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 Chelliah[1] and Carole J Proctor[2] 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

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of human neurodegenerative diseases but the molecular basis of their cytoxicity 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.

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 m^2

2.4 Unit `length`

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

Definition m

2.5 Unit `time`

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

Definition s

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

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

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 Condition
PolyQ		cytosol	item	⊟	⊟
Proteasome		cytosol	item	⊟	⊟
NatP		cytosol	item	⊟	⊟
MisP		cytosol	item	⊟	⊟
MisP_Proteasome		cytosol	item	⊟	⊟
AggP1		cytosol	item	⊟	⊟
AggP2		cytosol	item	⊟	⊟
AggP3		cytosol	item	⊟	⊟
AggP4		cytosol	item	⊟	⊟
AggP5		cytosol	item	⊟	⊟
AggPolyQ1		cytosol	item	⊟	⊟
AggPolyQ2		cytosol	item	⊟	⊟
AggPolyQ3		cytosol	item	⊟	⊟
AggPolyQ4		cytosol	item	⊟	⊟
AggPolyQ5		cytosol	item	⊟	⊟
SeqAggP		cytosol	item	⊟	⊟
AggP_Proteasome		cytosol	item	⊟	⊟
mRFPu		cytosol	item	⊟	⊟
mRFPu_Proteasome		cytosol	item	⊟	⊟
PolyQ_Proteasome		cytosol	item	⊟	⊟
ROS		cytosol	item	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
p38_P		cytosol	item	☐	☐
p38		cytosol	item	☐	☐
Source		cytosol	item	☑	☑
Sink		cytosol	item	☑	☑
p38death		cytosol	item	☐	☐
PIdeath		cytosol	item	☐	☐

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			$8 \cdot 10^{-5}$		☑
kbinMisPProt			$5 \cdot 10^{-8}$		☑
krelMisPProt			10^{-8}		☑
kdegMisP			0.010		☑
kgenROSp38			$7 \cdot 10^{-4}$		☑
kp38act			1.000		⊟
kp38death			$9 \cdot 10^{-8}$		☑
kPIdeath			$2.5 \cdot 10^{-8}$		☑
kproteff			1.000		⊟
kalive			1.000		⊟
oligomers	oligomers		0.000		⊟

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

$$\text{p38death} > 0 \tag{4}$$

Assignment

$$\text{kalive} = 0 \tag{5}$$

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

№	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	

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

№	Id	Name	Reaction Equation	SBO
47	MisP-_Aggregation1		$2\,\mathrm{MisP} \longrightarrow \mathrm{AggP1}$	
48	MisP-_Aggregation2		$\mathrm{MisP} + \mathrm{AggP1} \longrightarrow \mathrm{AggP2}$	
49	MisP-_Aggregation3		$\mathrm{MisP} + \mathrm{AggP2} \longrightarrow \mathrm{AggP3}$	
50	MisP-_Aggregation4		$\mathrm{MisP} + \mathrm{AggP3} \longrightarrow \mathrm{AggP4}$	
51	MisP-_Aggregation5		$\mathrm{MisP} + \mathrm{AggP4} \longrightarrow \mathrm{AggP5}$	
52	MisP-_Disaggregation1		$\mathrm{AggP1} \longrightarrow 2\,\mathrm{MisP}$	
53	MisP-_Disaggregation2		$\mathrm{AggP2} \longrightarrow \mathrm{MisP} + \mathrm{AggP1}$	
54	MisP-_Disaggregation3		$\mathrm{AggP3} \longrightarrow \mathrm{MisP} + \mathrm{AggP2}$	
55	MisP-_Disaggregation4		$\mathrm{AggP4} \longrightarrow \mathrm{MisP} + \mathrm{AggP3}$	
56	MisP-_Disaggregation5		$\mathrm{AggP5} \longrightarrow \mathrm{MisP} + \mathrm{AggP4}$	
57	MisP-_InclusionFormation		$\mathrm{MisP} + \mathrm{AggP5} \longrightarrow 7\,\mathrm{SeqAggP}$	
58	MisPInclusionGrowth		$\mathrm{MisP} + \mathrm{SeqAggP} \longrightarrow 2\,\mathrm{SeqAggP}$	
59	ProteasomeInhibitionAggP1		$\mathrm{AggP1} + \mathrm{Proteasome} \longrightarrow \mathrm{AggP\_Proteasome}$	
60	ProteasomeInhibitionAggP2		$\mathrm{AggP2} + \mathrm{Proteasome} \longrightarrow \mathrm{AggP\_Proteasome}$	
61	ProteasomeInhibitionAggP3		$\mathrm{AggP3} + \mathrm{Proteasome} \longrightarrow \mathrm{AggP\_Proteasome}$	
62	ProteasomeInhibitionAggP4		$\mathrm{AggP4} + \mathrm{Proteasome} \longrightarrow \mathrm{AggP\_Proteasome}$	
63	ProteasomeInhibitionAggP5		$\mathrm{AggP5} + \mathrm{Proteasome} \longrightarrow \mathrm{AggP\_Proteasome}$	
64	ROSgenerationSmallAggP1		$\mathrm{AggP1} \longrightarrow \mathrm{AggP1} + \mathrm{ROS}$	

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

8.1 Reaction `polyQSynthesis`

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

Reaction equation

$$\text{Source} \longrightarrow \text{PolyQ} \tag{6}$$

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

$$v_1 = \text{ksynPolyQ} \cdot \text{Source} \cdot \text{kalive} \tag{7}$$

8.2 Reaction `polyqProteasomeBinding`

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

Reaction equation

$$\text{PolyQ} + \text{Proteasome} \longrightarrow \text{PolyQ\_Proteasome} \tag{8}$$

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

$$v_2 = \text{kbinPolyQ} \cdot \text{PolyQ} \cdot \text{Proteasome} \cdot \text{kalive} \tag{9}$$

8.3 Reaction polyqProteasomeRelease

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

Reaction equation

$$\text{PolyQ\_Proteasome} \longrightarrow \text{PolyQ} + \text{Proteasome} \tag{10}$$

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

$$v_3 = \text{krelPolyQ} \cdot \text{PolyQ\_Proteasome} \cdot \text{kalive} \tag{11}$$

8.4 Reaction PolyQDegradation

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

Reaction equation

$$\text{PolyQ\_Proteasome} \longrightarrow \text{Proteasome} \tag{12}$$

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

$$v_4 = \text{kdegPolyQ} \cdot \text{PolyQ\_Proteasome} \cdot \text{kalive} \cdot \text{kproteff} \tag{13}$$

8.5 Reaction mRFPuSynthesis

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

Reaction equation

$$\text{Source} \longrightarrow \text{mRFPu} \tag{14}$$

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

$$v_5 = \text{ksynmRFPu} \cdot \text{Source} \cdot \text{kalive} \tag{15}$$

8.6 Reaction mRFPuProteasomeBinding

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

Reaction equation

$$\text{mRFPu} + \text{Proteasome} \longrightarrow \text{mRFPu\_Proteasome} \tag{16}$$

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

$$v_6 = \text{kbinmRFPu} \cdot \text{mRFPu} \cdot \text{Proteasome} \cdot \text{kalive} \tag{17}$$

8.7 Reaction mRFPuProteasomeRelease

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

Reaction equation

$$\text{mRFPu\_Proteasome} \longrightarrow \text{mRFPu} + \text{Proteasome} \tag{18}$$

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

$$v_7 = \text{krelmRFPu} \cdot \text{mRFPu\_Proteasome} \cdot \text{kalive} \tag{19}$$

8.8 Reaction mRFPuDegradation

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

Reaction equation

$$\text{mRFPu\_Proteasome} \longrightarrow \text{Proteasome} \tag{20}$$

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

$$v_8 = \text{kdegmRFPu} \cdot \text{mRFPu\_Proteasome} \cdot \text{kalive} \cdot \text{kproteff} \tag{21}$$

8.9 Reaction PolyQAggregation1

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

Reaction equation

$$2\,\text{PolyQ} + \text{ROS} \longrightarrow \text{AggPolyQ1} + \text{ROS} \tag{22}$$

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

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

8.10 Reaction PolyQAggregation2

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

Reaction equation

$$\text{PolyQ} + \text{AggPolyQ1} + \text{ROS} \longrightarrow \text{AggPolyQ2} + \text{ROS} \tag{24}$$

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

$$v_{10} = \text{kaggPolyQ} \cdot \text{PolyQ} \cdot \text{AggPolyQ1} \cdot \frac{\text{ROS}^2}{10^2 + \text{ROS}^2} \cdot \text{kalive} \tag{25}$$

8.11 Reaction PolyQAggregation3

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

Reaction equation

$$\text{PolyQ} + \text{AggPolyQ2} + \text{ROS} \longrightarrow \text{AggPolyQ3} + \text{ROS} \tag{26}$$

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

$$v_{11} = \text{kaggPolyQ} \cdot \text{PolyQ} \cdot \text{AggPolyQ2} \cdot \frac{\text{ROS}^2}{10^2 + \text{ROS}^2} \cdot \text{kalive} \tag{27}$$

8.12 Reaction PolyQAggregation4

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

Reaction equation

$$\text{PolyQ} + \text{AggPolyQ3} + \text{ROS} \longrightarrow \text{AggPolyQ4} + \text{ROS} \tag{28}$$

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

$$v_{12} = \text{kaggPolyQ} \cdot \text{PolyQ} \cdot \text{AggPolyQ3} \cdot \frac{\text{ROS}^2}{10^2 + \text{ROS}^2} \cdot \text{kalive} \tag{29}$$

8.13 Reaction PolyQAggregation5

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

Reaction equation

$$\text{PolyQ} + \text{AggPolyQ4} + \text{ROS} \longrightarrow \text{AggPolyQ5} + \text{ROS} \tag{30}$$

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

$$v_{13} = \text{kaggPolyQ} \cdot \text{PolyQ} \cdot \text{AggPolyQ4} \cdot \frac{\text{ROS}^2}{10^2 + \text{ROS}^2} \cdot \text{kalive} \tag{31}$$

8.14 Reaction PolyQDisaggregation5

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

Reaction equation

$$\text{AggPolyQ5} \longrightarrow \text{PolyQ} + \text{AggPolyQ4} \tag{32}$$

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

$$v_{14} = \text{kdisaggPolyQ5} \cdot \text{AggPolyQ5} \cdot \text{kalive} \tag{33}$$

8.15 Reaction PolyQDisaggregation4

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

Reaction equation

$$\text{AggPolyQ4} \longrightarrow \text{PolyQ} + \text{AggPolyQ3} \tag{34}$$

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

$$v_{15} = \text{kdisaggPolyQ4} \cdot \text{AggPolyQ4} \cdot \text{kalive} \tag{35}$$

8.16 Reaction PolyQDisaggregation3

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

Reaction equation

$$\text{AggPolyQ3} \longrightarrow \text{PolyQ} + \text{AggPolyQ2} \tag{36}$$

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

$$v_{16} = \text{kdisaggPolyQ3} \cdot \text{AggPolyQ3} \cdot \text{kalive} \tag{37}$$

8.17 Reaction `PolyQDisaggregation2`

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

Reaction equation

$$\text{AggPolyQ2} \longrightarrow \text{PolyQ} + \text{AggPolyQ1} \tag{38}$$

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

$$v_{17} = \text{kdisaggPolyQ2} \cdot \text{AggPolyQ2} \cdot \text{kalive} \tag{39}$$

8.18 Reaction `PolyQDisaggregation1`

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

Reaction equation

$$\text{AggPolyQ1} \longrightarrow 2\,\text{PolyQ} \tag{40}$$

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

$$v_{18} = \text{kdisaggPolyQ1} \cdot \text{AggPolyQ1} \cdot \text{kalive} \tag{41}$$

8.19 Reaction PolyQInclusionFormation

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

Reaction equation

$$\text{PolyQ} + \text{AggPolyQ5} \longrightarrow 7\,\text{SeqAggP} \tag{42}$$

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

$$v_{19} = \text{kaggPolyQ} \cdot \text{PolyQ} \cdot \text{AggPolyQ5} \cdot \text{kalive} \tag{43}$$

8.20 Reaction PolyQInclusionGrowth

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

Reaction equation

$$\text{PolyQ} + \text{SeqAggP} \longrightarrow 2\,\text{SeqAggP} \tag{44}$$

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

$$v_{20} = \text{kseqPolyQ} \cdot \text{PolyQ} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{45}$$

8.21 Reaction ProteasomeInhibition1

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

Reaction equation

$$\text{AggPolyQ1} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{46}$$

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

$$v_{21} = \text{kinhprot} \cdot \text{AggPolyQ1} \cdot \text{Proteasome} \cdot \text{kalive} \tag{47}$$

8.22 Reaction ProteasomeInhibition2

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

Reaction equation

$$\text{AggPolyQ2} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{48}$$

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

$$v_{22} = \text{kinhprot} \cdot \text{AggPolyQ2} \cdot \text{Proteasome} \cdot \text{kalive} \tag{49}$$

8.23 Reaction ProteasomeInhibition3

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

Reaction equation

$$\text{AggPolyQ3} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{50}$$

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

$$v_{23} = \text{kinhprot} \cdot \text{AggPolyQ3} \cdot \text{Proteasome} \cdot \text{kalive} \tag{51}$$

8.24 Reaction ProteasomeInhibition4

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

Reaction equation

$$\text{AggPolyQ4} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{52}$$

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

$$v_{24} = \text{kinhprot} \cdot \text{AggPolyQ4} \cdot \text{Proteasome} \cdot \text{kalive} \tag{53}$$

8.25 Reaction ProteasomeInhibition5

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

Reaction equation

$$\text{AggPolyQ5} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{54}$$

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

$$v_{25} = \text{kinhprot} \cdot \text{AggPolyQ5} \cdot \text{Proteasome} \cdot \text{kalive} \tag{55}$$

8.26 Reaction mRFPuProteasomeSequestering

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

Reaction equation

$$\text{mRFPu\_Proteasome} + \text{SeqAggP} \longrightarrow 2\,\text{SeqAggP} \tag{56}$$

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

$$v_{26} = \text{kseqmRFPuProt} \cdot \text{mRFPu\_Proteasome} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{57}$$

8.27 Reaction `mRFPuSequestering`

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

Reaction equation

$$\text{mRFPu} + \text{SeqAggP} \longrightarrow 2\,\text{SeqAggP} \tag{58}$$

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

$$v_{27} = \text{kseqmRFPu} \cdot \text{mRFPu} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{59}$$

8.28 Reaction `ROSgenerationBasal`

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

Reaction equation

$$\text{Source} \longrightarrow \text{ROS} \tag{60}$$

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

$$v_{28} = \text{kgenROS} \cdot \text{Source} \cdot \text{kalive} \tag{61}$$

8.29 Reaction ROSgenerationSmallAggPolyQ1

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

Reaction equation

$$\text{AggPolyQ1} \longrightarrow \text{AggPolyQ1} + \text{ROS} \tag{62}$$

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

$$v_{29} = \text{kgenROSAggP} \cdot \text{AggPolyQ1} \cdot \text{kalive} \tag{63}$$

8.30 Reaction ROSgenerationSmallAggPolyQ2

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

Reaction equation

$$\text{AggPolyQ2} \longrightarrow \text{AggPolyQ2} + \text{ROS} \tag{64}$$

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

$$v_{30} = \text{kgenROSAggP} \cdot \text{AggPolyQ2} \cdot \text{kalive} \tag{65}$$

8.31 Reaction ROSgenerationSmallAggPolyQ3

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

Reaction equation

$$\text{AggPolyQ3} \longrightarrow \text{AggPolyQ3} + \text{ROS} \tag{66}$$

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

$$v_{31} = \text{kgenROSAggP} \cdot \text{AggPolyQ3} \cdot \text{kalive} \tag{67}$$

8.32 Reaction ROSgenerationSmallAggPolyQ4

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

Reaction equation

$$\text{AggPolyQ4} \longrightarrow \text{AggPolyQ4} + \text{ROS} \tag{68}$$

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

$$v_{32} = \text{kgenROSAggP} \cdot \text{AggPolyQ4} \cdot \text{kalive} \tag{69}$$

8.33 Reaction ROSgenerationSmallAggPolyQ5

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

Reaction equation

$$\text{AggPolyQ5} \longrightarrow \text{AggPolyQ5} + \text{ROS} \tag{70}$$

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

$$v_{33} = \text{kgenROSAggP} \cdot \text{AggPolyQ5} \cdot \text{kalive} \tag{71}$$

8.34 Reaction ROSgenerationAggPProteasome

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

Reaction equation

$$\text{AggP\_Proteasome} \longrightarrow \text{AggP\_Proteasome} + \text{ROS} \tag{72}$$

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

$$v_{34} = \text{kgenROSAggP} \cdot \text{AggP\_Proteasome} \cdot \text{kalive} \tag{73}$$

8.35 Reaction ROSremoval

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

Reaction equation

$$\text{ROS} \longrightarrow \text{Sink} \tag{74}$$

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

$$v_{35} = \text{kremROS} \cdot \text{ROS} \cdot \text{kalive} \tag{75}$$

8.36 Reaction p38activation

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

Reaction equation

$$\text{ROS} + \text{p38} \longrightarrow \text{ROS} + \text{p38\_P} \tag{76}$$

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

$$v_{36} = \text{kactp38} \cdot \text{ROS} \cdot \text{p38} \cdot \text{kalive} \tag{77}$$

8.37 Reaction p38inactivation

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

Reaction equation

$$\text{p38\_P} \longrightarrow \text{p38} \tag{78}$$

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

$$v_{37} = \text{kinactp38} \cdot \text{p38\_P} \cdot \text{kalive} \tag{79}$$

8.38 Reaction AggP_ProteasomeSequestering

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

Reaction equation

$$\text{AggP\_Proteasome} + \text{SeqAggP} \longrightarrow 2\,\text{SeqAggP} \tag{80}$$

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

$$v_{38} = \text{kseqAggPProt} \cdot \text{AggP\_Proteasome} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{81}$$

8.39 Reaction PolyQ_ProteasomeSequestering

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

Reaction equation

$$\text{PolyQ\_Proteasome} + \text{SeqAggP} \longrightarrow 2\,\text{SeqAggP} \tag{82}$$

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

$$v_{39} = \text{kseqPolyQProt} \cdot \text{PolyQ\_Proteasome} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{83}$$

8.40 Reaction MisP_ProteasomeSequestering

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

Reaction equation

$$\text{MisP\_Proteasome} + \text{SeqAggP} \longrightarrow 2\,\text{SeqAggP} \tag{84}$$

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

$$v_{40} = \text{kseqMisPProt} \cdot \text{MisP\_Proteasome} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{85}$$

8.41 Reaction ProteinSynthesis

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

Reaction equation

$$\text{Source} \longrightarrow \text{NatP} \tag{86}$$

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

$$v_{41} = \text{ksynNatP} \cdot \text{Source} \cdot \text{kalive} \tag{87}$$

8.42 Reaction Misfolding

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

Reaction equation

$$\text{NatP} + \text{ROS} \longrightarrow \text{MisP} + \text{ROS} \tag{88}$$

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

$$v_{42} = \text{kmisfold} \cdot \text{NatP} \cdot \text{ROS} \cdot \text{kalive} \tag{89}$$

8.43 Reaction Refolding

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

Reaction equation

$$\text{MisP} \longrightarrow \text{NatP} \tag{90}$$

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

$$v_{43} = \text{krefold} \cdot \text{MisP} \cdot \text{kalive} \tag{91}$$

8.44 Reaction MisP_ProteasomeBinding

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

Reaction equation

$$\text{MisP} + \text{Proteasome} \longrightarrow \text{MisP\_Proteasome} \tag{92}$$

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

$$v_{44} = \text{kbinMisPProt} \cdot \text{MisP} \cdot \text{Proteasome} \cdot \text{kalive} \tag{93}$$

8.45 Reaction MisP_ProteasomeRelease

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

Reaction equation

$$\text{MisP\_Proteasome} \longrightarrow \text{MisP} + \text{Proteasome} \tag{94}$$

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

$$v_{45} = \text{krelMisPProt} \cdot \text{MisP\_Proteasome} \cdot \text{kalive} \tag{95}$$

8.46 Reaction MisP_Degradation

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

Reaction equation

$$\text{MisP\_Proteasome} \longrightarrow \text{Proteasome} \tag{96}$$

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

$$v_{46} = \text{kdegMisP} \cdot \text{MisP\_Proteasome} \cdot \text{kalive} \cdot \text{kproteff} \tag{97}$$

8.47 Reaction MisP_Aggregation1

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

Reaction equation

$$2\,\text{MisP} \longrightarrow \text{AggP1} \tag{98}$$

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

$$v_{47} = \text{kaggMisP} \cdot \text{MisP} \cdot (\text{MisP} - 1) \cdot 0.5 \cdot \text{kalive} \tag{99}$$

8.48 Reaction MisP_Aggregation2

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

Reaction equation

$$\text{MisP} + \text{AggP1} \longrightarrow \text{AggP2} \tag{100}$$

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

$$v_{48} = \text{kagg2MisP} \cdot \text{MisP} \cdot \text{AggP1} \cdot \text{kalive} \tag{101}$$

8.49 Reaction MisP_Aggregation3

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

Reaction equation

$$\mathrm{MisP} + \mathrm{AggP2} \longrightarrow \mathrm{AggP3} \tag{102}$$

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

$$v_{49} = \mathrm{kagg2MisP} \cdot \mathrm{MisP} \cdot \mathrm{AggP2} \cdot \mathrm{kalive} \tag{103}$$

8.50 Reaction MisP_Aggregation4

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

Reaction equation

$$\mathrm{MisP} + \mathrm{AggP3} \longrightarrow \mathrm{AggP4} \tag{104}$$

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

$$v_{50} = \text{kagg2MisP} \cdot \text{MisP} \cdot \text{AggP3} \cdot \text{kalive} \tag{105}$$

8.51 Reaction MisP_Aggregation5

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

Reaction equation

$$\text{MisP} + \text{AggP4} \longrightarrow \text{AggP5} \tag{106}$$

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

$$v_{51} = \text{kagg2MisP} \cdot \text{MisP} \cdot \text{AggP4} \cdot \text{kalive} \tag{107}$$

8.52 Reaction MisP_Disaggregation1

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

Reaction equation

$$\text{AggP1} \longrightarrow 2\,\text{MisP} \tag{108}$$

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

$$v_{52} = \text{kdisaggMisP1} \cdot \text{AggP1} \cdot \text{kalive} \tag{109}$$

8.53 Reaction MisP_Disaggregation2

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

Reaction equation

$$\text{AggP2} \longrightarrow \text{MisP} + \text{AggP1} \tag{110}$$

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

$$v_{53} = \text{kdisaggMisP2} \cdot \text{AggP2} \cdot \text{kalive} \tag{111}$$

8.54 Reaction MisP_Disaggregation3

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

Reaction equation

$$\text{AggP3} \longrightarrow \text{MisP} + \text{AggP2} \tag{112}$$

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

$$v_{54} = \text{kdisaggMisP3} \cdot \text{AggP3} \cdot \text{kalive} \tag{113}$$

8.55 Reaction MisP_Disaggregation4

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

Reaction equation

$$\text{AggP4} \longrightarrow \text{MisP} + \text{AggP3} \tag{114}$$

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

$$v_{55} = \text{kdisaggMisP4} \cdot \text{AggP4} \cdot \text{kalive} \tag{115}$$

8.56 Reaction MisP_Disaggregation5

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

Reaction equation

$$\text{AggP5} \longrightarrow \text{MisP} + \text{AggP4} \tag{116}$$

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

$$v_{56} = \text{kdisaggMisP5} \cdot \text{AggP5} \cdot \text{kalive} \tag{117}$$

8.57 Reaction MisP_InclusionFormation

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

Reaction equation

$$\text{MisP} + \text{AggP5} \longrightarrow 7\,\text{SeqAggP} \tag{118}$$

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

$$v_{57} = \text{kagg2MisP} \cdot \text{MisP} \cdot \text{AggP5} \cdot \text{kalive} \tag{119}$$

8.58 Reaction MisPInclusionGrowth

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

Reaction equation

$$\text{MisP} + \text{SeqAggP} \longrightarrow 2\,\text{SeqAggP} \tag{120}$$

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

$$v_{58} = \text{kseqMisP} \cdot \text{MisP} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{121}$$

8.59 Reaction ProteasomeInhibitionAggP1

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

Reaction equation

$$\text{AggP1} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{122}$$

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

$$v_{59} = \text{kinhprot} \cdot \text{AggP1} \cdot \text{Proteasome} \cdot \text{kalive} \tag{123}$$

8.60 Reaction ProteasomeInhibitionAggP2

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

Reaction equation

$$\text{AggP2} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{124}$$

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

$$v_{60} = \text{kinhprot} \cdot \text{AggP2} \cdot \text{Proteasome} \cdot \text{kalive} \tag{125}$$

8.61 Reaction ProteasomeInhibitionAggP3

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

Reaction equation

$$\text{AggP3} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{126}$$

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

$$v_{61} = \text{kinhprot} \cdot \text{AggP3} \cdot \text{Proteasome} \cdot \text{kalive} \tag{127}$$

8.62 Reaction ProteasomeInhibitionAggP4

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

Reaction equation

$$\text{AggP4} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{128}$$

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

$$v_{62} = \text{kinhprot} \cdot \text{AggP4} \cdot \text{Proteasome} \cdot \text{kalive} \tag{129}$$

8.63 Reaction ProteasomeInhibitionAggP5

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

Reaction equation

$$\text{AggP5} + \text{Proteasome} \longrightarrow \text{AggP\_Proteasome} \tag{130}$$

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

$$v_{63} = \text{kinhprot} \cdot \text{AggP5} \cdot \text{Proteasome} \cdot \text{kalive} \tag{131}$$

8.64 Reaction ROSgenerationSmallAggP1

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

Reaction equation

$$\text{AggP1} \longrightarrow \text{AggP1} + \text{ROS} \tag{132}$$

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

$$v_{64} = \text{kgenROSAggP} \cdot \text{AggP1} \cdot \text{kalive} \tag{133}$$

8.65 Reaction ROSgenerationSmallAggP2

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

Reaction equation

$$\text{AggP2} \longrightarrow \text{AggP2} + \text{ROS} \tag{134}$$

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

$$v_{65} = \text{kgenROSAggP} \cdot \text{AggP2} \cdot \text{kalive} \tag{135}$$

8.66 Reaction ROSgenerationSmallAggP3

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

Reaction equation

$$\text{AggP3} \longrightarrow \text{AggP3} + \text{ROS} \tag{136}$$

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

$$v_{66} = \text{kgenROSAggP} \cdot \text{AggP3} \cdot \text{kalive} \tag{137}$$

8.67 Reaction ROSgenerationSmallAggP4

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

Reaction equation

$$\text{AggP4} \longrightarrow \text{AggP4} + \text{ROS} \tag{138}$$

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

$$v_{67} = \text{kgenROSAggP} \cdot \text{AggP4} \cdot \text{kalive} \tag{139}$$

8.68 Reaction ROSgenerationSmallAggP5

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

Reaction equation

$$\text{AggP5} \longrightarrow \text{AggP5} + \text{ROS} \tag{140}$$

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

$$v_{68} = \text{kgenROSAggP} \cdot \text{AggP5} \cdot \text{kalive} \tag{141}$$

8.69 Reaction p38_P_ROS_Generation

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

Reaction equation

$$\text{p38\_P} \longrightarrow \text{p38\_P} + \text{ROS} \tag{142}$$

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

$$v_{69} = \text{kgenROSp38} \cdot \text{p38\_P} \cdot \text{kp38act} \cdot \text{kalive} \tag{143}$$

8.70 Reaction ROSgenerationSeqAggP

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

Reaction equation

$$\text{SeqAggP} \longrightarrow \text{SeqAggP} + \text{ROS} \tag{144}$$

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

$$v_{70} = \text{kgenROSSeqAggP} \cdot \text{SeqAggP} \cdot \text{kalive} \tag{145}$$

8.71 Reaction P38DeathPathway

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

Reaction equation

$$\text{p38\_P} \longrightarrow \text{p38\_P} + \text{p38death} \tag{146}$$

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

$$v_{71} = \text{kp38death} \cdot \text{p38\_P} \cdot \text{kalive} \cdot \text{kp38act} \tag{147}$$

8.72 Reaction PIDeathPathway

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

Reaction equation

$$\text{AggP\_Proteasome} \longrightarrow \text{AggP\_Proteasome} + \text{PIdeath} \tag{148}$$

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

$$v_{72} = \text{kPIdeath} \cdot \text{AggP\_Proteasome} \cdot \text{kalive} \tag{149}$$

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, PolyQInclusionFor PolyQInclusionGrowth and as a product in polyQSynthesis, polyqProteasomeRelease, PolyQDisaggregation5, PolyQDisaggregation4, PolyQDisaggregation3, PolyQDisaggregation2, PolyQDisaggregation1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PolyQ} = v_1 + v_3 + v_{14} + v_{15} + v_{16} + v_{17} + 2\,v_{18} - v_2 - 2\,v_9 - v_{10} - v_{11} - v_{12} - v_{13} - v_{19} - v_{20} \tag{150}$$

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, ProteasomeInhibiti ProteasomeInhibitionAggP3, ProteasomeInhibitionAggP4, ProteasomeInhibitionAggP5 and as a product in polyqProteasomeRelease, PolyQDegradation, mRFPuProteasomeRelease, mRFPuDegradation, MisP_ProteasomeRelease, MisP_Degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Proteasome} = v_3 + v_4 + v_7 + v_8 + v_{45} + v_{46} - v_2 - v_6 - v_{21} - v_{22} - v_{23} - v_{24} - v_{25} - v_{44} - v_{59} - v_{60} - v_{61} - v_{62} - v_{63} \tag{151}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{NatP} = v_{41} + v_{43} - v_{42} \tag{152}$$

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, MisPInclusionGrowth and as a product in

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MisP} = v_{42} + v_{45} + 2\,v_{52} + v_{53} + v_{54} + v_{55} + v_{56} - v_{43} - v_{44} - 2\,v_{47} - v_{48} - v_{49} - v_{50} - v_{51} - v_{57} - v_{58} \tag{153}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MisP\_Proteasome} = v_{44} - v_{40} - v_{45} - v_{46} \tag{154}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggP1} = v_{47} + v_{53} + v_{64} - v_{48} - v_{52} - v_{59} - v_{64} \tag{155}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggP2} = v_{48} + v_{54} + v_{65} - v_{49} - v_{53} - v_{60} - v_{65} \tag{156}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggP3} = v_{49} + v_{55} + v_{66} - v_{50} - v_{54} - v_{61} - v_{66} \tag{157}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggP4} = v_{50} + v_{56} + v_{67} - v_{51} - v_{55} - v_{62} - v_{67} \tag{158}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggP5} = v_{51} + v_{68} - v_{56} - v_{57} - v_{63} - v_{68} \tag{159}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggPolyQ1} = v_{9} + v_{17} + v_{29} - v_{10} - v_{18} - v_{21} - v_{29} \tag{160}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggPolyQ2} = v_{10} + v_{16} + v_{30} - v_{11} - v_{17} - v_{22} - v_{30} \tag{161}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggPolyQ3} = v_{11} + v_{15} + v_{31} - v_{12} - v_{16} - v_{23} - v_{31} \tag{162}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggPolyQ4} = v_{12} + v_{14} + v_{32} - v_{13} - v_{15} - v_{24} - v_{32} \tag{163}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggPolyQ5} = v_{13} + v_{33} - v_{14} - v_{19} - v_{25} - v_{33} \tag{164}$$

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, ROSgenerationSeqAg

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SeqAggP} = {} & 7\,v_{19} + 2\,v_{20} + 2\,v_{26} + 2\,v_{27} + 2\,v_{38} + 2\,v_{39} + 2\,v_{40} + 7\,v_{57} + 2\,v_{58} \\ & + v_{70} - v_{20} - v_{26} - v_{27} - v_{38} - v_{39} - v_{40} - v_{58} - v_{70}\end{aligned} \tag{165}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{AggP\_Proteasome} = v_{21} + v_{22} + v_{23} + v_{24} + v_{25} + v_{34} + v_{59} + v_{60} + v_{61} + v_{62} + v_{63} + v_{72} - v_{34} - v_{38} - v_{72} \tag{166}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mRFPu} = v_5 + v_7 - v_6 - v_{27} \tag{167}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mRFPu\_Proteasome} = v_6 - v_7 - v_8 - v_{26} \tag{168}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PolyQ\_Proteasome} = v_2 - v_3 - v_4 - v_{39} \tag{169}$$

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, ROSgenerationSmal ROSgenerationSmallAggP5, p38_P_ROS_Generation, ROSgenerationSeqAggP).

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

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p38\_P} = v_{36} + v_{69} + v_{71} - v_{37} - v_{69} - v_{71} \tag{171}$$

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).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p38} = v_{37} - v_{36} \tag{172}$$

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:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Source} = 0 \tag{173}$$

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:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Sink} = 0 \tag{174}$$

9.26 Species p38death

Initial amount 0 item

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{p38death} = v_{71} \tag{175}$$

9.27 Species PIdeath

Initial amount 0 item

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PIdeath} = v_{72} \tag{176}$$

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