SBML Model Report

Model name: "Kallenberger2014 - CD95L induced apoptosis initiated by caspase-8, wild-type HeLa cells (cis/trans variant)"

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: Vijayalakshmi Chelliah[1] and Stefan Kallenberger[2] at March 14th 2014 at 12:21 a. m. and last time modified at February 25th 2015 at 12:37 a. m. Table 1 provides an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	18
events	0	constraints	0
reactions	13	function definitions	0
global parameters	12	unit definitions	0
rules	1	initial assignments	0

Model Notes

Kallenberger2014 - CD95L induced apoptosis initiated by caspase-8, wild-type HeLa cells (cis/trans variant)

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The paper describes a new approach that combines single cell and population data in the same model. The model consists of a large number of single cell models, which are fitted to single cell data. Simultaneously, ensemble averages are fitted to population data. It is assumed that the kinetics in each cell can be described with the same kinetic parameters. Therefore, cell-to-cell variability is explained by variable initial protein concentrations.

There are four variants of the model (with [CD95L]=500ng/ml = 16.6nM), i) cistrans (in CD95-HeLa cells) [MODEL1403050000], ii) cistrans (in wild-type HeLa cells) [MODEL1403050001], iii) cistrans-cistrans (in CD95-HeLa cells) [MODEL1403050002], and iv) cistrans-cistrans (in wild-type HeLa cells) [MODEL1403050003].

These model contain the equations for one „average cell„ with median initial concentrations for CD95, FADD, p55, BID, PrNES_mCherry and PrER_mGFP. By integrating the model, it should be possible to obtain trajectories for PrER_mGFP, PrNES_mCherry, p43 and p18 similar as in Figure 4A (CD95-HeLa cells) and Figure 4B (wild-type HeLa cells).

This model is described in the article:Intra- and Interdimeric Caspase-8 Self-Cleavage Controls Strength and Timing of CD95-Induced ApoptosisStefan M. Kallenberger, Jol Beaudouin, Juliane Claus, Carmen Fischer, Peter K. Sorger, Stefan Legewie, and Roland Eils11 March 2014: Vol. 7, Issue 316, p. ra23

Abstract:

Apoptosis in response to the ligand CD95L (also known as Fas ligand) is initiated by caspase-8, which is activated by dimerization and self-cleavage at death-inducing signaling complexes (DISCs). Previous work indicated that the degree of substrate cleavage by caspase-8 determines whether a cell dies or survives in response to a death stimulus. To determine how a death ligand stimulus is effectively translated into caspase-8 activity, we assessed this activity over time in single cells with compartmentalized probes that are cleaved by caspase-8 and used multiscale modeling to simultaneously describe single-cell and population data with an ensemble of single-cell models. We derived and experimentally validated a minimal model in which cleavage of caspase-8 in the enzymatic domain occurs in an interdimeric manner through interaction between DISCs, whereas prodomain cleavage sites are cleaved in an intradimeric manner within DISCs. Modeling indicated that sustained membrane-bound caspase-8 activity is followed by transient cytosolic activity, which can be interpreted as a molecular timer mechanism reflected by a limited lifetime of active caspase-8. The activation of caspase-8 by combined intra- and interdimeric cleavage ensures weak signaling at low concentrations of CD95L and strongly accelerated activation at higher ligand concentrations, thereby contributing to precise control of apoptosis.

This model is hosted on BioModels Database and identifiedby: BIOMD0000000524 .

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

2 Unit Definitions

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

2.1 Unit `substance`

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

Definition mol

2.2 Unit `volume`

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

Definition l

2.3 Unit `area`

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

Definition m^2

2.4 Unit `length`

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

Definition m

2.5 Unit `time`

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

Definition s

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

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

3.1 Compartment `cell`

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

Name cell

4 Species

This model contains 18 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
CD95	CD95	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
FADD	FADD	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
p55free	p55free	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bid	Bid	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PrNES_mCherry	PrNES_mCherry	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PrER_mGFP	PrER_mGFP	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
DISC	DISC	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
DISCp55	DISCp55	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
p30	p30	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
p43	p43	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
p18	p18	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
p18inactive	p18inactive	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
tBid	tBid	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PrNES	PrNES	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
mCherry	mCherry	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PrER	PrER	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
mGFP	mGFP	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
CD95L	CD95L	cell	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Parameters

This model contains twelve global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kon_FADD			$8.11711012144556 \cdot 10^{-4}$		☑
koff_FADD			0.006		☑
kDISC			$4.91828591049766 \cdot 10^{-4}$		☑
kD216			0.011		☑
kD374trans_p55			$4.46994772958953 \cdot 10^{-4}$		☑
kD374trans_p43			0.003		☑
kdiss_p18			0.095		☑
kBid			$5.2867403363568 \cdot 10^{-4}$		☑
kD374probe			0.002		☑
KDR			8.985		☑
KDL			15.422		☑
CD95act			0.000		⊟

6 Rule

This is an overview of one rule.

6.1 Rule CD95act

Rule CD95act is an assignment rule for parameter CD95act:

$$\text{CD95act} = \frac{[\text{CD95}]^3 \cdot \text{KDL}^2 \cdot [\text{CD95L}]}{([\text{CD95L}] + \text{KDL}) \cdot \left([\text{CD95}]^2 \cdot \text{KDL}^2 + \text{KDR} \cdot [\text{CD95L}]^2 + 2 \cdot \text{KDR} \cdot \text{KDL} \cdot [\text{CD95L}] + \text{KDR} \cdot \text{KDL}^2\right)} \tag{1}$$

7 Reactions

This model contains 13 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		$\mathrm{FADD} \xrightarrow{\mathrm{FADD}} \mathrm{DISC}$	
2	reaction_2		$\mathrm{DISC} \xrightarrow{\mathrm{DISC}} \mathrm{FADD}$	
3	reaction_3		$\mathrm{p55free} + \mathrm{DISC} \xrightarrow{\mathrm{p55free,\ DISC}} \mathrm{DISCp55}$	
4	reaction_4		$\mathrm{DISCp55} \xrightarrow{\mathrm{DISCp55}} \mathrm{p30}$	
5	reaction_5		$\mathrm{p43} \xrightarrow{\mathrm{p43}} \mathrm{p18} + \mathrm{DISC}$	
6	reaction_6		$\mathrm{DISCp55} \xrightarrow{\mathrm{DISCp55,\ p30,\ DISCp55,\ p30}} \mathrm{p43}$	
7	reaction_7		$\mathrm{DISCp55} \xrightarrow{\mathrm{p43,\ DISCp55,\ p43}} \mathrm{p43}$	
8	reaction_8		$\mathrm{p30} \xrightarrow{\mathrm{DISCp55,\ p30,\ p30,\ DISCp55}} \mathrm{p18} + \mathrm{DISC}$	
9	reaction_9		$\mathrm{p30} \xrightarrow{\mathrm{p43,\ p30,\ p43}} \mathrm{p18} + \mathrm{DISC}$	
10	reaction_10		$\mathrm{p18} \xrightarrow{\mathrm{p18}} \mathrm{p18inactive}$	
11	reaction_11		$\mathrm{Bid} \xrightarrow{\mathrm{p43,\ p18,\ Bid,\ p43,\ p18}} \mathrm{tBid}$	
12	reaction_12		$\mathrm{PrNES\_mCherry} \xrightarrow{\mathrm{p43,\ p18,\ PrNES\_mCherry,\ p43,\ p18}} \mathrm{PrNES} + \mathrm{mCherry}$	
13	reaction_13		$\mathrm{PrER\_mGFP} \xrightarrow{\mathrm{p18,\ PrER\_mGFP,\ p18}} \mathrm{PrER} + \mathrm{mGFP}$	

7.1 Reaction `reaction_1`

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

Reaction equation

$$\mathrm{FADD} \xrightarrow{\mathrm{FADD}} \mathrm{DISC} \tag{2}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
`FADD`	FADD	

Modifier

Table 7: Properties of each modifier.

Id	Name	SBO
`FADD`	FADD	

Product

Table 8: Properties of each product.

Id	Name	SBO
`DISC`	DISC	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \mathrm{kon\_FADD} \cdot \mathrm{CD95act} \cdot [\mathrm{FADD}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{3}$$

7.2 Reaction `reaction_2`

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

Reaction equation

$$\mathrm{DISC} \xrightarrow{\mathrm{DISC}} \mathrm{FADD} \tag{4}$$

Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
DISC	DISC	

Modifier

Table 10: Properties of each modifier.

Id	Name	SBO
DISC	DISC	

Product

Table 11: Properties of each product.

Id	Name	SBO
FADD	FADD	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \text{koff\_FADD} \cdot [\text{DISC}] \cdot \text{vol}(\text{cell}) \tag{5}$$

7.3 Reaction reaction_3

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

Reaction equation

$$\text{p55free} + \text{DISC} \xrightarrow{\text{p55free, DISC}} \text{DISCp55} \tag{6}$$

Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
p55free	p55free	

Id	Name	SBO
DISC	DISC	

Modifiers

Table 13: Properties of each modifier.

Id	Name	SBO
p55free	p55free	
DISC	DISC	

Product

Table 14: Properties of each product.

Id	Name	SBO
DISCp55	DISCp55	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{kDISC} \cdot [\mathrm{p55free}] \cdot [\mathrm{DISC}] \cdot \mathrm{vol}(\mathrm{cell}) \tag{7}$$

7.4 Reaction reaction_4

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

Reaction equation

$$\mathrm{DISCp55} \xrightarrow{\mathrm{DISCp55}} \mathrm{p30} \tag{8}$$

Reactant

Table 15: Properties of each reactant.

Id	Name	SBO
DISCp55	DISCp55	

Modifier

Table 16: Properties of each modifier.

Id	Name	SBO
DISCp55	DISCp55	

Product

Table 17: Properties of each product.

Id	Name	SBO
p30	p30	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \mathrm{kD216} \cdot [\mathrm{DISCp55}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{9}$$

7.5 Reaction reaction_5

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

Reaction equation

$$\mathrm{p43} \xrightarrow{\mathrm{p43}} \mathrm{p18} + \mathrm{DISC} \tag{10}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
p43	p43	

Modifier

Table 19: Properties of each modifier.

Id	Name	SBO
p43	p43	

Products

Table 20: Properties of each product.

Id	Name	SBO
p18	p18	
DISC	DISC	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{kD216} \cdot [\mathrm{p43}] \cdot \mathrm{vol}\,(\mathrm{cell}) \tag{11}$$

7.6 Reaction reaction_6

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

Reaction equation

$$\mathrm{DISCp55} \xrightarrow{\mathrm{DISCp55,\ p30,\ DISCp55,\ p30}} \mathrm{p43} \tag{12}$$

Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
DISCp55	DISCp55	

Modifiers

Table 22: Properties of each modifier.

Id	Name	SBO
DISCp55	DISCp55	
p30	p30	
DISCp55	DISCp55	
p30	p30	

Product

Table 23: Properties of each product.

Id	Name	SBO
p43	p43	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \text{kD374trans\_p55} \cdot [\text{DISCp55}] \cdot ([\text{DISCp55}] + [\text{p30}]) \cdot \text{vol}(\text{cell}) \tag{13}$$

7.7 Reaction reaction_7

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

Reaction equation

$$\text{DISCp55} \xrightarrow{\text{p43, DISCp55, p43}} \text{p43} \tag{14}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
DISCp55	DISCp55	

Modifiers

Table 25: Properties of each modifier.

Id	Name	SBO
p43	p43	
DISCp55	DISCp55	
p43	p43	

Product

Table 26: Properties of each product.

Id	Name	SBO
p43	p43	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \text{kD374trans\_p43} \cdot [\text{DISCp55}] \cdot [\text{p43}] \cdot \text{vol}(\text{cell}) \tag{15}$$

7.8 Reaction `reaction_8`

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

Reaction equation

$$\text{p30} \xrightarrow{\text{DISCp55, p30, p30, DISCp55}} \text{p18} + \text{DISC} \tag{16}$$

Reactant

Table 27: Properties of each reactant.

Id	Name	SBO
p30	p30	

Modifiers

Table 28: Properties of each modifier.

Id	Name	SBO
DISCp55	DISCp55	
p30	p30	
p30	p30	
DISCp55	DISCp55	

Products

Table 29: Properties of each product.

Id	Name	SBO
p18	p18	
DISC	DISC	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \text{kD374trans\_p55} \cdot [\text{p30}] \cdot ([\text{DISCp55}] + [\text{p30}]) \cdot \text{vol}(\text{cell}) \tag{17}$$

7.9 Reaction `reaction_9`

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

Reaction equation

$$\text{p30} \xrightarrow{\text{p43, p30, p43}} \text{p18} + \text{DISC} \tag{18}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
p30	p30	

Modifiers

Table 31: Properties of each modifier.

Id	Name	SBO
p43	p43	
p30	p30	
p43	p43	

Products

Table 32: Properties of each product.

Id	Name	SBO
p18	p18	
DISC	DISC	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \text{kD374trans\_p43} \cdot [\text{p30}] \cdot [\text{p43}] \cdot \text{vol}(\text{cell}) \tag{19}$$

7.10 Reaction `reaction_10`

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

Reaction equation

$$\text{p18} \xrightarrow{\text{p18}} \text{p18inactive} \tag{20}$$

Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
`p18`	p18	

Modifier

Table 34: Properties of each modifier.

Id	Name	SBO
`p18`	p18	

Product

Table 35: Properties of each product.

Id	Name	SBO
`p18inactive`	p18inactive	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \text{kdiss\_p18} \cdot [\text{p18}] \cdot \text{vol}(\text{cell}) \tag{21}$$

7.11 Reaction `reaction_11`

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

Reaction equation

$$\text{Bid} \xrightarrow{\text{p43, p18, Bid, p43, p18}} \text{tBid} \tag{22}$$

Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
`Bid`	Bid	

Modifiers

Table 37: Properties of each modifier.

Id	Name	SBO
`p43`	p43	
`p18`	p18	
`Bid`	Bid	
`p43`	p43	
`p18`	p18	

Product

Table 38: Properties of each product.

Id	Name	SBO
`tBid`	tBid	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \text{kBid} \cdot [\text{Bid}] \cdot ([\text{p43}] + [\text{p18}]) \cdot \text{vol}(\text{cell}) \tag{23}$$

7.12 Reaction `reaction_12`

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

Reaction equation

$$\text{PrNES\_mCherry} \xrightarrow{\text{p43, p18, PrNES\_mCherry, p43, p18}} \text{PrNES} + \text{mCherry} \tag{24}$$

Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
PrNES_mCherry	PrNES_mCherry	

Modifiers

Table 40: Properties of each modifier.

Id	Name	SBO
p43	p43	
p18	p18	
PrNES_mCherry	PrNES_mCherry	
p43	p43	
p18	p18	

Products

Table 41: Properties of each product.

Id	Name	SBO
PrNES	PrNES	
mCherry	mCherry	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{kD374probe} \cdot [\text{PrNES\_mCherry}] \cdot ([\text{p43}] + [\text{p18}]) \cdot \text{vol}(\text{cell}) \tag{25}$$

7.13 Reaction reaction_13

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

Reaction equation

$$\text{PrER\_mGFP} \xrightarrow{\text{p18, PrER\_mGFP, p18}} \text{PrER} + \text{mGFP} \tag{26}$$

Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
PrER_mGFP	PrER_mGFP	

Modifiers

Table 43: Properties of each modifier.

Id	Name	SBO
p18	p18	
PrER_mGFP	PrER_mGFP	
p18	p18	

Products

Table 44: Properties of each product.

Id	Name	SBO
PrER	PrER	
mGFP	mGFP	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \text{kD374probe} \cdot [\text{PrER\_mGFP}] \cdot [\text{p18}] \cdot \text{vol}(\text{cell}) \tag{27}$$

8 Derived Rate Equations

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

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

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

8.1 Species `CD95`

Name CD95

Initial concentration $12\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CD95} = 0 \tag{28}$$

8.2 Species `FADD`

Name FADD

Initial concentration $90\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{FADD} = v_2 - v_1 \tag{29}$$

8.3 Species `p55free`

Name p55free

Initial concentration $127\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in `reaction_3` and as a modifier in `reaction_3`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p55free} = -v_3 \tag{30}$$

8.4 Species `Bid`

Name Bid

Initial concentration $224\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in `reaction_11` and as a modifier in `reaction_11`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bid} = -v_{11} \tag{31}$$

8.5 Species PrNES_mCherry

Name PrNES_mCherry

Initial concentration $1909\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_12 and as a modifier in reaction_12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PrNES\_mCherry} = -v_{12} \tag{32}$$

8.6 Species PrER_mGFP

Name PrER_mGFP

Initial concentration $3316\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in reaction_13 and as a modifier in reaction_13).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PrER\_mGFP} = -v_{13} \tag{33}$$

8.7 Species DISC

Name DISC

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

This species takes part in eight reactions (as a reactant in reaction_2, reaction_3 and as a product in reaction_1, reaction_5, reaction_8, reaction_9 and as a modifier in reaction_2, reaction_3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{DISC} = v_1 + v_5 + v_8 + v_9 - v_2 - v_3 \tag{34}$$

8.8 Species DISCp55

Name DISCp55

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

This species takes part in ten reactions (as a reactant in reaction_4, reaction_6, reaction_7 and as a product in reaction_3 and as a modifier in reaction_4, reaction_6, reaction_6, reaction_7, reaction_8, reaction_8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{DISCp55} = v_3 - v_4 - v_6 - v_7 \tag{35}$$

8.9 Species p30

Name p30

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

This species takes part in eight reactions (as a reactant in reaction_8, reaction_9 and as a product in reaction_4 and as a modifier in reaction_6, reaction_6, reaction_8, reaction_8, reaction_9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p30} = v_4 - v_8 - v_9 \tag{36}$$

8.10 Species p43

Name p43

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

This species takes part in twelve reactions (as a reactant in reaction_5 and as a product in reaction_6, reaction_7 and as a modifier in reaction_5, reaction_7, reaction_7, reaction_9, reaction_9, reaction_11, reaction_11, reaction_12, reaction_12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p43} = v_6 + v_7 - v_5 \tag{37}$$

8.11 Species p18

Name p18

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

This species takes part in eleven reactions (as a reactant in reaction_10 and as a product in reaction_5, reaction_8, reaction_9 and as a modifier in reaction_10, reaction_11, reaction_11, reaction_12, reaction_12, reaction_13, reaction_13).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p18} = v_5 + v_8 + v_9 - v_{10} \tag{38}$$

8.12 Species p18inactive

Name p18inactive

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

This species takes part in one reaction (as a product in reaction_10).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p18inactive} = v_{10} \tag{39}$$

8.13 Species tBid

Name tBid

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

This species takes part in one reaction (as a product in reaction_11).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{tBid} = v_{11} \tag{40}$$

8.14 Species PrNES

Name PrNES

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

This species takes part in one reaction (as a product in reaction_12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PrNES} = v_{12} \tag{41}$$

8.15 Species mCherry

Name mCherry

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

This species takes part in one reaction (as a product in reaction_12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mCherry} = v_{12} \tag{42}$$

8.16 Species PrER

Name PrER

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

This species takes part in one reaction (as a product in reaction_13).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PrER} = v_{13} \tag{43}$$

8.17 Species mGFP

Name mGFP

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

This species takes part in one reaction (as a product in reaction_13).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mGFP} = v_{13} \tag{44}$$

8.18 Species CD95L

Name CD95L

Initial concentration $16.6\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{CD95L} = 0 \tag{45}$$

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