm{mIRSp\_SHP2} \longrightarrow \mathrm{mIRS} + \mathrm{SHP2}$	
43	reaction_49		$\mathrm{GAB} + \mathrm{PIP3} \rightleftharpoons \mathrm{mGAB}$	
44	reaction_50		$\mathrm{mGAB} \xrightarrow{\mathrm{Rp,\ aSrc}} \mathrm{mGABp}$	
45	reaction_51		$\mathrm{mGABp} \longrightarrow \mathrm{mGAB}$	
46	reaction_52		$\mathrm{GS} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_GS}$	
47	reaction_53		$\mathrm{PI3K} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_PI3K}$	
48	reaction_54		$\mathrm{RasGAP} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_RasGAP}$	
49	reaction_55		$\mathrm{SHP2} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_SHP2}$	
50	reaction_56		$\mathrm{mGABp\_SHP2} \longrightarrow \mathrm{SHP2} + \mathrm{mGAB}$	

№	Id	Name	Reaction Equation	SBO
51	reaction_57		$\text{mGABp\_SHP2} \xrightarrow{\text{Rp, aSrc}} \text{mGABp\_pSHP2}$	
52	reaction_58		$\text{mGABp\_pSHP2} \longrightarrow \text{mGABp\_SHP2}$	
53	reaction_59		$\text{GS} + \text{mGABp\_pSHP2} \rightleftharpoons \text{mGABp\_pSHP2\_GS}$	
54	reaction_60		$\emptyset \xrightarrow{\text{Rp\_PI3K, IRp\_PI3K, mIRSp\_PI3K, mGABp\_PI3K, tRas\_PI3K}} \text{PIP3}$	
55	reaction_61		$\text{PIP3} \longrightarrow \text{Null}$	
56	reaction_62		$\text{dRas} \xrightarrow{\text{Rp\_GS, Rp\_pShc\_GS, mIRSp\_GS, mGABp\_GS, mGABp\_pSHP2\_GS}} \text{tRas}$	
57	reaction_63		$\text{tRas} \xrightarrow{\text{Rp\_RasGAP, IRp\_RasGAP, mGABp\_RasGAP, bRasGAP}} \text{dRas}$	
58	reaction_64		$\text{PI3K} + \text{tRas} \longrightarrow \text{tRas\_PI3K}$	
59	reaction_65		$\text{Raf} \xrightarrow{\text{tRas}} \text{aRaf}$	
60	reaction_66		$\text{aRaf} \xrightarrow{\text{aSrc}} \text{aaRaf}$	
61	reaction_67		$\text{aaRaf} \xrightarrow{\text{pAkt, PKA, ppAkt}} \text{Raf}$	
62	reaction_68		$\text{Mek} \xrightarrow{\text{aaRaf}} \text{ppMek}$	
63	reaction_69		$\text{ppMek} \longrightarrow \text{Mek}$	
64	reaction_70		$\text{Erk} \xrightarrow{\text{ppMek}} \text{pErk}$	
65	reaction_71		$\text{pErk} \xrightarrow{\text{Erk, ppMek}} \text{ppErk}$	
66	reaction_72		$\text{ppErk} \longrightarrow \text{pErk}$	
67	reaction_73		$\text{pErk} \xrightarrow{\text{ppErk}} \text{Erk}$	
68	reaction_74		$\text{PIP3} + \text{PDK1} \rightleftharpoons \text{mPDK1}$	
69	reaction_75		$\text{Akt} \xrightarrow{\text{mPDK1}} \text{pAkt}$	
70	reaction_76		$\text{pAkt} \longrightarrow \text{Akt}$	
71	reaction_77		$\text{mTOR} \xrightleftharpoons{\text{pAkt, ppAkt}} \text{amTOR}$	
72	reaction_78		$\text{pAkt} \xrightleftharpoons{\text{amTOR}} \text{ppAkt}$	

№	Id	Name	Reaction Equation	SBO
73	reaction_79		$GS \overset{ppErk}{\rightleftharpoons} iGS$	
74	reaction_80		$mGAB \overset{ppErk}{\rightleftharpoons} imGAB$	
75	reaction_81		$mIRS \overset{amTOR}{\rightleftharpoons} imIRS$	
76	reaction_82		$Rp \longrightarrow Ri$	
77	reaction_83		$Ri \longrightarrow Rd$	
78	reaction_84		$IRp \longrightarrow IRi$	
79	reaction_85		$IRi \longrightarrow IRL$	
80	reaction_88		$mIRSp \rightleftharpoons IRSp + PIP3$	
81	reaction_89		$mIRSp\_PI3K \rightleftharpoons PIP3 + IRSp\_PI3K$	
82	reaction_90		$mIRSp\_GS \rightleftharpoons PIP3 + IRSp\_GS$	
83	reaction_91		$mIRSp\_SHP2 \rightleftharpoons PIP3 + IRSp\_SHP2$	
84	reaction_92		$mGABp \rightleftharpoons PIP3 + GABp$	
85	reaction_93		$mGABp\_PI3K \rightleftharpoons PIP3 + GABp\_PI3K$	
86	reaction_94		$mGABp\_GS \rightleftharpoons PIP3 + GABp\_GS$	
87	reaction_95		$mGABp\_RasGAP \rightleftharpoons PIP3 + GABp\_RasGAP$	
88	reaction_96		$mGABp\_SHP2 \rightleftharpoons PIP3 + GABp\_SHP2$	
89	reaction_97		$mGABp\_pSHP2 \rightleftharpoons PIP3 + GABp\_pSHP2$	
90	reaction_98		$mGABp\_pSHP2\_GS \rightleftharpoons PIP3 + GABp\_pSHP2\_GS$	
91	reaction_99		$IRSp\_PI3K \longrightarrow PI3K + IRS$	
92	reaction_100		$IRSp\_GS \longrightarrow GS + IRS$	
93	reaction_101		$IRSp\_SHP2 \longrightarrow IRS + SHP2$	
94	reaction_102		$mGABp\_pSHP2 \longrightarrow SHP2 + mGAB$	
95	reaction_103		$mGABp\_pSHP2\_GS \longrightarrow GS + SHP2 + mGAB$	
96	reaction_104		$GABp \longrightarrow GAB$	
97	reaction_105		$GABp\_PI3K \longrightarrow PI3K + GAB$	
98	reaction_106		$GABp\_GS \longrightarrow GS + GAB$	
99	reaction_107		$GABp\_RasGAP \longrightarrow RasGAP + GAB$	

№	Id	Name	Reaction Equation	SBO
100	reaction_108		$\mathrm{GABp\_SHP2} \longrightarrow \mathrm{SHP2} + \mathrm{GAB}$	
101	reaction_109		$\mathrm{GABp\_pSHP2} \longrightarrow \mathrm{SHP2} + \mathrm{GAB}$	
102	reaction_110		$\mathrm{GABp\_pSHP2\_GS} \longrightarrow \mathrm{GS} + \mathrm{SHP2} + \mathrm{GAB}$	
103	reaction_111		$\mathrm{mGABp\_RasGAP} \xrightarrow{\mathrm{mIRSp\_SHP2,\ mGABp\_SHP2,\ mGABp\_pSHP2,\ mGABp\_pSHP2\_}$ mGAB	
104	reaction_112		$\mathrm{Rp\_RasGAP} \xrightarrow{\mathrm{mGABp\_SHP2,\ mGABp\_pSHP2,\ mGABp\_pSHP2\_GS}} \mathrm{Rp} +$ RasGAP	
105	reaction_113		$\mathrm{IRp\_RasGAP} \xrightarrow{\mathrm{mGABp\_SHP2,\ mGABp\_pSHP2,\ mGABp\_pSHP2\_GS}} \mathrm{RasGAP} +$ IRp	
106	reaction_114		$\mathrm{Rp\_RasGAP} \xrightarrow{\mathrm{mIRSp\_SHP2}} \mathrm{Rp} + \mathrm{RasGAP}$	
107	reaction_115		$\mathrm{IRp\_RasGAP} \xrightarrow{\mathrm{mIRSp\_SHP2}} \mathrm{RasGAP} + \mathrm{IRp}$	
108	reaction_117		$\mathrm{mGABp} \overset{\mathrm{ppErk}}{\rightleftharpoons} \mathrm{imGABp}$	
109	reaction_118		$\mathrm{imGABp} \longrightarrow \mathrm{imGAB}$	

7.1 Reaction reaction_1

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

Reaction equation

$$\mathrm{R} + \mathrm{EGF} \rightleftharpoons \mathrm{RE} \tag{30}$$

Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
R		
EGF		

Product

Table 7: Properties of each product.

Id	Name	SBO
RE		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_1 = (\mathrm{k1} \cdot [\mathrm{R}] \cdot [\mathrm{EGF}] - \mathrm{k\_1} \cdot [\mathrm{RE}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{31}$$

7.2 Reaction reaction_2

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

Reaction equation

$$2\,\mathrm{RE} \rightleftharpoons \mathrm{Rd} \tag{32}$$

Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
RE		

Product

Table 9: Properties of each product.

Id	Name	SBO
Rd		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_2 = (\mathrm{k2} \cdot [\mathrm{RE}] \cdot [\mathrm{RE}] - \mathrm{k\_2} \cdot [\mathrm{Rd}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{33}$$

7.3 Reaction `reaction_3`

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

Reaction equation

$$\mathrm{Rd} \longrightarrow \mathrm{Rp} \tag{34}$$

Reactant

Table 10: Properties of each reactant.

Id	Name	SBO
Rd		

Product

Table 11: Properties of each product.

Id	Name	SBO
Rp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_3 = \mathrm{k3} \cdot [\mathrm{Rd}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{35}$$

7.4 Reaction reaction_4

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

Reaction equation

$$\mathrm{Rp} + \mathrm{GS} \rightleftharpoons \mathrm{Rp\_GS} \tag{36}$$

Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
Rp		
GS		

Product

Table 13: Properties of each product.

Id	Name	SBO
Rp_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_4 = (\mathrm{k4} \cdot [\mathrm{Rp}] \cdot [\mathrm{GS}] - \mathrm{k\_4} \cdot [\mathrm{Rp\_GS}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{37}$$

7.5 Reaction reaction_5

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

Reaction equation

$$\mathrm{Rp} + \mathrm{Shc} \rightleftharpoons \mathrm{Rp\_Shc} \tag{38}$$

Reactants

Table 14: Properties of each reactant.

Id	Name	SBO
Rp		

Id	Name	SBO
Shc		

Product

Table 15: Properties of each product.

Id	Name	SBO
Rp_Shc		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_5 = (\mathrm{k5} \cdot [\mathrm{Rp}] \cdot [\mathrm{Shc}] - \mathrm{k\_5} \cdot [\mathrm{Rp\_Shc}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{39}$$

7.6 Reaction reaction_6

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

Reaction equation

$$\mathrm{Rp\_Shc} \longrightarrow \mathrm{Rp\_pShc} \tag{40}$$

Reactant

Table 16: Properties of each reactant.

Id	Name	SBO
Rp_Shc		

Product

Table 17: Properties of each product.

Id	Name	SBO
Rp_pShc		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_6 = \mathrm{k6} \cdot [\mathrm{Rp\_Shc}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{41}$$

7.7 Reaction reaction_7

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\mathrm{Rp\_pShc} \rightleftharpoons \mathrm{Rp} + \mathrm{pShc} \tag{42}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
Rp_pShc		

Products

Table 19: Properties of each product.

Id	Name	SBO
Rp		
pShc		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_7 = (\mathrm{k\_7} \cdot [\mathrm{Rp\_pShc}] - \mathrm{k7} \cdot [\mathrm{Rp}] \cdot [\mathrm{pShc}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{43}$$

7.8 Reaction reaction_8

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

Reaction equation

$$\mathrm{pShc} \longrightarrow \mathrm{Shc} \tag{44}$$

Reactant

Table 20: Properties of each reactant.

Id	Name	SBO
pShc		

Product

Table 21: Properties of each product.

Id	Name	SBO
Shc		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_8 = \frac{\mathrm{V8} \cdot [\mathrm{pShc}]}{\mathrm{Km8} + [\mathrm{pShc}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{45}$$

7.9 Reaction reaction_9

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

Reaction equation

$$\mathrm{GS} + \mathrm{Rp\_pShc} \rightleftharpoons \mathrm{Rp\_pShc\_GS} \tag{46}$$

Reactants

Table 22: Properties of each reactant.

Id	Name	SBO
GS		
Rp_pShc		

Product

Table 23: Properties of each product.

Id	Name	SBO
Rp_pShc_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_9 = (\mathrm{k9} \cdot [\mathrm{Rp\_pShc}] \cdot [\mathrm{GS}] - \mathrm{k\_9} \cdot [\mathrm{Rp\_pShc\_GS}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{47}$$

7.10 Reaction `reaction_10`

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\mathrm{Rp\_pShc\_GS} \rightleftharpoons \mathrm{Rp} + \mathrm{pShc\_GS} \tag{48}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
`Rp_pShc_GS`		

Products

Table 25: Properties of each product.

Id	Name	SBO
`Rp`		
`pShc_GS`		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{10} = (\mathrm{k\_10} \cdot [\mathrm{Rp\_pShc\_GS}] - \mathrm{k10} \cdot [\mathrm{Rp}] \cdot [\mathrm{pShc\_GS}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{49}$$

7.11 Reaction `reaction_11`

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\mathrm{pShc\_GS} \rightleftharpoons \mathrm{GS} + \mathrm{pShc} \tag{50}$$

Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
pShc_GS		

Products

Table 27: Properties of each product.

Id	Name	SBO
GS		
pShc		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{11} = (\mathrm{k\_11} \cdot [\mathrm{pShc\_GS}] - \mathrm{k11} \cdot [\mathrm{pShc}] \cdot [\mathrm{GS}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{51}$$

7.12 Reaction reaction_12

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

Reaction equation

$$\mathrm{Rp} + \mathrm{PI3K} \rightleftharpoons \mathrm{Rp\_PI3K} \tag{52}$$

Reactants

Table 28: Properties of each reactant.

Id	Name	SBO
Rp		
PI3K		

Product

Table 29: Properties of each product.

Id	Name	SBO
Rp_PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{12} = (\mathrm{k12} \cdot [\mathrm{Rp}] \cdot [\mathrm{PI3K}] - \mathrm{k\_12} \cdot [\mathrm{Rp\_PI3K}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{53}$$

7.13 Reaction reaction_13

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

Reaction equation

$$\mathrm{Rp} + \mathrm{RasGAP} \rightleftharpoons \mathrm{Rp\_RasGAP} \tag{54}$$

Reactants

Table 30: Properties of each reactant.

Id	Name	SBO
Rp		
RasGAP		

Product

Table 31: Properties of each product.

Id	Name	SBO
Rp_RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{13} = (\mathrm{k13} \cdot [\mathrm{Rp}] \cdot [\mathrm{RasGAP}] - \mathrm{k\_13} \cdot [\mathrm{Rp\_RasGAP}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{55}$$

7.14 Reaction reaction_17

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

Reaction equation

$$\mathrm{Rp} \longrightarrow \mathrm{Null} \tag{56}$$

Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
Rp		

Product

Table 33: Properties of each product.

Id	Name	SBO
Null		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{14} = \mathrm{k17} \cdot [\mathrm{Rp}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{57}$$

7.15 Reaction reaction_18

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

Reaction equation

$$\mathrm{Rp\_GS} \longrightarrow \mathrm{GS} \tag{58}$$

Reactant

Table 34: Properties of each reactant.

Id	Name	SBO
Rp_GS		

Product

Table 35: Properties of each product.

Id	Name	SBO
GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{15} = \mathrm{k17} \cdot [\mathrm{Rp\_GS}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{59}$$

7.16 Reaction reaction_19

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

Reaction equation

$$\mathrm{Rp\_Shc} \longrightarrow \mathrm{Shc} \tag{60}$$

Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
Rp_Shc		

Product

Table 37: Properties of each product.

Id	Name	SBO
Shc		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{16} = \mathrm{k17} \cdot [\mathrm{Rp\_Shc}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{61}$$

7.17 Reaction reaction_20

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

Reaction equation

$$\mathrm{Rp\_pShc} \longrightarrow \mathrm{pShc} \tag{62}$$

Reactant

Table 38: Properties of each reactant.

Id	Name	SBO
Rp_pShc		

Product

Table 39: Properties of each product.

Id	Name	SBO
pShc		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{17} = \mathrm{k17} \cdot [\mathrm{Rp\_pShc}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{63}$$

7.18 Reaction reaction_21

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

Reaction equation

$$\mathrm{Rp\_pShc\_GS} \longrightarrow \mathrm{pShc\_GS} \tag{64}$$

Reactant

Table 40: Properties of each reactant.

Id	Name	SBO
Rp_pShc_GS		

Product

Table 41: Properties of each product.

Id	Name	SBO
pShc_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{18} = \mathrm{k17} \cdot [\mathrm{Rp\_pShc\_GS}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{65}$$

7.19 Reaction reaction_22

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

Reaction equation

$$\mathrm{Rp\_PI3K} \longrightarrow \mathrm{PI3K} \tag{66}$$

Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
Rp_PI3K		

Product

Table 43: Properties of each product.

Id	Name	SBO
PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{19} = \mathrm{k17} \cdot [\mathrm{Rp\_PI3K}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{67}$$

7.20 Reaction reaction_23

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

Reaction equation

$$\text{Rp\_RasGAP} \longrightarrow \text{RasGAP} \tag{68}$$

Reactant

Table 44: Properties of each reactant.

Id	Name	SBO
Rp_RasGAP		

Product

Table 45: Properties of each product.

Id	Name	SBO
RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{20} = \mathrm{k17} \cdot [\text{Rp\_RasGAP}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{69}$$

7.21 Reaction reaction_24

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

Reaction equation

$$\mathrm{I} + \mathrm{IR} \rightleftharpoons \mathrm{IRL} \tag{70}$$

Reactants

Table 46: Properties of each reactant.

Id	Name	SBO
I		
IR		

Product

Table 47: Properties of each product.

Id	Name	SBO
IRL		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{21} = (\mathrm{k24} \cdot [\mathrm{IR}] \cdot [\mathrm{I}] - \mathrm{k\_24} \cdot [\mathrm{IRL}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{71}$$

7.22 Reaction reaction_25

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

Reaction equation

$$\mathrm{IRL} \longrightarrow \mathrm{IRp} \tag{72}$$

Reactant

Table 48: Properties of each reactant.

Id	Name	SBO
IRL		

Product

Table 49: Properties of each product.

Id	Name	SBO
IRp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{22} = \mathrm{k25} \cdot [\mathrm{IRL}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{73}$$

7.23 Reaction reaction_26

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

Reaction equation

$$\mathrm{PI3K} + \mathrm{IRp} \rightleftharpoons \mathrm{IRp\_PI3K} \tag{74}$$

Reactants

Table 50: Properties of each reactant.

Id	Name	SBO
PI3K		
IRp		

Product

Table 51: Properties of each product.

Id	Name	SBO
IRp_PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{23} = (\mathrm{k26} \cdot [\mathrm{IRp}] \cdot [\mathrm{PI3K}] - \mathrm{k\_26} \cdot [\mathrm{IRp\_PI3K}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{75}$$

7.24 Reaction reaction_27

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

Reaction equation

$$\mathrm{RasGAP} + \mathrm{IRp} \rightleftharpoons \mathrm{IRp\_RasGAP} \tag{76}$$

Reactants

Table 52: Properties of each reactant.

Id	Name	SBO
RasGAP		
IRp		

Product

Table 53: Properties of each product.

Id	Name	SBO
IRp_RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{24} = (\mathrm{k27} \cdot [\mathrm{IRp}] \cdot [\mathrm{RasGAP}] - \mathrm{k\_27} \cdot [\mathrm{IRp\_RasGAP}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{77}$$

7.25 Reaction reaction_28

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

Reaction equation

$$\mathrm{IRp} + \mathrm{IRS} \rightleftharpoons \mathrm{IRp\_IRS} \tag{78}$$

Reactants

Table 54: Properties of each reactant.

Id	Name	SBO
IRp		
IRS		

Product

Table 55: Properties of each product.

Id	Name	SBO
IRp_IRS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{25} = (\mathrm{k28} \cdot [\mathrm{IRp}] \cdot [\mathrm{IRS}] - \mathrm{k\_28} \cdot [\mathrm{IRp\_IRS}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{79}$$

7.26 Reaction reaction_29

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

Reaction equation

$$\text{IRp\_IRS} \longrightarrow \text{IRp\_IRSp} \tag{80}$$

Reactant

Table 56: Properties of each reactant.

Id	Name	SBO
IRp_IRS		

Product

Table 57: Properties of each product.

Id	Name	SBO
IRp_IRSp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{26} = \mathrm{k29} \cdot [\text{IRp\_IRS}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{81}$$

7.27 Reaction reaction_30

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{IRp\_IRSp} \rightleftharpoons \text{IRp} + \text{IRSp} \tag{82}$$

Reactant

Table 58: Properties of each reactant.

Id	Name	SBO
IRp_IRSp		

Products

Table 59: Properties of each product.

Id	Name	SBO
IRp		
IRSp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{27} = (\mathrm{k\_30} \cdot [\mathrm{IRp\_IRSp}] - \mathrm{k30} \cdot [\mathrm{IRp}] \cdot [\mathrm{IRSp}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{83}$$

7.28 Reaction `reaction_31`

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

Reaction equation

$$\mathrm{IRSp} \longrightarrow \mathrm{IRS} \tag{84}$$

Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
IRSp		

Product

Table 61: Properties of each product.

Id	Name	SBO
IRS		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{28} = \frac{\mathrm{V31} \cdot [\mathrm{IRSp}]}{\mathrm{Km31} + [\mathrm{IRSp}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{85}$$

7.29 Reaction reaction_34

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

Reaction equation

$$\mathrm{IRp} \longrightarrow \mathrm{Null} \tag{86}$$

Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
IRp		

Product

Table 63: Properties of each product.

Id	Name	SBO
Null		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{29} = \mathrm{k17} \cdot [\mathrm{IRp}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{87}$$

7.30 Reaction reaction_35

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

Reaction equation

$$\mathrm{IRp\_PI3K} \longrightarrow \mathrm{PI3K} \tag{88}$$

Reactant

Table 64: Properties of each reactant.

Id	Name	SBO
IRp_PI3K		

Product

Table 65: Properties of each product.

Id	Name	SBO
PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{30} = \mathrm{k17} \cdot [\mathrm{IRp\_PI3K}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{89}$$

7.31 Reaction reaction_36

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

Reaction equation

$$\mathrm{IRp\_RasGAP} \longrightarrow \mathrm{RasGAP} \tag{90}$$

Reactant

Table 66: Properties of each reactant.

Id	Name	SBO
IRp_RasGAP		

Product

Table 67: Properties of each product.

Id	Name	SBO
RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{31} = \mathrm{k17} \cdot [\mathrm{IRp\_RasGAP}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{91}$$

7.32 Reaction reaction_37

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

Reaction equation

$$\text{IRp\_IRS} \longrightarrow \text{IRS} \tag{92}$$

Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
IRp_IRS		

Product

Table 69: Properties of each product.

Id	Name	SBO
IRS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{32} = \mathrm{k17} \cdot [\text{IRp\_IRS}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{93}$$

7.33 Reaction reaction_38

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

Reaction equation

$$\text{IRp\_IRSp} \longrightarrow \text{IRSp} \tag{94}$$

Reactant

Table 70: Properties of each reactant.

Id	Name	SBO
IRp_IRSp		

Product

Table 71: Properties of each product.

Id	Name	SBO
IRSp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{33} = \mathrm{k17} \cdot [\mathrm{IRp\_IRSp}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{95}$$

7.34 Reaction reaction_40

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

Reaction equation

$$\mathrm{iSrc} \xrightarrow{\mathrm{Rp,\ IRp}} \mathrm{aSrc} \tag{96}$$

Reactant

Table 72: Properties of each reactant.

Id	Name	SBO
iSrc		

Modifiers

Table 73: Properties of each modifier.

Id	Name	SBO
Rp		
IRp		

Product

Table 74: Properties of each product.

Id	Name	SBO
aSrc		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \mathrm{mol}$

$$v_{34} = \frac{\mathrm{kcat40} \cdot [\mathrm{iSrc}] \cdot ([\mathrm{Rp}] + \mathrm{alpha40} \cdot [\mathrm{IRp}])}{\mathrm{Km40} + [\mathrm{iSrc}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{97}$$

7.35 Reaction `reaction_41`

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

Reaction equation

$$\mathrm{aSrc} \longrightarrow \mathrm{iSrc} \tag{98}$$

Reactant

Table 75: Properties of each reactant.

Id	Name	SBO
aSrc		

Product

Table 76: Properties of each product.

Id	Name	SBO
iSrc		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{35} = \frac{\mathrm{V41} \cdot [\mathrm{aSrc}]}{\mathrm{Km41} + [\mathrm{aSrc}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{99}$$

7.36 Reaction reaction_42

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

Reaction equation

$$\mathrm{IRS} + \mathrm{PIP3} \rightleftharpoons \mathrm{mIRS} \tag{100}$$

Reactants

Table 77: Properties of each reactant.

Id	Name	SBO
IRS		
PIP3		

Product

Table 78: Properties of each product.

Id	Name	SBO
mIRS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{36} = (\mathrm{k42} \cdot [\mathrm{IRS}] \cdot [\mathrm{PIP3}] - \mathrm{k\_42} \cdot [\mathrm{mIRS}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{101}$$

7.37 Reaction reaction_43

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

Reaction equation

$$\mathrm{mIRS} \xrightarrow{\mathrm{Rp,\ IRp}} \mathrm{mIRSp} \tag{102}$$

Reactant

Table 79: Properties of each reactant.

Id	Name	SBO
mIRS		

Modifiers

Table 80: Properties of each modifier.

Id	Name	SBO
Rp		
IRp		

Product

Table 81: Properties of each product.

Id	Name	SBO
mIRSp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\,\mathrm{mol}$

$$v_{37} = \frac{\mathrm{kcat43} \cdot [\mathrm{mIRS}] \cdot ([\mathrm{IRp}] + \mathrm{alpha43} \cdot [\mathrm{Rp}])}{\mathrm{Km43} + [\mathrm{mIRS}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{103}$$

7.38 Reaction reaction_44

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

Reaction equation

$$\mathrm{mIRSp} \longrightarrow \mathrm{mIRS} \tag{104}$$

Reactant

Table 82: Properties of each reactant.

Id	Name	SBO
mIRSp		

Product

Table 83: Properties of each product.

Id	Name	SBO
mIRS		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{38} = \frac{\mathrm{V31} \cdot [\mathrm{mIRSp}]}{\mathrm{Km31} + [\mathrm{mIRSp}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{105}$$

7.39 Reaction reaction_45

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

Reaction equation

$$\mathrm{GS} + \mathrm{mIRSp} \rightleftharpoons \mathrm{mIRSp\_GS} \tag{106}$$

Reactants

Table 84: Properties of each reactant.

Id	Name	SBO
GS		
mIRSp		

Product

Table 85: Properties of each product.

Id	Name	SBO
mIRSp_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{39} = (\mathrm{k45} \cdot [\mathrm{mIRSp}] \cdot [\mathrm{GS}] - \mathrm{k\_45} \cdot [\mathrm{mIRSp\_GS}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{107}$$

7.40 Reaction reaction_46

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

Reaction equation

$$\mathrm{PI3K} + \mathrm{mIRSp} \rightleftharpoons \mathrm{mIRSp\_PI3K} \tag{108}$$

Reactants

Table 86: Properties of each reactant.

Id	Name	SBO
PI3K		
mIRSp		

Product

Table 87: Properties of each product.

Id	Name	SBO
mIRSp_PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{40} = (\mathrm{k46} \cdot [\mathrm{mIRSp}] \cdot [\mathrm{PI3K}] - \mathrm{k\_46} \cdot [\mathrm{mIRSp\_PI3K}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{109}$$

7.41 Reaction reaction_47

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

Reaction equation

$$\mathrm{mIRSp} + \mathrm{SHP2} \rightleftharpoons \mathrm{mIRSp\_SHP2} \tag{110}$$

Reactants

Table 88: Properties of each reactant.

Id	Name	SBO
mIRSp		

Id	Name	SBO
SHP2		

Product

Table 89: Properties of each product.

Id	Name	SBO
mIRSp_SHP2		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{41} = (\mathrm{k47} \cdot [\mathrm{mIRSp}] \cdot [\mathrm{SHP2}] - \mathrm{k\_47} \cdot [\mathrm{mIRSp\_SHP2}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{111}$$

7.42 Reaction reaction_48

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

Reaction equation

$$\mathrm{mIRSp\_SHP2} \longrightarrow \mathrm{mIRS} + \mathrm{SHP2} \tag{112}$$

Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
mIRSp_SHP2		

Products

Table 91: Properties of each product.

Id	Name	SBO
mIRS		
SHP2		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{42} = \mathrm{k48} \cdot [\mathrm{mIRSp\_SHP2}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{113}$$

7.43 Reaction `reaction_49`

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

Reaction equation

$$\mathrm{GAB} + \mathrm{PIP3} \rightleftharpoons \mathrm{mGAB} \tag{114}$$

Reactants

Table 92: Properties of each reactant.

Id	Name	SBO
`GAB`		
`PIP3`		

Product

Table 93: Properties of each product.

Id	Name	SBO
`mGAB`		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{43} = (\mathrm{k49} \cdot [\mathrm{GAB}] \cdot [\mathrm{PIP3}] - \mathrm{k\_49} \cdot [\mathrm{mGAB}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{115}$$

7.44 Reaction `reaction_50`

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

Reaction equation

$$\mathrm{mGAB} \xrightarrow{\mathrm{Rp,\ aSrc}} \mathrm{mGABp} \tag{116}$$

Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
mGAB		

Modifiers

Table 95: Properties of each modifier.

Id	Name	SBO
Rp		
aSrc		

Product

Table 96: Properties of each product.

Id	Name	SBO
mGABp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \mathrm{mol}$

$$v_{44} = \frac{\mathrm{kcat50} \cdot [\mathrm{mGAB}] \cdot ([\mathrm{Rp}] + \mathrm{alpha50} \cdot [\mathrm{aSrc}])}{\mathrm{Km50} + [\mathrm{mGAB}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{117}$$

7.45 Reaction reaction_51

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

Reaction equation

$$\mathrm{mGABp} \longrightarrow \mathrm{mGAB} \tag{118}$$

Reactant

Table 97: Properties of each reactant.

Id	Name	SBO
mGABp		

Product

Table 98: Properties of each product.

Id	Name	SBO
mGAB		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{45} = \frac{\mathrm{V51} \cdot [\mathrm{mGABp}]}{\mathrm{Km51} + [\mathrm{mGABp}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{119}$$

7.46 Reaction reaction_52

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

Reaction equation

$$\mathrm{GS} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_GS} \tag{120}$$

Reactants

Table 99: Properties of each reactant.

Id	Name	SBO
GS		
mGABp		

Product

Table 100: Properties of each product.

Id	Name	SBO
mGABp_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{46} = (\mathrm{k52} \cdot [\mathrm{mGABp}] \cdot [\mathrm{GS}] - \mathrm{k\_52} \cdot [\mathrm{mGABp\_GS}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{121}$$

7.47 Reaction `reaction_53`

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

Reaction equation

$$\mathrm{PI3K} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_PI3K} \tag{122}$$

Reactants

Table 101: Properties of each reactant.

Id	Name	SBO
`PI3K`		
`mGABp`		

Product

Table 102: Properties of each product.

Id	Name	SBO
`mGABp_PI3K`		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{47} = (\mathrm{k53} \cdot [\mathrm{mGABp}] \cdot [\mathrm{PI3K}] - \mathrm{k\_53} \cdot [\mathrm{mGABp\_PI3K}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{123}$$

7.48 Reaction `reaction_54`

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

Reaction equation

$$\mathrm{RasGAP} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_RasGAP} \tag{124}$$

Reactants

Table 103: Properties of each reactant.

Id	Name	SBO
RasGAP		
mGABp		

Product

Table 104: Properties of each product.

Id	Name	SBO
mGABp_RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{48} = (\mathrm{k54} \cdot [\mathrm{mGABp}] \cdot [\mathrm{RasGAP}] - \mathrm{k\_54} \cdot [\mathrm{mGABp\_RasGAP}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \qquad (125)$$

7.49 Reaction reaction_55

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

Reaction equation

$$\mathrm{SHP2} + \mathrm{mGABp} \rightleftharpoons \mathrm{mGABp\_SHP2} \qquad (126)$$

Reactants

Table 105: Properties of each reactant.

Id	Name	SBO
SHP2		
mGABp		

Product

Table 106: Properties of each product.

Id	Name	SBO
mGABp_SHP2		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{49} = (\mathrm{k55} \cdot [\mathrm{mGABp}] \cdot [\mathrm{SHP2}] - \mathrm{k\_55} \cdot [\mathrm{mGABp\_SHP2}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{127}$$

7.50 Reaction reaction_56

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

Reaction equation

$$\mathrm{mGABp\_SHP2} \longrightarrow \mathrm{SHP2} + \mathrm{mGAB} \tag{128}$$

Reactant

Table 107: Properties of each reactant.

Id	Name	SBO
mGABp_SHP2		

Products

Table 108: Properties of each product.

Id	Name	SBO
SHP2		
mGAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{50} = \mathrm{k56} \cdot [\mathrm{mGABp\_SHP2}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{129}$$

7.51 Reaction reaction_57

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

Reaction equation

$$\text{mGABp\_SHP2} \xrightarrow{\text{Rp, aSrc}} \text{mGABp\_pSHP2} \tag{130}$$

Reactant

Table 109: Properties of each reactant.

Id	Name	SBO
mGABp_SHP2		

Modifiers

Table 110: Properties of each modifier.

Id	Name	SBO
Rp		
aSrc		

Product

Table 111: Properties of each product.

Id	Name	SBO
mGABp_pSHP2		

Kinetic Law

Derived unit $\text{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \text{mol}$

$$v_{51} = \frac{\text{kcat57} \cdot [\text{mGABp\_SHP2}] \cdot ([\text{Rp}] + [\text{aSrc}])}{\text{Km57} + [\text{mGABp\_SHP2}]} \cdot \text{vol}(\text{cell}) \tag{131}$$

7.52 Reaction reaction_58

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

Reaction equation

$$\text{mGABp\_pSHP2} \longrightarrow \text{mGABp\_SHP2} \tag{132}$$

Reactant

Table 112: Properties of each reactant.

Id	Name	SBO
mGABp_pSHP2		

Product

Table 113: Properties of each product.

Id	Name	SBO
mGABp_SHP2		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{52} = \frac{\mathrm{V58} \cdot [\mathrm{mGABp\_pSHP2}]}{\mathrm{Km58} + [\mathrm{mGABp\_pSHP2}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{133}$$

7.53 Reaction reaction_59

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

Reaction equation

$$\mathrm{GS} + \mathrm{mGABp\_pSHP2} \rightleftharpoons \mathrm{mGABp\_pSHP2\_GS} \tag{134}$$

Reactants

Table 114: Properties of each reactant.

Id	Name	SBO
GS		
mGABp_pSHP2		

Product

Table 115: Properties of each product.

Id	Name	SBO
mGABp_pSHP2_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{53} = (\mathrm{k59} \cdot [\mathrm{mGABp\_pSHP2}] \cdot [\mathrm{GS}] - \mathrm{k\_59} \cdot [\mathrm{mGABp\_pSHP2\_GS}]) \cdot \mathrm{vol}(\mathrm{cell}) \quad (135)$$

7.54 Reaction `reaction_60`

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

Reaction equation

$$\emptyset \xrightarrow{\mathrm{Rp\_PI3K,\ IRp\_PI3K,\ mIRSp\_PI3K,\ mGABp\_PI3K,\ tRas\_PI3K}} \mathrm{PIP3} \quad (136)$$

Modifiers

Table 116: Properties of each modifier.

Id	Name	SBO
`Rp_PI3K`		
`IRp_PI3K`		
`mIRSp_PI3K`		
`mGABp_PI3K`		
`tRas_PI3K`		

Product

Table 117: Properties of each product.

Id	Name	SBO
`PIP3`		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{54} = \mathrm{k60} \cdot ([\mathrm{Rp\_PI3K}] + [\mathrm{IRp\_PI3K}] + [\mathrm{mIRSp\_PI3K}] + [\mathrm{mGABp\_PI3K}] + [\mathrm{tRas\_PI3K}]) \cdot \mathrm{vol}(\mathrm{cell}) \quad (137)$$

7.55 Reaction `reaction_61`

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

Reaction equation

$$\text{PIP3} \longrightarrow \text{Null} \tag{138}$$

Reactant

Table 118: Properties of each reactant.

Id	Name	SBO
PIP3		

Product

Table 119: Properties of each product.

Id	Name	SBO
Null		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{55} = \mathrm{k61} \cdot [\mathrm{PIP3}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{139}$$

7.56 Reaction reaction_62

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

Reaction equation

$$\text{dRas} \xrightarrow{\text{Rp\_GS, Rp\_pShc\_GS, mIRSp\_GS, mGABp\_GS, mGABp\_pSHP2\_GS}} \text{tRas} \tag{140}$$

Reactant

Table 120: Properties of each reactant.

Id	Name	SBO
dRas		

Modifiers

Table 121: Properties of each modifier.

Id	Name	SBO
Rp_GS		
Rp_pShc_GS		
mIRSp_GS		
mGABp_GS		
mGABp_pSHP2_GS		

Product

Table 122: Properties of each product.

Id	Name	SBO
tRas		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \mathrm{mol}$

$$v_{56} = \frac{\mathrm{kcat62} \cdot [\mathrm{dRas}] \cdot ([\mathrm{Rp\_GS}] + [\mathrm{Rp\_pShc\_GS}] + [\mathrm{mIRSp\_GS}] + [\mathrm{mGABp\_GS}] + [\mathrm{mGABp\_pSHP2\_GS}])}{\mathrm{Km62} + [\mathrm{dRas}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{141}$$

7.57 Reaction reaction_63

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

Reaction equation

$$\mathrm{tRas} \xrightarrow{\mathrm{Rp\_RasGAP,\ IRp\_RasGAP,\ mGABp\_RasGAP,\ bRasGAP}} \mathrm{dRas} \tag{142}$$

Reactant

Table 123: Properties of each reactant.

Id	Name	SBO
tRas		

Modifiers

Table 124: Properties of each modifier.

Id	Name	SBO
Rp_RasGAP		
IRp_RasGAP		
mGABp_RasGAP		
bRasGAP		

Product

Table 125: Properties of each product.

Id	Name	SBO
dRas		

Kinetic Law

Derived unit $s^{-1} \cdot 9.999999999999998 \cdot 10^{-10}$ mol

$$v_{57} = \frac{\text{kcat63} \cdot [\text{tRas}] \cdot ([\text{bRasGAP}] + [\text{mGABp\_RasGAP}] + [\text{Rp\_RasGAP}] + [\text{IRp\_RasGAP}])}{\text{Km63} + [\text{tRas}]} \cdot \text{vol}(\text{cell}) \tag{143}$$

7.58 Reaction reaction_64

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

Reaction equation

$$\text{PI3K} + \text{tRas} \longrightarrow \text{tRas\_PI3K} \tag{144}$$

Reactants

Table 126: Properties of each reactant.

Id	Name	SBO
PI3K		
tRas		

Product

Table 127: Properties of each product.

Id	Name	SBO
tRas_PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{58} = (\mathrm{k64} \cdot [\mathrm{tRas}] \cdot [\mathrm{PI3K}] - \mathrm{k\_64} \cdot [\mathrm{tRas\_PI3K}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{145}$$

7.59 Reaction reaction_65

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

Reaction equation

$$\mathrm{Raf} \xrightarrow{\mathrm{tRas}} \mathrm{aRaf} \tag{146}$$

Reactant

Table 128: Properties of each reactant.

Id	Name	SBO
Raf		

Modifier

Table 129: Properties of each modifier.

Id	Name	SBO
tRas		

Product

Table 130: Properties of each product.

Id	Name	SBO
aRaf		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \mathrm{mol}$

$$v_{59} = \frac{\mathrm{kcat65} \cdot [\mathrm{tRas}] \cdot [\mathrm{Raf}]}{\mathrm{Km65} + [\mathrm{Raf}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{147}$$

7.60 Reaction `reaction_66`

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

Reaction equation

$$\mathrm{aRaf} \xrightarrow{\mathrm{aSrc}} \mathrm{aaRaf} \tag{148}$$

Reactant

Table 131: Properties of each reactant.

Id	Name	SBO
`aRaf`		

Modifier

Table 132: Properties of each modifier.

Id	Name	SBO
`aSrc`		

Product

Table 133: Properties of each product.

Id	Name	SBO
`aaRaf`		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \mathrm{mol}$

$$v_{60} = \frac{\mathrm{kcat66} \cdot [\mathrm{aSrc}] \cdot [\mathrm{aRaf}]}{\mathrm{Km66} + [\mathrm{aRaf}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{149}$$

7.61 Reaction reaction_67

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

Reaction equation

$$\text{aaRaf} \xrightarrow{\text{pAkt, PKA, ppAkt}} \text{Raf} \tag{150}$$

Reactant

Table 134: Properties of each reactant.

Id	Name	SBO
aaRaf		

Modifiers

Table 135: Properties of each modifier.

Id	Name	SBO
pAkt		
PKA		
ppAkt		

Product

Table 136: Properties of each product.

Id	Name	SBO
Raf		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{61} = \left(\mathrm{kcat67} \cdot [\mathrm{aaRaf}] \cdot \frac{[\mathrm{PKA}]}{\mathrm{Km67} + [\mathrm{aaRaf}]} + \mathrm{alpha67} \cdot [\mathrm{aaRaf}] \cdot ([\mathrm{pAkt}] + \mathrm{beta67} \cdot [\mathrm{ppAkt}]) \right) \cdot \mathrm{vol}(\mathrm{cell}) \tag{151}$$

7.62 Reaction reaction_68

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

Reaction equation

$$\text{Mek} \xrightarrow{\text{aaRaf}} \text{ppMek} \tag{152}$$

Reactant

Table 137: Properties of each reactant.

Id	Name	SBO
Mek		

Modifier

Table 138: Properties of each modifier.

Id	Name	SBO
aaRaf		

Product

Table 139: Properties of each product.

Id	Name	SBO
ppMek		

Kinetic Law

Derived unit $\text{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \text{mol}$

$$v_{62} = \frac{\text{kcat68} \cdot [\text{aaRaf}] \cdot [\text{Mek}]}{\text{Km68} + [\text{Mek}]} \cdot \text{vol}\,(\text{cell}) \tag{153}$$

7.63 Reaction reaction_69

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

Reaction equation

$$\text{ppMek} \longrightarrow \text{Mek} \tag{154}$$

Reactant

Table 140: Properties of each reactant.

Id	Name	SBO
ppMek		

Product

Table 141: Properties of each product.

Id	Name	SBO
Mek		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{63} = \frac{\mathrm{V69} \cdot [\mathrm{ppMek}]}{\mathrm{Km69} + [\mathrm{ppMek}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{155}$$

7.64 Reaction reaction_70

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

Reaction equation

$$\mathrm{Erk} \xrightarrow{\mathrm{ppMek}} \mathrm{pErk} \tag{156}$$

Reactant

Table 142: Properties of each reactant.

Id	Name	SBO
Erk		

Modifier

Table 143: Properties of each modifier.

Id	Name	SBO
ppMek		

Product

Table 144: Properties of each product.

Id	Name	SBO
pErk		

Kinetic Law

Derived unit $s^{-1} \cdot 9.999999999999998 \cdot 10^{-10}$ mol

$$v_{64} = \frac{\text{kcat70} \cdot [\text{Erk}] \cdot [\text{ppMek}]}{\text{Km70} + [\text{Erk}] + [\text{pErk}] \cdot \frac{\text{Km70}}{\text{Km71}}} \cdot \text{vol}(\text{cell}) \tag{157}$$

7.65 Reaction reaction_71

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

Reaction equation

$$\text{pErk} \xrightarrow{\text{Erk, ppMek}} \text{ppErk} \tag{158}$$

Reactant

Table 145: Properties of each reactant.

Id	Name	SBO
pErk		

Modifiers

Table 146: Properties of each modifier.

Id	Name	SBO
Erk		
ppMek		

Product

Table 147: Properties of each product.

Id	Name	SBO
ppErk		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \mathrm{mol}$

$$v_{65} = \frac{\mathrm{kcat71} \cdot [\mathrm{pErk}] \cdot [\mathrm{ppMek}]}{\mathrm{Km71} + [\mathrm{pErk}] + [\mathrm{Erk}] \cdot \frac{\mathrm{Km71}}{\mathrm{Km70}}} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{159}$$

7.66 Reaction reaction_72

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

Reaction equation

$$\mathrm{ppErk} \longrightarrow \mathrm{pErk} \tag{160}$$

Reactant

Table 148: Properties of each reactant.

Id	Name	SBO
ppErk		

Product

Table 149: Properties of each product.

Id	Name	SBO
pErk		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{66} = \frac{\mathrm{V72} \cdot [\mathrm{ppErk}]}{\mathrm{Km72} + [\mathrm{ppErk}] + [\mathrm{pErk}] \cdot \frac{\mathrm{Km72}}{\mathrm{Km73}}} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{161}$$

7.67 Reaction reaction_73

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

Reaction equation

$$\text{pErk} \xrightarrow{\text{ppErk}} \text{Erk} \tag{162}$$

Reactant

Table 150: Properties of each reactant.

Id	Name	SBO
pErk		

Modifier

Table 151: Properties of each modifier.

Id	Name	SBO
ppErk		

Product

Table 152: Properties of each product.

Id	Name	SBO
Erk		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \text{mol} \cdot \text{s}^{-1}$

$$v_{67} = \frac{\text{V73} \cdot [\text{pErk}]}{\text{Km73} + [\text{pErk}] + [\text{ppErk}] \cdot \frac{\text{Km73}}{\text{Km72}}} \cdot \text{vol}(\text{cell}) \tag{163}$$

7.68 Reaction reaction_74

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

Reaction equation

$$\mathrm{PIP3} + \mathrm{PDK1} \rightleftharpoons \mathrm{mPDK1} \tag{164}$$

Reactants

Table 153: Properties of each reactant.

Id	Name	SBO
PIP3		
PDK1		

Product

Table 154: Properties of each product.

Id	Name	SBO
mPDK1		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{68} = (\mathrm{k74} \cdot [\mathrm{PDK1}] \cdot [\mathrm{PIP3}] - \mathrm{k\_74} \cdot [\mathrm{mPDK1}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{165}$$

7.69 Reaction reaction_75

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

Reaction equation

$$\mathrm{Akt} \xrightarrow{\mathrm{mPDK1}} \mathrm{pAkt} \tag{166}$$

Reactant

Table 155: Properties of each reactant.

Id	Name	SBO
Akt		

Modifier

Table 156: Properties of each modifier.

Id	Name	SBO
mPDK1		

Product

Table 157: Properties of each product.

Id	Name	SBO
pAkt		

Kinetic Law

Derived unit $s^{-1} \cdot 9.999999999999998 \cdot 10^{-10}$ mol

$$v_{69} = \frac{\text{kcat75} \cdot [\text{mPDK1}] \cdot [\text{Akt}]}{\text{Km75} + [\text{Akt}]} \cdot \text{vol}(\text{cell}) \tag{167}$$

7.70 Reaction reaction_76

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

Reaction equation

$$\text{pAkt} \longrightarrow \text{Akt} \tag{168}$$

Reactant

Table 158: Properties of each reactant.

Id	Name	SBO
pAkt		

Product

Table 159: Properties of each product.

Id	Name	SBO
Akt		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{70} = \frac{\mathrm{V76} \cdot [\mathrm{pAkt}]}{\mathrm{Km76} + [\mathrm{pAkt}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{169}$$

7.71 Reaction `reaction_77`

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

Reaction equation

$$\mathrm{mTOR} \xrightleftharpoons{\mathrm{pAkt},\ \mathrm{ppAkt}} \mathrm{amTOR} \tag{170}$$

Reactant

Table 160: Properties of each reactant.

Id	Name	SBO
`mTOR`		

Modifiers

Table 161: Properties of each modifier.

Id	Name	SBO
`pAkt`		
`ppAkt`		

Product

Table 162: Properties of each product.

Id	Name	SBO
`amTOR`		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{71} = \left(\mathrm{kcat77} \cdot [\mathrm{mTOR}] \cdot \frac{\mathrm{alpha77} \cdot [\mathrm{pAkt}] + [\mathrm{ppAkt}]}{\mathrm{Km77} + [\mathrm{mTOR}]} - \mathrm{k\_77} \cdot [\mathrm{amTOR}]\right) \cdot \mathrm{vol}\,(\mathrm{cell}) \quad (171)$$

7.72 Reaction `reaction_78`

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

Reaction equation

$$\mathrm{pAkt} \overset{\mathrm{amTOR}}{\rightleftharpoons} \mathrm{ppAkt} \quad (172)$$

Reactant

Table 163: Properties of each reactant.

Id	Name	SBO
`pAkt`		

Modifier

Table 164: Properties of each modifier.

Id	Name	SBO
`amTOR`		

Product

Table 165: Properties of each product.

Id	Name	SBO
`ppAkt`		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{72} = \left(\mathrm{kcat78} \cdot [\mathrm{amTOR}] \cdot \frac{[\mathrm{pAkt}]}{\mathrm{Km78} + [\mathrm{pAkt}]} - \mathrm{k\_78} \cdot [\mathrm{ppAkt}]\right) \cdot \mathrm{vol}\,(\mathrm{cell}) \quad (173)$$

7.73 Reaction `reaction_79`

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

Reaction equation

$$\mathrm{GS} \overset{\mathrm{ppErk}}{\rightleftharpoons} \mathrm{iGS} \tag{174}$$

Reactant

Table 166: Properties of each reactant.

Id	Name	SBO
GS		

Modifier

Table 167: Properties of each modifier.

Id	Name	SBO
ppErk		

Product

Table 168: Properties of each product.

Id	Name	SBO
iGS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{73} = \left(\mathrm{kcat79} \cdot [\mathrm{ppErk}] \cdot \frac{[\mathrm{GS}]}{\mathrm{Km79} + [\mathrm{GS}]} - \mathrm{k\_79} \cdot [\mathrm{iGS}] \right) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{175}$$

7.74 Reaction reaction_80

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

Reaction equation

$$\mathrm{mGAB} \overset{\mathrm{ppErk}}{\rightleftharpoons} \mathrm{imGAB} \tag{176}$$

Reactant

Table 169: Properties of each reactant.

Id	Name	SBO
mGAB		

Modifier

Table 170: Properties of each modifier.

Id	Name	SBO
ppErk		

Product

Table 171: Properties of each product.

Id	Name	SBO
imGAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{74} = \left(\mathrm{kcat80} \cdot [\mathrm{mGAB}] \cdot \frac{[\mathrm{ppErk}]}{\mathrm{Km80} + [\mathrm{mGAB}]} - \mathrm{k\_80} \cdot [\mathrm{imGAB}] \right) \cdot \mathrm{vol}\,(\mathrm{cell}) \qquad (177)$$

7.75 Reaction reaction_81

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

Reaction equation

$$\mathrm{mIRS} \overset{\mathrm{amTOR}}{\rightleftharpoons} \mathrm{imIRS} \qquad (178)$$

Reactant

Table 172: Properties of each reactant.

Id	Name	SBO
mIRS		

Modifier

Table 173: Properties of each modifier.

Id	Name	SBO
amTOR		

Product

Table 174: Properties of each product.

Id	Name	SBO
imIRS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{75} = \left(\mathrm{kcat81} \cdot [\mathrm{mIRS}] \cdot \frac{[\mathrm{amTOR}]}{\mathrm{Km81} + [\mathrm{mIRS}]} - \mathrm{k\_81} \cdot [\mathrm{imIRS}] \right) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{179}$$

7.76 Reaction reaction_82

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

Reaction equation

$$\mathrm{Rp} \longrightarrow \mathrm{Ri} \tag{180}$$

Reactant

Table 175: Properties of each reactant.

Id	Name	SBO
Rp		

Product

Table 176: Properties of each product.

Id	Name	SBO
Ri		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{76} = \frac{\mathrm{V\_82} \cdot [\mathrm{Rp}]}{\mathrm{Km82} + [\mathrm{Rp}]} \cdot \mathrm{vol}(\mathrm{cell}) \tag{181}$$

7.77 Reaction reaction_83

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

Reaction equation

$$\mathrm{Ri} \longrightarrow \mathrm{Rd} \tag{182}$$

Reactant

Table 177: Properties of each reactant.

Id	Name	SBO
Ri		

Product

Table 178: Properties of each product.

Id	Name	SBO
Rd		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{77} = \mathrm{k83} \cdot [\mathrm{Ri}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{183}$$

7.78 Reaction reaction_84

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

Reaction equation

$$\mathrm{IRp} \longrightarrow \mathrm{IRi} \tag{184}$$

Reactant

Table 179: Properties of each reactant.

Id	Name	SBO
IRp		

Product

Table 180: Properties of each product.

Id	Name	SBO
IRi		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{78} = \frac{\mathrm{V\_84} \cdot [\mathrm{IRp}]}{\mathrm{Km84} + [\mathrm{IRp}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{185}$$

7.79 Reaction reaction_85

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

Reaction equation

$$\mathrm{IRi} \longrightarrow \mathrm{IRL} \tag{186}$$

Reactant

Table 181: Properties of each reactant.

Id	Name	SBO
IRi		

Product

Table 182: Properties of each product.

Id	Name	SBO
IRL		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{79} = \mathrm{k85} \cdot [\mathrm{IRi}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{187}$$

7.80 Reaction reaction_88

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\mathrm{mIRSp} \rightleftharpoons \mathrm{IRSp} + \mathrm{PIP3} \tag{188}$$

Reactant

Table 183: Properties of each reactant.

Id	Name	SBO
mIRSp		

Products

Table 184: Properties of each product.

Id	Name	SBO
IRSp		
PIP3		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{80} = (\mathrm{k\_42} \cdot [\mathrm{mIRSp}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{IRSp}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{189}$$

7.81 Reaction reaction_89

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{mIRSp\_PI3K} \rightleftharpoons \text{PIP3} + \text{IRSp\_PI3K} \tag{190}$$

Reactant

Table 185: Properties of each reactant.

Id	Name	SBO
mIRSp_PI3K		

Products

Table 186: Properties of each product.

Id	Name	SBO
PIP3		
IRSp_PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{81} = (\text{k\_42} \cdot [\text{mIRSp\_PI3K}] - \text{k42} \cdot [\text{PIP3}] \cdot [\text{IRSp\_PI3K}]) \cdot \text{vol}(\text{cell}) \tag{191}$$

7.82 Reaction reaction_90

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{mIRSp\_GS} \rightleftharpoons \text{PIP3} + \text{IRSp\_GS} \tag{192}$$

Reactant

Table 187: Properties of each reactant.

Id	Name	SBO
mIRSp_GS		

Products

Table 188: Properties of each product.

Id	Name	SBO
PIP3		
IRSp_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{82} = (\mathrm{k\_42} \cdot [\mathrm{mIRSp\_GS}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{IRSp\_GS}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{193}$$

7.83 Reaction reaction_91

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\mathrm{mIRSp\_SHP2} \rightleftharpoons \mathrm{PIP3} + \mathrm{IRSp\_SHP2} \tag{194}$$

Reactant

Table 189: Properties of each reactant.

Id	Name	SBO
mIRSp_SHP2		

Products

Table 190: Properties of each product.

Id	Name	SBO
PIP3		
IRSp_SHP2		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{83} = (\mathrm{k\_42} \cdot [\mathrm{mIRSp\_SHP2}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{IRSp\_SHP2}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{195}$$

7.84 Reaction reaction_92

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{mGABp} \rightleftharpoons \text{PIP3} + \text{GABp} \tag{196}$$

Reactant

Table 191: Properties of each reactant.

Id	Name	SBO
mGABp		

Products

Table 192: Properties of each product.

Id	Name	SBO
PIP3		
GABp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{84} = (\mathrm{k\_42} \cdot [\mathrm{mGABp}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{GABp}]) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{197}$$

7.85 Reaction reaction_93

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{mGABp\_PI3K} \rightleftharpoons \text{PIP3} + \text{GABp\_PI3K} \tag{198}$$

Reactant

Table 193: Properties of each reactant.

Id	Name	SBO
mGABp_PI3K		

Products

Table 194: Properties of each product.

Id	Name	SBO
PIP3		
GABp_PI3K		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{85} = (\mathrm{k\_42} \cdot [\mathrm{mGABp\_PI3K}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{GABp\_PI3K}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{199}$$

7.86 Reaction `reaction_94`

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\mathrm{mGABp\_GS} \rightleftharpoons \mathrm{PIP3} + \mathrm{GABp\_GS} \tag{200}$$

Reactant

Table 195: Properties of each reactant.

Id	Name	SBO
mGABp_GS		

Products

Table 196: Properties of each product.

Id	Name	SBO
PIP3		
GABp_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{86} = (\mathrm{k\_42} \cdot [\mathrm{mGABp\_GS}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{GABp\_GS}]) \cdot \mathrm{vol}(\mathrm{cell}) \tag{201}$$

7.87 Reaction reaction_95

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{mGABp\_RasGAP} \rightleftharpoons \text{PIP3} + \text{GABp\_RasGAP} \tag{202}$$

Reactant

Table 197: Properties of each reactant.

Id	Name	SBO
mGABp_RasGAP		

Products

Table 198: Properties of each product.

Id	Name	SBO
PIP3		
GABp_RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{87} = (\text{k\_42} \cdot [\text{mGABp\_RasGAP}] - \text{k49} \cdot [\text{PIP3}] \cdot [\text{GABp\_RasGAP}]) \cdot \text{vol}(\text{cell}) \tag{203}$$

7.88 Reaction reaction_96

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{mGABp\_SHP2} \rightleftharpoons \text{PIP3} + \text{GABp\_SHP2} \tag{204}$$

Reactant

Table 199: Properties of each reactant.

Id	Name	SBO
mGABp_SHP2		

Products

Table 200: Properties of each product.

Id	Name	SBO
PIP3		
GABp_SHP2		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{88} = (\mathrm{k\_42} \cdot [\mathrm{mGABp\_SHP2}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{GABp\_SHP2}]) \cdot \mathrm{vol}(\mathrm{cell}) \quad (205)$$

7.89 Reaction reaction_97

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\mathrm{mGABp\_pSHP2} \rightleftharpoons \mathrm{PIP3} + \mathrm{GABp\_pSHP2} \quad (206)$$

Reactant

Table 201: Properties of each reactant.

Id	Name	SBO
mGABp_pSHP2		

Products

Table 202: Properties of each product.

Id	Name	SBO
PIP3		
GABp_pSHP2		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{89} = (\mathrm{k\_42} \cdot [\mathrm{mGABp\_pSHP2}] - \mathrm{k42} \cdot [\mathrm{PIP3}] \cdot [\mathrm{GABp\_pSHP2}]) \cdot \mathrm{vol}(\mathrm{cell}) \quad (207)$$

7.90 Reaction reaction_98

This is a reversible reaction of one reactant forming two products.

Reaction equation

$$\text{mGABp\_pSHP2\_GS} \rightleftharpoons \text{PIP3} + \text{GABp\_pSHP2\_GS} \tag{208}$$

Reactant

Table 203: Properties of each reactant.

Id	Name	SBO
mGABp_pSHP2_GS		

Products

Table 204: Properties of each product.

Id	Name	SBO
PIP3		
GABp_pSHP2_GS		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{90} = (\text{k\_42} \cdot [\text{mGABp\_pSHP2\_GS}] - \text{k42} \cdot [\text{PIP3}] \cdot [\text{GABp\_pSHP2\_GS}]) \cdot \text{vol}(\text{cell}) \tag{209}$$

7.91 Reaction reaction_99

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

Reaction equation

$$\text{IRSp\_PI3K} \longrightarrow \text{PI3K} + \text{IRS} \tag{210}$$

Reactant

Table 205: Properties of each reactant.

Id	Name	SBO
IRSp_PI3K		

Products

Table 206: Properties of each product.

Id	Name	SBO
PI3K		
IRS		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{91} = \frac{\mathrm{V31} \cdot [\mathrm{IRSp\_PI3K}]}{\mathrm{Km31} + [\mathrm{IRSp\_PI3K}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{211}$$

7.92 Reaction reaction_100

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

Reaction equation

$$\mathrm{IRSp\_GS} \longrightarrow \mathrm{GS} + \mathrm{IRS} \tag{212}$$

Reactant

Table 207: Properties of each reactant.

Id	Name	SBO
IRSp_GS		

Products

Table 208: Properties of each product.

Id	Name	SBO
GS		
IRS		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{92} = \frac{\mathrm{V31} \cdot [\mathrm{IRSp\_GS}]}{\mathrm{Km31} + [\mathrm{IRSp\_GS}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{213}$$

7.93 Reaction `reaction_101`

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

Reaction equation

$$\mathrm{IRSp\_SHP2} \longrightarrow \mathrm{IRS} + \mathrm{SHP2} \tag{214}$$

Reactant

Table 209: Properties of each reactant.

Id	Name	SBO
IRSp_SHP2		

Products

Table 210: Properties of each product.

Id	Name	SBO
IRS		
SHP2		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{93} = \mathrm{k48} \cdot [\mathrm{IRSp\_SHP2}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{215}$$

7.94 Reaction `reaction_102`

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

Reaction equation

$$\mathrm{mGABp\_pSHP2} \longrightarrow \mathrm{SHP2} + \mathrm{mGAB} \tag{216}$$

Reactant

Table 211: Properties of each reactant.

Id	Name	SBO
mGABp_pSHP2		

Products

Table 212: Properties of each product.

Id	Name	SBO
SHP2		
mGAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{94} = \mathrm{k56} \cdot [\mathrm{mGABp\_pSHP2}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{217}$$

7.95 Reaction reaction_103

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

Reaction equation

$$\mathrm{mGABp\_pSHP2\_GS} \longrightarrow \mathrm{GS} + \mathrm{SHP2} + \mathrm{mGAB} \tag{218}$$

Reactant

Table 213: Properties of each reactant.

Id	Name	SBO
mGABp_pSHP2_GS		

Products

Table 214: Properties of each product.

Id	Name	SBO
GS		
SHP2		

Id	Name	SBO
mGAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{95} = \mathrm{k56} \cdot [\mathrm{mGABp\_pSHP2\_GS}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{219}$$

7.96 Reaction reaction_104

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

Reaction equation

$$\mathrm{GABp} \longrightarrow \mathrm{GAB} \tag{220}$$

Reactant

Table 215: Properties of each reactant.

Id	Name	SBO
GABp		

Product

Table 216: Properties of each product.

Id	Name	SBO
GAB		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{96} = \frac{\mathrm{V51} \cdot [\mathrm{GABp}]}{\mathrm{Km51} + [\mathrm{GABp}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{221}$$

7.97 Reaction reaction_105

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

Reaction equation

$$\text{GABp\_PI3K} \longrightarrow \text{PI3K} + \text{GAB} \tag{222}$$

Reactant

Table 217: Properties of each reactant.

Id	Name	SBO
GABp_PI3K		

Products

Table 218: Properties of each product.

Id	Name	SBO
PI3K		
GAB		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \text{mol} \cdot \text{s}^{-1}$

$$v_{97} = \frac{\text{V51} \cdot [\text{GABp\_PI3K}]}{\text{Km51} + [\text{GABp\_PI3K}]} \cdot \text{vol}(\text{cell}) \tag{223}$$

7.98 Reaction reaction_106

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

Reaction equation

$$\text{GABp\_GS} \longrightarrow \text{GS} + \text{GAB} \tag{224}$$

Reactant

Table 219: Properties of each reactant.

Id	Name	SBO
GABp_GS		

Products

Table 220: Properties of each product.

Id	Name	SBO
GS		
GAB		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{98} = \frac{\mathrm{V51} \cdot [\mathrm{GABp\_GS}]}{\mathrm{Km51} + [\mathrm{GABp\_GS}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{225}$$

7.99 Reaction reaction_107

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

Reaction equation

$$\mathrm{GABp\_RasGAP} \longrightarrow \mathrm{RasGAP} + \mathrm{GAB} \tag{226}$$

Reactant

Table 221: Properties of each reactant.

Id	Name	SBO
GABp_RasGAP		

Products

Table 222: Properties of each product.

Id	Name	SBO
RasGAP		
GAB		

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{s}^{-1}$

$$v_{99} = \frac{\mathrm{V51} \cdot [\mathrm{GABp\_RasGAP}]}{\mathrm{Km51} + [\mathrm{GABp\_RasGAP}]} \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{227}$$

7.100 Reaction reaction_108

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

Reaction equation

$$\mathrm{GABp\_SHP2} \longrightarrow \mathrm{SHP2} + \mathrm{GAB} \tag{228}$$

Reactant

Table 223: Properties of each reactant.

Id	Name	SBO
GABp_SHP2		

Products

Table 224: Properties of each product.

Id	Name	SBO
SHP2		
GAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{100} = \mathrm{k56} \cdot [\mathrm{GABp\_SHP2}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{229}$$

7.101 Reaction reaction_109

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

Reaction equation

$$\mathrm{GABp\_pSHP2} \longrightarrow \mathrm{SHP2} + \mathrm{GAB} \tag{230}$$

Reactant

Table 225: Properties of each reactant.

Id	Name	SBO
GABp_pSHP2		

Products

Table 226: Properties of each product.

Id	Name	SBO
SHP2		
GAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{101} = \mathrm{k56} \cdot [\mathrm{GABp\_pSHP2}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{231}$$

7.102 Reaction reaction_110

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

Reaction equation

$$\mathrm{GABp\_pSHP2\_GS} \longrightarrow \mathrm{GS} + \mathrm{SHP2} + \mathrm{GAB} \tag{232}$$

Reactant

Table 227: Properties of each reactant.

Id	Name	SBO
GABp_pSHP2_GS		

Products

Table 228: Properties of each product.

Id	Name	SBO
GS		
SHP2		

Id	Name	SBO
GAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{102} = \mathrm{k56} \cdot [\mathrm{GABp\_pSHP2\_GS}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{233}$$

7.103 Reaction reaction_111

This is an irreversible reaction of one reactant forming two products influenced by four modifiers.

Reaction equation

$$\mathrm{mGABp\_RasGAP} \xrightarrow{\mathrm{mIRSp\_SHP2,\ mGABp\_SHP2,\ mGABp\_pSHP2,\ mGABp\_pSHP2\_GS}} \mathrm{RasGAP} + \mathrm{mGAB} \tag{234}$$

Reactant

Table 229: Properties of each reactant.

Id	Name	SBO
mGABp_RasGAP		

Modifiers

Table 230: Properties of each modifier.

Id	Name	SBO
mIRSp_SHP2		
mGABp_SHP2		
mGABp_pSHP2		
mGABp_pSHP2_GS		

Products

Table 231: Properties of each product.

Id	Name	SBO
RasGAP		
mGAB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{103} = \mathrm{k111} \cdot ([\mathrm{mGABp\_SHP2}] + [\mathrm{mGABp\_pSHP2}] + [\mathrm{mGABp\_pSHP2\_GS}] + [\mathrm{mIRSp\_SHP2}]) \cdot [\mathrm{mGABp\_RasGAP}] \cdot \mathrm{vol}(\mathrm{cell}) \quad (235)$$

7.104 Reaction `reaction_112`

This is an irreversible reaction of one reactant forming two products influenced by three modifiers.

Reaction equation

$$\mathrm{Rp\_RasGAP} \xrightarrow{\mathrm{mGABp\_SHP2,\ mGABp\_pSHP2,\ mGABp\_pSHP2\_GS}} \mathrm{Rp} + \mathrm{RasGAP} \quad (236)$$

Reactant

Table 232: Properties of each reactant.

Id	Name	SBO
Rp_RasGAP		

Modifiers

Table 233: Properties of each modifier.

Id	Name	SBO
mGABp_SHP2		
mGABp_pSHP2		
mGABp_pSHP2_GS		

Products

Table 234: Properties of each product.

Id	Name	SBO
Rp		
RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{104} = \mathrm{k111} \cdot ([\mathrm{mGABp\_SHP2}] + [\mathrm{mGABp\_pSHP2}] + [\mathrm{mGABp\_pSHP2\_GS}]) \cdot [\mathrm{Rp\_RasGAP}] \cdot \mathrm{vol}(\mathrm{cell}) \quad (237)$$

7.105 Reaction reaction_113

This is an irreversible reaction of one reactant forming two products influenced by three modifiers.

Reaction equation

$$\mathrm{IRp\_RasGAP} \xrightarrow{\mathrm{mGABp\_SHP2,\ mGABp\_pSHP2,\ mGABp\_pSHP2\_GS}} \mathrm{RasGAP} + \mathrm{IRp} \quad (238)$$

Reactant

Table 235: Properties of each reactant.

Id	Name	SBO
IRp_RasGAP		

Modifiers

Table 236: Properties of each modifier.

Id	Name	SBO
mGABp_SHP2		
mGABp_pSHP2		
mGABp_pSHP2_GS		

Products

Table 237: Properties of each product.

Id	Name	SBO
RasGAP		
IRp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{105} = \mathrm{k111} \cdot ([\mathrm{mGABp\_SHP2}] + [\mathrm{mGABp\_pSHP2}] + [\mathrm{mGABp\_pSHP2\_GS}]) \cdot [\mathrm{IRp\_RasGAP}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{239}$$

7.106 Reaction reaction_114

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

Reaction equation

$$\mathrm{Rp\_RasGAP} \xrightarrow{\mathrm{mIRSp\_SHP2}} \mathrm{Rp} + \mathrm{RasGAP} \tag{240}$$

Reactant

Table 238: Properties of each reactant.

Id	Name	SBO
Rp_RasGAP		

Modifier

Table 239: Properties of each modifier.

Id	Name	SBO
mIRSp_SHP2		

Products

Table 240: Properties of each product.

Id	Name	SBO
Rp		
RasGAP		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{106} = \mathrm{k111} \cdot [\mathrm{mIRSp\_SHP2}] \cdot [\mathrm{Rp\_RasGAP}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{241}$$

7.107 Reaction reaction_115

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

Reaction equation

$$\mathrm{IRp\_RasGAP} \xrightarrow{\mathrm{mIRSp\_SHP2}} \mathrm{RasGAP} + \mathrm{IRp} \tag{242}$$

Reactant

Table 241: Properties of each reactant.

Id	Name	SBO
IRp_RasGAP		

Modifier

Table 242: Properties of each modifier.

Id	Name	SBO
mIRSp_SHP2		

Products

Table 243: Properties of each product.

Id	Name	SBO
RasGAP		
IRp		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{107} = \mathrm{k111} \cdot [\mathrm{mIRSp\_SHP2}] \cdot [\mathrm{IRp\_RasGAP}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{243}$$

7.108 Reaction `reaction_117`

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

Reaction equation

$$\mathrm{mGABp} \overset{\mathrm{ppErk}}{\rightleftharpoons} \mathrm{imGABp} \tag{244}$$

Reactant

Table 244: Properties of each reactant.

Id	Name	SBO
`mGABp`		

Modifier

Table 245: Properties of each modifier.

Id	Name	SBO
`ppErk`		

Product

Table 246: Properties of each product.

Id	Name	SBO
`imGABp`		

Kinetic Law

Derived unit contains undeclared units

$$v_{108} = \left(\frac{2 \cdot \mathrm{kcat80} \cdot [\mathrm{mGABp}] \cdot [\mathrm{ppErk}]}{\mathrm{Km80} + [\mathrm{mGABp}]} - \mathrm{k\_80} \cdot [\mathrm{imGABp}] \right) \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{245}$$

7.109 Reaction reaction_118

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

Reaction equation

$$\text{imGABBp} \longrightarrow \text{imGABB} \tag{246}$$

Reactant

Table 247: Properties of each reactant.

Id	Name	SBO
imGABBp		

Product

Table 248: Properties of each product.

Id	Name	SBO
imGABB		

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{nmol}$

$$v_{109} = \mathrm{k118} \cdot [\mathrm{imGABBp}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{247}$$

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.

8.1 Species EGF

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

This species takes part in one reaction (as a reactant in reaction_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{EGF} = -v_1 \tag{248}$$

8.2 Species I

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in reaction_24).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{I} = -v_{21} \tag{249}$$

8.3 Species RE

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_2 and as a product in reaction_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RE} = v_1 - 2v_2 \tag{250}$$

8.4 Species Rd

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_3 and as a product in reaction_2, reaction_83).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rd} = v_2 + v_{77} - v_3 \tag{251}$$

8.5 Species Rp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in 15 reactions (as a reactant in reaction_4, reaction_5, reaction_12, reaction_13, reaction_17, reaction_82 and as a product in reaction_3, reaction_7, reaction_10, reaction_112, reaction_114 and as a modifier in reaction_40, reaction_43, reaction_50, reaction_57).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rp} = v_3 + v_7 + v_{10} + v_{104} + v_{106} - v_4 - v_5 - v_{12} - v_{13} - v_{14} - v_{76} \tag{252}$$

8.6 Species GS

Initial concentration $200\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in twelve reactions (as a reactant in reaction_4, reaction_9, reaction_45, reaction_52, reaction_59, reaction_79 and as a product in reaction_11, reaction_18, reaction_100, reaction_103, reaction_106, reaction_110).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GS} = v_{11} + v_{15} + v_{92} + v_{95} + v_{98} + v_{102} - v_4 - v_9 - v_{39} - v_{46} - v_{53} - v_{73} \tag{253}$$

8.7 Species Rp_GS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_18 and as a product in reaction_4 and as a modifier in reaction_62).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rp\_GS} = v_4 - v_{15} \tag{254}$$

8.8 Species Shc

Initial concentration $270\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_5 and as a product in reaction_8, reaction_19).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Shc} = v_8 + v_{16} - v_5 \tag{255}$$

8.9 Species Rp_Shc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_6, reaction_19 and as a product in reaction_5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rp\_Shc} = v_5 - v_6 - v_{16} \tag{256}$$

8.10 Species Rp_pShc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_7, reaction_9, reaction_20 and as a product in reaction_6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rp\_pShc} = v_6 - v_7 - v_9 - v_{17} \tag{257}$$

8.11 Species pShc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_8 and as a product in reaction_7, reaction_11, reaction_20).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{pShc} = v_7 + v_{11} + v_{17} - v_8 \tag{258}$$

8.12 Species Rp_pShc_GS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_10, reaction_21 and as a product in reaction_9 and as a modifier in reaction_62).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rp\_pShc\_GS} = v_9 - v_{10} - v_{18} \tag{259}$$

8.13 Species PI3K

Initial concentration $200\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in nine reactions (as a reactant in reaction_12, reaction_26, reaction_46, reaction_53, reaction_64 and as a product in reaction_22, reaction_35, reaction_99, reaction_105).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PI3K} = v_{19} + v_{30} + v_{91} + v_{97} - v_{12} - v_{23} - v_{40} - v_{47} - v_{58} \tag{260}$$

8.14 Species Rp_PI3K

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_22 and as a product in reaction_12 and as a modifier in reaction_60).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rp\_PI3K} = v_{12} - v_{19} \tag{261}$$

8.15 Species RasGAP

Initial concentration $50\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eleven reactions (as a reactant in reaction_13, reaction_27, reaction_54 and as a product in reaction_23, reaction_36, reaction_107, reaction_111, reaction_112, reaction_113, reaction_114, reaction_115).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RasGAP} = v_{20} + v_{31} + v_{99} + v_{103} + v_{104} + v_{105} + v_{106} + v_{107} - v_{13} - v_{24} - v_{48} \tag{262}$$

8.16 Species Rp_RasGAP

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_23, reaction_112, reaction_114 and as a product in reaction_13 and as a modifier in reaction_63).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rp\_RasGAP} = v_{13} - v_{20} - v_{104} - v_{106} \tag{263}$$

8.17 Species IRL

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_25 and as a product in reaction_24, reaction_85).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRL} = v_{21} + v_{79} - v_{22} \tag{264}$$

8.18 Species IRp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eleven reactions (as a reactant in reaction_26, reaction_27, reaction_28, reaction_34, reaction_84 and as a product in reaction_25, reaction_30, reaction_113, reaction_115 and as a modifier in reaction_40, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRp} = v_{22} + v_{27} + v_{105} + v_{107} - v_{23} - v_{24} - v_{25} - v_{29} - v_{78} \tag{265}$$

8.19 Species IRp_PI3K

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_35 and as a product in reaction_26 and as a modifier in reaction_60).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRp\_PI3K} = v_{23} - v_{30} \tag{266}$$

8.20 Species IRp_RasGAP

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_36, reaction_113, reaction_115 and as a product in reaction_27 and as a modifier in reaction_63).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRp\_RasGAP} = v_{24} - v_{31} - v_{105} - v_{107} \tag{267}$$

8.21 Species IRS

Initial concentration $300\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in seven reactions (as a reactant in reaction_28, reaction_42 and as a product in reaction_31, reaction_37, reaction_99, reaction_100, reaction_101).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRS} = v_{28} + v_{32} + v_{91} + v_{92} + v_{93} - v_{25} - v_{36} \tag{268}$$

8.22 Species IRp_IRS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_29, reaction_37 and as a product in reaction_28).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRp\_IRS} = v_{25} - v_{26} - v_{32} \tag{269}$$

8.23 Species IRp_IRSp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_30, reaction_38 and as a product in reaction_29).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRp\_IRSp} = v_{26} - v_{27} - v_{33} \tag{270}$$

8.24 Species IRSp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_31 and as a product in reaction_30, reaction_38, reaction_88).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRSp} = v_{27} + v_{33} + v_{80} - v_{28} \tag{271}$$

8.25 Species iSrc

Initial concentration $518\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_40 and as a product in reaction_41).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{iSrc} = v_{35} - v_{34} \tag{272}$$

8.26 Species mIRS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_43, reaction_81 and as a product in reaction_42, reaction_44, reaction_48).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mIRS} = v_{36} + v_{38} + v_{42} - v_{37} - v_{75} \tag{273}$$

8.27 Species mIRSp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in six reactions (as a reactant in reaction_44, reaction_45, reaction_46, reaction_47, reaction_88 and as a product in reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mIRSp} = v_{37} - v_{38} - v_{39} - v_{40} - v_{41} - v_{80} \tag{274}$$

8.28 Species mIRSp_GS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_90 and as a product in reaction_45 and as a modifier in reaction_62).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mIRSp\_GS} = v_{39} - v_{82} \tag{275}$$

8.29 Species mIRSp_PI3K

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_89 and as a product in reaction_46 and as a modifier in reaction_60).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mIRSp\_PI3K} = v_{40} - v_{81} \tag{276}$$

8.30 Species SHP2

Initial concentration $300\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in ten reactions (as a reactant in reaction_47, reaction_55 and as a product in reaction_48, reaction_56, reaction_101, reaction_102, reaction_103, reaction_108, reaction_109, reaction_110).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SHP2} = v_{42} + v_{50} + v_{93} + v_{94} + v_{95} + v_{100} + v_{101} + v_{102} - v_{41} - v_{49} \tag{277}$$

8.31 Species mIRSp_SHP2

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in six reactions (as a reactant in reaction_48, reaction_91 and as a product in reaction_47 and as a modifier in reaction_111, reaction_114, reaction_115).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mIRSp\_SHP2} = v_{41} - v_{42} - v_{83} \tag{278}$$

8.32 Species GAB

Initial concentration $225\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eight reactions (as a reactant in reaction_49 and as a product in reaction_104, reaction_105, reaction_106, reaction_107, reaction_108, reaction_109, reaction_110).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GAB} = v_{96} + v_{97} + v_{98} + v_{99} + v_{100} + v_{101} + v_{102} - v_{43} \tag{279}$$

8.33 Species mGAB

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eight reactions (as a reactant in reaction_50, reaction_80 and as a product in reaction_49, reaction_51, reaction_56, reaction_102, reaction_103, reaction_111).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGAB} = v_{43} + v_{45} + v_{50} + v_{94} + v_{95} + v_{103} - v_{44} - v_{74} \tag{280}$$

8.34 Species mGABp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eight reactions (as a reactant in reaction_51, reaction_52, reaction_53, reaction_54, reaction_55, reaction_92, reaction_117 and as a product in reaction_50).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGABp} = v_{44} - v_{45} - v_{46} - v_{47} - v_{48} - v_{49} - v_{84} - v_{108} \tag{281}$$

8.35 Species mGABp_GS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_94 and as a product in reaction_52 and as a modifier in reaction_62).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGABp\_GS} = v_{46} - v_{86} \tag{282}$$

8.36 Species mGABp_PI3K

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_93 and as a product in reaction_53 and as a modifier in reaction_60).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGABp\_PI3K} = v_{47} - v_{85} \tag{283}$$

8.37 Species mGABp_SHP2

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eight reactions (as a reactant in reaction_56, reaction_57, reaction_96 and as a product in reaction_55, reaction_58 and as a modifier in reaction_111, reaction_112, reaction_113).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGABp\_SHP2} = v_{49} + v_{52} - v_{50} - v_{51} - v_{88} \tag{284}$$

8.38 Species mGABp_pSHP2

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in eight reactions (as a reactant in reaction_58, reaction_59, reaction_97, reaction_102 and as a product in reaction_57 and as a modifier in reaction_111, reaction_112, reaction_113).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGABp\_pSHP2} = v_{51} - v_{52} - v_{53} - v_{89} - v_{94} \tag{285}$$

8.39 Species PIP3

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in 16 reactions (as a reactant in reaction_42, reaction_49, reaction_61, reaction_74 and as a product in reaction_60, reaction_88, reaction_89, reaction_90, reaction_91, reaction_92, reaction_93, reaction_94, reaction_95, reaction_96, reaction_97, reaction_98).

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PIP3} = {} & v_{54} + v_{80} + v_{81} + v_{82} + v_{83} + v_{84} + v_{85} + v_{86} \\ & + v_{87} + v_{88} + v_{89} + v_{90} - v_{36} - v_{43} - v_{55} - v_{68}\end{aligned} \tag{286}$$

8.40 Species dRas

Initial concentration $150\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_62 and as a product in reaction_63).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{dRas} = v_{57} - v_{56} \tag{287}$$

8.41 Species Raf

Initial concentration $100\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_65 and as a product in reaction_67).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Raf} = v_{61} - v_{59} \tag{288}$$

8.42 Species aRaf

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_66 and as a product in reaction_65).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{aRaf} = v_{59} - v_{60} \tag{289}$$

8.43 Species Mek

Initial concentration $200\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_68 and as a product in reaction_69).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Mek} = v_{63} - v_{62} \tag{290}$$

8.44 Species Erk

Initial concentration $400\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_70 and as a product in reaction_73 and as a modifier in reaction_71).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Erk} = v_{67} - v_{64} \tag{291}$$

8.45 Species pErk

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_71, reaction_73 and as a product in reaction_70, reaction_72).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{pErk} = v_{64} + v_{66} - v_{65} - v_{67} \tag{292}$$

8.46 Species PDK1

Initial concentration $100\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in reaction_74).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PDK1} = -v_{68} \tag{293}$$

8.47 Species Akt

Initial concentration $100\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_75 and as a product in reaction_76).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Akt} = v_{70} - v_{69} \tag{294}$$

8.48 Species pAkt

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_76, reaction_78 and as a product in reaction_75 and as a modifier in reaction_67, reaction_77).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{pAkt} = v_{69} - v_{70} - v_{72} \tag{295}$$

8.49 Species mTOR

Initial concentration $100\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in reaction_77).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mTOR} = -v_{71} \tag{296}$$

8.50 Species Null

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in reaction_17, reaction_34, reaction_61).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Null} = v_{14} + v_{29} + v_{55} \tag{297}$$

8.51 Species aaRaf

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_67 and as a product in reaction_66 and as a modifier in reaction_68).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{aaRaf} = v_{60} - v_{61} \tag{298}$$

8.52 Species PKA

Initial concentration $100\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a modifier in reaction_67).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PKA} = 0 \tag{299}$$

8.53 Species pShc_GS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in reaction_11 and as a product in reaction_10, reaction_21).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{pShc\_GS} = v_{10} + v_{18} - v_{11} \tag{300}$$

8.54 Species ppMek

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_69 and as a product in reaction_68 and as a modifier in reaction_70, reaction_71).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ppMek} = v_{62} - v_{63} \tag{301}$$

8.55 Species mGABp_pSHP2_GS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in seven reactions (as a reactant in reaction_98, reaction_103 and as a product in reaction_59 and as a modifier in reaction_62, reaction_111, reaction_112, reaction_113).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGABp\_pSHP2\_GS} = v_{53} - v_{90} - v_{95} \tag{302}$$

8.56 Species R

Initial concentration $100\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in reaction_1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R} = -v_1 \tag{303}$$

8.57 Species ppErk

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in six reactions (as a reactant in reaction_72 and as a product in reaction_71 and as a modifier in reaction_73, reaction_79, reaction_80, reaction_117).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ppErk} = v_{65} - v_{66} \tag{304}$$

8.58 Species IR

Initial concentration $150\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in reaction_24).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IR} = -v_{21} \tag{305}$$

8.59 Species mPDK1

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a product in reaction_74 and as a modifier in reaction_75).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mPDK1} = v_{68} \tag{306}$$

8.60 Species tRas

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_63, reaction_64 and as a product in reaction_62 and as a modifier in reaction_65).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{tRas} = v_{56} - v_{57} - v_{58} \tag{307}$$

8.61 Species tRas_PI3K

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a product in reaction_64 and as a modifier in reaction_60).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{tRas\_PI3K} = v_{58} \tag{308}$$

8.62 Species ppAkt

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in reaction_78 and as a modifier in reaction_67, reaction_77).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ppAkt} = v_{72} \tag{309}$$

8.63 Species mGABp_RasGAP

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in reaction_95, reaction_111 and as a product in reaction_54 and as a modifier in reaction_63).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGABp\_RasGAP} = v_{48} - v_{87} - v_{103} \tag{310}$$

8.64 Species amTOR

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in reaction_77 and as a modifier in reaction_78, reaction_81).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{amTOR} = v_{71} \tag{311}$$

8.65 Species iGS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in reaction_79).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{iGS} = v_{73} \tag{312}$$

8.66 Species imGAB

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a product in reaction_80, reaction_118).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{imGAB} = v_{74} + v_{109} \tag{313}$$

8.67 Species imIRS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in reaction_81).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{imIRS} = v_{75} \tag{314}$$

8.68 Species aSrc

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in reaction_41 and as a product in reaction_40 and as a modifier in reaction_50, reaction_57, reaction_66).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{aSrc} = v_{34} - v_{35} \tag{315}$$

8.69 Species Ri

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_83 and as a product in reaction_82).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ri} = v_{76} - v_{77} \tag{316}$$

8.70 Species IRi

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_85 and as a product in reaction_84).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRi} = v_{78} - v_{79} \tag{317}$$

8.71 Species iPX

Initial concentration $200\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species does not take part in any reactions. Its quantity does hence not change over time:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{iPX} = 0 \tag{318}$$

8.72 Species aPX

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species does not take part in any reactions. Its quantity does hence not change over time:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{aPX} = 0 \tag{319}$$

8.73 Species aPX_GS

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species does not take part in any reactions. Its quantity does hence not change over time:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{aPX\_GS} = 0 \tag{320}$$

8.74 Species IRSp_PI3K

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_99 and as a product in reaction_89).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRSp\_PI3K} = v_{81} - v_{91} \tag{321}$$

8.75 Species IRSp_GS

Initial concentration $0\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_100 and as a product in reaction_90).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRSp\_GS} = v_{82} - v_{92} \tag{322}$$

8.76 Species IRSp_SHP2

Initial concentration $0\,\mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_101 and as a product in reaction_91).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IRSp\_SHP2} = v_{83} - v_{93} \tag{323}$$

8.77 Species GABp

Initial concentration $0\,\mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_104 and as a product in reaction_92).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GABp} = v_{84} - v_{96} \tag{324}$$

8.78 Species GABp_PI3K

Initial concentration $0\,\mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_105 and as a product in reaction_93).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GABp\_PI3K} = v_{85} - v_{97} \tag{325}$$

8.79 Species GABp_GS

Initial concentration $0\,\mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_106 and as a product in reaction_94).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GABp\_GS} = v_{86} - v_{98} \tag{326}$$

8.80 Species GABp_RasGAP

Initial concentration $0\,\mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_107 and as a product in reaction_95).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GABp\_RasGAP} = v_{87} - v_{99} \tag{327}$$

8.81 Species GABp_SHP2

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_108 and as a product in reaction_96).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GABp\_SHP2} = v_{88} - v_{100} \tag{328}$$

8.82 Species GABp_pSHP2

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_109 and as a product in reaction_97).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GABp\_pSHP2} = v_{89} - v_{101} \tag{329}$$

8.83 Species GABp_pSHP2_GS

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_110 and as a product in reaction_98).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{GABp\_pSHP2\_GS} = v_{90} - v_{102} \tag{330}$$

8.84 Species imGABp

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_118 and as a product in reaction_117).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{imGABp} = v_{108} - v_{109} \tag{331}$$

8.85 Species bRasGAP

Initial concentration $10^{-5}\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a modifier in reaction_63).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{bRasGAP} = 0 \tag{332}$$

8.86 Species phosphorylated_Akt

Involved in rule phosphorylated_Akt

One rule which determines this species' quantity.

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