

## SBML Model Report

# Model name: “Sharp2013 - Lipopolysaccharide induced NFkB activation”



May 6, 2016

## 1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following three authors: Nick Juty<sup>1</sup>, Vijayalakshmi Chelliah<sup>2</sup> and Gemma Sharp<sup>3</sup> at September 24<sup>th</sup> 2013 at 3:42 p. m. and last time modified at March eighth 2014 at 8:25 p. m. Table 1 provides an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	53
events	0	constraints	0
reactions	59	function definitions	2
global parameters	0	unit definitions	2
rules	0	initial assignments	0

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## 2 Unit Definitions

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

### 2.1 Unit volume

**Name** volume

**Definition** ml

### 2.2 Unit substance

**Name** substance

**Definition**  $\mu\text{mol}$

### 2.3 Unit area

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

**Definition**  $\text{m}^2$

### 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
compartment_1	compartment	0000290	3	1	litre	<input checked="" type="checkbox"/>	

### 3.1 Compartment compartment\_1

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

**Name** compartment

**SBO:0000290** physical compartment

## 4 Species

This model contains 53 species. The boundary condition of 18 of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 7 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
species_1	CD14	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_2	IRAK4	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_3	LBP	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_4	LPS	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_5	LPS:LBP:CD14:TLR4:TIRAP:MyD88:IRAK4	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_6	MyD88	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_7	TIRAP	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_8	TLR4	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_9	IRAK1	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_10	TRAF6	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_11	TRAF6:IRAK1[P]	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_12	TAK1:TAB1:TAB2	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_13	TAK1:TAB1:TAB2:TRAF6	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_14	IKK	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_15	IKK[P]	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_16	RIP1	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_17	TRAM	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_18	TRIF	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_19	IRF3	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_20	IRF3[P]	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_21	IRF3[P](nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
species_22	source	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_23	sink	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_24	TNFa	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_25	TNFR1	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_26	TRADD	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_27	TRAF2	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
species_28	TNFa:TNFR1:TRAF2:TRADD:RIP1	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_29	IkB <sub>a</sub>	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_30	IkB <sub>a</sub> :NFkB	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_31	NFkB	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_32	IKK[P]:IkB <sub>a</sub> :NFkB	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_33	IkB <sub>b</sub>	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_34	IkB <sub>b</sub> :NFkB	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_35	IKK[P]:IkB <sub>b</sub> :NFkB	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_36	IkBe	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_37	IkBe:NFkB	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_38	IKK[P]:IkBe:NFkB	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_39	NFkB(nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_40	IkB <sub>a</sub> (nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_41	IkB <sub>a</sub> :NFkB(nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_42	IkB <sub>b</sub> (nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_43	IkB <sub>b</sub> :NFkB(nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_44	IkBe(nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_45	IkBe:NFkB(nuc)	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_46	IkB <sub>a</sub> _mRNA	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_47	IkB <sub>b</sub> _mRNA	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_48	IkBe_mRNA	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
species_49	IKK[P]:IkBa	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_50	IKK[P]:IkBb	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_51	IKK[P]:IkBe	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_52	LPS:LBP:CD14:TLR4:RIP1:TRAM:TRIF:TBK1/IKKe	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_53	TBK1/IKKe	compartment_1	$\mu\text{mol} \cdot \text{ml}^{-1}$	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

## 5 Function definitions

This is an overview of two function definitions.

### 5.1 Function definition `function_2`

**Name** Modified Michaelis Menten

**Arguments** `k`, `Enzyme`, `Substrate`, `Km`

**Mathematical Expression**

$$\frac{k \cdot \text{Enzyme} \cdot \text{Substrate}}{K_m + \text{Substrate}} \quad (1)$$

### 5.2 Function definition `function_1`

**Name** Modified Mass Action

**Arguments** `k1`, `Enzyme`, `Substrate1`, `Substrate2`, `k2`, `Product`

**Mathematical Expression**

$$k_1 \cdot \text{Enzyme} \cdot \text{Substrate}_1 \cdot \text{Substrate}_2 - k_2 \cdot \text{Product} \quad (2)$$

## 6 Reactions

This model contains 59 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 4: Overview of all reactions

Nº	Id	Name	Reaction Equation	SBO
1	reaction_1	MYD881) Receptor Complex Formation	$\begin{array}{c} \text{species}_4 + \text{species}_3 + \text{species}_1 + \\ \text{species}_8 + \text{species}_6 + \text{species}_2 + \\ \text{species}_7 \end{array} \xrightarrow{\text{species}_4, \text{species}_3, \text{species}_1, \text{species}_8, \text{species}_6, \text{species}_2, \text{species}_7, \text{species}_7} \text{species}_7$	
2	reaction_2	MYD882) IRAK1 and TRAF6 Phosphorylation	$\text{species}_9 + \text{species}_{10} \xrightarrow{\text{species}_5, \text{species}_5, \text{species}_9, \text{species}_{10}, \text{species}_{11}} \text{species}_{11}$	
3	reaction_3	MYD883) TAK/TAB Binds to TRAF6	$\text{species}_{11} + \text{species}_{12} \xrightarrow{\text{species}_{11}, \text{species}_{12}, \text{species}_{13}} \text{species}_{13}$	
4	reaction_4	MYD884) IKK Phosphorylation by TAK1	$\text{species}_{14} \xrightarrow{\text{species}_{13}, \text{species}_{13}, \text{species}_{14}} \text{species}_{15}$	
5	reaction_5	MYD885) IKK[P] Dephosphorylation	$\text{species}_{15} \xrightarrow{\text{species}_{15}} \text{species}_{14}$	
6	reaction_6	TRIF01) Receptor Complex Formation	$\begin{array}{c} \text{species}_4 + \text{species}_3 + \text{species}_1 + \text{species}_8 + \\ \text{species}_{18} + \text{species}_{17} + \text{species}_{16} + \\ \text{species}_{53} \end{array} \xrightarrow{\text{species}_4, \text{species}_3, \text{species}_1, \text{species}_8, \text{species}_{18}, \text{species}_{17}, \text{species}_{16}, \text{species}_{53}} \text{species}_{53}$	
7	reaction_7	TRIF02) IRF3 Phosphorylation	$\text{species}_{19} \xrightarrow{\text{species}_{52}, \text{species}_{52}, \text{species}_{19}} \text{species}_{20}$	
8	reaction_8	TRIF03) IRF3 Dephosphorylation	$\text{species}_{20} \xrightarrow{\text{species}_{20}} \text{species}_{19}$	
9	reaction_9	TRIF04) IRF3 Nuclear Import/Export	$\text{species}_{20} \xrightarrow{\text{species}_{20}, \text{species}_{21}} \text{species}_{21}$	
10	reaction_10	TRIF05) Inducible TNFa Synthesis	$2 \text{ species}_{21} \xrightarrow{\text{species}_{21}} \text{species}_{24} + 2 \text{ species}_{21}$	
11	reaction_11	TRIF06) Constitutive TNFa Synthesis	$\text{species}_{22} \xrightarrow{\text{species}_{22}} \text{species}_{24}$	
12	reaction_12	TRIF09) TNFa Degradation	$\text{species}_{24} \xrightarrow{\text{species}_{24}} \text{species}_{23}$	



Nº	Id	Name	Reaction Equation	SBO
13	reaction_13	TRIF10) TNFa Receptor Complex Formation	$\text{species\_24} + \text{species\_25} + \text{species\_27} + \text{species\_26} + \text{species\_16} \xrightarrow{\text{species\_24, species\_25, species\_27, species\_26, species\_16, species\_28}} \text{species\_15}$	spec
14	reaction_14	TRIF11) IKK Phosphorylation by RIP1	$\text{species\_14} \xrightarrow{\text{species\_28, species\_28, species\_14}} \text{species\_15}$	
15	reaction_15	NFkB01) IkBa:NfKB Binding	$\text{species\_29} + \text{species\_31} \xrightarrow{\text{species\_29, species\_31, species\_30}} \text{species\_30}$	
16	reaction_16	NFkB02) IKK:IkBa:NfKB Binding (1)	$\text{species\_15} + \text{species\_30} \xrightarrow{\text{species\_15, species\_30, species\_32}} \text{species\_32}$	
17	reaction_17	NFkB03) IkBb:NfKB Binding	$\text{species\_33} + \text{species\_31} \xrightarrow{\text{species\_33, species\_31, species\_34}} \text{species\_34}$	
18	reaction_18	NFkB04) IKK:IkBb:NfKB Binding (1)	$\text{species\_15} + \text{species\_34} \xrightarrow{\text{species\_15, species\_34, species\_35}} \text{species\_35}$	
19	reaction_19	NFkB05) IkBe:NfKB Binding	$\text{species\_36} + \text{species\_31} \xrightarrow{\text{species\_36, species\_31, species\_37}} \text{species\_37}$	
20	reaction_20	NFkB06) IKK:IkBe:NfKB Binding (1)	$\text{species\_15} + \text{species\_37} \xrightarrow{\text{species\_15, species\_37, species\_38}} \text{species\_38}$	
21	reaction_21	NFkB07) IKK:IkBa:NfKB Catalysis	$\text{species\_32} \xrightarrow{\text{species\_32}} \text{species\_15} + \text{species\_31}$	
22	reaction_22	NFkB08) IKK:IkBb:NfKB Catalysis	$\text{species\_35} \xrightarrow{\text{species\_35}} \text{species\_15} + \text{species\_31}$	
23	reaction_23	NFkB09) IKK:IkBe:NfKB Catalysis	$\text{species\_38} \xrightarrow{\text{species\_38}} \text{species\_15} + \text{species\_31}$	
24	reaction_24	NFkB10) IkBa:NfKB Constitutive Degradation	$\text{species\_30} \xrightarrow{\text{species\_30}} \text{species\_31}$	
25	reaction_25	NFkB11) IkBb:NfKB Constitutive Degradation	$\text{species\_34} \xrightarrow{\text{species\_34}} \text{species\_31}$	
26	reaction_26	NFkB12) IkBe:NfKB Constitutive Degradation	$\text{species\_37} \xrightarrow{\text{species\_37}} \text{species\_31}$	
27	reaction_27	NFkB13) NfKB Nuclear Import/Export	$\text{species\_31} \xrightarrow{\text{species\_31, species\_39}} \text{species\_39}$	
28	reaction_28	NFkB14) Nuclear IkBa:NfKB Binding	$\text{species\_40} + \text{species\_39} \xrightarrow{\text{species\_40, species\_39, species\_41}} \text{species\_41}$	

Nº	Id	Name	Reaction Equation	SBO
29	reaction_29	NFkB15) Nuclear IκBβ:NFκB Binding	$\text{species\_42} + \text{species\_39} \xrightleftharpoons{\text{species\_42, species\_39, species\_43}} \text{species\_43}$	
30	reaction_30	NFkB16) Nuclear IκBε:NFκB Binding	$\text{species\_44} + \text{species\_39} \xrightleftharpoons{\text{species\_44, species\_39, species\_45}} \text{species\_45}$	
31	reaction_31	NFkB17) Constitutive IκBα mRNA Synthesis	$\text{species\_22} \xrightarrow{\text{species\_22}} \text{species\_46}$	
32	reaction_32	NFkB18) Inducible IκBα mRNA Synthesis	$2 \text{ species\_39} \xrightarrow{\text{species\_39}} \text{species\_46} + 2 \text{ species\_39}$	
33	reaction_33	NFkB19) IκBα mRNA degradation	$\text{species\_46} \xrightarrow{\text{species\_46}} \text{species\_23}$	
34	reaction_34	NFkB20) Constitutive IκBβ mRNA Synthesis	$\text{species\_22} \xrightarrow{\text{species\_22}} \text{species\_47}$	
35	reaction_35	NFkB21) IκBβ mRNA degradation	$\text{species\_47} \xrightarrow{\text{species\_47}} \text{species\_23}$	
36	reaction_36	NFkB22) Constitutive IκBε mRNA Synthesis	$\text{species\_22} \xrightarrow{\text{species\_22}} \text{species\_48}$	
37	reaction_37	NFkB23) IκBε mRNA degradation	$\text{species\_48} \xrightarrow{\text{species\_48}} \text{species\_23}$	
38	reaction_38	NFkB24) IKK:IκBα Binding	$\text{species\_15} + \text{species\_29} \xrightleftharpoons{\text{species\_15, species\_29, species\_49}} \text{species\_49}$	
39	reaction_39	NFkB25) IκBα Translation	$\text{species\_46} \xrightarrow{\text{species\_46}} \text{species\_29} + \text{species\_46}$	
40	reaction_40	NFkB26) IκBα Degradation	$\text{species\_29} \xrightarrow{\text{species\_29}} \text{species\_23}$	
41	reaction_41	NFkB27) IκBα Nuclear Import/Export	$\text{species\_29} \xrightleftharpoons{\text{species\_29, species\_40}} \text{species\_40}$	
42	reaction_42	NFkB28) IKK:IκBβ Binding	$\text{species\_15} + \text{species\_33} \xrightleftharpoons{\text{species\_15, species\_33, species\_50}} \text{species\_50}$	
43	reaction_43	NFkB29) IκBβ Translation	$\text{species\_47} \xrightarrow{\text{species\_47}} \text{species\_33} + \text{species\_47}$	
44	reaction_44	NFkB30) IκBβ Degradation	$\text{species\_33} \xrightarrow{\text{species\_33}} \text{species\_23}$	
45	reaction_45	NFkB31) IκBβ Nuclear Import/Export	$\text{species\_33} \xrightleftharpoons{\text{species\_33, species\_42}} \text{species\_42}$	
46	reaction_46	NFkB32) IKK:IκBε Binding	$\text{species\_15} + \text{species\_36} \xrightleftharpoons{\text{species\_15, species\_36, species\_51}} \text{species\_51}$	
47	reaction_47	NFkB33) IκBε Translation	$\text{species\_48} \xrightarrow{\text{species\_48}} \text{species\_36} + \text{species\_48}$	

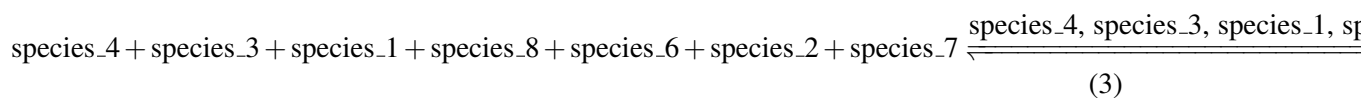
Nº	Id	Name	Reaction Equation	SBO
48	reaction_48	NFkB34) IkBe Degradation	$\text{species\_36} \xrightarrow{\text{species\_36}} \text{species\_23}$	
49	reaction_49	NFkB35) IkBe Nuclear Import/Export	$\text{species\_36} \xrightleftharpoons{\text{species\_36, species\_44}} \text{species\_44}$	
50	reaction_50	NFkB36) IKK:IkB $\alpha$ :NFkB Binding (2)	$\text{species\_49} + \text{species\_31} \xrightleftharpoons{\text{species\_49, species\_31, species\_32}} \text{species\_32}$	
51	reaction_51	NFkB37) IkB $\alpha$ :NFkB Nuclear Export	$\text{species\_41} \xrightarrow{\text{species\_41}} \text{species\_30}$	
52	reaction_52	NFkB38) IKK:IkB $\beta$ :NFkB Binding (2)	$\text{species\_50} + \text{species\_31} \xrightleftharpoons{\text{species\_50, species\_31, species\_35}} \text{species\_35}$	
53	reaction_53	NFkB39) IkB $\beta$ :NFkB Nuclear Export	$\text{species\_43} \xrightarrow{\text{species\_43}} \text{species\_34}$	
54	reaction_54	NFkB40) IKK:IkB $\epsilon$ :NFkB Binding (2)	$\text{species\_51} + \text{species\_31} \xrightleftharpoons{\text{species\_51, species\_31, species\_38}} \text{species\_38}$	
55	reaction_55	NFkB41) IkB $\epsilon$ :NFkB Nuclear Export	$\text{species\_45} \xrightarrow{\text{species\_45}} \text{species\_37}$	
56	reaction_56	NFkB42) IKK:IkB $\alpha$ Catalysis	$\text{species\_49} \xrightarrow{\text{species\_49}} \text{species\_15}$	
57	reaction_57	NFkB43) IKK:IkB $\beta$ Catalysis	$\text{species\_50} \xrightarrow{\text{species\_50}} \text{species\_15}$	
58	reaction_58	NFkB44) IKK:IkB $\epsilon$ Catalysis	$\text{species\_51} \xrightarrow{\text{species\_51}} \text{species\_15}$	
59	reaction_59	TRIF06a)Inducible TNFa Synthesis by NFkB	$2 \text{ species\_39} \xrightarrow{\text{species\_39}} \text{species\_24} + 2 \text{ species\_39}$	

## 6.1 Reaction `reaction_1`

This is a reversible reaction of seven reactants forming one product influenced by eight modifiers.

**Name** MYD881) Receptor Complex Formation

### Reaction equation



### Reactants

Table 5: Properties of each reactant.

Id	Name	SBO
species_4	LPS	
species_3	LBP	
species_1	CD14	
species_8	TLR4	
species_6	MyD88	
species_2	IRAK4	
species_7	TIRAP	

### Modifiers

Table 6: Properties of each modifier.

Id	Name	SBO
species_4	LPS	
species_3	LBP	
species_1	CD14	
species_8	TLR4	
species_6	MyD88	
species_2	IRAK4	
species_7	TIRAP	
species_5	LPS:LBP:CD14:TLR4:TIRAP:MyD88:IRAK4	

### Product

Table 7: Properties of each product.

Id	Name	SBO
species_5	LPS:LBP:CD14:TLR4:TIRAP:MyD88:IRAK4	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_1 = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_4] \cdot [\text{species}_3] \cdot [\text{species}_1] \cdot [\text{species}_8] \cdot [\text{species}_6] \cdot [\text{species}_2] \cdot [\text{species}_7] - k_2 \cdot [\text{species}_5]) \quad (4)$$

Table 8: Properties of each parameter.

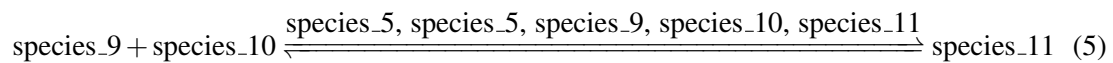
Id	Name	SBO	Value	Unit	Constant
k1	k1		$10^{-4}$		<input checked="" type="checkbox"/>
k2	k2		$10^{-4}$		<input checked="" type="checkbox"/>

## 6.2 Reaction [reaction\\_2](#)

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

**Name** MYD882) IRAK1 and TRAF6 Phosphorylation

### Reaction equation



### Reactants

Table 9: Properties of each reactant.

Id	Name	SBO
species_9	IRAK1	
species_10	TRAF6	

### Modifiers

Table 10: Properties of each modifier.

Id	Name	SBO
species_5	LPS:LBP:CD14:TLR4:TIRAP:MyD88:IRAK4	
species_5	LPS:LBP:CD14:TLR4:TIRAP:MyD88:IRAK4	
species_9	IRAK1	
species_10	TRAF6	
species_11	TRAF6:IRAK1[P]	

## Product

Table 11: Properties of each product.

Id	Name	SBO
species_11	TRAF6:IRAK1[P]	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_2 = \text{vol}(\text{compartment}_1) \cdot \text{function}_1(k_1, [\text{species}_5], [\text{species}_9], [\text{species}_{10}], k_2, [\text{species}_{11}]) \quad (6)$$

$$\begin{aligned} \text{function}_1(k_1, \text{Enzyme}, \text{Substrate1}, \text{Substrate2}, k_2, \text{Product}) \\ = k_1 \cdot \text{Enzyme} \cdot \text{Substrate1} \cdot \text{Substrate2} - k_2 \cdot \text{Product} \end{aligned} \quad (7)$$

$$\begin{aligned} \text{function}_1(k_1, \text{Enzyme}, \text{Substrate1}, \text{Substrate2}, k_2, \text{Product}) \\ = k_1 \cdot \text{Enzyme} \cdot \text{Substrate1} \cdot \text{Substrate2} - k_2 \cdot \text{Product} \end{aligned} \quad (8)$$

Table 12: Properties of each parameter.

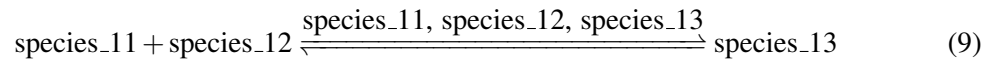
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.001		<input checked="" type="checkbox"/>
k2	k2		0.001		<input checked="" type="checkbox"/>

## 6.3 Reaction `reaction_3`

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

**Name** MYD883) TAK/TAB Binds to TRAF6

## Reaction equation



## Reactants

Table 13: Properties of each reactant.

Id	Name	SBO
species_11	TRAF6:IRAK1[P]	
species_12	TAK1:TAB1:TAB2	

## Modifiers

Table 14: Properties of each modifier.

Id	Name	SBO
species_11	TRAF6:IRAK1[P]	
species_12	TAK1:TAB1:TAB2	
species_13	TAK1:TAB1:TAB2:TRAF6	

## Product

Table 15: Properties of each product.

Id	Name	SBO
species_13	TAK1:TAB1:TAB2:TRAF6	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_3 = \text{vol}(\text{compartment\_1}) \cdot (k_1 \cdot [\text{species\_11}] \cdot [\text{species\_12}] - k_2 \cdot [\text{species\_13}]) \quad (10)$$

Table 16: Properties of each parameter.

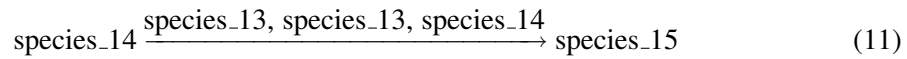
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.003		<input checked="" type="checkbox"/>
k2	k2		0.010		<input checked="" type="checkbox"/>

## 6.4 Reaction `reaction_4`

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

**Name** MYD884) IKK Phosphorylation by TAK1

### Reaction equation



### Reactant

Table 17: Properties of each reactant.

Id	Name	SBO
species_14	IKK	

### Modifiers

Table 18: Properties of each modifier.

Id	Name	SBO
species_13	TAK1:TAB1:TAB2:TRAF6	
species_13	TAK1:TAB1:TAB2:TRAF6	
species_14	IKK	

### Product

Table 19: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_4 = \text{vol}(\text{compartment\_1}) \cdot \text{function\_2}(k, [\text{species\_13}], [\text{species\_14}], \text{Km}) \quad (12)$$

$$\text{function\_2}(k, \text{Enzyme}, \text{Substrate}, \text{Km}) = \frac{k \cdot \text{Enzyme} \cdot \text{Substrate}}{\text{Km} + \text{Substrate}} \quad (13)$$



$$\text{function\_2}(k, \text{Enzyme}, \text{Substrate}, K_m) = \frac{k \cdot \text{Enzyme} \cdot \text{Substrate}}{K_m + \text{Substrate}} \quad (14)$$

Table 20: Properties of each parameter.

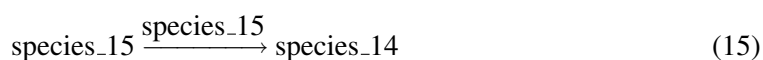
Id	Name	SBO	Value	Unit	Constant
k	k		0.1		<input checked="" type="checkbox"/>
Km	Km		0.1		<input checked="" type="checkbox"/>

## 6.5 Reaction `reaction_5`

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

**Name** MYD885) IKK[P] Dephosphorylation

### Reaction equation



### Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
species_15	IKK[P]	

### Modifier

Table 22: Properties of each modifier.

Id	Name	SBO
species_15	IKK[P]	

### Product

Table 23: Properties of each product.

Id	Name	SBO
species_14	IKK	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_5 = \text{vol}(\text{compartment}_1) \cdot k1 \cdot [\text{species}_{15}] \quad (16)$$

Table 24: Properties of each parameter.

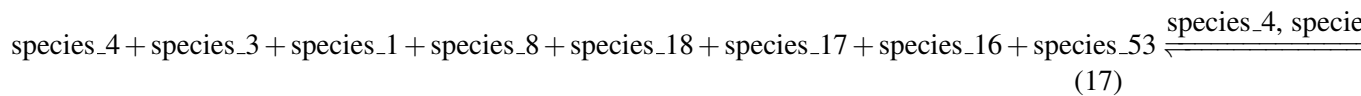
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.1		<input checked="" type="checkbox"/>

## 6.6 Reaction `reaction_6`

This is a reversible reaction of eight reactants forming one product influenced by nine modifiers.

**Name** TRIF01) Receptor Complex Formation

### Reaction equation



### Reactants

Table 25: Properties of each reactant.

Id	Name	SBO
species_4	LPS	
species_3	LBP	
species_1	CD14	
species_8	TLR4	
species_18	TRIF	
species_17	TRAM	
species_16	RIP1	
species_53	TBK1/IKKe	

### Modifiers

Table 26: Properties of each modifier.

Id	Name	SBO
species_4	LPS	
species_3	LBP	
species_1	CD14	
species_8	TLR4	
species_18	TRIF	
species_17	TRAM	
species_16	RIP1	
species_53	TBK1/IKKe	
species_52	LPS:LBP:CD14:TLR4:RIP1:TRAM:TRIF:TBK/IKKe	

## Product

Table 27: Properties of each product.

Id	Name	SBO
species_52	LPS:LBP:CD14:TLR4:RIP1:TRAM:TRIF:TBK/IKKe	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_6 = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_4] \cdot [\text{species}_3] \cdot [\text{species}_1] \cdot [\text{species}_8] \cdot [\text{species}_18] \cdot [\text{species}_17] \cdot [\text{species}_16] \cdot [\text{species}_53] - k_2 \cdot [\text{species}_52]) \quad (18)$$

Table 28: Properties of each parameter.

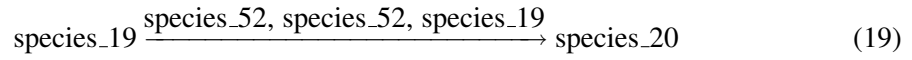
Id	Name	SBO	Value	Unit	Constant
k1	k1		$10^{-4}$		<input checked="" type="checkbox"/>
k2	k2		$10^{-4}$		<input checked="" type="checkbox"/>

## 6.7 Reaction reaction\_7

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

**Name** TRIF02) IRF3 Phosphorylation

## Reaction equation



## Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
species_19	IRF3	

## Modifiers

Table 30: Properties of each modifier.

Id	Name	SBO
species_52	LPS:LBP:CD14:TLR4:RIP1:TRAM:TRIF:TBK/IKKe	
species_52	LPS:LBP:CD14:TLR4:RIP1:TRAM:TRIF:TBK/IKKe	
species_19	IRF3	

## Product

Table 31: Properties of each product.

Id	Name	SBO
species_20	IRF3[P]	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_7 = \text{vol}(\text{compartment\_1}) \cdot \text{function\_2}(k, [\text{species\_52}], [\text{species\_19}], \text{Km}) \quad (20)$$

$$\text{function\_2}(k, \text{Enzyme}, \text{Substrate}, \text{Km}) = \frac{k \cdot \text{Enzyme} \cdot \text{Substrate}}{\text{Km} + \text{Substrate}} \quad (21)$$

$$\text{function\_2}(k, \text{Enzyme}, \text{Substrate}, \text{Km}) = \frac{k \cdot \text{Enzyme} \cdot \text{Substrate}}{\text{Km} + \text{Substrate}} \quad (22)$$

Table 32: Properties of each parameter.

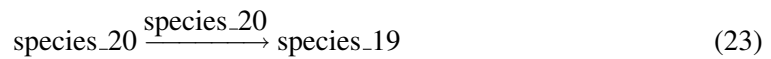
Id	Name	SBO	Value	Unit	Constant
k	k		0.1		<input checked="" type="checkbox"/>
Km	Km		0.1		<input checked="" type="checkbox"/>

## 6.8 Reaction `reaction_8`

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

**Name** TRIF03) IRF3 Dephosphorylation

### Reaction equation



### Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
species_20	IRF3[P]	

### Modifier

Table 34: Properties of each modifier.

Id	Name	SBO
species_20	IRF3[P]	

### Product

Table 35: Properties of each product.

Id	Name	SBO
species_19	IRF3	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_8 = \text{vol}(\text{compartment}_1) \cdot k1 \cdot [\text{species}_20] \quad (24)$$

Table 36: Properties of each parameter.

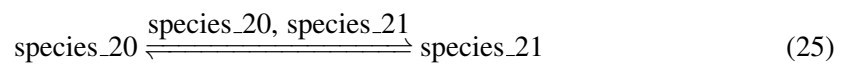
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.1		<input checked="" type="checkbox"/>

## 6.9 Reaction `reaction_9`

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

**Name** TRIF04) IRF3 Nuclear Import/Export

### Reaction equation



### Reactant

Table 37: Properties of each reactant.

Id	Name	SBO
species_20	IRF3[P]	

### Modifiers

Table 38: Properties of each modifier.

Id	Name	SBO
species_20	IRF3[P]	
species_21	IRF3[P](nuc)	

### Product

Table 39: Properties of each product.

Id	Name	SBO
species_21	IRF3[P](nuc)	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_9 = \text{vol}(\text{compartment\_1}) \cdot (k1 \cdot [\text{species\_20}] - k2 \cdot [\text{species\_21}]) \quad (26)$$

Table 40: Properties of each parameter.

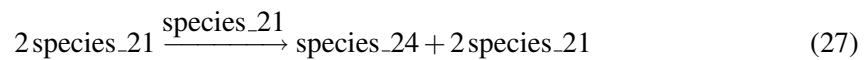
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.1		<input checked="" type="checkbox"/>
k2	k2		0.1		<input checked="" type="checkbox"/>

## 6.10 Reaction `reaction_10`

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

**Name** TRIF05) Inducible TNFa Synthesis

### Reaction equation



### Reactant

Table 41: Properties of each reactant.

Id	Name	SBO
<code>species_21</code>	IRF3[P](nuc)	

### Modifier

Table 42: Properties of each modifier.

Id	Name	SBO
<code>species_21</code>	IRF3[P](nuc)	

### Products

Table 43: Properties of each product.

Id	Name	SBO
species_24	TNFa	
species_21	IRF3[P](nuc)	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{10} = \text{vol}(\text{compartment}_1) \cdot k1 \cdot [\text{species}_21]^2 \quad (28)$$

Table 44: Properties of each parameter.

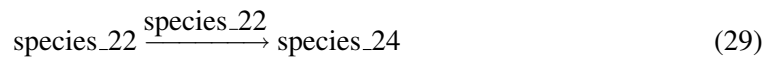
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.02		<input checked="" type="checkbox"/>

### 6.11 Reaction [reaction\\_11](#)

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

**Name** TRIF06) Constitutive TNFa Synthesis

### Reaction equation



### Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
species_22	source	

### Modifier

Table 46: Properties of each modifier.

Id	Name	SBO
species_22	source	



## Product

Table 47: Properties of each product.

Id	Name	SBO
species_24	TNFa	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{11} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_22}] \quad (30)$$

Table 48: Properties of each parameter.

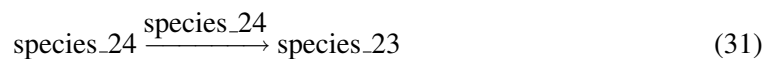
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.001		<input checked="" type="checkbox"/>

## 6.12 Reaction [reaction\\_12](#)

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

**Name** TRIF09) TNFa Degradation

## Reaction equation



## Reactant

Table 49: Properties of each reactant.

Id	Name	SBO
species_24	TNFa	

## Modifier

Table 50: Properties of each modifier.

Id	Name	SBO
species_24	TNFa	

Id	Name	SBO
----	------	-----

## Product

Table 51: Properties of each product.

Id	Name	SBO
species_23	sink	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{12} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_24}] \quad (32)$$

Table 52: Properties of each parameter.

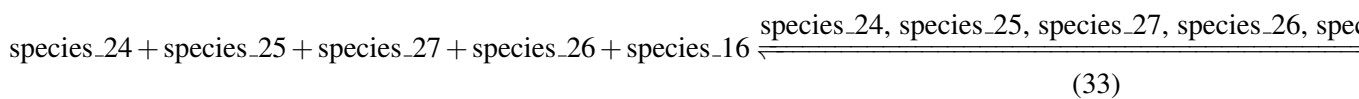
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.1		<input checked="" type="checkbox"/>

### 6.13 Reaction [reaction\\_13](#)

This is a reversible reaction of five reactants forming one product influenced by six modifiers.

**Name** TRIF10) TNFa Receptor Complex Formation

#### Reaction equation



## Reactants

Table 53: Properties of each reactant.

Id	Name	SBO
species_24	TNFa	
species_25	TNFR1	
species_27	TRAF2	
species_26	TRADD	

Id	Name	SBO
species_16	RIP1	

## Modifiers

Table 54: Properties of each modifier.

Id	Name	SBO
species_24	TNFa	
species_25	TNFR1	
species_27	TRAF2	
species_26	TRADD	
species_16	RIP1	
species_28	TNFa:TNFR1:TRAF2:TRADD:RIP1	

## Product

Table 55: Properties of each product.

Id	Name	SBO
species_28	TNFa:TNFR1:TRAF2:TRADD:RIP1	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{13} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_24] \cdot [\text{species}_25] \cdot [\text{species}_27] \cdot [\text{species}_26] \cdot [\text{species}_16] - k_2 \cdot [\text{species}_28]) \quad (34)$$

Table 56: Properties of each parameter.

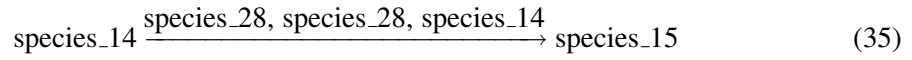
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.1		<input checked="" type="checkbox"/>
k2	k2		0.1		<input checked="" type="checkbox"/>

### 6.14 Reaction [reaction\\_14](#)

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

**Name** TRIF11) IKK Phosphorylation by RIP1

## Reaction equation



## Reactant

Table 57: Properties of each reactant.

Id	Name	SBO
species_14	IKK	

## Modifiers

Table 58: Properties of each modifier.

Id	Name	SBO
species_28	TNFa:TNFR1:TRAF2:TRADD:RIP1	
species_28	TNFa:TNFR1:TRAF2:TRADD:RIP1	
species_14	IKK	

## Product

Table 59: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{14} = \text{vol}(\text{compartment\_1}) \cdot \text{function\_2}(k, [\text{species\_28}], [\text{species\_14}], K_m) \quad (36)$$

$$\text{function\_2}(k, \text{Enzyme}, \text{Substrate}, K_m) = \frac{k \cdot \text{Enzyme} \cdot \text{Substrate}}{K_m + \text{Substrate}} \quad (37)$$

$$\text{function\_2}(k, \text{Enzyme}, \text{Substrate}, K_m) = \frac{k \cdot \text{Enzyme} \cdot \text{Substrate}}{K_m + \text{Substrate}} \quad (38)$$

Table 60: Properties of each parameter.

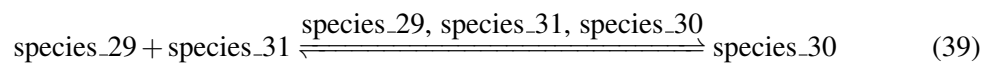
Id	Name	SBO	Value	Unit	Constant
k	k		0.1		<input checked="" type="checkbox"/>
Km	Km		0.1		<input checked="" type="checkbox"/>

### 6.15 Reaction [reaction\\_15](#)

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

**Name** NFkB01) IkBa:NFkB Binding

#### Reaction equation



#### Reactants

Table 61: Properties of each reactant.

Id	Name	SBO
species_29	IkBa	
species_31	NFkB	

#### Modifiers

Table 62: Properties of each modifier.

Id	Name	SBO
species_29	IkBa	
species_31	NFkB	
species_30	IkBa:NFkB	

#### Product

Table 63: Properties of each product.

Id	Name	SBO
species_30	IkBa:NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{15} = \text{vol}(\text{compartment\_1}) \cdot (k1 \cdot [\text{species\_29}] \cdot [\text{species\_31}] - k2 \cdot [\text{species\_30}]) \quad (40)$$

Table 64: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		<input checked="" type="checkbox"/>
k2	k2		$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

## 6.16 Reaction `reaction_16`

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

**Name** NFkB02) IKK:IkBα:NFκB Binding (1)

### Reaction equation



### Reactants

Table 65: Properties of each reactant.

Id	Name	SBO
species_15	IKK[P]	
species_30	IκBα:NFκB	

### Modifiers

Table 66: Properties of each modifier.

Id	Name	SBO
species_15	IKK[P]	
species_30	IκBα:NFκB	
species_32	IKK[P]:IκBα:NFκB	

### Product

Table 67: Properties of each product.

Id	Name	SBO
species_32	IKK[P]:IkBa:NfKb	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{16} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_{15}] \cdot [\text{species}_{30}] - k_2 \cdot [\text{species}_{32}]) \quad (42)$$

Table 68: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.185		<input checked="" type="checkbox"/>
k2	k2		0.013		<input checked="" type="checkbox"/>

## 6.17 Reaction [reaction\\_17](#)

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

**Name** NFkB03) IkBb:NfKb Binding

## Reaction equation



## Reactants

Table 69: Properties of each reactant.

Id	Name	SBO
species_33	IkBb	
species_31	NFkB	

## Modifiers

Table 70: Properties of each modifier.

Id	Name	SBO
species_33	IkBb	

Id	Name	SBO
species_31	NFkB	
species_34	IkBb:NFkB	

## Product

Table 71: Properties of each product.

Id	Name	SBO
species_34	IkBb:NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{17} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_33] \cdot [\text{species}_31] - k_2 \cdot [\text{species}_34]) \quad (44)$$

Table 72: Properties of each parameter.

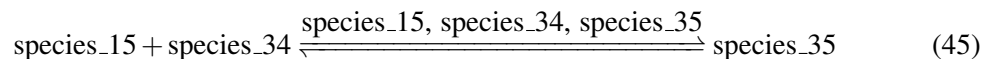
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		✓
k2	k2		$5 \cdot 10^{-4}$		✓

## 6.18 Reaction [reaction\\_18](#)

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

**Name** NFkB04) IKK:IkBb:NFkB Binding (1)

### Reaction equation



## Reactants

Table 73: Properties of each reactant.

Id	Name	SBO
species_15	IKK[P]	
species_34	IkBb:NFkB	



## Modifiers

Table 74: Properties of each modifier.

Id	Name	SBO
species_15	IKK[P]	
species_34	IkBb:Nfkb	
species_35	IKK[P]:IkBb:Nfkb	

## Product

Table 75: Properties of each product.

Id	Name	SBO
species_35	IKK[P]:IkBb:Nfkb	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{18} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_15] \cdot [\text{species}_34] - k_2 \cdot [\text{species}_35]) \quad (46)$$

Table 76: Properties of each parameter.

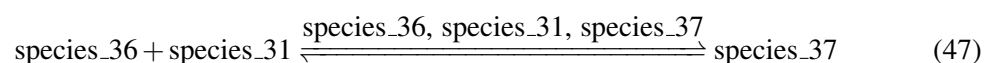
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.048		✓
k2	k2		0.002		✓

### 6.19 Reaction [reaction\\_19](#)

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

**Name** NFkB05) IkBb:Nfkb Binding

#### Reaction equation



#### Reactants

Table 77: Properties of each reactant.

Id	Name	SBO
species_36	IkBe	
species_31	NFkB	

## Modifiers

Table 78: Properties of each modifier.

Id	Name	SBO
species_36	IkBe	
species_31	NFkB	
species_37	IkBe:NFkB	

## Product

Table 79: Properties of each product.

Id	Name	SBO
species_37	IkBe:NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{19} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_36] \cdot [\text{species}_31] - k_2 \cdot [\text{species}_37]) \quad (48)$$

Table 80: Properties of each parameter.

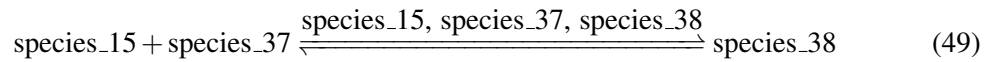
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		<input checked="" type="checkbox"/>
k2	k2		$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.20 Reaction `reaction_20`

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

**Name** NFkB06) IKK:IkBe:NFkB Binding (1)

## Reaction equation



## Reactants

Table 81: Properties of each reactant.

Id	Name	SBO
species_15	IKK[P]	
species_37	IkBe:Nfkb	

## Modifiers

Table 82: Properties of each modifier.

Id	Name	SBO
species_15	IKK[P]	
species_37	IkBe:Nfkb	
species_38	IKK[P]:IkBe:Nfkb	

## Product

Table 83: Properties of each product.

Id	Name	SBO
species_38	IKK[P]:IkBe:Nfkb	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{20} = \text{vol}(\text{compartment\_1}) \cdot (k_1 \cdot [\text{species\_15}] \cdot [\text{species\_37}] - k_2 \cdot [\text{species\_38}]) \quad (50)$$

Table 84: Properties of each parameter.

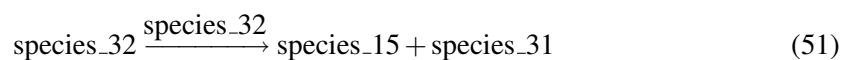
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.070		<input checked="" type="checkbox"/>
k2	k2		0.002		<input checked="" type="checkbox"/>

## 6.21 Reaction `reaction_21`

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

**Name** NFkB07) IKK:IkBα:NFκB Catalysis

### Reaction equation



### Reactant

Table 85: Properties of each reactant.

Id	Name	SBO
species_32	IKK[P]:IkBa:NFkB	

### Modifier

Table 86: Properties of each modifier.

Id	Name	SBO
species_32	IKK[P]:IkBa:NFkB	

### Products

Table 87: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	
species_31	NFkB	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{21} = \text{vol}(\text{compartment\_1}) \cdot k_1 \cdot [\text{species\_32}] \quad (52)$$

Table 88: Properties of each parameter.

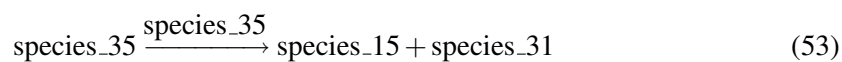
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.020		<input checked="" type="checkbox"/>

## 6.22 Reaction [reaction\\_22](#)

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

**Name** NFkB08) IKK:IkBb:NFkB Catalysis

### Reaction equation



### Reactant

Table 89: Properties of each reactant.

Id	Name	SBO
species_35	IKK[P]:IkBb:NFkB	

### Modifier

Table 90: Properties of each modifier.

Id	Name	SBO
species_35	IKK[P]:IkBb:NFkB	

### Products

Table 91: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	
species_31	NFkB	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{22} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_35}] \quad (54)$$

Table 92: Properties of each parameter.

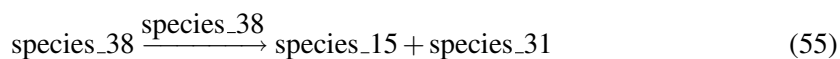
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.008		<input checked="" type="checkbox"/>

### 6.23 Reaction [reaction\\_23](#)

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

**Name** NFkB09) IKK:IkBε:NFkB Catalysis

#### Reaction equation



#### Reactant

Table 93: Properties of each reactant.

Id	Name	SBO
species_38	IKK[P]:IkBe:NFkB	

#### Modifier

Table 94: Properties of each modifier.

Id	Name	SBO
species_38	IKK[P]:IkBe:NFkB	

#### Products

Table 95: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	
species_31	NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{23} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_38}] \quad (56)$$

Table 96: Properties of each parameter.

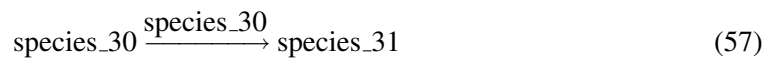
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.011		<input checked="" type="checkbox"/>

## 6.24 Reaction [reaction\\_24](#)

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

**Name** NFkB10) IkBa:Nfkb Constitutive Degradation

### Reaction equation



### Reactant

Table 97: Properties of each reactant.

Id	Name	SBO
species_30	IkBa:Nfkb	

### Modifier

Table 98: Properties of each modifier.

Id	Name	SBO
species_30	IkBa:Nfkb	

### Product

Table 99: Properties of each product.

Id	Name	SBO
species_31	Nfkb	

Id	Name	SBO
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## Kinetic Law

**Derived unit** contains undeclared units

$$v_{24} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_30}] \quad (58)$$

Table 100: Properties of each parameter.

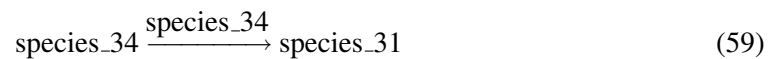
Id	Name	SBO	Value	Unit	Constant
k1	k1		$2.25 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

## 6.25 Reaction [reaction\\_25](#)

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

**Name** NFkB11) IkBb:NFkB Constitutive Degradation

## Reaction equation



## Reactant

Table 101: Properties of each reactant.

Id	Name	SBO
species_34	IkBb:NFkB	

## Modifier

Table 102: Properties of each modifier.

Id	Name	SBO
species_34	IkBb:NFkB	

## Product



Table 103: Properties of each product.

Id	Name	SBO
species_31	NFkB	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{25} = \text{vol}(\text{compartment}_1) \cdot k1 \cdot [\text{species}_{34}] \quad (60)$$

Table 104: Properties of each parameter.

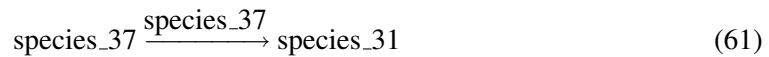
Id	Name	SBO	Value	Unit	Constant
k1	k1		$2.25 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

### 6.26 Reaction [reaction\\_26](#)

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

**Name** NFkB12) IkBe:NFkB Constitutive Degradation

### Reaction equation



### Reactant

Table 105: Properties of each reactant.

Id	Name	SBO
species_37	IkBe:NFkB	

### Modifier

Table 106: Properties of each modifier.

Id	Name	SBO
species_37	IkBe:NFkB	

## Product

Table 107: Properties of each product.

Id	Name	SBO
species_31	NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{26} = \text{vol}(\text{compartment}_1) \cdot k1 \cdot [\text{species}_37] \quad (62)$$

Table 108: Properties of each parameter.

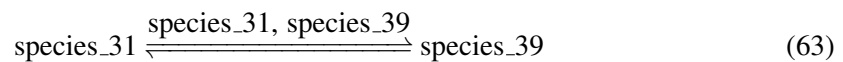
Id	Name	SBO	Value	Unit	Constant
k1	k1		$2.25 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

## 6.27 Reaction [reaction\\_27](#)

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

**Name** NFkB13) NFkB Nuclear Import/Export

## Reaction equation



## Reactant

Table 109: Properties of each reactant.

Id	Name	SBO
species_31	NFkB	

## Modifiers

Table 110: Properties of each modifier.

Id	Name	SBO
species_31	NFkB	
species_39	NFkB(nuc)	

## Product

Table 111: Properties of each product.

Id	Name	SBO
species_39	NFkB(nuc)	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{27} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_31] - k_2 \cdot [\text{species}_39]) \quad (64)$$

Table 112: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.090		<input checked="" type="checkbox"/>
k2	k2		$8 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

## 6.28 Reaction [reaction\\_28](#)

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

**Name** NFkB14) Nuclear IkBa:NFkB Binding

### Reaction equation



## Reactants

Table 113: Properties of each reactant.

Id	Name	SBO
species_40	IkBa(nuc)	

Id	Name	SBO
species_39	NFkB(nuc)	

## Modifiers

Table 114: Properties of each modifier.

Id	Name	SBO
species_40	IkBa(nuc)	
species_39	NFkB(nuc)	
species_41	IkBa:NFkB(nuc)	

## Product

Table 115: Properties of each product.

Id	Name	SBO
species_41	IkBa:NFkB(nuc)	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{28} = \text{vol}(\text{compartment}_1) \cdot (k1 \cdot [\text{species}_40] \cdot [\text{species}_39] - k2 \cdot [\text{species}_41]) \quad (66)$$

Table 116: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		✓
k2	k2		$5 \cdot 10^{-4}$		✓

### 6.29 Reaction [reaction\\_29](#)

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

**Name** NFkB15) Nuclear IkBb:NFkB Binding

#### Reaction equation



## Reactants

Table 117: Properties of each reactant.

Id	Name	SBO
species_42	IkBb(nuc)	
species_39	NFkB(nuc)	

## Modifiers

Table 118: Properties of each modifier.

Id	Name	SBO
species_42	IkBb(nuc)	
species_39	NFkB(nuc)	
species_43	IkBb:NFkB(nuc)	

## Product

Table 119: Properties of each product.

Id	Name	SBO
species_43	IkBb:NFkB(nuc)	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{29} = \text{vol}(\text{compartment}_1) \cdot (k1 \cdot [\text{species}_42] \cdot [\text{species}_39] - k2 \cdot [\text{species}_43]) \quad (68)$$

Table 120: Properties of each parameter.

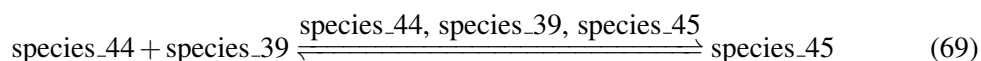
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		<input checked="" type="checkbox"/>
k2	k2		$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.30 Reaction `reaction_30`

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

**Name** NFkB16) Nuclear IkBe:NFkB Binding

### Reaction equation



### Reactants

Table 121: Properties of each reactant.

Id	Name	SBO
species_44	IkBe(nuc)	
species_39	NFkB(nuc)	

### Modifiers

Table 122: Properties of each modifier.

Id	Name	SBO
species_44	IkBe(nuc)	
species_39	NFkB(nuc)	
species_45	IkBe:NFkB(nuc)	

### Product

Table 123: Properties of each product.

Id	Name	SBO
species_45	IkBe:NFkB(nuc)	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{30} = \text{vol}(\text{compartment\_1}) \cdot (k1 \cdot [\text{species\_44}] \cdot [\text{species\_39}] - k2 \cdot [\text{species\_45}]) \quad (70)$$

Table 124: Properties of each parameter.

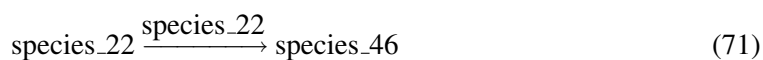
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		<input checked="" type="checkbox"/>
k2	k2		$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.31 Reaction `reaction_31`

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

**Name** NFkB17) Constitutive IkBa mRNA Synthesis

#### Reaction equation



#### Reactant

Table 125: Properties of each reactant.

Id	Name	SBO
species_22	source	

#### Modifier

Table 126: Properties of each modifier.

Id	Name	SBO
species_22	source	

#### Product

Table 127: Properties of each product.

Id	Name	SBO
species_46	IkBa.mRNA	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{31} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_22}] \quad (72)$$

Table 128: Properties of each parameter.

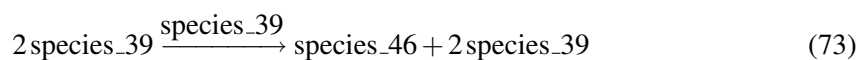
Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.54 \cdot 10^{-6}$		<input checked="" type="checkbox"/>

### 6.32 Reaction `reaction_32`

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

**Name** NFkB18) Inducible IkBa mRNA Synthesis

#### Reaction equation



#### Reactant

Table 129: Properties of each reactant.

Id	Name	SBO
<code>species_39</code>	NFkB(nuc)	

#### Modifier

Table 130: Properties of each modifier.

Id	Name	SBO
<code>species_39</code>	NFkB(nuc)	

#### Products

Table 131: Properties of each product.

Id	Name	SBO
<code>species_46</code>	IkBa_mRNA	
<code>species_39</code>	NFkB(nuc)	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{32} = \text{vol}(\text{compartment\_1}) \cdot k_1 \cdot [\text{species\_39}]^2 \quad (74)$$



Table 132: Properties of each parameter.

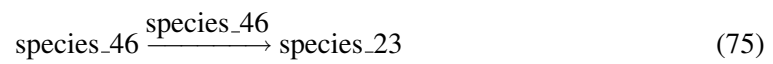
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.017		<input checked="" type="checkbox"/>

### 6.33 Reaction [reaction\\_33](#)

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

**Name** NFkB19) IkBa mRNA degradation

#### Reaction equation



#### Reactant

Table 133: Properties of each reactant.

Id	Name	SBO
species_46	IkBa_mRNA	

#### Modifier

Table 134: Properties of each modifier.

Id	Name	SBO
species_46	IkBa_mRNA	

#### Product

Table 135: Properties of each product.

Id	Name	SBO
species_23	sink	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{33} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_46}] \quad (76)$$

Table 136: Properties of each parameter.

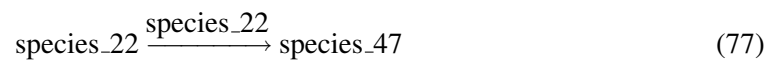
Id	Name	SBO	Value	Unit	Constant
k1	k1		$2.8 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.34 Reaction [reaction\\_34](#)

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

**Name** NFkB20) Constitutive IkBb mRNA Synthesis

#### Reaction equation



#### Reactant

Table 137: Properties of each reactant.

Id	Name	SBO
species_22	source	

#### Modifier

Table 138: Properties of each modifier.

Id	Name	SBO
species_22	source	

#### Product

Table 139: Properties of each product.

Id	Name	SBO
species_47	IkBb_mRNA	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{34} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_22}] \quad (78)$$

Table 140: Properties of each parameter.

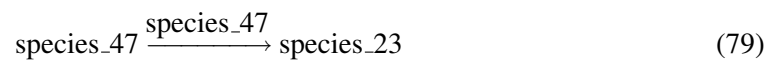
Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.78 \cdot 10^{-7}$		<input checked="" type="checkbox"/>

### 6.35 Reaction [reaction\\_35](#)

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

**Name** NFkB21) IkBb mRNA degradation

#### Reaction equation



#### Reactant

Table 141: Properties of each reactant.

Id	Name	SBO
species_47	IkBb_mRNA	

#### Modifier

Table 142: Properties of each modifier.

Id	Name	SBO
species_47	IkBb_mRNA	

#### Product

Table 143: Properties of each product.

Id	Name	SBO
species_23	sink	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{35} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_47}] \quad (80)$$

Table 144: Properties of each parameter.

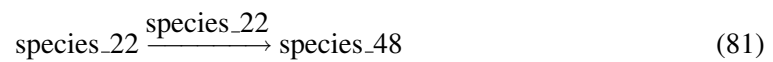
Id	Name	SBO	Value	Unit	Constant
k1	k1		$2.8 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.36 Reaction [reaction\\_36](#)

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

**Name** NFkB22) Constitutive IkBe mRNA Synthesis

#### Reaction equation



#### Reactant

Table 145: Properties of each reactant.

Id	Name	SBO
species_22	source	

#### Modifier

Table 146: Properties of each modifier.

Id	Name	SBO
species_22	source	

#### Product

Table 147: Properties of each product.

Id	Name	SBO
species_48	IkBe_mRNA	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{36} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_22}] \quad (82)$$

Table 148: Properties of each parameter.

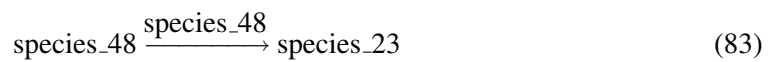
Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.27 \cdot 10^{-7}$		<input checked="" type="checkbox"/>

### 6.37 Reaction [reaction\\_37](#)

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

**Name** NFkB23) IkBe mRNA degradation

#### Reaction equation



#### Reactant

Table 149: Properties of each reactant.

Id	Name	SBO
species_48	IkBe_mRNA	

#### Modifier

Table 150: Properties of each modifier.

Id	Name	SBO
species_48	IkBe_mRNA	

#### Product

Table 151: Properties of each product.

Id	Name	SBO
species_23	sink	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{37} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_48}] \quad (84)$$

Table 152: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		$2.8 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.38 Reaction [reaction\\_38](#)

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

**Name** NFkB24) IKK:IkBa Binding

#### Reaction equation



#### Reactants

Table 153: Properties of each reactant.

Id	Name	SBO
species_15	IKK[P]	
species_29	IkBa	

#### Modifiers

Table 154: Properties of each modifier.

Id	Name	SBO
species_15	IKK[P]	
species_29	IkBa	
species_49	IKK[P]:IkBa	

#### Product

Table 155: Properties of each product.

Id	Name	SBO
species_49	IKK[P]:IkBa	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{38} = \text{vol}(\text{compartment\_1}) \cdot (k1 \cdot [\text{species\_15}] \cdot [\text{species\_29}] - k2 \cdot [\text{species\_49}]) \quad (86)$$

Table 156: Properties of each parameter.

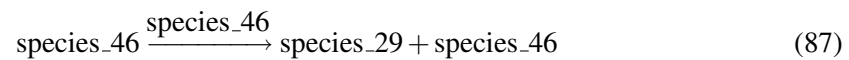
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.023		<input checked="" type="checkbox"/>
k2	k2		0.001		<input checked="" type="checkbox"/>

## 6.39 Reaction [reaction\\_39](#)

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

**Name** NFkB25) IkBa Translation

### Reaction equation



### Reactant

Table 157: Properties of each reactant.

Id	Name	SBO
species_46	IkBa_mRNA	

### Modifier

Table 158: Properties of each modifier.

Id	Name	SBO
species_46	IkBa_mRNA	

### Products

Table 159: Properties of each product.

Id	Name	SBO
species_29	IkBa	
species_46	IkBa_mRNA	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{39} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_46}] \quad (88)$$

Table 160: Properties of each parameter.

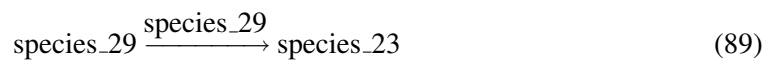
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.004		<input checked="" type="checkbox"/>

### 6.40 Reaction [reaction\\_40](#)

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

**Name** NFkB26) IkBa Degradation

### Reaction equation



### Reactant

Table 161: Properties of each reactant.

Id	Name	SBO
species_29	IkBa	

### Modifier

Table 162: Properties of each modifier.

Id	Name	SBO
species_29	IkBa	



## Product

Table 163: Properties of each product.

Id	Name	SBO
species_23	sink	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{40} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_29}] \quad (90)$$

Table 164: Properties of each parameter.

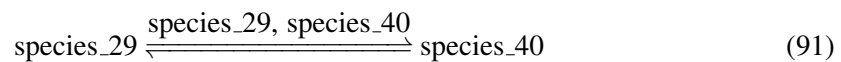
Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.13 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.41 Reaction [reaction\\_41](#)

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

**Name** NFkB27) IkBa Nuclear Import/Export

## Reaction equation



## Reactant

Table 165: Properties of each reactant.

Id	Name	SBO
species_29	IkBa	

## Modifiers

Table 166: Properties of each modifier.

Id	Name	SBO
species_29	IkBa	
species_40	IkBa(nuc)	

## Product

Table 167: Properties of each product.

Id	Name	SBO
species_40	IkBa(nuc)	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{41} = \text{vol}(\text{compartment}_1) \cdot (k1 \cdot [\text{species}_29] - k2 \cdot [\text{species}_40]) \quad (92)$$

Table 168: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		$3 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
k2	k2		$2 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

## 6.42 Reaction [reaction\\_42](#)

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

**Name** NFkB28) IKK:IkBb Binding

### Reaction equation



## Reactants

Table 169: Properties of each reactant.

Id	Name	SBO
species_15	IKK[P]	

Id	Name	SBO
species_33	IkBb	

## Modifiers

Table 170: Properties of each modifier.

Id	Name	SBO
species_15	IKK[P]	
species_33	IkBb	
species_50	IKK[P]:IkBb	

## Product

Table 171: Properties of each product.

Id	Name	SBO
species_50	IKK[P]:IkBb	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{42} = \text{vol}(\text{compartment}_1) \cdot (k1 \cdot [\text{species}_15] \cdot [\text{species}_33] - k2 \cdot [\text{species}_50]) \quad (94)$$

Table 172: Properties of each parameter.

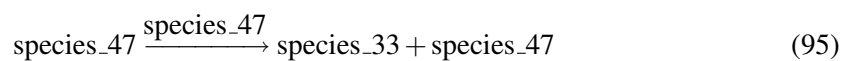
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.006		<input checked="" type="checkbox"/>
k2	k2		0.002		<input checked="" type="checkbox"/>

### 6.43 Reaction [reaction\\_43](#)

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

**Name** NFkB29) IkBb Translation

#### Reaction equation



## Reactant

Table 173: Properties of each reactant.

Id	Name	SBO
species_47	IkBb.mRNA	

## Modifier

Table 174: Properties of each modifier.

Id	Name	SBO
species_47	IkBb.mRNA	

## Products

Table 175: Properties of each product.

Id	Name	SBO
species_33	IkBb	
species_47	IkBb.mRNA	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{43} = \text{vol}(\text{compartment}_1) \cdot k1 \cdot [\text{species}_47] \quad (96)$$

Table 176: Properties of each parameter.

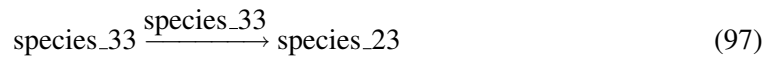
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.004		<input checked="" type="checkbox"/>

### 6.44 Reaction [reaction\\_44](#)

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

**Name** NFkB30) IkBb Degradation

## Reaction equation



## Reactant

Table 177: Properties of each reactant.

Id	Name	SBO
species_33	IkBb	

## Modifier

Table 178: Properties of each modifier.

Id	Name	SBO
species_33	IkBb	

## Product

Table 179: Properties of each product.

Id	Name	SBO
species_23	sink	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{44} = \text{vol}(\text{compartment\_1}) \cdot k_1 \cdot [\text{species\_33}] \quad (98)$$

Table 180: Properties of each parameter.

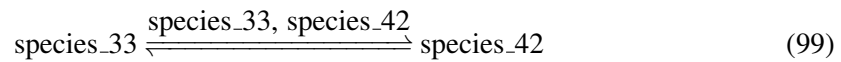
Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.13 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

## 6.45 Reaction [reaction\\_45](#)

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

**Name** NFkB31) IkBb Nuclear Import/Export

### Reaction equation



### Reactant

Table 181: Properties of each reactant.

Id	Name	SBO
species_33	IkBb	

### Modifiers

Table 182: Properties of each modifier.

Id	Name	SBO
species_33	IkBb	
species_42	IkBb(nuc)	

### Product

Table 183: Properties of each product.

Id	Name	SBO
species_42	IkBb(nuc)	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{45} = \text{vol}(\text{compartment\_1}) \cdot (k1 \cdot [\text{species\_33}] - k2 \cdot [\text{species\_42}]) \quad (100)$$

Table 184: Properties of each parameter.

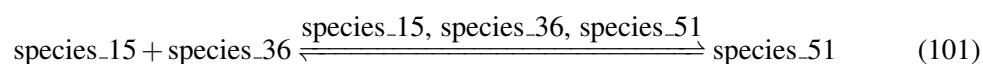
Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
k2	k2		$10^{-4}$		<input checked="" type="checkbox"/>

## 6.46 Reaction `reaction_46`

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

**Name** NFkB32) IKK:IkBBe Binding

### Reaction equation



### Reactants

Table 185: Properties of each reactant.

Id	Name	SBO
<code>species_15</code>	IKK[P]	
<code>species_36</code>	IkBBe	

### Modifiers

Table 186: Properties of each modifier.

Id	Name	SBO
<code>species_15</code>	IKK[P]	
<code>species_36</code>	IkBBe	
<code>species_51</code>	IKK[P]:IkBBe	

### Product

Table 187: Properties of each product.

Id	Name	SBO
<code>species_51</code>	IKK[P]:IkBBe	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{46} = \text{vol}(\text{compartment\_1}) \cdot (k_1 \cdot [\text{species\_15}] \cdot [\text{species\_36}] - k_2 \cdot [\text{species\_51}]) \quad (102)$$

Table 188: Properties of each parameter.

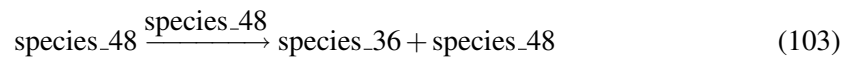
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.009		<input checked="" type="checkbox"/>
k2	k2		0.002		<input checked="" type="checkbox"/>

### 6.47 Reaction [reaction\\_47](#)

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

**Name** NFkB33) IkBe Translation

#### Reaction equation



#### Reactant

Table 189: Properties of each reactant.

Id	Name	SBO
species_48	IkBe_mRNA	

#### Modifier

Table 190: Properties of each modifier.

Id	Name	SBO
species_48	IkBe_mRNA	

#### Products

Table 191: Properties of each product.

Id	Name	SBO
species_36	IkBe	
species_48	IkBe_mRNA	

#### Kinetic Law

**Derived unit** contains undeclared units



$$v_{47} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_48}] \quad (104)$$

Table 192: Properties of each parameter.

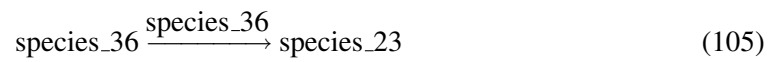
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.004		<input checked="" type="checkbox"/>

#### 6.48 Reaction [reaction\\_48](#)

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

**Name** NFkB34) IkBe Degradation

#### Reaction equation



#### Reactant

Table 193: Properties of each reactant.

Id	Name	SBO
species_36	IkBe	

#### Modifier

Table 194: Properties of each modifier.

Id	Name	SBO
species_36	IkBe	

#### Product

Table 195: Properties of each product.

Id	Name	SBO
species_23	sink	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{48} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_36}] \quad (106)$$

Table 196: Properties of each parameter.

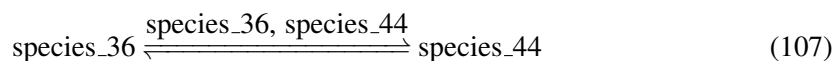
Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.13 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

## 6.49 Reaction [reaction\\_49](#)

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

**Name** NFkB35) IkBe Nuclear Import/Export

### Reaction equation



### Reactant

Table 197: Properties of each reactant.

Id	Name	SBO
species_36	IkBe	

### Modifiers

Table 198: Properties of each modifier.

Id	Name	SBO
species_36	IkBe	
species_44	IkBe(nuc)	

### Product

Table 199: Properties of each product.

Id	Name	SBO
species_44	IkBe(nuc)	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{49} = \text{vol}(\text{compartment}_1) \cdot (k1 \cdot [\text{species}_36] - k2 \cdot [\text{species}_44]) \quad (108)$$

Table 200: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		$1.5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
k2	k2		$10^{-4}$		<input checked="" type="checkbox"/>

## 6.50 Reaction [reaction\\_50](#)

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

**Name** NFkB36) IKK:IkBa:NFkB Binding (2)

## Reaction equation



## Reactants

Table 201: Properties of each reactant.

Id	Name	SBO
species_49	IKK[P]:IkBa	
species_31	NFkB	

## Modifiers

Table 202: Properties of each modifier.

Id	Name	SBO
species_49	IKK[P]:IkBa	

Id	Name	SBO
species_31	NFkB	
species_32	IKK[P]:IkBa:NFkB	

## Product

Table 203: Properties of each product.

Id	Name	SBO
species_32	IKK[P]:IkBa:NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{50} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_{49}] \cdot [\text{species}_{31}] - k_2 \cdot [\text{species}_{32}]) \quad (110)$$

Table 204: Properties of each parameter.

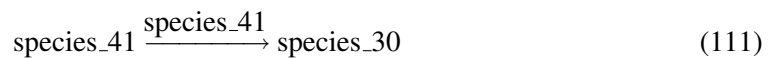
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		<input checked="" type="checkbox"/>
k2	k2		$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.51 Reaction [reaction\\_51](#)

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

**Name** NFkB37) IkBa:NFkB Nuclear Export

## Reaction equation



## Reactant

Table 205: Properties of each reactant.

Id	Name	SBO
species_41	IkBa:NFkB(nuc)	

## Modifier

Table 206: Properties of each modifier.

Id	Name	SBO
species_41	IkBa:NFkB(nuc)	

## Product

Table 207: Properties of each product.

Id	Name	SBO
species_30	IkBa:NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{51} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_41}] \quad (112)$$

Table 208: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.014		<input checked="" type="checkbox"/>

### 6.52 Reaction [reaction\\_52](#)

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

**Name** NFkB38) IKK:IkBb:NFkB Binding (2)

#### Reaction equation



#### Reactants

Table 209: Properties of each reactant.

Id	Name	SBO
species_50	IKK[P]:IkBb	
species_31	NFkB	

## Modifiers

Table 210: Properties of each modifier.

Id	Name	SBO
species_50	IKK[P]:IkBb	
species_31	NFkB	
species_35	IKK[P]:IkBb:NFkB	

## Product

Table 211: Properties of each product.

Id	Name	SBO
species_35	IKK[P]:IkBb:NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{52} = \text{vol}(\text{compartment}_1) \cdot (k_1 \cdot [\text{species}_50] \cdot [\text{species}_31] - k_2 \cdot [\text{species}_35]) \quad (114)$$

Table 212: Properties of each parameter.

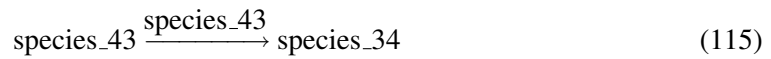
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		<input checked="" type="checkbox"/>
k2	k2		$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

### 6.53 Reaction `reaction_53`

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

**Name** NFkB39) IkBb:NFkB Nuclear Export

## Reaction equation



## Reactant

Table 213: Properties of each reactant.

Id	Name	SBO
species_43	IkBb:NFkB(nuc)	

## Modifier

Table 214: Properties of each modifier.

Id	Name	SBO
species_43	IkBb:NFkB(nuc)	

## Product

Table 215: Properties of each product.

Id	Name	SBO
species_34	IkBb:NFkB	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{53} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_43}] \quad (116)$$

Table 216: Properties of each parameter.

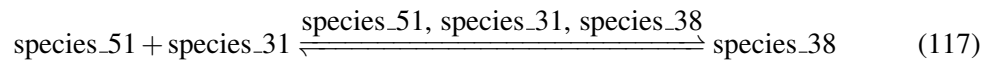
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.005		<input checked="" type="checkbox"/>

## 6.54 Reaction [reaction\\_54](#)

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

**Name** NFkB40) IKK:IkB:NfkB Binding (2)

### Reaction equation



### Reactants

Table 217: Properties of each reactant.

Id	Name	SBO
species_51	IKK[P]:IkBe	
species_31	NFkB	

### Modifiers

Table 218: Properties of each modifier.

Id	Name	SBO
species_51	IKK[P]:IkBe	
species_31	NFkB	
species_38	IKK[P]:IkBe:NfkB	

### Product

Table 219: Properties of each product.

Id	Name	SBO
species_38	IKK[P]:IkBe:NfkB	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{54} = \text{vol}(\text{compartment\_1}) \cdot (k1 \cdot [\text{species\_51}] \cdot [\text{species\_31}] - k2 \cdot [\text{species\_38}]) \quad (118)$$

Table 220: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.500		<input checked="" type="checkbox"/>
k2	k2		$5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

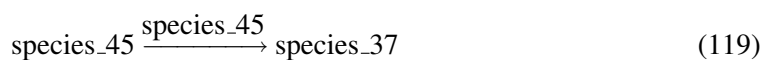


## 6.55 Reaction `reaction_55`

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

**Name** NFkB41) IkBe:Nfkb Nuclear Export

### Reaction equation



### Reactant

Table 221: Properties of each reactant.

Id	Name	SBO
species_45	IkBe:Nfkb(nuc)	

### Modifier

Table 222: Properties of each modifier.

Id	Name	SBO
species_45	IkBe:Nfkb(nuc)	

### Product

Table 223: Properties of each product.

Id	Name	SBO
species_37	IkBe:Nfkb	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{55} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_45}] \quad (120)$$

Table 224: Properties of each parameter.

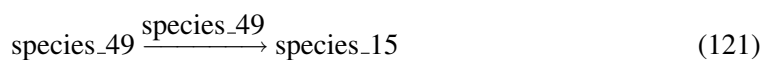
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.005		<input checked="" type="checkbox"/>

## 6.56 Reaction [reaction\\_56](#)

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

**Name** NFkB42) IKK:IkBa Catalysis

### Reaction equation



### Reactant

Table 225: Properties of each reactant.

Id	Name	SBO
species_49	IKK[P]:IkBa	

### Modifier

Table 226: Properties of each modifier.

Id	Name	SBO
species_49	IKK[P]:IkBa	

### Product

Table 227: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{56} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_49}] \quad (122)$$

Table 228: Properties of each parameter.

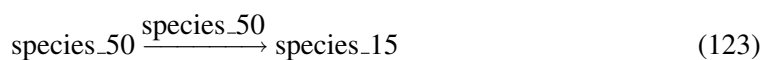
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.004		<input checked="" type="checkbox"/>

### 6.57 Reaction `reaction_57`

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

**Name** NFkB43) IKK:IkBb Catalysis

#### Reaction equation



#### Reactant

Table 229: Properties of each reactant.

Id	Name	SBO
species_50	IKK[P]:IkBb	

#### Modifier

Table 230: Properties of each modifier.

Id	Name	SBO
species_50	IKK[P]:IkBb	

#### Product

Table 231: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{57} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_50}] \quad (124)$$

Table 232: Properties of each parameter.

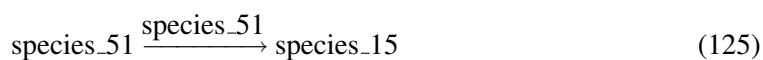
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.002		<input checked="" type="checkbox"/>

## 6.58 Reaction `reaction_58`

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

**Name** NFkB44) IKK:IkBBe Catalysis

### Reaction equation



### Reactant

Table 233: Properties of each reactant.

Id	Name	SBO
species_51	IKK[P]:IkBe	

### Modifier

Table 234: Properties of each modifier.

Id	Name	SBO
species_51	IKK[P]:IkBe	

### Product

Table 235: Properties of each product.

Id	Name	SBO
species_15	IKK[P]	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{58} = \text{vol}(\text{compartment\_1}) \cdot k1 \cdot [\text{species\_51}] \quad (126)$$

Table 236: Properties of each parameter.

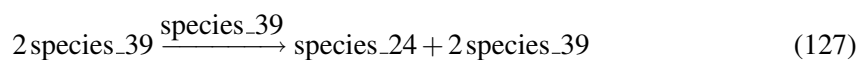
Id	Name	SBO	Value	Unit	Constant
k1	k1		0.002		<input checked="" type="checkbox"/>

## 6.59 Reaction `reaction_59`

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

**Name** TRIF06a)Inducible TNFa Synthesis by NFkB

### Reaction equation



### Reactant

Table 237: Properties of each reactant.

Id	Name	SBO
species_39	NFkB(nuc)	

### Modifier

Table 238: Properties of each modifier.

Id	Name	SBO
species_39	NFkB(nuc)	

### Products

Table 239: Properties of each product.

Id	Name	SBO
species_24	TNFa	
species_39	NFkB(nuc)	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{59} = \text{vol}(\text{compartment\_1}) \cdot k_1 \cdot [\text{species\_39}]^2 \quad (128)$$

Table 240: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1		0.001		<input checked="" type="checkbox"/>

## 7 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.

### 7.1 Species `species_1`

**Name** CD14

**Initial concentration** 1  $\mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in four reactions (as a reactant in [reaction\\_1](#), [reaction\\_6](#) and as a modifier in [reaction\\_1](#), [reaction\\_6](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species}_1 = 0 \quad (129)$$

### 7.2 Species `species_2`

**Name** IRAK4

**Initial concentration** 1  $\mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_1](#) and as a modifier in [reaction\\_1](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species}_2 = 0 \quad (130)$$

### 7.3 Species `species_3`

**Name** LBP

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in four reactions (as a reactant in [reaction\\_1](#), [reaction\\_6](#) and as a modifier in [reaction\\_1](#), [reaction\\_6](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_3} = 0 \quad (131)$$

### 7.4 Species `species_4`

**Name** LPS

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in four reactions (as a reactant in [reaction\\_1](#), [reaction\\_6](#) and as a modifier in [reaction\\_1](#), [reaction\\_6](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_4} = 0 \quad (132)$$

### 7.5 Species `species_5`

**Name** LPS:LBP:CD14:TLR4:TIRAP:MyD88:IRAK4

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

This species takes part in four reactions (as a product in [reaction\\_1](#) and as a modifier in [reaction\\_1](#), [reaction\\_2](#), [reaction\\_2](#)).

$$\frac{d}{dt}\text{species\_5} = v_1 \quad (133)$$

### 7.6 Species `species_6`

**Name** MyD88

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_1](#) and as a modifier in [reaction\\_1](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_6} = 0 \quad (134)$$

## 7.7 Species `species_7`

**Name** TIRAP

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_1](#) and as a modifier in [reaction\\_1](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_7} = 0 \quad (135)$$

## 7.8 Species `species_8`

**Name** TLR4

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in four reactions (as a reactant in [reaction\\_1](#), [reaction\\_6](#) and as a modifier in [reaction\\_1](#), [reaction\\_6](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_8} = 0 \quad (136)$$

## 7.9 Species `species_9`

**Name** IRAK1

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_2](#) and as a modifier in [reaction\\_2](#)).

$$\frac{d}{dt}\text{species\_9} = -v_2 \quad (137)$$

## 7.10 Species `species_10`

**Name** TRAF6

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_2](#) and as a modifier in [reaction\\_2](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_10} = 0 \quad (138)$$



### 7.11 Species `species_11`

**Name** TRAF6:IRAK1[P]

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

This species takes part in four reactions (as a reactant in [reaction\\_3](#) and as a product in [reaction\\_2](#) and as a modifier in [reaction\\_2](#), [reaction\\_3](#)).

$$\frac{d}{dt}\text{species\_11} = v_2 - v_3 \quad (139)$$

### 7.12 Species `species_12`

**Name** TAK1:TAB1:TAB2

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_3](#) and as a modifier in [reaction\\_3](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_12} = 0 \quad (140)$$

### 7.13 Species `species_13`

**Name** TAK1:TAB1:TAB2:TRAF6

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

This species takes part in four reactions (as a product in [reaction\\_3](#) and as a modifier in [reaction\\_3](#), [reaction\\_4](#), [reaction\\_4](#)).

$$\frac{d}{dt}\text{species\_13} = v_3 \quad (141)$$

### 7.14 Species `species_14`

**Name** IKK

**Initial concentration**  $0.1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in five reactions (as a reactant in [reaction\\_4](#), [reaction\\_14](#) and as a product in [reaction\\_5](#) and as a modifier in [reaction\\_4](#), [reaction\\_14](#)).

$$\frac{d}{dt}\text{species\_14} = v_5 - v_4 - v_{14} \quad (142)$$

### 7.15 Species `species_15`

**Name** IKK[P]

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

This species takes part in 22 reactions (as a reactant in [reaction\\_5](#), [reaction\\_16](#), [reaction\\_18](#), [reaction\\_20](#), [reaction\\_38](#), [reaction\\_42](#), [reaction\\_46](#) and as a product in [reaction\\_4](#), [reaction\\_14](#), [reaction\\_21](#), [reaction\\_22](#), [reaction\\_23](#), [reaction\\_56](#), [reaction\\_57](#), [reaction\\_58](#) and as a modifier in [reaction\\_5](#), [reaction\\_16](#), [reaction\\_18](#), [reaction\\_20](#), [reaction\\_38](#), [reaction\\_42](#), [reaction\\_46](#)).

$$\begin{aligned} \frac{d}{dt}\text{species\_15} = & \textcolor{blue}{v_4} + \textcolor{blue}{v_{14}} + \textcolor{blue}{v_{21}} + \textcolor{blue}{v_{22}} + \textcolor{blue}{v_{23}} + \textcolor{blue}{v_{56}} + \textcolor{blue}{v_{57}} + \textcolor{blue}{v_{58}} \\ & - \textcolor{blue}{v_5} - \textcolor{blue}{v_{16}} - \textcolor{blue}{v_{18}} - \textcolor{blue}{v_{20}} - \textcolor{blue}{v_{38}} - \textcolor{blue}{v_{42}} - \textcolor{blue}{v_{46}} \end{aligned} \quad (143)$$

### 7.16 Species `species_16`

**Name** RIP1

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in four reactions (as a reactant in [reaction\\_6](#), [reaction\\_13](#) and as a modifier in [reaction\\_6](#), [reaction\\_13](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_16} = 0 \quad (144)$$

### 7.17 Species `species_17`

**Name** TRAM

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_6](#) and as a modifier in [reaction\\_6](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_17} = 0 \quad (145)$$

### 7.18 Species `species_18`

**Name** TRIF

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_6](#) and as a modifier in [reaction\\_6](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_18} = 0 \quad (146)$$

### 7.19 Species [species\\_19](#)

**Name** IRF3

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_7](#) and as a product in [reaction\\_8](#) and as a modifier in [reaction\\_7](#)).

$$\frac{d}{dt}\text{species\_19} = v_8 - v_7 \quad (147)$$

### 7.20 Species [species\\_20](#)

**Name** IRF3[P]

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

This species takes part in five reactions (as a reactant in [reaction\\_8](#), [reaction\\_9](#) and as a product in [reaction\\_7](#) and as a modifier in [reaction\\_8](#), [reaction\\_9](#)).

$$\frac{d}{dt}\text{species\_20} = v_7 - v_8 - v_9 \quad (148)$$

### 7.21 Species [species\\_21](#)

**Name** IRF3[P](nuc)

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

This species takes part in five reactions (as a reactant in [reaction\\_10](#) and as a product in [reaction\\_9](#), [reaction\\_10](#) and as a modifier in [reaction\\_9](#), [reaction\\_10](#)).

$$\frac{d}{dt}\text{species\_21} = v_9 + 2 v_{10} - 2 v_{10} \quad (149)$$

## 7.22 Species `species_22`

**Name** source

**SBO:0000291** empty set

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in eight reactions (as a reactant in [reaction\\_11](#), [reaction\\_31](#), [reaction\\_34](#), [reaction\\_36](#) and as a modifier in [reaction\\_11](#), [reaction\\_31](#), [reaction\\_34](#), [reaction\\_36](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_22} = 0 \quad (150)$$

## 7.23 Species `species_23`

**Name** sink

**SBO:0000291** empty set

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

This species takes part in seven reactions (as a product in [reaction\\_12](#), [reaction\\_33](#), [reaction\\_35](#), [reaction\\_37](#), [reaction\\_40](#), [reaction\\_44](#), [reaction\\_48](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_23} = 0 \quad (151)$$

## 7.24 Species `species_24`

**Name** TNFa

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

This species takes part in seven reactions (as a reactant in [reaction\\_12](#), [reaction\\_13](#) and as a product in [reaction\\_10](#), [reaction\\_11](#), [reaction\\_59](#) and as a modifier in [reaction\\_12](#), [reaction\\_13](#)).

$$\frac{d}{dt}\text{species\_24} = v_{10} + v_{11} + v_{59} - v_{12} - v_{13} \quad (152)$$

### 7.25 Species `species_25`

**Name** TNFR1

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_13](#) and as a modifier in [reaction\\_13](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_25} = 0 \quad (153)$$

### 7.26 Species `species_26`

**Name** TRADD

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_13](#) and as a modifier in [reaction\\_13](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_26} = 0 \quad (154)$$

### 7.27 Species `species_27`

**Name** TRAF2

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_13](#) and as a modifier in [reaction\\_13](#)), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_27} = 0 \quad (155)$$

### 7.28 Species `species_28`

**Name** TNFa:TNFR1:TRAF2:TRADD:RIP1

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

This species takes part in four reactions (as a product in [reaction\\_13](#) and as a modifier in [reaction\\_13](#), [reaction\\_14](#), [reaction\\_14](#)).

$$\frac{d}{dt}\text{species\_28} = v_{13} \quad (156)$$

### 7.29 Species species\_29

**Name** IkBa

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

This species takes part in nine reactions (as a reactant in [reaction\\_15](#), [reaction\\_38](#), [reaction\\_40](#), [reaction\\_41](#) and as a product in [reaction\\_39](#) and as a modifier in [reaction\\_15](#), [reaction\\_38](#), [reaction\\_40](#), [reaction\\_41](#)).

$$\frac{d}{dt}\text{species\_29} = v_{39} - v_{15} - v_{38} - v_{40} - v_{41} \quad (157)$$

### 7.30 Species species\_30

**Name** IkBa:NFkB

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

This species takes part in seven reactions (as a reactant in [reaction\\_16](#), [reaction\\_24](#) and as a product in [reaction\\_15](#), [reaction\\_51](#) and as a modifier in [reaction\\_15](#), [reaction\\_16](#), [reaction\\_24](#)).

$$\frac{d}{dt}\text{species\_30} = v_{15} + v_{51} - v_{16} - v_{24} \quad (158)$$

### 7.31 Species species\_31

**Name** NFkB

**Initial concentration** 0.1  $\mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in 20 reactions (as a reactant in [reaction\\_15](#), [reaction\\_17](#), [reaction\\_19](#), [reaction\\_27](#), [reaction\\_50](#), [reaction\\_52](#), [reaction\\_54](#) and as a product in [reaction\\_21](#), [reaction\\_22](#), [reaction\\_23](#), [reaction\\_24](#), [reaction\\_25](#), [reaction\\_26](#) and as a modifier in [reaction\\_15](#), [reaction\\_17](#), [reaction\\_19](#), [reaction\\_27](#), [reaction\\_50](#), [reaction\\_52](#), [reaction\\_54](#)).

$$\begin{aligned} \frac{d}{dt}\text{species\_31} = & v_{21} + v_{22} + v_{23} + v_{24} + v_{25} + v_{26} - v_{15} \\ & - v_{17} - v_{19} - v_{27} - v_{50} - v_{52} - v_{54} \end{aligned} \quad (159)$$

### 7.32 Species species\_32

**Name** IKK[P]:IkBa:NFkB

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

This species takes part in six reactions (as a reactant in [reaction\\_21](#) and as a product in [reaction\\_16](#), [reaction\\_50](#) and as a modifier in [reaction\\_16](#), [reaction\\_21](#), [reaction\\_50](#)).

$$\frac{d}{dt}\text{species\_32} = v_{16} + v_{50} - v_{21} \quad (160)$$

### 7.33 Species [species\\_33](#)

**Name** IkBb

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

This species takes part in nine reactions (as a reactant in [reaction\\_17](#), [reaction\\_42](#), [reaction\\_44](#), [reaction\\_45](#) and as a product in [reaction\\_43](#) and as a modifier in [reaction\\_17](#), [reaction\\_42](#), [reaction\\_44](#), [reaction\\_45](#)).

$$\frac{d}{dt}\text{species\_33} = v_{43} - v_{17} - v_{42} - v_{44} - v_{45} \quad (161)$$

### 7.34 Species [species\\_34](#)

**Name** IkBb:NFkB

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

This species takes part in seven reactions (as a reactant in [reaction\\_18](#), [reaction\\_25](#) and as a product in [reaction\\_17](#), [reaction\\_53](#) and as a modifier in [reaction\\_17](#), [reaction\\_18](#), [reaction\\_25](#)).

$$\frac{d}{dt}\text{species\_34} = v_{17} + v_{53} - v_{18} - v_{25} \quad (162)$$

### 7.35 Species [species\\_35](#)

**Name** IKK[P]:IkBb:NFkB

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

This species takes part in six reactions (as a reactant in [reaction\\_22](#) and as a product in [reaction\\_18](#), [reaction\\_52](#) and as a modifier in [reaction\\_18](#), [reaction\\_22](#), [reaction\\_52](#)).

$$\frac{d}{dt}\text{species\_35} = v_{18} + v_{52} - v_{22} \quad (163)$$

### 7.36 Species `species_36`

**Name** IkBe

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

This species takes part in nine reactions (as a reactant in [reaction\\_19](#), [reaction\\_46](#), [reaction\\_48](#), [reaction\\_49](#) and as a product in [reaction\\_47](#) and as a modifier in [reaction\\_19](#), [reaction\\_46](#), [reaction\\_48](#), [reaction\\_49](#)).

$$\frac{d}{dt}\text{species\_36} = v_{47} - v_{19} - v_{46} - v_{48} - v_{49} \quad (164)$$

### 7.37 Species `species_37`

**Name** IkBe:NFkB

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

This species takes part in seven reactions (as a reactant in [reaction\\_20](#), [reaction\\_26](#) and as a product in [reaction\\_19](#), [reaction\\_55](#) and as a modifier in [reaction\\_19](#), [reaction\\_20](#), [reaction\\_26](#)).

$$\frac{d}{dt}\text{species\_37} = v_{19} + v_{55} - v_{20} - v_{26} \quad (165)$$

### 7.38 Species `species_38`

**Name** IKK[P]:IkBe:NFkB

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

This species takes part in six reactions (as a reactant in [reaction\\_23](#) and as a product in [reaction\\_20](#), [reaction\\_54](#) and as a modifier in [reaction\\_20](#), [reaction\\_23](#), [reaction\\_54](#)).

$$\frac{d}{dt}\text{species\_38} = v_{20} + v_{54} - v_{23} \quad (166)$$

### 7.39 Species `species_39`

**Name** NFkB(nuc)

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

This species takes part in 14 reactions (as a reactant in [reaction\\_28](#), [reaction\\_29](#), [reaction\\_30](#), [reaction\\_32](#), [reaction\\_59](#) and as a product in [reaction\\_27](#), [reaction\\_32](#), [reaction\\_59](#) and as a modifier in [reaction\\_27](#), [reaction\\_28](#), [reaction\\_29](#), [reaction\\_30](#), [reaction\\_32](#), [reaction\\_59](#)).

$$\frac{d}{dt}\text{species\_39} = v_{27} + 2 v_{32} + 2 v_{59} - v_{28} - v_{29} - v_{30} - 2 v_{32} - 2 v_{59} \quad (167)$$



#### 7.40 Species `species_40`

**Name** IkBa(nuc)

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

This species takes part in four reactions (as a reactant in [reaction\\_28](#) and as a product in [reaction\\_41](#) and as a modifier in [reaction\\_28](#), [reaction\\_41](#)).

$$\frac{d}{dt}\text{species\_40} = v_{41} - v_{28} \quad (168)$$

#### 7.41 Species `species_41`

**Name** IkBa:NFkB(nuc)

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

This species takes part in four reactions (as a reactant in [reaction\\_51](#) and as a product in [reaction\\_28](#) and as a modifier in [reaction\\_28](#), [reaction\\_51](#)).

$$\frac{d}{dt}\text{species\_41} = v_{28} - v_{51} \quad (169)$$

#### 7.42 Species `species_42`

**Name** IkBb(nuc)

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

This species takes part in four reactions (as a reactant in [reaction\\_29](#) and as a product in [reaction\\_45](#) and as a modifier in [reaction\\_29](#), [reaction\\_45](#)).

$$\frac{d}{dt}\text{species\_42} = v_{45} - v_{29} \quad (170)$$

#### 7.43 Species `species_43`

**Name** IkBb:NFkB(nuc)

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

This species takes part in four reactions (as a reactant in [reaction\\_53](#) and as a product in [reaction\\_29](#) and as a modifier in [reaction\\_29](#), [reaction\\_53](#)).

$$\frac{d}{dt}\text{species\_43} = v_{29} - v_{53} \quad (171)$$

#### 7.44 Species `species_44`

**Name** IkBe(nuc)

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

This species takes part in four reactions (as a reactant in [reaction\\_30](#) and as a product in [reaction\\_49](#) and as a modifier in [reaction\\_30](#), [reaction\\_49](#)).

$$\frac{d}{dt}\text{species\_44} = v_{49} - v_{30} \quad (172)$$

#### 7.45 Species `species_45`

**Name** IkBe:NFKB(nuc)

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

This species takes part in four reactions (as a reactant in [reaction\\_55](#) and as a product in [reaction\\_30](#) and as a modifier in [reaction\\_30](#), [reaction\\_55](#)).

$$\frac{d}{dt}\text{species\_45} = v_{30} - v_{55} \quad (173)$$

#### 7.46 Species `species_46`

**Name** IkBa\_mRNA

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

This species takes part in seven reactions (as a reactant in [reaction\\_33](#), [reaction\\_39](#) and as a product in [reaction\\_31](#), [reaction\\_32](#), [reaction\\_39](#) and as a modifier in [reaction\\_33](#), [reaction\\_39](#)).

$$\frac{d}{dt}\text{species\_46} = v_{31} + v_{32} + v_{39} - v_{33} - v_{39} \quad (174)$$

#### 7.47 Species `species_47`

**Name** IkBb\_mRNA

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

This species takes part in six reactions (as a reactant in [reaction\\_35](#), [reaction\\_43](#) and as a product in [reaction\\_34](#), [reaction\\_43](#) and as a modifier in [reaction\\_35](#), [reaction\\_43](#)).

$$\frac{d}{dt}\text{species\_47} = v_{34} + v_{43} - v_{35} - v_{43} \quad (175)$$

### 7.48 Species `species_48`

**Name** IkBe\_mRNA

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

This species takes part in six reactions (as a reactant in [reaction\\_37](#), [reaction\\_47](#) and as a product in [reaction\\_36](#), [reaction\\_47](#) and as a modifier in [reaction\\_37](#), [reaction\\_47](#)).

$$\frac{d}{dt}\text{species\_48} = v_{36} + v_{47} - v_{37} - v_{47} \quad (176)$$

### 7.49 Species `species_49`

**Name** IKK[P]:IkBa

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

This species takes part in six reactions (as a reactant in [reaction\\_50](#), [reaction\\_56](#) and as a product in [reaction\\_38](#) and as a modifier in [reaction\\_38](#), [reaction\\_50](#), [reaction\\_56](#)).

$$\frac{d}{dt}\text{species\_49} = v_{38} - v_{50} - v_{56} \quad (177)$$

### 7.50 Species `species_50`

**Name** IKK[P]:IkBb

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

This species takes part in six reactions (as a reactant in [reaction\\_52](#), [reaction\\_57](#) and as a product in [reaction\\_42](#) and as a modifier in [reaction\\_42](#), [reaction\\_52](#), [reaction\\_57](#)).

$$\frac{d}{dt}\text{species\_50} = v_{42} - v_{52} - v_{57} \quad (178)$$

### 7.51 Species `species_51`

**Name** IKK[P]:IkBe

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

This species takes part in six reactions (as a reactant in [reaction\\_54](#), [reaction\\_58](#) and as a product in [reaction\\_46](#) and as a modifier in [reaction\\_46](#), [reaction\\_54](#), [reaction\\_58](#)).

$$\frac{d}{dt}\text{species\_51} = v_{46} - v_{54} - v_{58} \quad (179)$$

## 7.52 Species `species_52`

**Name** LPS:LBP:CD14:TLR4:RIP1:TRAM:TRIF:TBK/IKKe

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

This species takes part in four reactions (as a product in `reaction_6` and as a modifier in `reaction_6`, `reaction_7`, `reaction_7`).

$$\frac{d}{dt}\text{species\_52} = v_6 \quad (180)$$

## 7.53 Species `species_53`

**Name** TBK1/IKKe

**Initial concentration**  $1 \mu\text{mol} \cdot \text{ml}^{-1}$

This species takes part in two reactions (as a reactant in `reaction_6` and as a modifier in `reaction_6`), which do not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{species\_53} = 0 \quad (181)$$

# A Glossary of Systems Biology Ontology Terms

**SBO:0000290 physical compartment:** Specific location of space, that can be bounded or not.

A physical compartment can have 1, 2 or 3 dimensions

**SBO:0000291 empty set:** Entity defined by the absence of any actual object. An empty set is often used to represent the source of a creation process or the result of a degradation process.

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

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