

SBML Model Report

Model name: “Tang2010_PolyGlutamate”



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 Chelliah¹ and Carole J Proctor² at September 27th 2010 at 12:21 a. m. and last time modified at June third 2014 at 9:03 p. 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	1
species types	0	species	27
events	2	constraints	0
reactions	72	function definitions	0
global parameters	48	unit definitions	1
rules	1	initial assignments	0

Model Notes

This a model from the article:

Experimental and computational analysis of polyglutamine-mediated cytotoxicity.

Tang MY, Proctor CJ, Woulfe J, Gray DA. *PLoS Comput Biol.*2010 Sep 23;6(9). [20885783](#),

Abstract:

Expanded polyglutamine (polyQ) proteins are known to be the causative agents of a number

¹EMBL-EBI, viji@ebi.ac.uk

²Centre for Integrated Systems Biology of Ageing and Nutrition, Institute for Ageing and Health, Newcastle University, UK, c.j.proctor@newcastle.ac.uk

of human neurodegenerative diseases but the molecular basis of their cytotoxicity is still poorly understood. PolyQ tracts may impede the activity of the proteasome, and evidence from single cell imaging suggests that the sequestration of polyQ into inclusion bodies can reduce the proteasomal burden and promote cell survival, at least in the short term. The presence of misfolded protein also leads to activation of stress kinases such as p38MAPK, which can be cytotoxic. The relationships of these systems are not well understood. We have used fluorescent reporter systems imaged in living cells, and stochastic computer modeling to explore the relationships of polyQ, p38MAPK activation, generation of reactive oxygen species (ROS), proteasome inhibition, and inclusion body formation. In cells expressing a polyQ protein inclusion, body formation was preceded by proteasome inhibition but cytotoxicity was greatly reduced by administration of a p38MAPK inhibitor. Computer simulations suggested that without the generation of ROS, the proteasome inhibition and activation of p38MAPK would have significantly reduced toxicity. Our data suggest a vicious cycle of stress kinase activation and proteasome inhibition that is ultimately lethal to cells. There was close agreement between experimental data and the predictions of a stochastic computer model, supporting a central role for proteasome inhibition and p38MAPK activation in inclusion body formation and ROS-mediated cell death.

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To cite BioModels Database, please use: Li C, Donizelli M, Rodriguez N, Dharuri H, Endler L, Chelliah V, Li L, He E, Henry A, Stefan MI, Snoep JL, Hucka M, Le Novre N, Laibe C (2010) BioModels Database: An enhanced, curated and annotated resource for published quantitative kinetic models. *BMC Syst Biol.*, 4:92.

2 Unit Definitions

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

2.1 Unit substance

Definition item

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 m²

2.4 Unit length

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

Definition m

2.5 Unit time

Notes Second is the predefined SBML unit for time.

Definition s

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
cytosol			3	1	litre	<input checked="" type="checkbox"/>	

3.1 Compartment cytosol

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

4 Species

This model contains 27 species. The boundary condition of two of these species is set to true so that these species' amount cannot be changed by any reaction. Section 9 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 Condi- tion
PolyQ		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
Proteasome		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
NatP		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
MisP		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
MisP_Proteasome		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggP1		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggP2		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggP3		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggP4		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggP5		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggPolyQ1		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggPolyQ2		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggPolyQ3		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggPolyQ4		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggPolyQ5		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
SeqAggP		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
AggP_Proteasome		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
mRFPu		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
mRFPu_Proteasome		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
PolyQ_Proteasome		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
ROS		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
p38_P		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
p38		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
Source		cytosol	item	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sink		cytosol	item	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
p38death		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>
PIdeath		cytosol	item	<input type="checkbox"/>	<input type="checkbox"/>

5 Parameters

This model contains 48 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kaggPolyQ			$5 \cdot 10^{-8}$		✓
kdisaggPolyQ1			$5 \cdot 10^{-7}$		✓
kdisaggPolyQ2			$4 \cdot 10^{-7}$		✓
kdisaggPolyQ3			$3 \cdot 10^{-7}$		✓
kdisaggPolyQ4			$2 \cdot 10^{-7}$		✓
kdisaggPolyQ5			10^{-7}		✓
kseqPolyQ			$8 \cdot 10^{-7}$		✓
kinhprot			$5 \cdot 10^{-9}$		✓
kaggMisP			10^{-11}		✓
kagg2MisP			10^{-10}		✓
kdisaggMisP1			$5 \cdot 10^{-7}$		✓
kdisaggMisP2			$4 \cdot 10^{-7}$		✓
kdisaggMisP3			$3 \cdot 10^{-7}$		✓
kdisaggMisP4			$2 \cdot 10^{-7}$		✓
kdisaggMisP5			10^{-7}		✓
ksynmRFPu			0.138		✓
kbinmRFPu			$5 \cdot 10^{-7}$		✓
krelmRFPu			10^{-8}		✓
kdegmRFPu			0.005		✓
ksynPolyQ			0.007		✓
kbinPolyQ			$5 \cdot 10^{-8}$		✓
krelPolyQ			10^{-9}		✓
kdegPolyQ			0.003		✓
kgenROS			0.002		✓
kremROS			$2 \cdot 10^{-4}$		✓
kgenROSAggP			$5 \cdot 10^{-6}$		✓
kgenROSSeqAggP			10^{-7}		✓
kactp38			$5 \cdot 10^{-6}$		✓
kinactp38			0.002		✓
kseqMisP			10^{-9}		✓
kseqAggPProt			$5 \cdot 10^{-7}$		✓
kseqPolyQProt			$5 \cdot 10^{-7}$		✓
kseqMisPProt			$5 \cdot 10^{-7}$		✓
kseqmRFPuProt			$5 \cdot 10^{-7}$		✓
kseqmRFPu			10^{-10}		✓
ksynNatP			2.400		✓
kmisfold			$2 \cdot 10^{-6}$		✓

Id	Name	SBO	Value	Unit	Constant
krefold			$8 \cdot 10^{-5}$		<input checked="" type="checkbox"/>
kbinMisPProt			$5 \cdot 10^{-8}$		<input checked="" type="checkbox"/>
krelMisPProt			10^{-8}		<input checked="" type="checkbox"/>
kdegMisP			0.010		<input checked="" type="checkbox"/>
kgenROSp38			$7 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
kp38act			1.000		<input type="checkbox"/>
kp38death			$9 \cdot 10^{-8}$		<input checked="" type="checkbox"/>
kPIdeath			$2.5 \cdot 10^{-8}$		<input checked="" type="checkbox"/>
kproteff			1.000		<input type="checkbox"/>
kalive			1.000		<input type="checkbox"/>
oligomers	oligomers		0.000		<input type="checkbox"/>

6 Rule

This is an overview of one rule.

6.1 Rule `oligomers`

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

$$\text{oligomers} = \text{AggPolyQ1} + \text{AggPolyQ2} + \text{AggPolyQ3} + \text{AggPolyQ4} + \text{AggPolyQ5} \quad (1)$$

Derived unit item

7 Events

This is an overview of two events. Each event is initiated whenever its trigger condition switches from false to true. A delay function postpones the effects of an event to a later time point. At the time of execution, an event can assign values to species, parameters or compartments if these are not set to constant.

7.1 Event `PIcellDeath`

Trigger condition

$$\text{PIdeath} > 0 \quad (2)$$

Assignment

$$\text{kalive} = 0 \quad (3)$$

7.2 Event `p38cellDeath`

Trigger condition

$$p38death > 0 \quad (4)$$

Assignment

$$kalive = 0 \quad (5)$$

8 Reactions

This model contains 72 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	polyQSynthesis		Source \longrightarrow PolyQ	
2	polyqProteasomeBinding		PolyQ + Proteasome \longrightarrow PolyQ_Proteasome	
3	polyqProteasomeRelease		PolyQ_Proteasome \longrightarrow PolyQ + Proteasome	
4	PolyQDegradation		PolyQ_Proteasome \longrightarrow Proteasome	
5	mRFPuSynthesis		Source \longrightarrow mRFPu	
6	mRFPuProteasomeBinding		mRFPu + Proteasome \longrightarrow mRFPu_Proteasome	
7	mRFPuProteasomeRelease		mRFPu_Proteasome \longrightarrow mRFPu + Proteasome	
8	mRFPuDegradation		mRFPu_Proteasome \longrightarrow Proteasome	
9	PolyQAggregation1		2 PolyQ + ROS \longrightarrow AggPolyQ1 + ROS	
10	PolyQAggregation2		PolyQ + AggPolyQ1 + ROS \longrightarrow AggPolyQ2 + ROS	
11	PolyQAggregation3		PolyQ + AggPolyQ2 + ROS \longrightarrow AggPolyQ3 + ROS	
12	PolyQAggregation4		PolyQ + AggPolyQ3 + ROS \longrightarrow AggPolyQ4 + ROS	
13	PolyQAggregation5		PolyQ + AggPolyQ4 + ROS \longrightarrow AggPolyQ5 + ROS	
14	PolyQDisaggregation5		AggPolyQ5 \longrightarrow PolyQ + AggPolyQ4	
15	PolyQDisaggregation4		AggPolyQ4 \longrightarrow PolyQ + AggPolyQ3	
16	PolyQDisaggregation3		AggPolyQ3 \longrightarrow PolyQ + AggPolyQ2	
17	PolyQDisaggregation2		AggPolyQ2 \longrightarrow PolyQ + AggPolyQ1	
18	PolyQDisaggregation1		AggPolyQ1 \longrightarrow 2 PolyQ	
19	PolyQInclusionFormation		PolyQ + AggPolyQ5 \longrightarrow 7 SeqAggP	
20	PolyQInclusionGrowth		PolyQ + SeqAggP \longrightarrow 2 SeqAggP	
21	ProteasomeInhibition1		AggPolyQ1 + Proteasome \longrightarrow AggP_Proteasome	
22	ProteasomeInhibition2		AggPolyQ2 + Proteasome \longrightarrow AggP_Proteasome	
23	ProteasomeInhibition3		AggPolyQ3 + Proteasome \longrightarrow AggP_Proteasome	

Nº	Id	Name	Reaction Equation	SBO
24	ProteasomeInhibition4		$\text{AggPolyQ4} + \text{Proteasome} \longrightarrow \text{AggP_Proteasome}$	
25	ProteasomeInhibition5		$\text{AggPolyQ5} + \text{Proteasome} \longrightarrow \text{AggP_Proteasome}$	
26	mRFPuProteasomeSequestering		$\text{mRFPu_Proteasome} + \text{SeqAggP} \longrightarrow 2 \text{SeqAggP}$	
27	mRFPuSequestering		$\text{mRFPu} + \text{SeqAggP} \longrightarrow 2 \text{SeqAggP}$	
28	ROSgenerationBasal		$\text{Source} \longrightarrow \text{ROS}$	
29	ROSgenerationSmallAggPolyQ1		$\text{AggPolyQ1} \longrightarrow \text{AggPolyQ1} + \text{ROS}$	
30	ROSgenerationSmallAggPolyQ2		$\text{AggPolyQ2} \longrightarrow \text{AggPolyQ2} + \text{ROS}$	
31	ROSgenerationSmallAggPolyQ3		$\text{AggPolyQ3} \longrightarrow \text{AggPolyQ3} + \text{ROS}$	
32	ROSgenerationSmallAggPolyQ4		$\text{AggPolyQ4} \longrightarrow \text{AggPolyQ4} + \text{ROS}$	
33	ROSgenerationSmallAggPolyQ5		$\text{AggPolyQ5} \longrightarrow \text{AggPolyQ5} + \text{ROS}$	
34	ROSgenerationAggPProteasome		$\text{AggP_Proteasome} \longrightarrow \text{AggP_Proteasome} + \text{ROS}$	
35	ROSremoval		$\text{ROS} \longrightarrow \text{Sink}$	
36	p38activation		$\text{ROS} + \text{p38} \longrightarrow \text{ROS} + \text{p38_P}$	
37	p38inactivation		$\text{p38_P} \longrightarrow \text{p38}$	
38	AggP- _ProteasomeSequestering		$\text{AggP_Proteasome} + \text{SeqAggP} \longrightarrow 2 \text{SeqAggP}$	
39	PolyQ- _ProteasomeSequestering		$\text{PolyQ_Proteasome} + \text{SeqAggP} \longrightarrow 2 \text{SeqAggP}$	
40	MisP- _ProteasomeSequestering		$\text{MisP_Proteasome} + \text{SeqAggP} \longrightarrow 2 \text{SeqAggP}$	
41	ProteinSynthesis		$\text{Source} \longrightarrow \text{NatP}$	
42	Misfolding		$\text{NatP} + \text{ROS} \longrightarrow \text{MisP} + \text{ROS}$	
43	Refolding		$\text{MisP} \longrightarrow \text{NatP}$	
44	MisP- _ProteasomeBinding		$\text{MisP} + \text{Proteasome} \longrightarrow \text{MisP_Proteasome}$	
45	MisP- _ProteasomeRelease		$\text{MisP_Proteasome} \longrightarrow \text{MisP} + \text{Proteasome}$	
46	MisP- _Degradation		$\text{MisP_Proteasome} \longrightarrow \text{Proteasome}$	

Nº	Id	Name	Reaction Equation	SBO
47	MisP-		$2 \text{ MisP} \longrightarrow \text{AggP1}$	
	_Aggregation1			
48	MisP-		$\text{MisP} + \text{AggP1} \longrightarrow \text{AggP2}$	
	_Aggregation2			
49	MisP-		$\text{MisP} + \text{AggP2} \longrightarrow \text{AggP3}$	
	_Aggregation3			
50	MisP-		$\text{MisP} + \text{AggP3} \longrightarrow \text{AggP4}$	
	_Aggregation4			
51	MisP-		$\text{MisP} + \text{AggP4} \longrightarrow \text{AggP5}$	
	_Aggregation5			
52	MisP-		$\text{AggP1} \longrightarrow 2 \text{ MisP}$	
	_Disaggregation1			
53	MisP-		$\text{AggP2} \longrightarrow \text{MisP} + \text{AggP1}$	
	_Disaggregation2			
54	MisP-		$\text{AggP3} \longrightarrow \text{MisP} + \text{AggP2}$	
	_Disaggregation3			
55	MisP-		$\text{AggP4} \longrightarrow \text{MisP} + \text{AggP3}$	
	_Disaggregation4			
56	MisP-		$\text{AggP5} \longrightarrow \text{MisP} + \text{AggP4}$	
	_Disaggregation5			
57	MisP-		$\text{MisP} + \text{AggP5} \longrightarrow 7 \text{ SeqAggP}$	
	_InclusionFormation			
58	MisPInclusionGrowth		$\text{MisP} + \text{SeqAggP} \longrightarrow 2 \text{ SeqAggP}$	
59	ProteasomeInhibitionAggP1		$\text{AggP1} + \text{Proteasome} \longrightarrow \text{AggP_Proteasome}$	
60	ProteasomeInhibitionAggP2		$\text{AggP2} + \text{Proteasome} \longrightarrow \text{AggP_Proteasome}$	
61	ProteasomeInhibitionAggP3		$\text{AggP3} + \text{Proteasome} \longrightarrow \text{AggP_Proteasome}$	
62	ProteasomeInhibitionAggP4		$\text{AggP4} + \text{Proteasome} \longrightarrow \text{AggP_Proteasome}$	
63	ProteasomeInhibitionAggP5		$\text{AggP5} + \text{Proteasome} \longrightarrow \text{AggP_Proteasome}$	
64	ROSGenerationSmallAggP1		$\text{AggP1} \longrightarrow \text{AggP1} + \text{ROS}$	

Nº	Id	Name	Reaction Equation	SBO
65	ROSgenerationSmallAggP2		$\text{AggP2} \longrightarrow \text{AggP2} + \text{ROS}$	
66	ROSgenerationSmallAggP3		$\text{AggP3} \longrightarrow \text{AggP3} + \text{ROS}$	
67	ROSgenerationSmallAggP4		$\text{AggP4} \longrightarrow \text{AggP4} + \text{ROS}$	
68	ROSgenerationSmallAggP5		$\text{AggP5} \longrightarrow \text{AggP5} + \text{ROS}$	
69	p38_P_ROS- _Generation		$\text{p38_P} \longrightarrow \text{p38_P} + \text{ROS}$	
70	ROSgenerationSeqAggP		$\text{SeqAggP} \longrightarrow \text{SeqAggP} + \text{ROS}$	
71	P38DeathPathway		$\text{p38_P} \longrightarrow \text{p38_P} + \text{p38death}$	
72	PIDeathPathway		$\text{AggP_Proteasome} \longrightarrow \text{AggP_Proteasome} + \text{PIdeath}$	

8.1 Reaction polyQSynthesis

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

Reaction equation



Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
Source		

Product

Table 7: Properties of each product.

Id	Name	SBO
PolyQ		

Kinetic Law

Derived unit contains undeclared units

$$v_1 = k_{\text{synPolyQ}} \cdot \text{Source} \cdot k_{\text{alive}} \quad (7)$$

8.2 Reaction polyqProteasomeBinding

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

Reaction equation



Reactants

Table 8: Properties of each reactant.

Id	Name	SBO
PolyQ		
Proteasome		

Product

Table 9: Properties of each product.

Id	Name	SBO
PolyQ_Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_2 = k_{\text{binPolyQ}} \cdot \text{PolyQ} \cdot \text{Proteasome} \cdot k_{\text{alive}} \quad (9)$$

8.3 Reaction polyqProteasomeRelease

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

Reaction equation



Reactant

Table 10: Properties of each reactant.

Id	Name	SBO
PolyQ_Proteasome		

Products

Table 11: Properties of each product.

Id	Name	SBO
PolyQ		
Proteasome		

Kinetic Law

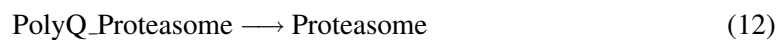
Derived unit contains undeclared units

$$v_3 = k_{\text{relPolyQ}} \cdot \text{PolyQ_Proteasome} \cdot k_{\text{alive}} \quad (11)$$

8.4 Reaction PolyQDegradation

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

Reaction equation



Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
PolyQ_Proteasome		

Product

Table 13: Properties of each product.

Id	Name	SBO
Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_4 = k_{\text{degPolyQ}} \cdot \text{PolyQ_Proteasome} \cdot k_{\text{alive}} \cdot k_{\text{proteff}} \quad (13)$$

8.5 Reaction mRFPuSynthesis

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

Reaction equation



Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
Source		

Product

Table 15: Properties of each product.

Id	Name	SBO
mRFPu		

Kinetic Law

Derived unit contains undeclared units

$$v_5 = k_{\text{synmRFPu}} \cdot \text{Source} \cdot k_{\text{alive}} \quad (15)$$

8.6 Reaction mRFPuProteasomeBinding

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

Reaction equation



Reactants

Table 16: Properties of each reactant.

Id	Name	SBO
mRFPu		
Proteasome		

Product

Table 17: Properties of each product.

Id	Name	SBO
mRFPu_Proteasome		

Kinetic Law

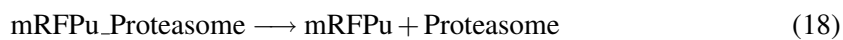
Derived unit contains undeclared units

$$v_6 = k_{\text{binmRFPu}} \cdot \text{mRFPu} \cdot \text{Proteasome} \cdot k_{\text{alive}} \quad (17)$$

8.7 Reaction `mRFPuProteasomeRelease`

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

Reaction equation



Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
mRFPu_Proteasome		

Products

Table 19: Properties of each product.

Id	Name	SBO
mRFPu		
Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_7 = k_{\text{rel}} \text{mRFPu} \cdot \text{mRFPu_Proteasome} \cdot k_{\text{alive}} \quad (19)$$

8.8 Reaction `mRFPuDegradation`

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

Reaction equation



Reactant

Table 20: Properties of each reactant.

Id	Name	SBO
mRFPu_Proteasome		

Product

Table 21: Properties of each product.

Id	Name	SBO
Proteasome		

Kinetic Law

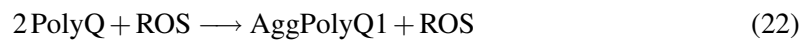
Derived unit contains undeclared units

$$v_8 = kdegmRFPu \cdot mRFPu_Proteasome \cdot kalive \cdot kproteff \quad (21)$$

8.9 Reaction PolyQAggregation1

This is an irreversible reaction of two reactants forming two products.

Reaction equation



Reactants

Table 22: Properties of each reactant.

Id	Name	SBO
PolyQ		
ROS		

Products

Table 23: Properties of each product.

Id	Name	SBO
AggPolyQ1		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_9 = kaggPolyQ \cdot \text{PolyQ} \cdot (\text{PolyQ} - 1) \cdot 0.5 \cdot \frac{\text{ROS}^2}{10^2 + \text{ROS}^2} \cdot kalive \quad (23)$$

8.10 Reaction `PolyQAggregation2`

This is an irreversible reaction of three reactants forming two products.

Reaction equation



Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
	PolyQ	
	AggPolyQ1	
	ROS	

Products

Table 25: Properties of each product.

Id	Name	SBO
	AggPolyQ2	
	ROS	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = k_{\text{aggPolyQ}} \cdot \text{PolyQ} \cdot \text{AggPolyQ1} \cdot \frac{\text{ROS}^2}{10^2 + \text{ROS}^2} \cdot \text{kalive} \quad (25)$$

8.11 Reaction `PolyQAggregation3`

This is an irreversible reaction of three reactants forming two products.

Reaction equation



Reactants

Table 26: Properties of each reactant.

Id	Name	SBO
PolyQ		
AggPolyQ2		
ROS		

Products

Table 27: Properties of each product.

Id	Name	SBO
AggPolyQ3		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = k_{aggPolyQ} \cdot PolyQ \cdot AggPolyQ2 \cdot \frac{ROS^2}{10^2 + ROS^2} \cdot kalive \quad (27)$$

8.12 Reaction PolyQAggregation4

This is an irreversible reaction of three reactants forming two products.

Reaction equation



Reactants

Table 28: Properties of each reactant.

Id	Name	SBO
PolyQ		
AggPolyQ3		
ROS		

Products

Table 29: Properties of each product.

Id	Name	SBO
AggPolyQ4		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = k_{aggPolyQ} \cdot PolyQ \cdot AggPolyQ3 \cdot \frac{ROS^2}{10^2 + ROS^2} \cdot kalive \quad (29)$$

8.13 Reaction PolyQAggregation5

This is an irreversible reaction of three reactants forming two products.

Reaction equation



Reactants

Table 30: Properties of each reactant.

Id	Name	SBO
PolyQ		
AggPolyQ4		
ROS		

Products

Table 31: Properties of each product.

Id	Name	SBO
AggPolyQ5		
ROS		

Kinetic Law

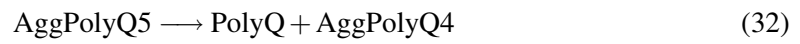
Derived unit contains undeclared units

$$v_{13} = k_{aggPolyQ} \cdot PolyQ \cdot AggPolyQ4 \cdot \frac{ROS^2}{10^2 + ROS^2} \cdot kalive \quad (31)$$

8.14 Reaction `PolyQDisaggregation5`

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

Reaction equation



Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
AggPolyQ5		

Products

Table 33: Properties of each product.

Id	Name	SBO
PolyQ		
AggPolyQ4		

Kinetic Law

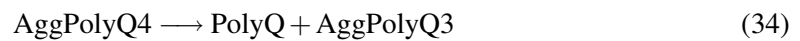
Derived unit contains undeclared units

$$v_{14} = k_{disaggPolyQ5} \cdot AggPolyQ5 \cdot kalive \quad (33)$$

8.15 Reaction `PolyQDisaggregation4`

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

Reaction equation



Reactant

Table 34: Properties of each reactant.

Id	Name	SBO
AggPolyQ4		

Products

Table 35: Properties of each product.

Id	Name	SBO
PolyQ		
AggPolyQ3		

Kinetic Law

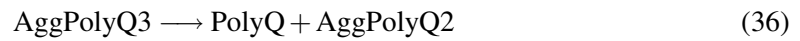
Derived unit contains undeclared units

$$v_{15} = k_{\text{disaggPolyQ4}} \cdot \text{AggPolyQ4} \cdot k_{\text{alive}} \quad (35)$$

8.16 Reaction PolyQDisaggregation3

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

Reaction equation



Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
AggPolyQ3		

Products

Table 37: Properties of each product.

Id	Name	SBO
PolyQ		
AggPolyQ2		

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = k_{\text{disaggPolyQ3}} \cdot \text{AggPolyQ3} \cdot k_{\text{alive}} \quad (37)$$

8.17 Reaction `PolyQDisaggregation2`

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

Reaction equation



Reactant

Table 38: Properties of each reactant.

Id	Name	SBO
AggPolyQ2		

Products

Table 39: Properties of each product.

Id	Name	SBO
PolyQ		
AggPolyQ1		

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = k_{\text{disaggPolyQ2}} \cdot \text{AggPolyQ2} \cdot k_{\text{alive}} \quad (39)$$

8.18 Reaction `PolyQDisaggregation1`

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

Reaction equation



Reactant

Table 40: Properties of each reactant.

Id	Name	SBO
AggPolyQ1		

Product

Table 41: Properties of each product.

Id	Name	SBO
PolyQ		

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = k_{\text{disaggPolyQ1}} \cdot \text{AggPolyQ1} \cdot k_{\text{alive}} \quad (41)$$

8.19 Reaction PolyQInclusionFormation

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

Reaction equation



Reactants

Table 42: Properties of each reactant.

Id	Name	SBO
PolyQ		
AggPolyQ5		

Product

Table 43: Properties of each product.

Id	Name	SBO
	SeqAggP	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = kaggPolyQ \cdot PolyQ \cdot AggPolyQ5 \cdot kalive \quad (43)$$

8.20 Reaction PolyQInclusionGrowth

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

Reaction equation



Reactants

Table 44: Properties of each reactant.

Id	Name	SBO
	PolyQ	
	SeqAggP	

Product

Table 45: Properties of each product.

Id	Name	SBO
	SeqAggP	

Kinetic Law

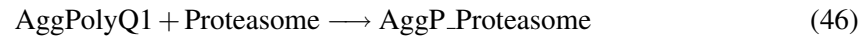
Derived unit contains undeclared units

$$v_{20} = kseqPolyQ \cdot PolyQ \cdot SeqAggP \cdot kalive \quad (45)$$

8.21 Reaction ProteasomeInhibition1

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

Reaction equation



Reactants

Table 46: Properties of each reactant.

Id	Name	SBO
AggPolyQ1		
Proteasome		

Product

Table 47: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

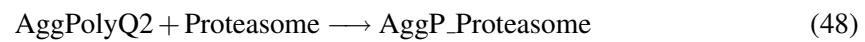
Derived unit contains undeclared units

$$v_{21} = \text{kinhprot} \cdot \text{AggPolyQ1} \cdot \text{Proteasome} \cdot \text{kalive} \quad (47)$$

8.22 Reaction `ProteasomeInhibition2`

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

Reaction equation



Reactants

Table 48: Properties of each reactant.

Id	Name	SBO
AggPolyQ2		
Proteasome		

Product

Table 49: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

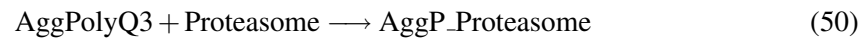
Derived unit contains undeclared units

$$v_{22} = \text{kinhprot} \cdot \text{AggPolyQ2} \cdot \text{Proteasome} \cdot \text{kalive} \quad (49)$$

8.23 Reaction `ProteasomeInhibition3`

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

Reaction equation



Reactants

Table 50: Properties of each reactant.

Id	Name	SBO
AggPolyQ3		
Proteasome		

Product

Table 51: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

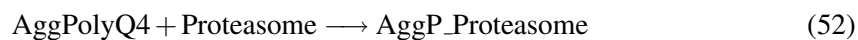
Derived unit contains undeclared units

$$v_{23} = \text{kinhprot} \cdot \text{AggPolyQ3} \cdot \text{Proteasome} \cdot \text{kalive} \quad (51)$$

8.24 Reaction `ProteasomeInhibition4`

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

Reaction equation



Reactants

Table 52: Properties of each reactant.

Id	Name	SBO
AggPolyQ4		
Proteasome		

Product

Table 53: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

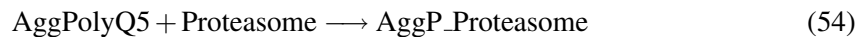
Derived unit contains undeclared units

$$v_{24} = \text{kinhprot} \cdot \text{AggPolyQ4} \cdot \text{Proteasome} \cdot \text{kalive} \quad (53)$$

8.25 Reaction `ProteasomeInhibition5`

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

Reaction equation



Reactants

Table 54: Properties of each reactant.

Id	Name	SBO
AggPolyQ5		

Id	Name	SBO
	Proteasome	

Product

Table 55: Properties of each product.

Id	Name	SBO
	AggP_Proteasome	

Kinetic Law

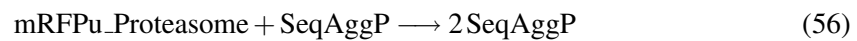
Derived unit contains undeclared units

$$v_{25} = \text{kinhprot} \cdot \text{AggPolyQ5} \cdot \text{Proteasome} \cdot \text{kalive} \quad (55)$$

8.26 Reaction [mRFPuProteasomeSequestering](#)

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

Reaction equation



Reactants

Table 56: Properties of each reactant.

Id	Name	SBO
	mRFPu_Proteasome	
	SeqAggP	

Product

Table 57: Properties of each product.

Id	Name	SBO
	SeqAggP	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = k_{\text{seqmRFPuProt}} \cdot \text{mRFPu_Proteasome} \cdot \text{SeqAggP} \cdot \text{kalive} \quad (57)$$

8.27 Reaction `mRFPuSequestering`

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

Reaction equation



Reactants

Table 58: Properties of each reactant.

Id	Name	SBO
mRFPu		
SeqAggP		

Product

Table 59: Properties of each product.

Id	Name	SBO
SeqAggP		

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = k_{\text{seqmRFPu}} \cdot \text{mRFPu} \cdot \text{SeqAggP} \cdot \text{kalive} \quad (59)$$

8.28 Reaction `ROSgenerationBasal`

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

Reaction equation



Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
Source		

Product

Table 61: Properties of each product.

Id	Name	SBO
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = k_{\text{genROS}} \cdot \text{Source} \cdot k_{\text{alive}} \quad (61)$$

8.29 Reaction ROSgenerationSmallAggPolyQ1

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

Reaction equation



Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
AggPolyQ1		

Products

Table 63: Properties of each product.

Id	Name	SBO
AggPolyQ1		

Id	Name	SBO
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = k_{\text{genROS}} \text{AggP} \cdot \text{AggPolyQ1} \cdot \text{kalive} \quad (63)$$

8.30 Reaction ROSgenerationSmallAggPolyQ2

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

Reaction equation



Reactant

Table 64: Properties of each reactant.

Id	Name	SBO
AggPolyQ2		

Products

Table 65: Properties of each product.

Id	Name	SBO
AggPolyQ2		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = k_{\text{genROS}} \text{AggP} \cdot \text{AggPolyQ2} \cdot \text{kalive} \quad (65)$$

8.31 Reaction ROSgenerationSmallAggPolyQ3

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

Reaction equation



Reactant

Table 66: Properties of each reactant.

Id	Name	SBO
AggPolyQ3		

Products

Table 67: Properties of each product.

Id	Name	SBO
AggPolyQ3		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = k_{\text{genROS}} \text{AggP} \cdot \text{AggPolyQ3} \cdot k_{\text{alive}} \quad (67)$$

8.32 Reaction `ROSgenerationSmallAggPolyQ4`

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

Reaction equation



Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
AggPolyQ4		

Products

Table 69: Properties of each product.

Id	Name	SBO
AggPolyQ4		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{32} = k_{\text{genROS}} \text{AggP} \cdot \text{AggPolyQ4} \cdot k_{\text{alive}} \quad (69)$$

8.33 Reaction ROSgenerationSmallAggPolyQ5

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

Reaction equation



Reactant

Table 70: Properties of each reactant.

Id	Name	SBO
AggPolyQ5		

Products

Table 71: Properties of each product.

Id	Name	SBO
AggPolyQ5		
ROS		

Kinetic Law

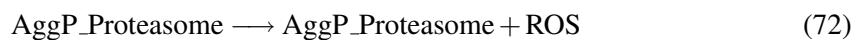
Derived unit contains undeclared units

$$v_{33} = k_{\text{genROS}} \text{AggP} \cdot \text{AggPolyQ5} \cdot k_{\text{alive}} \quad (71)$$

8.34 Reaction ROSgenerationAggPProteasome

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

Reaction equation



Reactant

Table 72: Properties of each reactant.

Id	Name	SBO
	AggP_Proteasome	

Products

Table 73: Properties of each product.

Id	Name	SBO
	AggP_Proteasome	
	ROS	

Kinetic Law

Derived unit contains undeclared units

$$v_{34} = k_{\text{genROS}} \cdot \text{AggP_Proteasome} \cdot k_{\text{alive}} \quad (73)$$

8.35 Reaction ROSremoval

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

Reaction equation



Reactant

Table 74: Properties of each reactant.

Id	Name	SBO
	ROS	

Product

Table 75: Properties of each product.

Id	Name	SBO
Sink		

Kinetic Law

Derived unit contains undeclared units

$$v_{35} = \text{kremROS} \cdot \text{ROS} \cdot \text{kalive} \quad (75)$$

8.36 Reaction `p38activation`

This is an irreversible reaction of two reactants forming two products.

Reaction equation



Reactants

Table 76: Properties of each reactant.

Id	Name	SBO
ROS		
p38		

Products

Table 77: Properties of each product.

Id	Name	SBO
ROS		
p38_P		

Kinetic Law

Derived unit contains undeclared units

$$v_{36} = \text{kactp38} \cdot \text{ROS} \cdot \text{p38} \cdot \text{kalive} \quad (77)$$

8.37 Reaction `p38inactivation`

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

Reaction equation



Reactant

Table 78: Properties of each reactant.

Id	Name	SBO
p38_P		

Product

Table 79: Properties of each product.

Id	Name	SBO
p38		

Kinetic Law

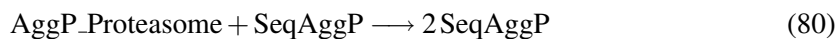
Derived unit contains undeclared units

$$v_{37} = \text{kinactp38} \cdot \text{p38_P} \cdot \text{kalive} \quad (79)$$

8.38 Reaction `AggP_ProteasomeSequestering`

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

Reaction equation



Reactants

Table 80: Properties of each reactant.

Id	Name	SBO
AggP_Proteasome		
SeqAggP		

Product

Table 81: Properties of each product.

Id	Name	SBO
	SeqAggP	

Kinetic Law

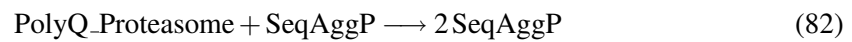
Derived unit contains undeclared units

$$v_{38} = k_{\text{seqAggPProt}} \cdot \text{AggP_Proteasome} \cdot \text{SeqAggP} \cdot k_{\text{alive}} \quad (81)$$

8.39 Reaction PolyQ-ProteasomeSequestering

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

Reaction equation



Reactants

Table 82: Properties of each reactant.

Id	Name	SBO
	PolyQ-Proteasome	
	SeqAggP	

Product

Table 83: Properties of each product.

Id	Name	SBO
	SeqAggP	

Kinetic Law

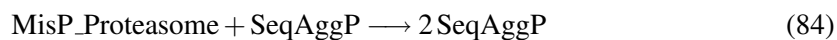
Derived unit contains undeclared units

$$v_{39} = k_{\text{seqPolyQProt}} \cdot \text{PolyQ_Proteasome} \cdot \text{SeqAggP} \cdot k_{\text{alive}} \quad (83)$$

8.40 Reaction MisP_ProteasomeSequestering

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

Reaction equation



Reactants

Table 84: Properties of each reactant.

Id	Name	SBO
MisP_Proteasome		
SeqAggP		

Product

Table 85: Properties of each product.

Id	Name	SBO
SeqAggP		

Kinetic Law

Derived unit contains undeclared units

$$v_{40} = k_{\text{seqMisPProt}} \cdot \text{MisP_Proteasome} \cdot \text{SeqAggP} \cdot k_{\text{alive}} \quad (85)$$

8.41 Reaction ProteinSynthesis

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

Reaction equation



Reactant

Table 86: Properties of each reactant.

Id	Name	SBO
Source		

Product

Table 87: Properties of each product.

Id	Name	SBO
NatP		

Kinetic Law

Derived unit contains undeclared units

$$v_{41} = \text{ksynNatP} \cdot \text{Source} \cdot \text{kalive} \quad (87)$$

8.42 Reaction Misfolding

This is an irreversible reaction of two reactants forming two products.

Reaction equation



Reactants

Table 88: Properties of each reactant.

Id	Name	SBO
NatP		
ROS		

Products

Table 89: Properties of each product.

Id	Name	SBO
MisP		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{42} = \text{kmisfold} \cdot \text{NatP} \cdot \text{ROS} \cdot \text{kalive} \quad (89)$$

8.43 Reaction Refolding

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

Reaction equation



Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
MisP		

Product

Table 91: Properties of each product.

Id	Name	SBO
NatP		

Kinetic Law

Derived unit contains undeclared units

$$v_{43} = k_{\text{refold}} \cdot \text{MisP} \cdot k_{\text{alive}} \quad (91)$$

8.44 Reaction MisP_ProteasomeBinding

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

Reaction equation



Reactants

Table 92: Properties of each reactant.

Id	Name	SBO
MisP		
Proteasome		

Product

Table 93: Properties of each product.

Id	Name	SBO
MisP_Proteasome		

Kinetic Law

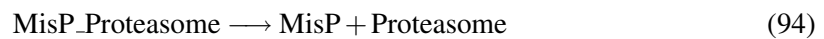
Derived unit contains undeclared units

$$v_{44} = k_{\text{binMisPProt}} \cdot \text{MisP} \cdot \text{Proteasome} \cdot k_{\text{alive}} \quad (93)$$

8.45 Reaction MisP_ProteasomeRelease

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

Reaction equation



Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
MisP_Proteasome		

Products

Table 95: Properties of each product.

Id	Name	SBO
MisP		
Proteasome		

Kinetic Law

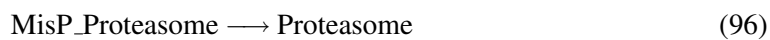
Derived unit contains undeclared units

$$v_{45} = k_{\text{relMisPProt}} \cdot \text{MisP_Proteasome} \cdot k_{\text{alive}} \quad (95)$$

8.46 Reaction MisP_Degradation

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

Reaction equation



Reactant

Table 96: Properties of each reactant.

Id	Name	SBO
MisP_Proteasome		

Product

Table 97: Properties of each product.

Id	Name	SBO
Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_{46} = k_{\text{degMisP}} \cdot \text{MisP_Proteasome} \cdot k_{\text{alive}} \cdot k_{\text{proteff}} \quad (97)$$

8.47 Reaction MisP_Aggregation1

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

Reaction equation



Reactant

Table 98: Properties of each reactant.

Id	Name	SBO
MisP		

Product

Table 99: Properties of each product.

Id	Name	SBO
AggP1		

Kinetic Law

Derived unit contains undeclared units

$$v_{47} = k_{aggMisP} \cdot MisP \cdot (MisP - 1) \cdot 0.5 \cdot kalive \quad (99)$$

8.48 Reaction `MisP_Aggregation2`

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

Reaction equation



Reactants

Table 100: Properties of each reactant.

Id	Name	SBO
MisP		
AggP1		

Product

Table 101: Properties of each product.

Id	Name	SBO
AggP2		

Kinetic Law

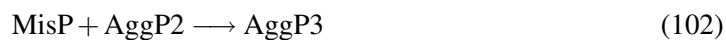
Derived unit contains undeclared units

$$v_{48} = k_{agg2MisP} \cdot MisP \cdot AggP1 \cdot kalive \quad (101)$$

8.49 Reaction MisP_Aggregation3

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

Reaction equation



Reactants

Table 102: Properties of each reactant.

Id	Name	SBO
MisP		
AggP2		

Product

Table 103: Properties of each product.

Id	Name	SBO
AggP3		

Kinetic Law

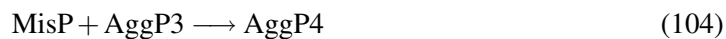
Derived unit contains undeclared units

$$v_{49} = k_{agg2} \text{MisP} \cdot \text{MisP} \cdot \text{AggP2} \cdot k_{alive} \quad (103)$$

8.50 Reaction MisP_Aggregation4

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

Reaction equation



Reactants

Table 104: Properties of each reactant.

Id	Name	SBO
MisP		

Id	Name	SBO
AggP3		

Product

Table 105: Properties of each product.

Id	Name	SBO
AggP4		

Kinetic Law

Derived unit contains undeclared units

$$v_{50} = k_{agg2MisP} \cdot MisP \cdot AggP3 \cdot k_{alive} \quad (105)$$

8.51 Reaction MisP_Aggregation5

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

Reaction equation



Reactants

Table 106: Properties of each reactant.

Id	Name	SBO
MisP		
AggP4		

Product

Table 107: Properties of each product.

Id	Name	SBO
AggP5		

Kinetic Law

Derived unit contains undeclared units

$$v_{51} = k_{agg2MisP} \cdot MisP \cdot AggP4 \cdot k_{alive} \quad (107)$$

8.52 Reaction `MisP_Disaggregation1`

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

Reaction equation



Reactant

Table 108: Properties of each reactant.

Id	Name	SBO
AggP1		

Product

Table 109: Properties of each product.

Id	Name	SBO
MisP		

Kinetic Law

Derived unit contains undeclared units

$$v_{52} = k_{disaggMisP1} \cdot AggP1 \cdot k_{alive} \quad (109)$$

8.53 Reaction `MisP_Disaggregation2`

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

Reaction equation



Reactant

Table 110: Properties of each reactant.

Id	Name	SBO
AggP2		

Products

Table 111: Properties of each product.

Id	Name	SBO
MisP		
AggP1		

Kinetic Law

Derived unit contains undeclared units

$$v_{53} = k_{\text{disaggMisP2}} \cdot \text{AggP2} \cdot k_{\text{alive}} \quad (111)$$

8.54 Reaction MisP_Disaggregation3

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

Reaction equation



Reactant

Table 112: Properties of each reactant.

Id	Name	SBO
AggP3		

Products

Table 113: Properties of each product.

Id	Name	SBO
MisP		
AggP2		

Kinetic Law

Derived unit contains undeclared units

$$v_{54} = k_{\text{disaggMisP3}} \cdot \text{AggP3} \cdot k_{\text{alive}} \quad (113)$$

8.55 Reaction `MisP_Disaggregation4`

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

Reaction equation



Reactant

Table 114: Properties of each reactant.

Id	Name	SBO
AggP4		

Products

Table 115: Properties of each product.

Id	Name	SBO
MisP		
AggP3		

Kinetic Law

Derived unit contains undeclared units

$$v_{55} = k_{\text{disaggMisP4}} \cdot \text{AggP4} \cdot k_{\text{alive}} \quad (115)$$

8.56 Reaction `MisP_Disaggregation5`

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

Reaction equation



Reactant

Table 116: Properties of each reactant.

Id	Name	SBO
AggP5		

Products

Table 117: Properties of each product.

Id	Name	SBO
MisP		
AggP4		

Kinetic Law

Derived unit contains undeclared units

$$v_{56} = k_{\text{disaggMisP5}} \cdot \text{AggP5} \cdot k_{\text{alive}} \quad (117)$$

8.57 Reaction `MisP_InclusionFormation`

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

Reaction equation



Reactants

Table 118: Properties of each reactant.

Id	Name	SBO
MisP		
AggP5		

Product

Table 119: Properties of each product.

Id	Name	SBO
	SeqAggP	

Kinetic Law

Derived unit contains undeclared units

$$v_{57} = kagg2MisP \cdot MisP \cdot AggP5 \cdot kalive \quad (119)$$

8.58 Reaction `MisPInclusionGrowth`

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

Reaction equation



Reactants

Table 120: Properties of each reactant.

Id	Name	SBO
	MisP	
	SeqAggP	

Product

Table 121: Properties of each product.

Id	Name	SBO
	SeqAggP	

Kinetic Law

Derived unit contains undeclared units

$$v_{58} = kseqMisP \cdot MisP \cdot SeqAggP \cdot kalive \quad (121)$$

8.59 Reaction `ProteasomeInhibitionAggP1`

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

Reaction equation



Reactants

Table 122: Properties of each reactant.

Id	Name	SBO
AggP1		
Proteasome		

Product

Table 123: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_{59} = \text{kinhprot} \cdot \text{AggP1} \cdot \text{Proteasome} \cdot \text{kalive} \quad (123)$$

8.60 Reaction `ProteasomeInhibitionAggP2`

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

Reaction equation



Reactants

Table 124: Properties of each reactant.

Id	Name	SBO
AggP2		
Proteasome		

Product

Table 125: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_{60} = \text{kinhprot} \cdot \text{AggP2} \cdot \text{Proteasome} \cdot \text{kalive} \quad (125)$$

8.61 Reaction `ProteasomeInhibitionAggP3`

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

Reaction equation



Reactants

Table 126: Properties of each reactant.

Id	Name	SBO
AggP3		
Proteasome		

Product

Table 127: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_{61} = \text{kinhprot} \cdot \text{AggP3} \cdot \text{Proteasome} \cdot \text{kalive} \quad (127)$$

8.62 Reaction `ProteasomeInhibitionAggP4`

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

Reaction equation



Reactants

Table 128: Properties of each reactant.

Id	Name	SBO
AggP4		
Proteasome		

Product

Table 129: Properties of each product.

Id	Name	SBO
AggP_Proteasome		

Kinetic Law

Derived unit contains undeclared units

$$v_{62} = \text{kinhprot} \cdot \text{AggP4} \cdot \text{Proteasome} \cdot \text{kalive} \quad (129)$$

8.63 Reaction `ProteasomeInhibitionAggP5`

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

Reaction equation



Reactants

Table 130: Properties of each reactant.

Id	Name	SBO
AggP5		

Id	Name	SBO
	Proteasome	

Product

Table 131: Properties of each product.

Id	Name	SBO
	AggP_Proteasome	

Kinetic Law

Derived unit contains undeclared units

$$v_{63} = \text{kinhprot} \cdot \text{AggP5} \cdot \text{Proteasome} \cdot \text{kalive} \quad (131)$$

8.64 Reaction [ROSgenerationSmallAggP1](#)

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

Reaction equation



Reactant

Table 132: Properties of each reactant.

Id	Name	SBO
	AggP1	

Products

Table 133: Properties of each product.

Id	Name	SBO
	AggP1	
	ROS	

Kinetic Law

Derived unit contains undeclared units

$$v_{64} = k_{\text{genROS}} \text{AggP} \cdot \text{AggP1} \cdot k_{\text{alive}} \quad (133)$$

8.65 Reaction ROSgenerationSmallAggP2

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

Reaction equation



Reactant

Table 134: Properties of each reactant.

Id	Name	SBO
AggP2		

Products

Table 135: Properties of each product.

Id	Name	SBO
AggP2		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{65} = k_{\text{genROS}} \text{AggP} \cdot \text{AggP2} \cdot k_{\text{alive}} \quad (135)$$

8.66 Reaction ROSgenerationSmallAggP3

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

Reaction equation



Reactant

Table 136: Properties of each reactant.

Id	Name	SBO
AggP3		

Products

Table 137: Properties of each product.

Id	Name	SBO
AggP3		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{66} = k_{\text{genROS}} \text{AggP} \cdot \text{AggP3} \cdot k_{\text{alive}} \quad (137)$$

8.67 Reaction `ROSgenerationSmallAggP4`

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

Reaction equation



Reactant

Table 138: Properties of each reactant.

Id	Name	SBO
AggP4		

Products

Table 139: Properties of each product.

Id	Name	SBO
AggP4		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{67} = k_{\text{genROS}} \text{AggP} \cdot \text{AggP4} \cdot \text{kalive} \quad (139)$$

8.68 Reaction ROSgenerationSmallAggP5

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

Reaction equation



Reactant

Table 140: Properties of each reactant.

Id	Name	SBO
AggP5		

Products

Table 141: Properties of each product.

Id	Name	SBO
AggP5		
ROS		

Kinetic Law

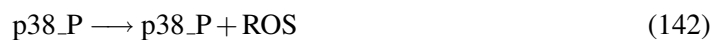
Derived unit contains undeclared units

$$v_{68} = k_{\text{genROS}} \text{AggP} \cdot \text{AggP5} \cdot \text{kalive} \quad (141)$$

8.69 Reaction p38_P_ROS_Generation

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

Reaction equation



Reactant

Table 142: Properties of each reactant.

Id	Name	SBO
p38_P		

Products

Table 143: Properties of each product.

Id	Name	SBO
p38_P		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{69} = k_{\text{genROS}} \cdot \text{p38_P} \cdot k_{\text{p38act}} \cdot \text{kalive} \quad (143)$$

8.70 Reaction ROSgenerationSeqAggP

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

Reaction equation



Reactant

Table 144: Properties of each reactant.

Id	Name	SBO
SeqAggP		

Products

Table 145: Properties of each product.

Id	Name	SBO
SeqAggP		
ROS		

Kinetic Law

Derived unit contains undeclared units

$$v_{70} = k_{\text{genROSSeqAggP}} \cdot \text{SeqAggP} \cdot \text{kalive} \quad (145)$$

8.71 Reaction P38DeathPathway

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

Reaction equation



Reactant

Table 146: Properties of each reactant.

Id	Name	SBO
p38_P		

Products

Table 147: Properties of each product.

Id	Name	SBO
p38_P		
p38death		

Kinetic Law

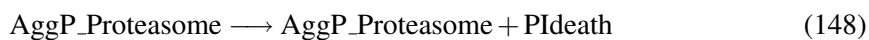
Derived unit contains undeclared units

$$v_{71} = k_{\text{p38death}} \cdot \text{p38_P} \cdot \text{kalive} \cdot k_{\text{p38act}} \quad (147)$$

8.72 Reaction `PIdeathPathway`

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

Reaction equation



Reactant

Table 148: Properties of each reactant.

Id	Name	SBO
AggP_Proteasome		

Products

Table 149: Properties of each product.

Id	Name	SBO
AggP_Proteasome		
PIdeath		

Kinetic Law

Derived unit contains undeclared units

$$v_{72} = k_{\text{PIdeath}} \cdot \text{AggP_Proteasome} \cdot k_{\text{alive}} \quad (149)$$

9 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.

9.1 Species PolyQ

Initial amount 1000 item

This species takes part in 15 reactions (as a reactant in [polyqProteasomeBinding](#), [PolyQAggregation1](#), [PolyQAggregation2](#), [PolyQAggregation3](#), [PolyQAggregation4](#), [PolyQAggregation5](#), [PolyQInclusionFormation](#), [PolyQInclusionGrowth](#) and as a product in [polyqSynthesis](#), [polyqProteasomeRelease](#), [PolyQDisaggregation5](#), [PolyQDisaggregation4](#), [PolyQDisaggregation3](#), [PolyQDisaggregation2](#), [PolyQDisaggregation1](#)).

$$\frac{d}{dt}\text{PolyQ} = v_1 + v_3 + v_{14} + v_{15} + v_{16} + v_{17} + 2 v_{18} - v_2 - 2 v_9 - v_{10} - v_{11} - v_{12} - v_{13} - v_{19} - v_{20} \quad (150)$$

9.2 Species Proteasome

Initial amount 1000 item

This species takes part in 19 reactions (as a reactant in [polyqProteasomeBinding](#), [mRFPuProteasomeBinding](#), [ProteasomeInhibition1](#), [ProteasomeInhibition2](#), [ProteasomeInhibition3](#), [ProteasomeInhibition4](#), [ProteasomeInhibition5](#), [MisP_ProteasomeBinding](#), [ProteasomeInhibitionAggP1](#), [ProteasomeInhibitionAggP2](#), [ProteasomeInhibitionAggP3](#), [ProteasomeInhibitionAggP4](#), [ProteasomeInhibitionAggP5](#) and as a product in [polyqProteasomeRelease](#), [PolyQDegradation](#), [mRFPuProteasomeRelease](#), [mRFPuDegradation](#), [MisP_ProteasomeRelease](#), [MisP_Degradation](#)).

$$\frac{d}{dt}\text{Proteasome} = v_3 + v_4 + v_7 + v_8 + v_{45} + v_{46} - v_2 - v_6 - v_{21} - v_{22} - v_{23} - v_{24} - v_{25} - v_{44} - v_{59} - v_{60} - v_{61} - v_{62} - v_{63} \quad (151)$$

9.3 Species NatP

Initial amount 19500 item

This species takes part in three reactions (as a reactant in [Misfolding](#) and as a product in [ProteinSynthesis](#), [Refolding](#)).

$$\frac{d}{dt}\text{NatP} = v_{41} + v_{43} - v_{42} \quad (152)$$

9.4 Species MisP

Initial amount 0 item

This species takes part in 16 reactions (as a reactant in [Refolding](#), [MisP_ProteasomeBinding](#), [MisP_Aggregation1](#), [MisP_Aggregation2](#), [MisP_Aggregation3](#), [MisP_Aggregation4](#), [MisP_Aggregation5](#), [MisP_InclusionFormation](#), [MisP_InclusionGrowth](#) and as a product in

Misfolding, MisP_ProteasomeRelease, MisP_Disaggregation1, MisP_Disaggregation2, MisP_Disaggregation3, MisP_Disaggregation4, MisP_Disaggregation5).

$$\begin{aligned} \frac{d}{dt}\text{MisP} = & v_{42} + v_{45} + 2 v_{52} + v_{53} + v_{54} + v_{55} + v_{56} - v_{43} \\ & - v_{44} - 2 v_{47} - v_{48} - v_{49} - v_{50} - v_{51} - v_{57} - v_{58} \end{aligned} \quad (153)$$

9.5 Species MisP_Proteasome

Initial amount 0 item

This species takes part in four reactions (as a reactant in MisP_ProteasomeSequestering, MisP_ProteasomeRelease, MisP_Degradation and as a product in MisP_ProteasomeBinding).

$$\frac{d}{dt}\text{MisP_Proteasome} = v_{44} - v_{40} - v_{45} - v_{46} \quad (154)$$

9.6 Species AggP1

Initial amount 0 item

This species takes part in seven reactions (as a reactant in MisP_Aggregation2, MisP_Disaggregation1, ProteasomeInhibitionAggP1, ROSgenerationSmallAggP1 and as a product in MisP_Aggregation1, MisP_Disaggregation2, ROSgenerationSmallAggP1).

$$\frac{d}{dt}\text{AggP1} = v_{47} + v_{53} + v_{64} - v_{48} - v_{52} - v_{59} - v_{64} \quad (155)$$

9.7 Species AggP2

Initial amount 0 item

This species takes part in seven reactions (as a reactant in MisP_Aggregation3, MisP_Disaggregation2, ProteasomeInhibitionAggP2, ROSgenerationSmallAggP2 and as a product in MisP_Aggregation2, MisP_Disaggregation3, ROSgenerationSmallAggP2).

$$\frac{d}{dt}\text{AggP2} = v_{48} + v_{54} + v_{65} - v_{49} - v_{53} - v_{60} - v_{65} \quad (156)$$

9.8 Species AggP3

Initial amount 0 item

This species takes part in seven reactions (as a reactant in MisP_Aggregation4, MisP_Disaggregation3, ProteasomeInhibitionAggP3, ROSgenerationSmallAggP3 and as a product in MisP_Aggregation3, MisP_Disaggregation4, ROSgenerationSmallAggP3).

$$\frac{d}{dt}\text{AggP3} = v_{49} + v_{55} + v_{66} - v_{50} - v_{54} - v_{61} - v_{66} \quad (157)$$

9.9 Species AggP4

Initial amount 0 item

This species takes part in seven reactions (as a reactant in [MisP_Aggregation5](#), [MisP_Disaggregation4](#), [ProteasomeInhibitionAggP4](#), [ROSGenerationSmallAggP4](#) and as a product in [MisP_Aggregation4](#), [MisP_Disaggregation5](#), [ROSGenerationSmallAggP4](#)).

$$\frac{d}{dt}\text{AggP4} = v_{50} + v_{56} + v_{67} - v_{51} - v_{55} - v_{62} - v_{67} \quad (158)$$

9.10 Species AggP5

Initial amount 0 item

This species takes part in six reactions (as a reactant in [MisP_Disaggregation5](#), [MisP_InclusionFormation](#), [ProteasomeInhibitionAggP5](#), [ROSGenerationSmallAggP5](#) and as a product in [MisP_Aggregation5](#), [ROSGenerationSmallAggP5](#)).

$$\frac{d}{dt}\text{AggP5} = v_{51} + v_{68} - v_{56} - v_{57} - v_{63} - v_{68} \quad (159)$$

9.11 Species AggPolyQ1

Initial amount 0 item

This species takes part in seven reactions (as a reactant in [PolyQAggregation2](#), [PolyQDisaggregation1](#), [ProteasomeInhibition1](#), [ROSGenerationSmallAggPolyQ1](#) and as a product in [PolyQAggregation1](#), [PolyQDisaggregation2](#), [ROSGenerationSmallAggPolyQ1](#)).

$$\frac{d}{dt}\text{AggPolyQ1} = v_9 + v_{17} + v_{29} - v_{10} - v_{18} - v_{21} - v_{29} \quad (160)$$

9.12 Species AggPolyQ2

Initial amount 0 item

This species takes part in seven reactions (as a reactant in [PolyQAggregation3](#), [PolyQDisaggregation2](#), [ProteasomeInhibition2](#), [ROSGenerationSmallAggPolyQ2](#) and as a product in [PolyQAggregation2](#), [PolyQDisaggregation3](#), [ROSGenerationSmallAggPolyQ2](#)).

$$\frac{d}{dt}\text{AggPolyQ2} = v_{10} + v_{16} + v_{30} - v_{11} - v_{17} - v_{22} - v_{30} \quad (161)$$

9.13 Species AggPolyQ3

Initial amount 0 item

This species takes part in seven reactions (as a reactant in [PolyQAggregation4](#), [PolyQDisaggregation3](#), [ProteasomeInhibition3](#), [ROSGenerationSmallAggPolyQ3](#) and as a product in [PolyQAggregation3](#), [PolyQDisaggregation4](#), [ROSGenerationSmallAggPolyQ3](#)).

$$\frac{d}{dt}\text{AggPolyQ3} = v_{11} + v_{15} + v_{31} - v_{12} - v_{16} - v_{23} - v_{31} \quad (162)$$

9.14 Species AggPolyQ4

Initial amount 0 item

This species takes part in seven reactions (as a reactant in [PolyQAggregation5](#), [PolyQDisaggregation4](#), [ProteasomeInhibition4](#), [ROSGenerationSmallAggPolyQ4](#) and as a product in [PolyQAggregation4](#), [PolyQDisaggregation5](#), [ROSGenerationSmallAggPolyQ4](#)).

$$\frac{d}{dt}\text{AggPolyQ4} = v_{12} + v_{14} + v_{32} - v_{13} - v_{15} - v_{24} - v_{32} \quad (163)$$

9.15 Species AggPolyQ5

Initial amount 0 item

This species takes part in six reactions (as a reactant in [PolyQDisaggregation5](#), [PolyQInclusionFormation](#), [ProteasomeInhibition5](#), [ROSGenerationSmallAggPolyQ5](#) and as a product in [PolyQAggregation5](#), [ROSGenerationSmallAggPolyQ5](#)).

$$\frac{d}{dt}\text{AggPolyQ5} = v_{13} + v_{33} - v_{14} - v_{19} - v_{25} - v_{33} \quad (164)$$

9.16 Species SeqAggP

Initial amount 0 item

This species takes part in 18 reactions (as a reactant in [PolyQInclusionGrowth](#), [mRFPuProteasomeSequestering](#), [mRFPuSequestering](#), [AggP_ProteasomeSequestering](#), [PolyQ_ProteasomeSequestering](#), [MisP_ProteasomeSequestering](#), [MisPInclusionGrowth](#), [ROSGenerationSeqAggP](#) and as a product in [PolyQInclusionFormation](#), [PolyQInclusionGrowth](#), [mRFPuProteasomeSequestering](#), [mRFPuSequestering](#), [AggP_ProteasomeSequestering](#), [PolyQ_ProteasomeSequestering](#), [MisP_ProteasomeSequestering](#), [MisP_InclusionFormation](#), [MisPInclusionGrowth](#), [ROSGenerationSeqAggP](#)).

$$\begin{aligned} \frac{d}{dt}\text{SeqAggP} = & 7 v_{19} + 2 v_{20} + 2 v_{26} + 2 v_{27} + 2 v_{38} + 2 v_{39} + 2 v_{40} + 7 v_{57} + 2 v_{58} \\ & + v_{70} - v_{20} - v_{26} - v_{27} - v_{38} - v_{39} - v_{40} - v_{58} - v_{70} \end{aligned} \quad (165)$$

9.17 Species AggP_Proteasome

Initial amount 0 item

This species takes part in 15 reactions (as a reactant in [ROSGenerationAggPProteasome](#), [AggP_ProteasomeSequestering](#), [PIDeathPathway](#) and as a product in [ProteasomeInhibition1](#), [ProteasomeInhibition2](#), [ProteasomeInhibition3](#), [ProteasomeInhibition4](#), [ProteasomeInhibition5](#), [ROSGenerationAggPProteasome](#), [ProteasomeInhibitionAggP1](#), [ProteasomeInhibitionAggP2](#), [ProteasomeInhibitionAggP3](#), [ProteasomeInhibitionAggP4](#), [ProteasomeInhibitionAggP5](#), [PIDeathPathway](#)).

$$\frac{d}{dt}\text{AggP_Proteasome} = v_{21} + v_{22} + v_{23} + v_{24} + v_{25} + v_{34} + v_{59} + v_{60} + v_{61} + v_{62} + v_{63} + v_{72} - v_{34} - v_{38} - v_{72} \quad (166)$$

9.18 Species mRFPu

Initial amount 300 item

This species takes part in four reactions (as a reactant in [mRFPuProteasomeBinding](#), [mRFPuSequestering](#) and as a product in [mRFPuSynthesis](#), [mRFPuProteasomeRelease](#)).

$$\frac{d}{dt}\text{mRFPu} = v_5 + v_7 - v_6 - v_{27} \quad (167)$$

9.19 Species mRFPu_Proteasome

Initial amount 0 item

This species takes part in four reactions (as a reactant in [mRFPuProteasomeRelease](#), [mRFPuDegradation](#), [mRFPuProteasomeSequestering](#) and as a product in [mRFPuProteasomeBinding](#)).

$$\frac{d}{dt}\text{mRFPu_Proteasome} = v_6 - v_7 - v_8 - v_{26} \quad (168)$$

9.20 Species PolyQ_Proteasome

Initial amount 0 item

This species takes part in four reactions (as a reactant in [polyqProteasomeRelease](#), [PolyQDegradation](#), [PolyQ_ProteasomeSequestering](#) and as a product in [polyqProteasomeBinding](#)).

$$\frac{d}{dt}\text{PolyQ_Proteasome} = v_2 - v_3 - v_4 - v_{39} \quad (169)$$

9.21 Species ROS

Initial amount 10 item

This species takes part in 29 reactions (as a reactant in [PolyQAggregation1](#), [PolyQAggregation2](#), [PolyQAggregation3](#), [PolyQAggregation4](#), [PolyQAggregation5](#), [ROSremoval](#), [p38activation](#), [Misfolding](#) and as a product in [PolyQAggregation1](#), [PolyQAggregation2](#), [PolyQAggregation3](#), [PolyQAggregation4](#), [PolyQAggregation5](#), [ROSGenerationBasal](#), [ROSGenerationSmallAggPolyQ1](#), [ROSGenerationSmallAggPolyQ2](#), [ROSGenerationSmallAggPolyQ3](#), [ROSGenerationSmallAggPolyQ4](#), [ROSGenerationSmallAggPolyQ5](#), [ROSGenerationAggPProteasome](#), [p38activation](#), [Misfolding](#), [ROSGenerationSmallAggP1](#), [ROSGenerationSmallAggP2](#), [ROSGenerationSmallAggP3](#), [ROSGenerationSmallAggP5](#), [p38_P_ROS_Generation](#), [ROSGenerationSeqAggP](#)).

$$\begin{aligned} \frac{d}{dt}ROS = & v_9 + v_{10} + v_{11} + v_{12} + v_{13} + v_{28} + v_{29} + v_{30} + v_{31} + v_{32} \\ & + v_{33} + v_{34} + v_{36} + v_{42} + v_{64} + v_{65} + v_{66} + v_{67} + v_{68} \\ & + v_{69} + v_{70} - v_9 - v_{10} - v_{11} - v_{12} - v_{13} - v_{35} - v_{36} - v_{42} \end{aligned} \quad (170)$$

9.22 Species p38_P

Initial amount 0 item

This species takes part in six reactions (as a reactant in [p38inactivation](#), [p38_P_ROS_Generation](#), [P38DeathPathway](#) and as a product in [p38activation](#), [p38_P_ROS_Generation](#), [P38DeathPathway](#)).

$$\frac{d}{dt}p38_P = v_{36} + v_{69} + v_{71} - v_{37} - v_{69} - v_{71} \quad (171)$$

9.23 Species p38

Initial amount 100 item

This species takes part in two reactions (as a reactant in [p38activation](#) and as a product in [p38inactivation](#)).

$$\frac{d}{dt}p38 = v_{37} - v_{36} \quad (172)$$

9.24 Species Source

Initial amount 1 item

This species takes part in four reactions (as a reactant in [polyQSynthesis](#), [mRFPuSynthesis](#), [ROSGenerationBasal](#), [ProteinSynthesis](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}Source = 0 \quad (173)$$

9.25 Species Sink

Initial amount 1 item

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

$$\frac{d}{dt}\text{Sink} = 0 \quad (174)$$

9.26 Species p38death

Initial amount 0 item

This species takes part in one reaction (as a product in [P38DeathPathway](#)).

$$\frac{d}{dt}\text{p38death} = v_{71} \quad (175)$$

9.27 Species PIdeth

Initial amount 0 item

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

$$\frac{d}{dt}\text{PIdeth} = v_{72} \quad (176)$$

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

^aCenter for Bioinformatics Tübingen (ZBIT), Germany

^bCalifornia Institute of Technology, Beckman Institute BNMC, Pasadena, United States

^cEuropean Bioinformatics Institute, Wellcome Trust Genome Campus, Hinxton, United Kingdom

^dEML Research gGmbH, Heidelberg, Germany