

## SBML Model Report

# Model name: “Kallenberger2014 - CD95L induced apoptosis initiated by caspase-8, CD95 HeLa cells (cis/trans variant)”



May 6, 2016

## 1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Vijayalakshmi Chelliah<sup>1</sup> and Stefan Kallenberger<sup>2</sup> at March thirteenth 2014 at 9:49 p. m. and last time modified at February 25<sup>th</sup> 2015 at 12:38 a. m. Table 1 shows an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	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, CD95 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 Apoptosis](#) Stefan M. Kallenberger, Jol Beaudouin, Juliane Claus, Carmen Fischer, Peter K. Sorger, Stefan Legewie, and Roland Eils 11 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 identified by: [BIOMD0000000523](#) .

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

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## 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<sup>2</sup>

### 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	0000290	3	1	litre	<input checked="" type="checkbox"/>	

### 3.1 Compartment `cell`

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

**Name** `cell`

**SBO:0000290** physical compartment

## 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	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
FADD	FADD	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
p55free	p55free	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
Bid	Bid	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
PrNES_mCherry	PrNES_mCherry	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
PrER_mGFP	PrER_mGFP	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
DISC	DISC	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
DISCp55	DISCp55	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
p30	p30	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
p43	p43	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
p18	p18	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
p18inactive	p18inactive	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
tBid	tBid	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
PrNES	PrNES	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
mCherry	mCherry	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
PrER	PrER	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
mGFP	mGFP	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
CD95L	CD95L	cell	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$

## 5 Parameters

This model contains twelve global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kon_FADD			$8.11711012144556 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
koff_FADD			0.006		<input checked="" type="checkbox"/>
kDISC			$4.91828591049766 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
kD216			0.011		<input checked="" type="checkbox"/>
kD374trans- _p55			$4.46994772958953 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
kD374trans- _p43			0.003		<input checked="" type="checkbox"/>
kdiss_p18			0.095		<input checked="" type="checkbox"/>
kBid			$5.2867403363568 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
kD374probe			0.002		<input checked="" type="checkbox"/>
KDR			8.985		<input checked="" type="checkbox"/>
KDL			15.422		<input checked="" type="checkbox"/>
CD95act			0.000		<input type="checkbox"/>

## 6 Rule

This is an overview of one rule.

### 6.1 Rule CD95act

Rule CD95act is an assignment rule for parameter CD95act:

$$\begin{aligned}
 &\text{CD95act} && (1) \\
 &= \frac{[\text{CD95}]^3 \cdot \text{KDL}^2 \cdot [\text{CD95L}]}{([\text{CD95L}] + \text{KDL}) \cdot ([\text{CD95}]^2 \cdot \text{KDL}^2 + \text{KDR} \cdot [\text{CD95L}]^2 + 2 \cdot \text{KDR} \cdot \text{KDL} \cdot [\text{CD95L}] + \text{KDR} \cdot \text{KDL}^2)}
 \end{aligned}$$

## 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

Nº	Id	Name	Reaction Equation	SBO
1	reaction_1		$\text{FADD} \xrightarrow{\text{FADD}} \text{DISC}$	
2	reaction_2		$\text{DISC} \xrightarrow{\text{DISC}} \text{FADD}$	
3	reaction_3		$\text{p55free} + \text{DISC} \xrightarrow{\text{p55free, DISC}} \text{DISCp55}$	
4	reaction_4		$\text{DISCp55} \xrightarrow{\text{DISCp55}} \text{p30}$	
5	reaction_5		$\text{p43} \xrightarrow{\text{p43}} \text{p18} + \text{DISC}$	
6	reaction_6		$\text{DISCp55} \xrightarrow{\text{DISCp55, p30, DISCp55, p30}} \text{p43}$	
7	reaction_7		$\text{DISCp55} \xrightarrow{\text{p43, DISCp55, p43}} \text{p43}$	
8	reaction_8		$\text{p30} \xrightarrow{\text{DISCp55, p30, p30, DISCp55}} \text{p18} + \text{DISC}$	
9	reaction_9		$\text{p30} \xrightarrow{\text{p43, p30, p43}} \text{p18} + \text{DISC}$	
10	reaction_10		$\text{p18} \xrightarrow{\text{p18}} \text{p18inactive}$	
11	reaction_11		$\text{Bid} \xrightarrow{\text{p43, p18, Bid, p43, p18}} \text{tBid}$	
12	reaction_12		$\text{PrNES\_mCherry} \xrightarrow{\text{p43, p18, PrNES\_mCherry, p43, p18}} \text{PrNES} + \text{mCherry}$	
13	reaction_13		$\text{PrER\_mGFP} \xrightarrow{\text{p18, PrER\_mGFP, p18}} \text{PrER} + \text{mGFP}$	

## 7.1 Reaction `reaction_1`

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

### Reaction equation



### 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

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

## 7.2 Reaction `reaction_2`

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

### Reaction equation





## 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

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

## 7.3 Reaction `reaction_3`

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

### Reaction equation



## 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

$$v_3 = k_{\text{DISC}} \cdot [\text{p55free}] \cdot [\text{DISC}] \cdot \text{vol}(\text{cell}) \quad (7)$$

## 7.4 Reaction `reaction_4`

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

### Reaction equation



## 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

$$v_4 = kD216 \cdot [\text{DISCp55}] \cdot \text{vol}(\text{cell}) \quad (9)$$

## 7.5 Reaction `reaction_5`

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

### Reaction equation



## 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

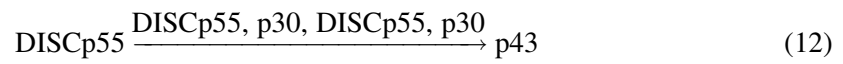
**Derived unit** contains undeclared units

$$v_5 = kD216 \cdot [p43] \cdot \text{vol}(\text{cell}) \quad (11)$$

## 7.6 Reaction `reaction_6`

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

### Reaction equation



## 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

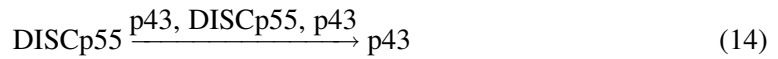
**Derived unit** contains undeclared units

$$v_6 = kD374trans\_p55 \cdot [DISCp55] \cdot ([DISCp55] + [p30]) \cdot vol(cell) \quad (13)$$

### 7.7 Reaction `reaction_7`

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

### Reaction equation



### 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

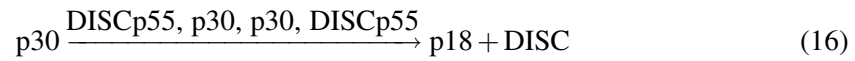
**Derived unit** contains undeclared units

$$v_7 = kD374trans\_p43 \cdot [DISCp55] \cdot [p43] \cdot vol(cell) \quad (15)$$

## 7.8 Reaction `reaction_8`

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

### Reaction equation



### 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

$$v_8 = kD374trans\_p55 \cdot [p30] \cdot ([DISCp55] + [p30]) \cdot vol(cell) \quad (17)$$

## 7.9 Reaction `reaction_9`

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

### Reaction equation



### 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

$$v_9 = kD374trans\_p43 \cdot [p30] \cdot [p43] \cdot vol(cell) \quad (19)$$

## 7.10 Reaction `reaction_10`

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

### Reaction equation



### 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

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



### 7.11 Reaction `reaction_11`

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

#### Reaction equation



#### 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

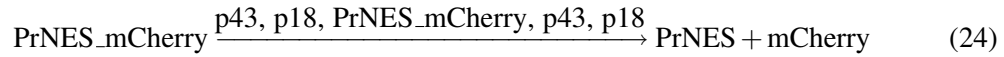
**Derived unit** contains undeclared units

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

### 7.12 Reaction `reaction_12`

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

## Reaction equation



## 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

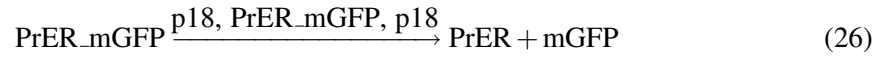
**Derived unit** contains undeclared units

$$v_{12} = kD374_{\text{probe}} \cdot [\text{PrNES\_mCherry}] \cdot ([\text{p43}] + [\text{p18}]) \cdot \text{vol}(\text{cell}) \quad (25)$$

## 7.13 Reaction `reaction_13`

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

## Reaction equation



## 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

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

## 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** 116 mol · l<sup>-1</sup>

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

$$\frac{d}{dt}\text{CD95} = 0 \quad (28)$$

## 8.2 Species FADD

**Name** FADD

**Initial concentration** 93 mol · l<sup>-1</sup>

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](#)).

$$\frac{d}{dt}\text{FADD} = v_2 - v_1 \quad (29)$$

## 8.3 Species p55free

**Name** p55free

**Initial concentration** 155 mol · l<sup>-1</sup>

This species takes part in two reactions (as a reactant in [reaction\\_3](#) and as a modifier in [reaction\\_3](#)).

$$\frac{d}{dt}\text{p55free} = -v_3 \quad (30)$$

## 8.4 Species Bid

**Name** Bid

**Initial concentration** 236 mol · l<sup>-1</sup>

This species takes part in two reactions (as a reactant in [reaction\\_11](#) and as a modifier in [reaction\\_11](#)).

$$\frac{d}{dt}\text{Bid} = -v_{11} \quad (31)$$

### 8.5 Species PrNES\_mCherry

**Name** PrNES\_mCherry

**Initial concentration** 973 mol · l<sup>-1</sup>

This species takes part in two reactions (as a reactant in [reaction\\_12](#) and as a modifier in [reaction\\_12](#)).

$$\frac{d}{dt}\text{PrNES\_mCherry} = -v_{12} \quad (32)$$

### 8.6 Species PrER\_mGFP

**Name** PrER\_mGFP

**Initial concentration** 5178 mol · l<sup>-1</sup>

This species takes part in two reactions (as a reactant in [reaction\\_13](#) and as a modifier in [reaction\\_13](#)).

$$\frac{d}{dt}\text{PrER\_mGFP} = -v_{13} \quad (33)$$

### 8.7 Species DISC

**Name** DISC

**Initial concentration** 0 mol · l<sup>-1</sup>

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](#)).

$$\frac{d}{dt}\text{DISC} = v_1 + v_5 + v_8 + v_9 - v_2 - v_3 \quad (34)$$

### 8.8 Species DISCp55

**Name** DISCp55

**Initial concentration** 0 mol · l<sup>-1</sup>

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](#)).

$$\frac{d}{dt}\text{DISCp55} = v_3 - v_4 - v_6 - v_7 \quad (35)$$

## 8.9 Species p30

**Name** p30

**Initial concentration** 0 mol · l<sup>-1</sup>

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](#)).

$$\frac{d}{dt}p30 = v_4 - v_8 - v_9 \quad (36)$$

## 8.10 Species p43

**Name** p43

**Initial concentration** 0 mol · l<sup>-1</sup>

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](#)).

$$\frac{d}{dt}p43 = v_6 + v_7 - v_5 \quad (37)$$

## 8.11 Species p18

**Name** p18

**Initial concentration** 0 mol · l<sup>-1</sup>

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](#)).

$$\frac{d}{dt}p18 = v_5 + v_8 + v_9 - v_{10} \quad (38)$$

## 8.12 Species p18inactive

**Name** p18inactive

**Initial concentration** 0 mol · l<sup>-1</sup>

This species takes part in one reaction (as a product in [reaction\\_10](#)).

$$\frac{d}{dt}p18inactive = v_{10} \quad (39)$$

### 8.13 Species tBid

**Name** tBid

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

This species takes part in one reaction (as a product in [reaction.11](#)).

$$\frac{d}{dt} \text{tBid} = v_{11} \quad (40)$$

### 8.14 Species PrNES

**Name** PrNES

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

This species takes part in one reaction (as a product in [reaction.12](#)).

$$\frac{d}{dt} \text{PrNES} = v_{12} \quad (41)$$

### 8.15 Species mCherry

**Name** mCherry

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

This species takes part in one reaction (as a product in [reaction.12](#)).

$$\frac{d}{dt} \text{mCherry} = v_{12} \quad (42)$$

### 8.16 Species PrER

**Name** PrER

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

This species takes part in one reaction (as a product in [reaction.13](#)).

$$\frac{d}{dt} \text{PrER} = v_{13} \quad (43)$$

### 8.17 Species mGFP

**Name** mGFP

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

This species takes part in one reaction (as a product in [reaction.13](#)).

$$\frac{d}{dt} \text{mGFP} = v_{13} \quad (44)$$

## 8.18 Species CD95L

**Name** CD95L

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

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

$$\frac{d}{dt}\text{CD95L} = 0 \quad (45)$$

## A Glossary of Systems Biology Ontology Terms

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

SBML<sup>2</sup>TeX was developed by Andreas Dräger<sup>a</sup>, Hannes Planatscher<sup>a</sup>, Dieudonné M Wouamba<sup>a</sup>, Adrian Schröder<sup>a</sup>, Michael Hucka<sup>b</sup>, Lukas Endler<sup>c</sup>, Martin Golebiewski<sup>d</sup> and Andreas Zell<sup>a</sup>. Please see <http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX> for more information.

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