

SBML Model Report

Model name: “Wegner2012-TGFbetaSignalling_FeedbackLoops”



May 5, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following three authors: Vijayalakshmi Chelliah¹, Katja Wegner² and Anastasia Bachmann³ at February tenth 2012 at 11:45 a.m. and last time modified at March 27th 2012 at 1:41 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	2
species types	0	species	53
events	0	constraints	0
reactions	91	function definitions	7
global parameters	10	unit definitions	2
rules	9	initial assignments	0

Model Notes

This model is from the article:

Dynamics and feedback loops in the transforming growth factor signaling pathway.

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Wegner K, Bachmann A, Schad JU, Lucarelli P, Sahle S, Nickel P, Meyer C, Klingmüller U, Dooley S, Kummer U. Biophys Chem. 2012 Jan 5. [22284904](#) ,

Abstract:

Transforming growth factor (TGF-) ligands activate a signaling cascade with multiple cell context dependent outcomes. Disruption or disturbance leads to variant clinical disorders. To develop strategies for disease intervention, delineation of the pathway in further detail is required. Current theoretical models of this pathway describe production and degradation of signal mediating proteins and signal transduction from the cell surface into the nucleus, whereas feedback loops have not exhaustively been included. In this study we present a mathematical model to determine the relevance of feedback regulators (Arkadia, Smad7, Smurf1, Smurf2, SnoN and Ski) on TGF- target gene expression and the potential to initiate stable oscillations within a realistic parameter space. We employed massive sampling of the parameters space to pinpoint crucial players for potential oscillations as well as transcriptional product levels. We identified Smad7 and Smurf2 with the highest impact on the dynamics. Based on these findings, we conducted preliminary time course experiments.

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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 time

Name time

Definition 60 s

2.2 Unit substance

Name substance

Definition μmol

2.3 Unit volume

Notes Litre is the predefined SBML unit for volume.

Definition 1

2.4 Unit area

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

Definition m^2

2.5 Unit length

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

Definition m

3 Compartments

This model contains two compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
_1	cytoplasm	0000290	3	1	litre	✓	
_3	nucleus	0000290	3	1	litre	✓	

3.1 Compartment _1

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

Name cytoplasm

SBO:0000290 physical compartment

3.2 Compartment _3

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

Name nucleus

SBO:0000290 physical compartment

4 Species

This model contains 53 species. Section 9 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
_75	TGF_RII	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_79	TGFbeta_TGF_RII	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_84	TGF_RI	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_96	Rec_active	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_99	Smad2_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_101	SARA	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_105	Smad2_SARA	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_129	pSmad2_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_147	Smad4_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_153	pSmad2_Smad4_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_174	Smad7_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_181	Smad7_Smurf2_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
_198	Rec_Smad7	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_1	Smurf2_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_2	SnoN_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_3	Smad3_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_4	pSmad3_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_5	Smad3_SARA	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_6	pSmad3_Smad4_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_7	Ski_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_8	Smad3_Ski_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_9	Smurf1_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
species_10	Smad7_Smurf1_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_11	pSmad2_Smad4_Ski_n	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_12	Smad2_Ski_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_13	pSmad2_SnoN_n	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_14	pSmad3_SnoN_n	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_15	Arkadia_c	_1	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_5	Smad4_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_9	pSmad2_Smad4_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_11	SnoN_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_13	pSmad2_Smad4_SnoN_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_15	Smurf2_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_19	pSmad2_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_21	Smad2_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_25	Smad7_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
_27	Smad7_Smurf2_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_16	Smad4_SnoN_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_17	Smad3_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_18	pSmad3_Smad4_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_19	Smad4_Smad2_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_20	pSmad3_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_21	pSmad3_Smad4_SnoN_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_22	Ski_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_23	Smad4_Ski_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_24	Smurf1_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_25	Smad7_Smurf1_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_26	pSmad3_Smad4_Ski_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>
species_27	Smad4_Smad3_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
species_28	freePromoters	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_29	inactivePromoters	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_30	geneProduct	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square
species_31	Arkadia_n	_3	$\mu\text{mol} \cdot \text{l}^{-1}$	\square	\square

5 Parameters

This model contains ten global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
parameter_1	TGFbeta	0000196	0.01		<input checked="" type="checkbox"/>
parameter_2	allSnoN		0.00		<input type="checkbox"/>
parameter_3	allSmad7		0.00		<input type="checkbox"/>
parameter_4	allSmurf2		0.00		<input type="checkbox"/>
parameter_5	allSmad2		0.00		<input type="checkbox"/>
parameter_6	allSmad4		0.00		<input type="checkbox"/>
parameter_7	allPSmad3		0.00		<input type="checkbox"/>
parameter_8	allSmad3		0.00		<input type="checkbox"/>
parameter_9	allSmad4cyt		0.00		<input type="checkbox"/>
parameter_10	allSmad4nuc		0.00		<input type="checkbox"/>

6 Function definitions

This is an overview of seven function definitions.

6.1 Function definition [function_4](#)

Name Constant flux (irreversible)

Argument v

Mathematical Expression

$$v \quad (1)$$

6.2 Function definition [function_1](#)

Name Henri-Michaelis-Menten (irreversible)

Arguments substrate, Km, V

Mathematical Expression

$$\frac{V \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (2)$$

6.3 Function definition [function_3](#)

Name Rate Law for SARA-Phosph [1]

Arguments k, rec, s, km

Mathematical Expression

$$\frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (3)$$

6.4 Function definition [function_2](#)

Name Rate Law for Rec_comp1 [1]

Arguments TGFbeta, k, s, s2

Mathematical Expression

$$k \cdot s \cdot s2 \cdot \text{TGFbeta} \quad (4)$$

6.5 Function definition [function_7](#)

Name Rate Law for Degradation

Arguments k1, substrate, modifier

Mathematical Expression

$$k1 \cdot \text{substrate} \cdot (1 + \text{modifier}) \quad (5)$$

6.6 Function definition [function_5](#)

Name Rate Law for flux and basicflux [1]

Arguments k, k1, m

Mathematical Expression

$$k + k1 \cdot m \quad (6)$$

6.7 Function definition [function_6](#)

Name Rate Law for fluxSmad7_1 [1]

Arguments k, k1, m, m2, m3

Mathematical Expression

$$\frac{k + k1 \cdot m}{1 + m2 + m3} \quad (7)$$

7 Rules

This is an overview of nine rules.

7.1 Rule `parameter_3`

Rule `parameter_3` is an assignment rule for parameter `parameter_3`:

$$\text{parameter_3} = [-174] + [-181] + [-198] + [-25] + [-27] \quad (8)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.2 Rule `parameter_2`

Rule `parameter_2` is an assignment rule for parameter `parameter_2`:

$$\text{parameter_2} = [\text{species_2}] + [-11] + [\text{species_16}] + [\text{species_16}] \quad (9)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.3 Rule `parameter_4`

Rule `parameter_4` is an assignment rule for parameter `parameter_4`:

$$\text{parameter_4} = [-181] + [\text{species_1}] + [-15] + [-27] \quad (10)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.4 Rule `parameter_5`

Rule `parameter_5` is an assignment rule for parameter `parameter_5`:

$$\text{parameter_5} = [-99] + [-105] + [-129] + [-153] + [-9] + [-13] + [-19] + [-21] + [\text{species_19}] \quad (11)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.5 Rule `parameter_6`

Rule `parameter_6` is an assignment rule for parameter `parameter_6`:

$$\begin{aligned} \text{parameter_6} = & [-147] + [-153] + [\text{species_6}] + [-5] + [-9] + [\text{species_18}] + [-13] + [\text{species_16}] \\ & + [\text{species_19}] + [\text{species_21}] + [\text{species_27}] + [\text{species_26}] + [\text{species_23}] \end{aligned} \quad (12)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.6 Rule `parameter_7`

Rule `parameter_7` is an assignment rule for parameter `parameter_7`:

$$\text{parameter_7} = [\text{species_4}] + [\text{species_6}] + [\text{species_18}] + [\text{species_20}] + [\text{species_21}] + [\text{species_26}] \quad (13)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.7 Rule `parameter_8`

Rule `parameter_8` is an assignment rule for parameter `parameter_8`:

$$\begin{aligned} \text{parameter_8} = & [\text{species_3}] + [\text{species_4}] + [\text{species_5}] + [\text{species_6}] + [\text{species_8}] + [\text{species_17}] \\ & + [\text{species_18}] + [\text{species_20}] + [\text{species_21}] + [\text{species_26}] + [\text{species_27}] \end{aligned} \quad (14)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.8 Rule `parameter_9`

Rule `parameter_9` is an assignment rule for parameter `parameter_9`:

$$\text{parameter_9} = [_{147}] + [_{153}] + [\text{species_6}] \quad (15)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

7.9 Rule `parameter_10`

Rule `parameter_10` is an assignment rule for parameter `parameter_10`:

$$\begin{aligned} \text{parameter_10} = & [\text{species_11}] + [_{5}] + [_{9}] + [_{13}] + [\text{species_18}] \\ & + [\text{species_16}] + [\text{species_18}] + [\text{species_19}] + [\text{species_21}] \\ & + [\text{species_23}] + [\text{species_26}] + [\text{species_26}] + [\text{species_27}] \end{aligned} \quad (16)$$

Derived unit $\mu\text{mol} \cdot \text{l}^{-1}$

8 Reactions

This model contains 91 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

Nº	Id	Name	Reaction Equation	SBO
1	_29	Smad_dissoc3	$\text{species_27} \longrightarrow .5 + 2 \text{ species_17}$	
2	_31	Smad2_dephosphNuc	$.9 \longrightarrow \text{species_19}$	
3	_33	Smad_inhibComp2SnoN	$.9 + 2 .11 \rightleftharpoons .13$	
4	_35	SnoN_degrad2	$3 .15 + \text{species_13} \longrightarrow 3 .19$	
5	_37	Smad_compNuc2	$.5 + 2 .19 \longrightarrow .9$	
6	_39	Smad2_dephosphNuc2	$.19 \longrightarrow .21$	
7	_41	Smad2_degrad	$.21 + .15 \longrightarrow \emptyset$	
8	_43	Smad7-Smurf2	$.15 + .25 \rightleftharpoons .27$	
9	_77	Rec_comp1	$2 .75 \xrightarrow{.75} .79$	
10	_86	Rec_comp2	$.79 + 2 .84 \rightleftharpoons .96$	
11	_103	SARA-comp2	$.101 + .99 \rightleftharpoons .105$	
12	_125	Smad2_phosph	$.99 \xrightarrow{.96} .129$	
13	_132	Smad2_phosphSARA	$.105 \xrightarrow{.96} .129 + .101$	
14	_139	Smad2-P_transp	$.129 \longrightarrow .19$	
15	_149	Smad_compCyt2	$.147 + 2 .129 \longrightarrow .153$	
16	_156	Smad4_transp	$.147 \rightleftharpoons .5$	
17	_164	Smad_compTransp2	$.153 \longrightarrow .9$	
18	_172	Smad7_transp	$.25 \rightleftharpoons .174$	
19	_178	Smad7-Smurf2_transp	$.27 \rightleftharpoons .181$	
20	_192	Rec_degrad1	$.181 + .96 \longrightarrow \emptyset$	
21	_194	Rec_inhib	$.174 + .96 \rightleftharpoons .198$	
22	reaction_1	fluxRecII	$\emptyset \longrightarrow .75$	

Nº	Id	Name	Reaction Equation	SBO
23	reaction_2	fluxSara	$\emptyset \xrightarrow{\text{species_30}} _101$	
24	reaction_3	fluxSmad7	$\emptyset \xrightarrow{\text{species_30, species_16, species_23}} _174$	
25	reaction_4	fluxSmurf2	$\emptyset \xrightarrow{\text{species_30}} \text{species_1}$	
26	reaction_5	fluxSnoN	$\emptyset \xrightarrow{\text{species_30}} \text{species_2}$	
27	reaction_6	fluxRecI	$\emptyset \longrightarrow _84$	
28	reaction_7	Smad4-SnoN	$_5 + _11 \rightleftharpoons \text{species_16}$	
29	reaction_8	Smad2_transp	$_99 \rightleftharpoons _21$	
30	reaction_9	Rec_degrad	$_96 \longrightarrow \emptyset$	
31	reaction_10	RecI_degrad	$_84 \longrightarrow \emptyset$	
32	reaction_11	RecII_degrad	$_75 \longrightarrow \emptyset$	
33	reaction_12	Rec_recycl	$_79 \longrightarrow 2 _75$	
34	reaction_13	fluxSmad2	$\emptyset \longrightarrow _99$	
35	reaction_14	fluxSmad4	$\emptyset \longrightarrow _147$	
36	reaction_15	Smad4_degrad	$_147 \longrightarrow \emptyset$	
37	reaction_16	SARA_degrad	$_101 \longrightarrow \emptyset$	
38	reaction_17	Smad2_dephospCyt	$_129 \longrightarrow _99$	
39	reaction_18	SnoN_degrad	$\text{species_2} \longrightarrow \emptyset$	
40	reaction_19	Smurf2_transp	$_15 \rightleftharpoons \text{species_1}$	
41	reaction_20	Smad2_cyt_degrad	$_99 \longrightarrow \emptyset$	
42	reaction_21	SnoN_trans	$\text{species_2} \rightleftharpoons _11$	
43	reaction_22	fluxSmad3	$\emptyset \longrightarrow \text{species_3}$	
44	reaction_23	Smad3_cyt_degrad	$\text{species_3} \longrightarrow \emptyset$	
45	reaction_24	Smad3_dephospCyt	$\text{species_4} \longrightarrow \text{species_3}$	
46	reaction_25	Smad3_dephospNuc	$\text{species_18} \longrightarrow \text{species_27}$	
47	reaction_26	Smad3_dephospNuc2	$\text{species_20} \longrightarrow \text{species_17}$	
48	reaction_27	Smad3_phosph	$\text{species_3} \xrightarrow{_96} \text{species_4}$	

Nº	Id	Name	Reaction Equation	SBO
49	reaction_28	Smad3_phosphSARA	$\text{species}_5 \xrightarrow{96} \text{species}_4 + _101$	
50	reaction_29	Smad3_degrad	$\text{species}_{17} \longrightarrow \emptyset$	
51	reaction_30	Smad3_transp	$\text{species}_3 \rightleftharpoons \text{species}_{17}$	
52	reaction_31	SARA-comp3	$_101 + \text{species}_3 \rightleftharpoons \text{species}_5$	
53	reaction_32	Smad_dissoc2	$\text{species}_{19} \longrightarrow _5 + 2 _21$	
54	reaction_33	Smad3-P-transp	$\text{species}_4 \longrightarrow \text{species}_{20}$	
55	reaction_34	Smad_compCyt3	$_147 + 2 \text{species}_4 \longrightarrow \text{species}_6$	
56	reaction_35	Smad_compNuc3	$_5 + 2 \text{species}_{20} \longrightarrow \text{species}_{18}$	
57	reaction_36	Smad_inhibComp3SnoN	$\text{species}_{18} + 2 _11 \rightleftharpoons \text{species}_{21}$	
58	reaction_37	Smad_compTransp3	$\text{species}_6 \longrightarrow \text{species}_{18}$	
59	reaction_38	SnoN_degrad3	$\text{species}_{14} \longrightarrow \text{species}_{20}$	
60	reaction_39	Smad7_degrad	$_174 \xrightarrow{\text{species}_{15}} \emptyset$	
61	reaction_40	Ski_degrad	$\text{species}_7 \longrightarrow \emptyset$	
62	reaction_41	Ski_trans	$\text{species}_7 \rightleftharpoons \text{species}_{22}$	
63	reaction_42	fluxSki	$\emptyset \xrightarrow{\text{species}_{30}} \text{species}_7$	
64	reaction_43	Smurf2_degrad	$\text{species}_1 \xrightarrow{-174} \emptyset$	
65	reaction_44	Smad4-Ski	$_5 + \text{species}_{22} \rightleftharpoons \text{species}_{23}$	
66	reaction_45	Smad3-Ski_cyt	$\text{species}_3 + \text{species}_7 \rightleftharpoons \text{species}_8$	
67	reaction_46	Smad7-Smurf1	$\text{species}_{24} + _25 \rightleftharpoons \text{species}_{25}$	
68	reaction_47	fluxSmurf1	$\emptyset \xrightarrow{\text{species}_{30}} \text{species}_9$	
69	reaction_48	Smad_inhibComp3Ski	$\text{species}_{18} + 2 \text{species}_{22} \rightleftharpoons \text{species}_{26}$	
70	reaction_49	Rec_degrad2	$\text{species}_{10} + _96 \longrightarrow \emptyset$	
71	reaction_50	Smad7-Smurf1_transp	$\text{species}_{25} \rightleftharpoons \text{species}_{10}$	
72	reaction_51	Smurf1_degrad	$\text{species}_9 \xrightarrow{-174} \emptyset$	
73	reaction_52	Smurf1_transp	$\text{species}_{24} \rightleftharpoons \text{species}_9$	
74	reaction_53	Smad3-freePromot	$\text{species}_{18} + \text{species}_{28} \rightleftharpoons \text{species}_{30}$	

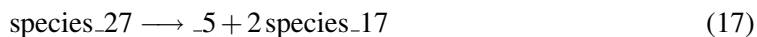
Nº	Id	Name	Reaction Equation	SBO
75	reaction_54	Smad2-freePromot	$_{_9} + \text{species_28} \rightleftharpoons \text{species_30}$	
76	reaction_55	Smad3-SnoN-freePromot	$\text{species_21} + \text{species_28} \rightleftharpoons \text{species_29}$	
77	reaction_56	Smad2-SnoN-gene	$_{_13} + \text{species_28} \rightleftharpoons \text{species_29}$	
78	reaction_57	Smad3-Ski-freePromot	$\text{species_26} + \text{species_28} \rightleftharpoons \text{species_29}$	
79	reaction_58	Smad_inhibComp2Ski	$_{_9} + 2 \text{ species_22} \rightleftharpoons \text{species_11}$	
80	reaction_59	Smad2-Ski-gene	$\text{species_11} + \text{species_28} \rightleftharpoons \text{species_29}$	
81	reaction_60	Smad4-freePromot	$\text{species_23} + \text{species_28} \rightleftharpoons \text{species_29}$	
82	reaction_61	Smad2-Ski_cyt	$_{_99} + \text{species_7} \rightleftharpoons \text{species_12}$	
83	reaction_62	Smad2-Snon	$3 \text{ }_{_19} + 3 \text{ }_{_11} \rightleftharpoons \text{species_13}$	
84	reaction_63	Smad3-Snon	$3 \text{ species_20} + 3 \text{ }_{_11} \rightleftharpoons \text{species_14}$	
85	reaction_64	Smad2-comp-degrad	$_{_9} \longrightarrow \emptyset$	
86	reaction_65	Samd3-comp-degrad	$\text{species_18} \longrightarrow \emptyset$	
87	reaction_66	fluxArkadia	$\emptyset \longrightarrow \text{species_15}$	
88	reaction_67	Arkadia_deg	$\text{species_15} \longrightarrow \emptyset$	
89	reaction_68	SnoN-deg2	$\text{species_13} + 3 \text{ species_31} \longrightarrow 3 \text{ }_{_19}$	
90	reaction_69	SnoN-deg3	$\text{species_14} + 3 \text{ species_31} \longrightarrow \text{species_20}$	
91	reaction_70	transArkadia	$\text{species_15} \rightleftharpoons \text{species_31}$	

8.1 Reaction _29

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

Name Smad_dissoc3

Reaction equation



Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
species_27	Smad4_Smad3_n	

Products

Table 7: Properties of each product.

Id	Name	SBO
_5	Smad4_n	
species_17	Smad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \text{vol}(_3) \cdot k_1 \cdot [\text{species_27}] \quad (18)$$

Table 8: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000282	0.049		<input checked="" type="checkbox"/>

8.2 Reaction _31

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

Name Smad2_dephosphNuc

Reaction equation



Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
_9	pSmad2_Smad4_n	

Product

Table 10: Properties of each product.

Id	Name	SBO
species_19	Smad4_Smad2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \text{vol}(_3) \cdot \text{function_1}([_9], \text{Km}, V) \quad (20)$$

$$\text{function_1}(\text{substrate}, \text{Km}, V) = \frac{V \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (21)$$

$$\text{function_1}(\text{substrate}, \text{Km}, V) = \frac{V \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (22)$$

Table 11: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	40.00		✓
V	V	0000186	2.34		✓

8.3 Reaction _33

This is a reversible reaction of two reactants forming one product.

Name Smad_inhibComp2SnoN

Reaction equation



Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
_9	pSmad2_Smad4_n	
_11	SnoN_n	

Product

Table 13: Properties of each product.

Id	Name	SBO
_13	pSmad2_Smad4_SnoN_n	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \text{vol}(_3) \cdot (k1 \cdot [_9] \cdot [_11]^2 - k2 \cdot [_13]) \quad (24)$$

Table 14: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.6		<input checked="" type="checkbox"/>
k2	k2	0000156	1.6		<input checked="" type="checkbox"/>

8.4 Reaction _35

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

Name SnoN_degrad2

Reaction equation



Reactants

Table 15: Properties of each reactant.

Id	Name	SBO
_15	Smurf2_n	
species_13	pSmad2_SnoN_n	

Product

Table 16: Properties of each product.

Id	Name	SBO
_19	pSmad2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = k1 \cdot [_15]^3 \cdot [\text{species_13}] \quad (26)$$

Table 17: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.232		☑

8.5 Reaction _37

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

Name Smad_compNuc2

Reaction equation



Reactants

Table 18: Properties of each reactant.

Id	Name	SBO
_5	Smad4_n	
_19	pSmad2_n	

Product

Table 19: Properties of each product.

Id	Name	SBO
_9	pSmad2_Smad4_n	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \text{vol}(_3) \cdot k1 \cdot [_5] \cdot [_{19}]^2 \quad (28)$$

Table 20: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000337	255.068		<input checked="" type="checkbox"/>

8.6 Reaction _39

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

Name Smad2_dephosphNuc2

Reaction equation



Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
_19	pSmad2_n	

Product

Table 22: Properties of each product.

Id	Name	SBO
_21	Smad2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \text{vol}(_3) \cdot \text{function_1}([_19], \text{Km}, \text{V}) \quad (30)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (31)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (32)$$

Table 23: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	0.53		<input checked="" type="checkbox"/>
V	V	0000186	3.51		<input checked="" type="checkbox"/>

8.7 Reaction _41

This is an irreversible reaction of two reactants forming no product.

Name Smad2_degrad

Reaction equation



Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
_21	Smad2_n	

Id	Name	SBO
_15	Smurf2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \text{vol}(_3) \cdot k1 \cdot [_{21}] \cdot [_{15}] \quad (34)$$

Table 25: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.2		<input checked="" type="checkbox"/>

8.8 Reaction _43

This is a reversible reaction of two reactants forming one product.

Name Smad7-Smurf2

Reaction equation



Reactants

Table 26: Properties of each reactant.

Id	Name	SBO
_15	Smurf2_n	
_25	Smad7_n	

Product

Table 27: Properties of each product.

Id	Name	SBO
_27	Smad7_Smurf2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \text{vol}(_3) \cdot (k1 \cdot [_{15}] \cdot [_{25}] - k2 \cdot [_{27}]) \quad (36)$$

Table 28: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	2.9		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.9 Reaction _77

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

Name Rec_comp1

Reaction equation



Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
_75	TGF_RII	

Modifier

Table 30: Properties of each modifier.

Id	Name	SBO
_75	TGF_RII	

Product

Table 31: Properties of each product.

Id	Name	SBO
_79	TGFbeta_TGF_RII	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \text{vol}(_1) \cdot \text{function_2}(\text{parameter_1}, k, [_{75}], [_{75}]) \quad (38)$$

$$\text{function_2}(\text{TGFbeta}, k, s, s2) = k \cdot s \cdot s2 \cdot \text{TGFbeta} \quad (39)$$

$$\text{function_2}(\text{TGFbeta}, k, s, s2) = k \cdot s \cdot s2 \cdot \text{TGFbeta} \quad (40)$$

Table 32: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000337	9.45		<input checked="" type="checkbox"/>

8.10 Reaction _86

This is a reversible reaction of two reactants forming one product.

Name Rec_comp2

Reaction equation



Reactants

Table 33: Properties of each reactant.

Id	Name	SBO
_79	TGFbeta_TGF_RII	
_84	TGF_RI	

Product

Table 34: Properties of each product.

Id	Name	SBO
_96	Rec_active	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \text{vol}(_1) \cdot (k1 \cdot [_{79}] \cdot [_{84}]^2 - k2 \cdot [_{96}]) \quad (42)$$

Table 35: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.033		<input checked="" type="checkbox"/>
k2	k2	0000156	0.033		<input checked="" type="checkbox"/>

8.11 Reaction _103

This is a reversible reaction of two reactants forming one product.

Name SARA-comp2

Reaction equation



Reactants

Table 36: Properties of each reactant.

Id	Name	SBO
_101	SARA	
_99	Smad2_c	

Product

Table 37: Properties of each product.

Id	Name	SBO
_105	Smad2_SARA	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \text{vol}(_1) \cdot (k1 \cdot [_{101}] \cdot [_{99}] - k2 \cdot [_{105}]) \quad (44)$$

Table 38: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.0		<input checked="" type="checkbox"/>
k2	k2	0000156	0.1		<input checked="" type="checkbox"/>

8.12 Reaction _125

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

Name Smad2_phosph

Reaction equation



Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
_{99}	Smad2_c	

Modifier

Table 40: Properties of each modifier.

Id	Name	SBO
_{96}	Rec_active	

Product

Table 41: Properties of each product.

Id	Name	SBO
_129	pSmad2_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{vol}(_1) \cdot \text{function_3}(k, [_{96}], [_{99}], \text{km}) \quad (46)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (47)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (48)$$

Table 42: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000025	1000.000		<input checked="" type="checkbox"/>
km	km	0000027	0.032		<input checked="" type="checkbox"/>

8.13 Reaction _132

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

Name Smad2_phosphSARA

Reaction equation



Reactant

Table 43: Properties of each reactant.

Id	Name	SBO
_105	Smad2_SARA	

Modifier

Table 44: Properties of each modifier.

Id	Name	SBO
_96	Rec_active	

Products

Table 45: Properties of each product.

Id	Name	SBO
_129	pSmad2_c	
_101	SARA	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \text{vol}(_1) \cdot \text{function_3}(k, [_96], [_105], \text{km}) \quad (50)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (51)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (52)$$

Table 46: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000025	3.51		<input checked="" type="checkbox"/>
km	km	0000027	0.53		<input checked="" type="checkbox"/>

8.14 Reaction _139

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

Name Smad2-P_transp

Reaction equation



Reactant

Table 47: Properties of each reactant.

Id	Name	SBO
_129	pSmad2_c	

Product

Table 48: Properties of each product.

Id	Name	SBO
_19	pSmad2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = k1 \cdot [_129] \quad (54)$$

Table 49: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000009	16.6		<input checked="" type="checkbox"/>

8.15 Reaction _149

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

Name Smad_compCyt2

Reaction equation



Reactants

Table 50: Properties of each reactant.

Id	Name	SBO
_147	Smad4_c	
_129	pSmad2_c	

Product

Table 51: Properties of each product.


Id	Name	SBO
_153	pSmad2_Smad4_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \text{vol}(_1) \cdot k1 \cdot [_{147}] \cdot [_{129}]^2 \quad (56)$$

Table 52: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000337	1000.0		

8.16 Reaction _156

This is a reversible reaction of one reactant forming one product.

Name Smad4.transp

Reaction equation



Reactant

Table 53: Properties of each reactant.

Id	Name	SBO
_147	Smad4_c	

Product

Table 54: Properties of each product.

Id	Name	SBO
_5	Smad4_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = k1 \cdot [_{147}] - k2 \cdot [_5] \quad (58)$$

Table 55: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.156		<input checked="" type="checkbox"/>
k2	k2	0000156	0.156		<input checked="" type="checkbox"/>

8.17 Reaction _164

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

Name Smad_compTransp2

Reaction equation



Reactant

Table 56: Properties of each reactant.

Id	Name	SBO
_153	pSmad2_Smad4_c	

Product

Table 57: Properties of each product.

Id	Name	SBO
_9	pSmad2_Smad4_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = k1 \cdot [_{153}] \quad (60)$$

Table 58: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000009	0.16		<input checked="" type="checkbox"/>

8.18 Reaction _172

This is a reversible reaction of one reactant forming one product.

Name Smad7_transp

Reaction equation



Reactant

Table 59: Properties of each reactant.

Id	Name	SBO
_25	Smad7_n	

Product

Table 60: Properties of each product.

Id	Name	SBO
_174	Smad7_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = k1 \cdot [_{25}] - k2 \cdot [_{174}] \quad (62)$$

Table 61: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.10		<input checked="" type="checkbox"/>
k2	k2	0000156	0.01		<input checked="" type="checkbox"/>

8.19 Reaction _178

This is a reversible reaction of one reactant forming one product.

Name Smad7-Smurf2_transp

Reaction equation



Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
_{27}	Smad7_Smurf2_n	

Product

Table 63: Properties of each product.

Id	Name	SBO
_{181}	Smad7_Smurf2_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = k1 \cdot [_{27}] - k2 \cdot [_{181}] \quad (64)$$

Table 64: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.00		<input checked="" type="checkbox"/>
k2	k2	0000156	0.01		<input checked="" type="checkbox"/>

8.20 Reaction _192

This is an irreversible reaction of two reactants forming no product.

Name Rec_degrad1

Reaction equation



Reactants

Table 65: Properties of each reactant.

Id	Name	SBO
_181	Smad7_Smurf2_c	
_96	Rec_active	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \text{vol}(_1) \cdot k1 \cdot [_181] \cdot [_96] \quad (66)$$

Table 66: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	1900.0		<input checked="" type="checkbox"/>

8.21 Reaction _194

This is a reversible reaction of two reactants forming one product.

Name Rec_inhib

Reaction equation



Reactants

Table 67: Properties of each reactant.

Id	Name	SBO
_174	Smad7_c	
_96	Rec_active	

Product

Table 68: Properties of each product.

Id	Name	SBO
_198	Rec_Smad7	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \text{vol}(_1) \cdot (k1 \cdot [_174] \cdot [_96] - k2 \cdot [_198]) \quad (68)$$

Table 69: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	8.69		<input checked="" type="checkbox"/>
k2	k2	0000156	0.01		<input checked="" type="checkbox"/>

8.22 Reaction `reaction_1`

This is an irreversible reaction of no reactant forming one product.

Name fluxRecII

Reaction equation



Product

Table 70: Properties of each product.

Id	Name	SBO
_75	TGF_RII	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \text{vol}(_1) \cdot \text{function_4}(v) \quad (70)$$

$$\text{function_4}(v) = v \quad (71)$$

$$\text{function_4}(v) = v \quad (72)$$

Table 71: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
v	v	0000009	0.001		<input checked="" type="checkbox"/>

8.23 Reaction `reaction_2`

This is an irreversible reaction of no reactant forming one product influenced by one modifier.

Name fluxSara

Reaction equation



Modifier

Table 72: Properties of each modifier.

Id	Name	SBO
species_30	geneProduct	

Product

Table 73: Properties of each product.

Id	Name	SBO
_101	SARA	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \text{vol}(_1) \cdot \text{function_5}(k, k1, [\text{species_30}]) \quad (74)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (75)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (76)$$

Table 74: Properties of each parameter.

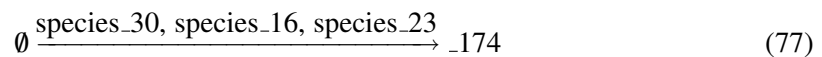
Id	Name	SBO	Value	Unit	Constant
k	k	0000153	10^{-4}		<input checked="" type="checkbox"/>
k1	k1	0000156	0.031		<input checked="" type="checkbox"/>

8.24 Reaction `reaction_3`

This is an irreversible reaction of no reactant forming one product influenced by three modifiers.

Name `fluxSmad7`

Reaction equation



Modifiers

Table 75: Properties of each modifier.

Id	Name	SBO
species_30	geneProduct	
species_16	Smad4_SnoN_n	

Id	Name	SBO
species_23	Smad4_Ski_n	

Product

Table 76: Properties of each product.

Id	Name	SBO
_174	Smad7_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \text{vol}(_1) \cdot \text{function_6}(k, k1, [\text{species_30}], [\text{species_16}], [\text{species_23}]) \quad (78)$$

$$\text{function_6}(k, k1, m, m2, m3) = \frac{k + k1 \cdot m}{1 + m2 + m3} \quad (79)$$

$$\text{function_6}(k, k1, m, m2, m3) = \frac{k + k1 \cdot m}{1 + m2 + m3} \quad (80)$$

Table 77: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000153	10^{-4}		<input checked="" type="checkbox"/>
k1	k1	0000156	0.100		<input checked="" type="checkbox"/>

8.25 Reaction [reaction_4](#)

This is an irreversible reaction of no reactant forming one product influenced by one modifier.

Name fluxSmurf2

Reaction equation



Modifier

Table 78: Properties of each modifier.

Id	Name	SBO
species_30	geneProduct	

Product

Table 79: Properties of each product.

Id	Name	SBO
species_1	Smurf2_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \text{vol}(-1) \cdot \text{function_5}(k, k1, [\text{species_30}]) \quad (82)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (83)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (84)$$

Table 80: Properties of each parameter.

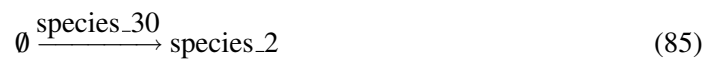
Id	Name	SBO	Value	Unit	Constant
k	k	0000153	$2.28 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
k1	k1	0000156	0.029		<input checked="" type="checkbox"/>

8.26 Reaction `reaction_5`

This is an irreversible reaction of no reactant forming one product influenced by one modifier.

Name fluxSnoN

Reaction equation



Modifier

Table 81: Properties of each modifier.

Id	Name	SBO
species_30	geneProduct	

Product

Table 82: Properties of each product.

Id	Name	SBO
species_2	SnoN_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \text{vol}(_1) \cdot \text{function_5}(k, k1, [\text{species_30}]) \quad (86)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (87)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (88)$$

Table 83: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000153	$2 \cdot 10^{-5}$		<input checked="" type="checkbox"/>
k1	k1	0000156	$5.5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

8.27 Reaction [reaction_6](#)

This is an irreversible reaction of no reactant forming one product.

Name fluxRecI

Reaction equation



Product

Table 84: Properties of each product.

Id	Name	SBO
_84	TGF_RI	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{vol}(_1) \cdot \text{function_4}(v) \quad (90)$$

$$\text{function_4}(v) = v \quad (91)$$

$$\text{function_4}(v) = v \quad (92)$$

Table 85: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
v	v	0000009	0.013		<input checked="" type="checkbox"/>

8.28 Reaction `reaction_7`

This is a reversible reaction of two reactants forming one product.

Name Smad4-SnoN

Reaction equation



Reactants

Table 86: Properties of each reactant.

Id	Name	SBO
_5	Smad4_n	
_11	SnoN_n	

Product

Table 87: Properties of each product.

Id	Name	SBO
species_16	Smad4_SnoN_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \text{vol}(_3) \cdot (k1 \cdot [_5] \cdot [_{11}] - k2 \cdot [\text{species_16}]) \quad (94)$$

Table 88: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.000		<input checked="" type="checkbox"/>
k2	k2	0000156	0.053		<input checked="" type="checkbox"/>

8.29 Reaction `reaction_8`

This is a reversible reaction of one reactant forming one product.

Name Smad2_transp

Reaction equation



Reactant

Table 89: Properties of each reactant.

Id	Name	SBO
_99	Smad2_c	

Product

Table 90: Properties of each product.

Id	Name	SBO
_21	Smad2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{29} = k1 \cdot [_{99}] - k2 \cdot [_{21}] \quad (96)$$

Table 91: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.156		<input checked="" type="checkbox"/>
k2	k2	0000156	0.336		<input checked="" type="checkbox"/>

8.30 Reaction `reaction_9`

This is an irreversible reaction of one reactant forming no product.

Name Rec_degrad

Reaction equation



Reactant

Table 92: Properties of each reactant.

Id	Name	SBO
_{96}	Rec_active	

Kinetic Law

Derived unit contains undeclared units

$$v_{30} = \text{vol}(_{1}) \cdot k1 \cdot [_{96}] \quad (98)$$

Table 93: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.028		<input checked="" type="checkbox"/>

8.31 Reaction [reaction_10](#)

This is an irreversible reaction of one reactant forming no product.

Name RecI_degrad

Reaction equation



Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
_84	TGF_RI	

Kinetic Law

Derived unit contains undeclared units

$$v_{31} = \text{vol}(_1) \cdot k1 \cdot [_84] \quad (100)$$

Table 95: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.028		<input checked="" type="checkbox"/>

8.32 Reaction [reaction_11](#)

This is an irreversible reaction of one reactant forming no product.

Name RecII_degrad

Reaction equation



Reactant

Table 96: Properties of each reactant.

Id	Name	SBO
_75	TGF_RII	

Kinetic Law

Derived unit contains undeclared units

$$v_{32} = \text{vol}(_1) \cdot k1 \cdot [_{75}] \quad (102)$$

Table 97: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.028		<input checked="" type="checkbox"/>

8.33 Reaction [reaction_12](#)

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

Name Rec_recycl

Reaction equation



Reactant

Table 98: Properties of each reactant.

Id	Name	SBO
_79	TGFbeta_TGF_RII	

Product

Table 99: Properties of each product.

Id	Name	SBO
_75	TGF_RII	

Kinetic Law

Derived unit contains undeclared units

$$v_{33} = \text{vol}(_1) \cdot k1 \cdot [_{79}] \quad (104)$$

Table 100: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000009	0.033		☑

8.34 Reaction `reaction_13`

This is an irreversible reaction of no reactant forming one product.

Name `fluxSmad2`

Reaction equation



Product

Table 101: Properties of each product.

Id	Name	SBO
_{99}	Smad2_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{34} = \text{vol}(_1) \cdot \text{function_4}(v) \quad (106)$$

$$\text{function_4}(v) = v \quad (107)$$

$$\text{function_4}(v) = v \quad (108)$$

Table 102: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
v	v	0000009	0.016		<input checked="" type="checkbox"/>

8.35 Reaction [reaction_14](#)

This is an irreversible reaction of no reactant forming one product.

Name fluxSmad4

Reaction equation



Product

Table 103: Properties of each product.

Id	Name	SBO
_147	Smad4.c	

Kinetic Law

Derived unit contains undeclared units

$$v_{35} = \text{vol}(_1) \cdot \text{function_4}(v) \quad (110)$$

$$\text{function_4}(v) = v \quad (111)$$

$$\text{function_4}(v) = v \quad (112)$$

Table 104: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
v	v	0000009	0.012		<input checked="" type="checkbox"/>

8.36 Reaction [reaction_15](#)

This is an irreversible reaction of one reactant forming no product.

Name Smad4_degrad

Reaction equation



Reactant

Table 105: Properties of each reactant.

Id	Name	SBO
_147	Smad4_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{36} = \text{vol}(_1) \cdot k1 \cdot _147 \quad (114)$$

Table 106: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.127		<input checked="" type="checkbox"/>

8.37 Reaction `reaction_16`

This is an irreversible reaction of one reactant forming no product.

Name SARA_degrad

Reaction equation



Reactant

Table 107: Properties of each reactant.

Id	Name	SBO
_101	SARA	

Kinetic Law

Derived unit contains undeclared units

$$v_{37} = \text{vol}(_1) \cdot k1 \cdot [_{101}] \quad (116)$$

Table 108: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.065		<input checked="" type="checkbox"/>

8.38 Reaction `reaction_17`

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

Name Smad2_dephospCyt

Reaction equation



Reactant

Table 109: Properties of each reactant.

Id	Name	SBO
_{129}	pSmad2_c	

Product

Table 110: Properties of each product.

Id	Name	SBO
_{99}	Smad2_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{38} = \text{vol}(_1) \cdot \text{function_1}([_{129}], \text{Km}, V) \quad (118)$$

$$\text{function_1}(\text{substrate}, \text{Km}, V) = \frac{V \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (119)$$

$$\text{function_1}(\text{substrate}, K_m, V) = \frac{V \cdot \text{substrate}}{K_m + \text{substrate}} \quad (120)$$

Table 111: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	3.51		<input checked="" type="checkbox"/>
V	V	0000186	0.53		<input checked="" type="checkbox"/>

8.39 Reaction [reaction_18](#)

This is an irreversible reaction of one reactant forming no product.

Name SnoN_degrad

Reaction equation



Reactant

Table 112: Properties of each reactant.

Id	Name	SBO
species_2	SnoN_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{39} = \text{vol}(.1) \cdot k1 \cdot [\text{species_2}] \quad (122)$$

Table 113: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.232		<input checked="" type="checkbox"/>

8.40 Reaction [reaction_19](#)

This is a reversible reaction of one reactant forming one product.

Name Smurf2_transp

Reaction equation



Reactant

Table 114: Properties of each reactant.

Id	Name	SBO
<code>_15</code>	Smurf2_n	

Product

Table 115: Properties of each product.

Id	Name	SBO
<code>species_1</code>	Smurf2_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{40} = k1 \cdot \text{[_15]} - k2 \cdot \text{[species_1]} \quad (124)$$

Table 116: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.233		<input checked="" type="checkbox"/>
k2	k2	0000156	1.806		<input checked="" type="checkbox"/>

8.41 Reaction `reaction_20`

This is an irreversible reaction of one reactant forming no product.

Name Smad2_cyt_degrad

Reaction equation



Reactant

Table 117: Properties of each reactant.

Id	Name	SBO
_99	Smad2_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{41} = \text{vol}(_{1}) \cdot k1 \cdot [_{99}] \quad (126)$$

Table 118: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.2		<input checked="" type="checkbox"/>

8.42 Reaction [reaction_21](#)

This is a reversible reaction of one reactant forming one product.

Name SnoN_trans

Reaction equation



Reactant

Table 119: Properties of each reactant.

Id	Name	SBO
species_2	SnoN_c	

Product

Table 120: Properties of each product.

Id	Name	SBO
_11	SnoN_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{42} = k1 \cdot [\text{species_2}] - k2 \cdot [-11] \quad (128)$$

Table 121: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.1		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.43 Reaction `reaction_22`

This is an irreversible reaction of no reactant forming one product.

Name `fluxSmad3`

Reaction equation



Product

Table 122: Properties of each product.

Id	Name	SBO
<code>species_3</code>	<code>Smad3_c</code>	

Kinetic Law

Derived unit contains undeclared units

$$v_{43} = \text{vol}(-1) \cdot \text{function_4}(v) \quad (130)$$

$$\text{function_4}(v) = v \quad (131)$$

$$\text{function_4}(v) = v \quad (132)$$

Table 123: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
v	v	0000009	0.045		<input checked="" type="checkbox"/>

8.44 Reaction [reaction_23](#)

This is an irreversible reaction of one reactant forming no product.

Name Smad3_cyt.degrad

Reaction equation



Reactant

Table 124: Properties of each reactant.

Id	Name	SBO
species_3	Smad3_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{44} = \text{vol}(.1) \cdot k1 \cdot [\text{species_3}] \quad (134)$$

Table 125: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.2		<input checked="" type="checkbox"/>

8.45 Reaction [reaction_24](#)

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

Name Smad3_dephospCyt

Reaction equation



Reactant

Table 126: Properties of each reactant.

Id	Name	SBO
species_4	pSmad3_c	

Product

Table 127: Properties of each product.

Id	Name	SBO
species_3	Smad3_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{45} = \text{vol}(.1) \cdot \text{function_1}([\text{species_4}], \text{Km}, \text{V}) \quad (136)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (137)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (138)$$

Table 128: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	3.51		<input checked="" type="checkbox"/>
V	V	0000186	0.53		<input checked="" type="checkbox"/>

8.46 Reaction `reaction_25`

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

Name Smad3_dephospNuc

Reaction equation



Reactant

Table 129: Properties of each reactant.

Id	Name	SBO
species_18	pSmad3_Smad4_n	

Product

Table 130: Properties of each product.

Id	Name	SBO
species_27	Smad4_Smad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{46} = \text{vol}(_3) \cdot \text{function_1}([\text{species_18}], \text{Km}, \text{V}) \quad (140)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (141)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (142)$$

Table 131: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	40.00		<input checked="" type="checkbox"/>
V	V	0000186	2.34		<input checked="" type="checkbox"/>

8.47 Reaction [reaction_26](#)

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

Name Smad3_dephospNuc2

Reaction equation



Reactant

Table 132: Properties of each reactant.

Id	Name	SBO
species_20	pSmad3_n	

Product

Table 133: Properties of each product.

Id	Name	SBO
species_17	Smad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{47} = \text{vol}(_3) \cdot \text{function_1}([[\text{species_20}], \text{Km}, \text{V}]) \quad (144)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (145)$$

$$\text{function_1}(\text{substrate}, \text{Km}, \text{V}) = \frac{\text{V} \cdot \text{substrate}}{\text{Km} + \text{substrate}} \quad (146)$$

Table 134: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Km	Km	0000027	0.53		<input checked="" type="checkbox"/>
V	V	0000186	3.51		<input checked="" type="checkbox"/>

8.48 Reaction [reaction_27](#)

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

Name Smad3_phosph

Reaction equation



Reactant

Table 135: Properties of each reactant.

Id	Name	SBO
species_3	Smad3_c	

Modifier

Table 136: Properties of each modifier.

Id	Name	SBO
_96	Rec_active	

Product

Table 137: Properties of each product.

Id	Name	SBO
species_4	pSmad3_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{48} = \text{vol}(-1) \cdot \text{function_3}(k, [-96], [\text{species_3}], \text{km}) \quad (148)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (149)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (150)$$

Table 138: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000025	1000.000		✓
km	km	0000027	0.032		✓

8.49 Reaction `reaction_28`

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

Name Smad3_phosphSARA

Reaction equation



Reactant

Table 139: Properties of each reactant.

Id	Name	SBO
species_5	Smad3_SARA	

Modifier

Table 140: Properties of each modifier.

Id	Name	SBO
.96	Rec_active	

Products

Table 141: Properties of each product.

Id	Name	SBO
species_4	pSmad3_c	
.101	SARA	

Kinetic Law

Derived unit contains undeclared units

$$v_{49} = \text{vol}(-1) \cdot \text{function_3}(k, [-96], [\text{species_5}], \text{km}) \quad (152)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (153)$$

$$\text{function_3}(k, \text{rec}, s, \text{km}) = \frac{k \cdot \text{rec} \cdot s}{\text{km} + s} \quad (154)$$

Table 142: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000025	3.51		<input checked="" type="checkbox"/>
km	km	0000027	0.53		<input checked="" type="checkbox"/>

8.50 Reaction [reaction_29](#)

This is an irreversible reaction of one reactant forming no product.

Name Smad3_degrad

Reaction equation



Reactant

Table 143: Properties of each reactant.

Id	Name	SBO
species_17	Smad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{50} = \text{vol}(_3) \cdot k1 \cdot [\text{species_17}] \quad (156)$$

Table 144: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.2		<input checked="" type="checkbox"/>

8.51 Reaction [reaction_30](#)

This is a reversible reaction of one reactant forming one product.

Name Smad3_transp

Reaction equation



Reactant

Table 145: Properties of each reactant.

Id	Name	SBO
species_3	Smad3_c	

Product

Table 146: Properties of each product.

Id	Name	SBO
species_17	Smad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{51} = k1 \cdot [\text{species_3}] - k2 \cdot [\text{species_17}] \quad (158)$$

Table 147: Properties of each parameter.

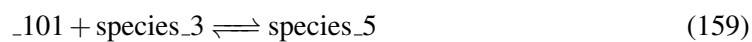
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.156		✓
k2	k2	0000156	0.336		✓

8.52 Reaction [reaction_31](#)

This is a reversible reaction of two reactants forming one product.

Name SARA-comp3

Reaction equation



Reactants

Table 148: Properties of each reactant.

Id	Name	SBO
_101	SARA	
species_3	Smad3_c	

Product

Table 149: Properties of each product.

Id	Name	SBO
species_5	Smad3_SARA	

Kinetic Law

Derived unit contains undeclared units

$$v_{52} = \text{vol}(_1) \cdot (k1 \cdot [_{101}] \cdot [\text{species}_3] - k2 \cdot [\text{species}_5]) \quad (160)$$

Table 150: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.0		<input checked="" type="checkbox"/>
k2	k2	0000156	0.1		<input checked="" type="checkbox"/>

8.53 Reaction [reaction_32](#)

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

Name Smad.dissoc2

Reaction equation



Reactant

Table 151: Properties of each reactant.

Id	Name	SBO
species_19	Smad4_Smad2_n	

Products

Table 152: Properties of each product.

Id	Name	SBO
_5	Smad4_n	
_21	Smad2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{53} = \text{vol}(_3) \cdot k1 \cdot [\text{species_19}] \quad (162)$$

Table 153: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000282	0.049		<input checked="" type="checkbox"/>

8.54 Reaction [reaction_33](#)

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

Name Smad3-P-transp

Reaction equation



Reactant

Table 154: Properties of each reactant.

Id	Name	SBO
species_4	pSmad3_c	

Product

Table 155: Properties of each product.

Id	Name	SBO
species_20	pSmad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{54} = k1 \cdot [\text{species}_4] \quad (164)$$

Table 156: Properties of each parameter.

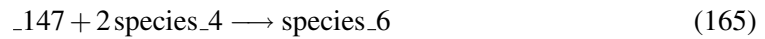
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000009	16.6		<input checked="" type="checkbox"/>

8.55 Reaction [reaction_34](#)

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

Name Smad_compCyt3

Reaction equation



Reactants

Table 157: Properties of each reactant.

Id	Name	SBO
_147	Smad4_c	
species_4	pSmad3_c	

Product

Table 158: Properties of each product.

Id	Name	SBO
species_6	pSmad3_Smad4_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{55} = \text{vol}(_1) \cdot k1 \cdot [_{147}] \cdot [\text{species}_4]^2 \quad (166)$$

Table 159: Properties of each parameter.

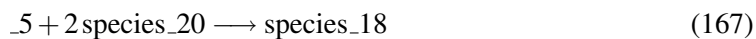
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000337	1000.0		<input checked="" type="checkbox"/>

8.56 Reaction `reaction_35`

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

Name Smad_compNuc3

Reaction equation



Reactants

Table 160: Properties of each reactant.

Id	Name	SBO
_5	Smad4_n	
species_20	pSmad3_n	

Product

Table 161: Properties of each product.

Id	Name	SBO
species_18	pSmad3_Smad4_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{56} = \text{vol}(_3) \cdot k1 \cdot [_5] \cdot [\text{species}_{20}]^2 \quad (168)$$

Table 162: Properties of each parameter.

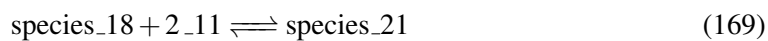
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000337	255.068		<input checked="" type="checkbox"/>

8.57 Reaction [reaction_36](#)

This is a reversible reaction of two reactants forming one product.

Name Smad_inhibComp3SnoN

Reaction equation



Reactants

Table 163: Properties of each reactant.

Id	Name	SBO
species_18	pSmad3_Smad4_n	
_11	SnoN_n	

Product

Table 164: Properties of each product.

Id	Name	SBO
species_21	pSmad3_Smad4_SnoN_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{57} = \text{vol}(_3) \cdot (k1 \cdot [\text{species_18}] \cdot [_11]^2 - k2 \cdot [\text{species_21}]) \quad (170)$$

Table 165: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.6		<input checked="" type="checkbox"/>
k2	k2	0000156	1.6		<input checked="" type="checkbox"/>

8.58 Reaction [reaction_37](#)

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

Name Smad.compTransp3

Reaction equation



Reactant

Table 166: Properties of each reactant.

Id	Name	SBO
species_6	pSmad3_Smad4_c	

Product

Table 167: Properties of each product.

Id	Name	SBO
species_18	pSmad3_Smad4_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{58} = k1 \cdot [\text{species_6}] \quad (172)$$

Table 168: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000337	0.16		<input checked="" type="checkbox"/>

8.59 Reaction [reaction_38](#)

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

Name SnoN_degrad3

Reaction equation



Reactant

Table 169: Properties of each reactant.

Id	Name	SBO
species_14	pSmad3_SnoN_n	

Product

Table 170: Properties of each product.

Id	Name	SBO
species_20	pSmad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{59} = k1 \cdot [\text{species_14}] \quad (174)$$

Table 171: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.232		<input checked="" type="checkbox"/>

8.60 Reaction [reaction_39](#)

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

Name Smad7_degrad

Reaction equation



Reactant

Table 172: Properties of each reactant.

Id	Name	SBO
_174	Smad7_c	

Modifier

Table 173: Properties of each modifier.

Id	Name	SBO
species_15	Arkadia_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{60} = \text{vol}(-1) \cdot \text{function_7}(k1, [-174], [\text{species_15}]) \quad (176)$$

$$\text{function_7}(k1, \text{substrate}, \text{modifier}) = k1 \cdot \text{substrate} \cdot (1 + \text{modifier}) \quad (177)$$

$$\text{function_7}(k1, \text{substrate}, \text{modifier}) = k1 \cdot \text{substrate} \cdot (1 + \text{modifier}) \quad (178)$$

Table 174: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.1		<input checked="" type="checkbox"/>

8.61 Reaction [reaction_40](#)

This is an irreversible reaction of one reactant forming no product.

Name Ski_degrad

Reaction equation



Reactant

Table 175: Properties of each reactant.

Id	Name	SBO
species_7	Ski_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{61} = \text{vol}(_1) \cdot k1 \cdot [\text{species_7}] \quad (180)$$

Table 176: Properties of each parameter.

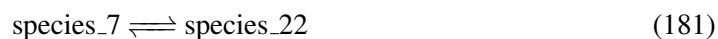
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.232		<input checked="" type="checkbox"/>

8.62 Reaction [reaction_41](#)

This is a reversible reaction of one reactant forming one product.

Name Ski_trans

Reaction equation



Reactant

Table 177: Properties of each reactant.

Id	Name	SBO
species_7	Ski_c	

Product

Table 178: Properties of each product.

Id	Name	SBO
species_22	Ski_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{62} = k1 \cdot [\text{species_7}] - k2 \cdot [\text{species_22}] \quad (182)$$

Table 179: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.1		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.63 Reaction [reaction_42](#)

This is an irreversible reaction of no reactant forming one product influenced by one modifier.

Name fluxSki

Reaction equation



Modifier

Table 180: Properties of each modifier.

Id	Name	SBO
species_30	geneProduct	

Product

Table 181: Properties of each product.

Id	Name	SBO
species_7	Ski_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{63} = \text{vol}(_1) \cdot \text{function_5}(k, k1, [\text{species_30}]) \quad (184)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (185)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (186)$$

Table 182: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000153	$2 \cdot 10^{-5}$		<input checked="" type="checkbox"/>
k1	k1	0000156	$5.5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>

8.64 Reaction `reaction_43`

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

Name Smurf2_degrad

Reaction equation



Reactant

Table 183: Properties of each reactant.

Id	Name	SBO
species_1	Smurf2_c	

Modifier

Table 184: Properties of each modifier.

Id	Name	SBO
_174	Smad7_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{64} = \text{vol}(_1) \cdot \text{function_7}(k1, [\text{species_1}], [_174]) \quad (188)$$

$$\text{function_7}(k1, \text{substrate}, \text{modifier}) = k1 \cdot \text{substrate} \cdot (1 + \text{modifier}) \quad (189)$$

$$\text{function_7}(k1, \text{substrate}, \text{modifier}) = k1 \cdot \text{substrate} \cdot (1 + \text{modifier}) \quad (190)$$

Table 185: Properties of each parameter.

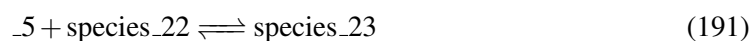
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.05		<input checked="" type="checkbox"/>

8.65 Reaction [reaction_44](#)

This is a reversible reaction of two reactants forming one product.

Name Smad4-Ski

Reaction equation



Reactants

Table 186: Properties of each reactant.

Id	Name	SBO
_5	Smad4.n	
species_22	Ski.n	

Product

Table 187: Properties of each product.

Id	Name	SBO
species_23	Smad4_Ski.n	

Kinetic Law

Derived unit contains undeclared units

$$v_{65} = \text{vol}(_3) \cdot (k1 \cdot [_5] \cdot [\text{species_22}] - k2 \cdot [\text{species_23}]) \quad (192)$$

Table 188: Properties of each parameter.

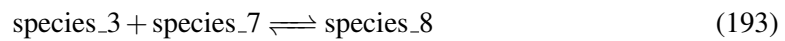
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.000		<input checked="" type="checkbox"/>
k2	k2	0000156	0.053		<input checked="" type="checkbox"/>

8.66 Reaction [reaction_45](#)

This is a reversible reaction of two reactants forming one product.

Name Smad3-Ski_cyt

Reaction equation



Reactants

Table 189: Properties of each reactant.

Id	Name	SBO
species_3	Smad3_c	
species_7	Ski_c	

Product

Table 190: Properties of each product.

Id	Name	SBO
species_8	Smad3_Ski_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{66} = \text{vol}(-1) \cdot (k1 \cdot [\text{species_3}] \cdot [\text{species_7}] - k2 \cdot [\text{species_8}]) \quad (194)$$

Table 191: Properties of each parameter.

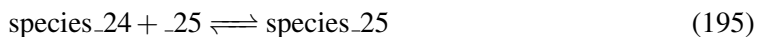
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.1		<input checked="" type="checkbox"/>
k2	k2	0000156	0.1		<input checked="" type="checkbox"/>

8.67 Reaction [reaction_46](#)

This is a reversible reaction of two reactants forming one product.

Name Smad7-Smurf1

Reaction equation



Reactants

Table 192: Properties of each reactant.

Id	Name	SBO
species_24	Smurf1_n	
_25	Smad7_n	

Product

Table 193: Properties of each product.

Id	Name	SBO
species_25	Smad7_Smurf1_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{67} = \text{vol}(\text{_3}) \cdot (k1 \cdot [\text{species_24}] \cdot [\text{_25}] - k2 \cdot [\text{species_25}]) \quad (196)$$

Table 194: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	2.9		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.68 Reaction [reaction_47](#)

This is an irreversible reaction of no reactant forming one product influenced by one modifier.

Name fluxSmurf1

Reaction equation



Modifier

Table 195: Properties of each modifier.

Id	Name	SBO
species_30	geneProduct	

Product

Table 196: Properties of each product.

Id	Name	SBO
species_9	Smurf1_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{68} = \text{vol}(_1) \cdot \text{function_5}(k, k1, [\text{species_30}]) \quad (198)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (199)$$

$$\text{function_5}(k, k1, m) = k + k1 \cdot m \quad (200)$$

Table 197: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k	k	0000153	10^{-4}		<input checked="" type="checkbox"/>
k1	k1	0000156	0.002		<input checked="" type="checkbox"/>

8.69 Reaction [reaction_48](#)

This is a reversible reaction of two reactants forming one product.

Name Smad_inhibComp3Ski

Reaction equation



Reactants

Table 198: Properties of each reactant.

Id	Name	SBO
species_18	pSmad3_Smad4_n	
species_22	Ski_n	

Product

Table 199: Properties of each product.

Id	Name	SBO
species_26	pSmad3_Smad4_Ski_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{69} = \text{vol}(_3) \cdot (k1 \cdot [\text{species_18}] \cdot [\text{species_22}]^2 - k2 \cdot [\text{species_26}]) \quad (202)$$

Table 200: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.6		<input checked="" type="checkbox"/>
k2	k2	0000156	1.6		<input checked="" type="checkbox"/>

8.70 Reaction [reaction_49](#)

This is an irreversible reaction of two reactants forming no product.

Name Rec_degrad2

Reaction equation



Reactants

Table 201: Properties of each reactant.


Id	Name	SBO
species_10	Smad7_Smurfl_c	
_96	Rec_active	

Kinetic Law

Derived unit contains undeclared units

$$v_{70} = \text{vol}(_1) \cdot k_1 \cdot [\text{species_10}] \cdot [_{96}] \quad (204)$$

Table 202: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	1900.0		

8.71 Reaction [reaction_50](#)

This is a reversible reaction of one reactant forming one product.

Name Smad7-Smurfl_transp

Reaction equation



Reactant

Table 203: Properties of each reactant.

Id	Name	SBO
species_25	Smad7_Smurfl_n	

Product

Table 204: Properties of each product.

Id	Name	SBO
species_10	Smad7_Smurfl_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{71} = k1 \cdot [\text{species_25}] - k2 \cdot [\text{species_10}] \quad (206)$$

Table 205: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.00		<input checked="" type="checkbox"/>
k2	k2	0000156	0.01		<input checked="" type="checkbox"/>

8.72 Reaction [reaction_51](#)

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

Name Smurfl_degrad

Reaction equation



Reactant

Table 206: Properties of each reactant.

Id	Name	SBO
species_9	Smurfl_c	

Modifier

Table 207: Properties of each modifier.

Id	Name	SBO
_174	Smad7_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{72} = \text{vol}(_1) \cdot \text{function_7}(k1, [\text{species_9}], [_{174}]) \quad (208)$$

$$\text{function_7}(k1, \text{substrate}, \text{modifier}) = k1 \cdot \text{substrate} \cdot (1 + \text{modifier}) \quad (209)$$

$$\text{function_7}(k1, \text{substrate}, \text{modifier}) = k1 \cdot \text{substrate} \cdot (1 + \text{modifier}) \quad (210)$$

Table 208: Properties of each parameter.

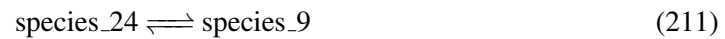
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.5		✓

8.73 Reaction [reaction_52](#)

This is a reversible reaction of one reactant forming one product.

Name Smurf1_transp

Reaction equation



Reactant

Table 209: Properties of each reactant.

Id	Name	SBO
species_24	Smurf1_n	

Product

Table 210: Properties of each product.

Id	Name	SBO
species_9	Smurf1_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{73} = k1 \cdot [\text{species_24}] - k2 \cdot [\text{species_9}] \quad (212)$$

Table 211: Properties of each parameter.

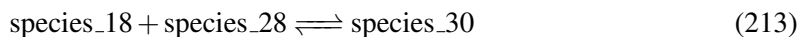
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.05		<input checked="" type="checkbox"/>
k2	k2	0000156	3.00		<input checked="" type="checkbox"/>

8.74 Reaction [reaction_53](#)

This is a reversible reaction of two reactants forming one product.

Name Smad3-freePromot

Reaction equation



Reactants

Table 212: Properties of each reactant.

Id	Name	SBO
species_18	pSmad3_Smad4_n	
species_28	freePromoters	

Product

Table 213: Properties of each product.

Id	Name	SBO
species_30	geneProduct	

Kinetic Law

Derived unit contains undeclared units

$$v_{74} = \text{vol}(_3) \cdot (k1 \cdot [\text{species_18}] \cdot [\text{species_28}] - k2 \cdot [\text{species_30}]) \quad (214)$$

Table 214: Properties of each parameter.

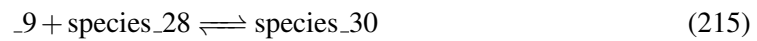
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.463		<input checked="" type="checkbox"/>
k2	k2	0000156	0.102		<input checked="" type="checkbox"/>

8.75 Reaction [reaction_54](#)

This is a reversible reaction of two reactants forming one product.

Name Smad2-freePromot

Reaction equation



Reactants

Table 215: Properties of each reactant.

Id	Name	SBO
_9	pSmad2_Smad4_n	
species_28	freePromoters	

Product

Table 216: Properties of each product.

Id	Name	SBO
species_30	geneProduct	

Kinetic Law

Derived unit contains undeclared units

$$v_{75} = \text{vol}(_3) \cdot (k1 \cdot [_9] \cdot [\text{species_28}] - k2 \cdot [\text{species_30}]) \quad (216)$$

Table 217: Properties of each parameter.

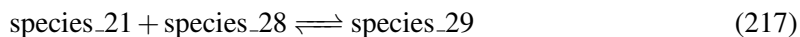
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.463		<input checked="" type="checkbox"/>
k2	k2	0000156	0.102		<input checked="" type="checkbox"/>

8.76 Reaction [reaction_55](#)

This is a reversible reaction of two reactants forming one product.

Name Smad3-SnoN-freePromot

Reaction equation



Reactants

Table 218: Properties of each reactant.

Id	Name	SBO
species_21	pSmad3_Smad4_SnoN_n	
species_28	freePromoters	

Product

Table 219: Properties of each product.

Id	Name	SBO
species_29	inactivePromoters	

Kinetic Law

Derived unit contains undeclared units

$$v_{76} = \text{vol}(_3) \cdot (k1 \cdot [\text{species_21}] \cdot [\text{species_28}] - k2 \cdot [\text{species_29}]) \quad (218)$$

Table 220: Properties of each parameter.

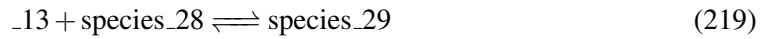
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.2		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.77 Reaction [reaction_56](#)

This is a reversible reaction of two reactants forming one product.

Name Smad2-SnoN-gene

Reaction equation



Reactants

Table 221: Properties of each reactant.

Id	Name	SBO
_13	pSmad2_Smad4_SnoN_n	
species_28	freePromoters	

Product

Table 222: Properties of each product.

Id	Name	SBO
species_29	inactivePromoters	

Kinetic Law

Derived unit contains undeclared units

$$v_{77} = \text{vol}(_3) \cdot (k1 \cdot _13 \cdot [\text{species_28}] - k2 \cdot [\text{species_29}]) \quad (220)$$

Table 223: Properties of each parameter.

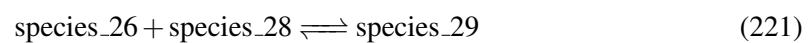
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.2		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.78 Reaction [reaction_57](#)

This is a reversible reaction of two reactants forming one product.

Name Smad3-Ski-freePromot

Reaction equation



Reactants

Table 224: Properties of each reactant.

Id	Name	SBO
species_26	pSmad3_Smad4_Ski_n	
species_28	freePromoters	

Product

Table 225: Properties of each product.

Id	Name	SBO
species_29	inactivePromoters	

Kinetic Law

Derived unit contains undeclared units

$$v_{78} = \text{vol}(_3) \cdot (k1 \cdot [\text{species_26}] \cdot [\text{species_28}] - k2 \cdot [\text{species_29}]) \quad (222)$$

Table 226: Properties of each parameter.

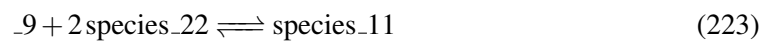
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.2		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.79 Reaction [reaction_58](#)

This is a reversible reaction of two reactants forming one product.

Name Smad.inhibComp2Ski

Reaction equation



Reactants

Table 227: Properties of each reactant.

Id	Name	SBO
_9	pSmad2_Smad4_n	
species_22	Ski_n	

Product

Table 228: Properties of each product.

Id	Name	SBO
species_11	pSmad2_Smad4_Ski_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{79} = k1 \cdot [_9] \cdot [\text{species_22}]^2 - k2 \cdot [\text{species_11}] \quad (224)$$

Table 229: Properties of each parameter.

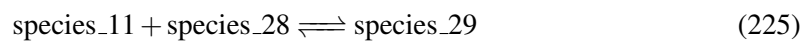
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.6		✓
k2	k2	0000156	1.6		✓

8.80 Reaction [reaction_59](#)

This is a reversible reaction of two reactants forming one product.

Name Smad2-Ski-gene

Reaction equation



Reactants

Table 230: Properties of each reactant.

Id	Name	SBO
species_11	pSmad2_Smad4_Ski_n	

Id	Name	SBO
species_28	freePromoters	

Product

Table 231: Properties of each product.

Id	Name	SBO
species_29	inactivePromoters	

Kinetic Law

Derived unit contains undeclared units

$$v_{80} = k1 \cdot [\text{species_11}] \cdot [\text{species_28}] - k2 \cdot [\text{species_29}] \quad (226)$$

Table 232: Properties of each parameter.

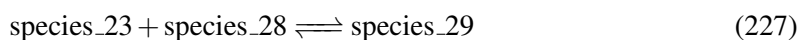
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.2		<input checked="" type="checkbox"/>
k2	k2	0000156	0.2		<input checked="" type="checkbox"/>

8.81 Reaction [reaction_60](#)

This is a reversible reaction of two reactants forming one product.

Name Smad4-freePromot

Reaction equation



Reactants

Table 233: Properties of each reactant.

Id	Name	SBO
species_23	Smad4_Ski_n	
species_28	freePromoters	

Product

Table 234: Properties of each product.

Id	Name	SBO
species_29	inactivePromoters	

Kinetic Law

Derived unit contains undeclared units

$$v_{81} = \text{vol}(_3) \cdot (k1 \cdot [\text{species_23}] \cdot [\text{species_28}] - k2 \cdot [\text{species_29}]) \quad (228)$$

Table 235: Properties of each parameter.

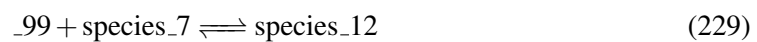
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.1		<input checked="" type="checkbox"/>
k2	k2	0000156	0.1		<input checked="" type="checkbox"/>

8.82 Reaction [reaction_61](#)

This is a reversible reaction of two reactants forming one product.

Name Smad2-Ski_cyt

Reaction equation



Reactants

Table 236: Properties of each reactant.

Id	Name	SBO
_99	Smad2_c	
species_7	Ski_c	

Product

Table 237: Properties of each product.

Id	Name	SBO
species_12	Smad2_Ski_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{82} = \text{vol}(_1) \cdot (k1 \cdot [_{99}] \cdot [\text{species}_7] - k2 \cdot [\text{species}_{12}]) \quad (230)$$

Table 238: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.1		<input checked="" type="checkbox"/>
k2	k2	0000156	0.1		<input checked="" type="checkbox"/>

8.83 Reaction [reaction_62](#)

This is a reversible reaction of two reactants forming one product.

Name Smad2-Snon

Reaction equation



Reactants

Table 239: Properties of each reactant.

Id	Name	SBO
_19	pSmad2_n	
_11	SnoN_n	

Product

Table 240: Properties of each product.

Id	Name	SBO
species_13	pSmad2_SnoN_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{83} = k1 \cdot [-19]^3 \cdot [-11]^3 - k2 \cdot [\text{species_13}] \quad (232)$$

Table 241: Properties of each parameter.

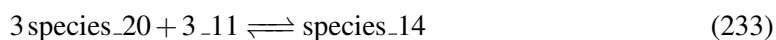
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.0		<input checked="" type="checkbox"/>
k2	k2	0000156	1.0		<input checked="" type="checkbox"/>

8.84 Reaction [reaction_63](#)

This is a reversible reaction of two reactants forming one product.

Name Smad3-Snon

Reaction equation



Reactants

Table 242: Properties of each reactant.

Id	Name	SBO
species_20	pSmad3_n	
_11	SnoN_n	

Product

Table 243: Properties of each product.

Id	Name	SBO
species_14	pSmad3_SnoN_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{84} = k1 \cdot [\text{species_20}]^3 \cdot [-11]^3 - k2 \cdot [\text{species_14}] \quad (234)$$

Table 244: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	1.0		<input checked="" type="checkbox"/>
k2	k2	0000156	1.0		<input checked="" type="checkbox"/>

8.85 Reaction [reaction_64](#)

This is an irreversible reaction of one reactant forming no product.

Name Smad2-comp-degrad

Reaction equation



Reactant

Table 245: Properties of each reactant.

Id	Name	SBO
_9	pSmad2_Smad4_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{85} = \text{vol}(_3) \cdot k1 \cdot [_9] \quad (236)$$

Table 246: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.005		<input checked="" type="checkbox"/>

8.86 Reaction [reaction_65](#)

This is an irreversible reaction of one reactant forming no product.

Name Samd3-comp-degrad

Reaction equation



Reactant

Table 247: Properties of each reactant.

Id	Name	SBO
species_18	pSmad3_Smad4_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{86} = \text{vol}(_3) \cdot k1 \cdot [\text{species_18}] \quad (238)$$

Table 248: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.005		✓

8.87 Reaction [reaction_66](#)

This is an irreversible reaction of no reactant forming one product.

Name fluxArkadia

Reaction equation



Product

Table 249: Properties of each product.

Id	Name	SBO
species_15	Arkadia_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{87} = \text{vol}(_1) \cdot \text{function_4}(v) \quad (240)$$

$$\text{function_4}(v) = v \quad (241)$$

$$\text{function_4}(v) = v \quad (242)$$

Table 250: Properties of each parameter.

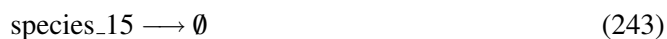
Id	Name	SBO	Value	Unit	Constant
v	v	0000009	$2 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

8.88 Reaction `reaction_67`

This is an irreversible reaction of one reactant forming no product.

Name Arkadia_deg

Reaction equation



Reactant

Table 251: Properties of each reactant.

Id	Name	SBO
species_15	Arkadia_c	

Kinetic Law

Derived unit contains undeclared units

$$v_{88} = \text{vol}(_1) \cdot k_1 \cdot [\text{species_15}] \quad (244)$$

Table 252: Properties of each parameter.

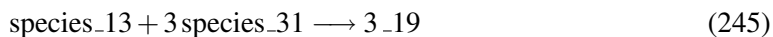
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.1		<input checked="" type="checkbox"/>

8.89 Reaction [reaction_68](#)

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

Name SnoN-deg2

Reaction equation



Reactants

Table 253: Properties of each reactant.

Id	Name	SBO
species_13	pSmad2_SnoN_n	
species_31	Arkadia_n	

Product

Table 254: Properties of each product.

Id	Name	SBO
_19	pSmad2_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{89} = k1 \cdot [\text{species_13}] \cdot [\text{species_31}]^3 \quad (246)$$

Table 255: Properties of each parameter.

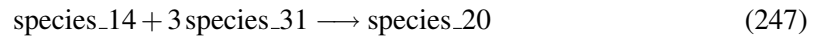
Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.1		<input checked="" type="checkbox"/>

8.90 Reaction [reaction_69](#)

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

Name SnoN-deg3

Reaction equation



Reactants

Table 256: Properties of each reactant.

Id	Name	SBO
species_14	pSmad3_SnoN_n	
species_31	Arkadia_n	

Product

Table 257: Properties of each product.

Id	Name	SBO
species_20	pSmad3_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{90} = k1 \cdot [\text{species_14}] \cdot [\text{species_31}]^3 \quad (248)$$

Table 258: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000356	0.1		<input checked="" type="checkbox"/>

8.91 Reaction [reaction_70](#)

This is a reversible reaction of one reactant forming one product.

Name transArkadia

Reaction equation



Reactant

Table 259: Properties of each reactant.

Id	Name	SBO
species_15	Arkadia_c	

Product

Table 260: Properties of each product.

Id	Name	SBO
species_31	Arkadia_n	

Kinetic Law

Derived unit contains undeclared units

$$v_{91} = k1 \cdot [\text{species_15}] - k2 \cdot [\text{species_31}] \quad (250)$$

Table 261: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1	k1	0000153	0.1		<input checked="" type="checkbox"/>
k2	k2	0000156	0.1		<input checked="" type="checkbox"/>

9 Derived Rate Equations

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

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

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

9.1 Species _75

Name TGF_RII

SBO:0000252 polypeptide chain

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

This species takes part in five reactions (as a reactant in [_77](#), [reaction_11](#) and as a product in [reaction_1](#), [reaction_12](#) and as a modifier in [_77](#)).

$$\frac{d}{dt}_{75} = v_{22} + 2 v_{33} - 2 v_9 - v_{32} \quad (251)$$

9.2 Species [_79](#)

Name TGFbeta_TGF_RII

SBO:0000296 macromolecular complex

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

This species takes part in three reactions (as a reactant in [_86](#), [reaction_12](#) and as a product in [_77](#)).

$$\frac{d}{dt}_{79} = v_9 - v_{10} - v_{33} \quad (252)$$

9.3 Species [_84](#)

Name TGF_RI

SBO:0000252 polypeptide chain

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

This species takes part in three reactions (as a reactant in [_86](#), [reaction_10](#) and as a product in [reaction_6](#)).

$$\frac{d}{dt}_{84} = v_{27} - 2 v_{10} - v_{31} \quad (253)$$

9.4 Species [_96](#)

Name Rec_active

SBO:0000247 simple chemical

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

This species takes part in nine reactions (as a reactant in [_192](#), [_194](#), [reaction_9](#), [reaction_49](#) and as a product in [_86](#) and as a modifier in [_125](#), [_132](#), [reaction_27](#), [reaction_28](#)).

$$\frac{d}{dt}_{96} = v_{10} - v_{20} - v_{21} - v_{30} - v_{70} \quad (254)$$

9.5 Species _99

Name Smad2_c

SBO:0000252 polypeptide chain

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

This species takes part in seven reactions (as a reactant in [_103](#), [_125](#), [reaction_8](#), [reaction_20](#), [reaction_61](#) and as a product in [reaction_13](#), [reaction_17](#)).

$$\frac{d}{dt}_{99} = v_{34} + v_{38} - v_{11} - v_{12} - v_{29} - v_{41} - v_{82} \quad (255)$$

9.6 Species _101

Name SARA

SBO:0000252 polypeptide chain

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

This species takes part in six reactions (as a reactant in [_103](#), [reaction_16](#), [reaction_31](#) and as a product in [_132](#), [reaction_2](#), [reaction_28](#)).

$$\frac{d}{dt}_{101} = v_{13} + v_{23} + v_{49} - v_{11} - v_{37} - v_{52} \quad (256)$$

9.7 Species _105

Name Smad2_SARA

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [_132](#) and as a product in [_103](#)).

$$\frac{d}{dt}_{105} = v_{11} - v_{13} \quad (257)$$

9.8 Species _129

Name pSmad2_c

SBO:0000252 polypeptide chain

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

This species takes part in five reactions (as a reactant in [_139](#), [_149](#), [reaction_17](#) and as a product in [_125](#), [_132](#)).

$$\frac{d}{dt}_{129} = v_{12} + v_{13} - v_{14} - 2 v_{15} - v_{38} \quad (258)$$

9.9 Species _147

Name Smad4_c

SBO:0000252 polypeptide chain

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

This species takes part in five reactions (as a reactant in [_149](#), [_156](#), [reaction_15](#), [reaction_34](#) and as a product in [reaction_14](#)).

$$\frac{d}{dt}_{147} = v_{35} - v_{15} - v_{16} - v_{36} - v_{55} \quad (259)$$

9.10 Species _153

Name pSmad2_Smad4_c

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [_164](#) and as a product in [_149](#)).

$$\frac{d}{dt}_{153} = v_{15} - v_{17} \quad (260)$$

9.11 Species _174

Name Smad7_c

SBO:0000252 polypeptide chain

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

This species takes part in six reactions (as a reactant in [_194](#), [reaction_39](#) and as a product in [_172](#), [reaction_3](#) and as a modifier in [reaction_43](#), [reaction_51](#)).

$$\frac{d}{dt}_{174} = v_{18} + v_{24} - v_{21} - v_{60} \quad (261)$$

9.12 Species _181

Name Smad7_Smurf2_c

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [_192](#) and as a product in [_178](#)).

$$\frac{d}{dt}_{181} = v_{19} - v_{20} \quad (262)$$

9.13 Species [_198](#)

Name Rec_Smad7

SBO:0000296 macromolecular complex

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

This species takes part in one reaction (as a product in [_194](#)).

$$\frac{d}{dt}_{198} = v_{21} \quad (263)$$

9.14 Species [species_1](#)

Name Smurf2_c

SBO:0000252 polypeptide chain

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

This species takes part in three reactions (as a reactant in [reaction_43](#) and as a product in [reaction_4](#), [reaction_19](#)).

$$\frac{d}{dt}\text{species}_1 = v_{25} + v_{40} - v_{64} \quad (264)$$

9.15 Species [species_2](#)

Name SnoN_c

SBO:0000252 polypeptide chain

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

This species takes part in three reactions (as a reactant in [reaction_18](#), [reaction_21](#) and as a product in [reaction_5](#)).

$$\frac{d}{dt}\text{species}_2 = v_{26} - v_{39} - v_{42} \quad (265)$$

9.16 Species [species_3](#)

Name Smad3_c

SBO:0000252 polypeptide chain

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

This species takes part in seven reactions (as a reactant in [reaction_23](#), [reaction_27](#), [reaction_30](#), [reaction_31](#), [reaction_45](#) and as a product in [reaction_22](#), [reaction_24](#)).

$$\frac{d}{dt}\text{species}_3 = v_{43} + v_{45} - v_{44} - v_{48} - v_{51} - v_{52} - v_{66} \quad (266)$$

9.17 Species `species_4`

Name pSmad3_c

SBO:0000252 polypeptide chain

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

This species takes part in five reactions (as a reactant in [reaction_24](#), [reaction_33](#), [reaction_34](#) and as a product in [reaction_27](#), [reaction_28](#)).

$$\frac{d}{dt}\text{species_4} = v_{48} + v_{49} - v_{45} - v_{54} - 2 v_{55} \quad (267)$$

9.18 Species `species_5`

Name Smad3_SARA

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_28](#) and as a product in [reaction_31](#)).

$$\frac{d}{dt}\text{species_5} = v_{52} - v_{49} \quad (268)$$

9.19 Species `species_6`

Name pSmad3_Smad4_c

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_37](#) and as a product in [reaction_34](#)).

$$\frac{d}{dt}\text{species_6} = v_{55} - v_{58} \quad (269)$$

9.20 Species `species_7`

Name Ski_c

SBO:0000252 polypeptide chain

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

This species takes part in five reactions (as a reactant in [reaction_40](#), [reaction_41](#), [reaction_45](#), [reaction_61](#) and as a product in [reaction_42](#)).

$$\frac{d}{dt}\text{species_7} = v_{63} - v_{61} - v_{62} - v_{66} - v_{82} \quad (270)$$

9.21 Species `species_8`

Name Smad3_Ski_c

SBO:0000296 macromolecular complex

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

This species takes part in one reaction (as a product in [reaction_45](#)).

$$\frac{d}{dt}\text{species_8} = v_{66} \quad (271)$$

9.22 Species `species_9`

Name Smurf1_c

SBO:0000252 polypeptide chain

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

This species takes part in three reactions (as a reactant in [reaction_51](#) and as a product in [reaction_47](#), [reaction_52](#)).

$$\frac{d}{dt}\text{species_9} = v_{68} + v_{73} - v_{72} \quad (272)$$

9.23 Species `species_10`

Name Smad7_Smurf1_c

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_49](#) and as a product in [reaction_50](#)).

$$\frac{d}{dt}\text{species_10} = v_{71} - v_{70} \quad (273)$$

9.24 Species `species_11`

Name pSmad2_Smad4_Ski_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_59](#) and as a product in [reaction_58](#)).

$$\frac{d}{dt}\text{species_11} = v_{79} - v_{80} \quad (274)$$

9.25 Species `species_12`

Name Smad2_Ski_c

SBO:0000296 macromolecular complex

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

This species takes part in one reaction (as a product in [reaction_61](#)).

$$\frac{d}{dt}\text{species_12} = v_{82} \quad (275)$$

9.26 Species `species_13`

Name pSmad2_SnoN_n

SBO:0000296 macromolecular complex

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

This species takes part in three reactions (as a reactant in [_35](#), [reaction_68](#) and as a product in [reaction_62](#)).

$$\frac{d}{dt}\text{species_13} = v_{83} - v_4 - v_{89} \quad (276)$$

9.27 Species `species_14`

Name pSmad3_SnoN_n

SBO:0000296 macromolecular complex

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

This species takes part in three reactions (as a reactant in [reaction_38](#), [reaction_69](#) and as a product in [reaction_63](#)).

$$\frac{d}{dt}\text{species_14} = v_{84} - v_{59} - v_{90} \quad (277)$$

9.28 Species `species_15`

Name Arkadia_c

SBO:0000252 polypeptide chain

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

This species takes part in four reactions (as a reactant in [reaction_67](#), [reaction_70](#) and as a product in [reaction_66](#) and as a modifier in [reaction_39](#)).

$$\frac{d}{dt}\text{species_15} = v_{87} - v_{88} - v_{91} \quad (278)$$

9.29 Species _5

Name Smad4_n

SBO:0000252 polypeptide chain

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

This species takes part in seven reactions (as a reactant in [_37](#), [reaction_7](#), [reaction_35](#), [reaction_44](#) and as a product in [_29](#), [_156](#), [reaction_32](#)).

$$\frac{d}{dt}_5 = v_1 + v_{16} + v_{53} - v_5 - v_{28} - v_{56} - v_{65} \quad (279)$$

9.30 Species _9

Name pSmad2_Smad4_n

SBO:0000296 macromolecular complex

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

This species takes part in seven reactions (as a reactant in [_31](#), [_33](#), [reaction_54](#), [reaction_58](#), [reaction_64](#) and as a product in [_37](#), [_164](#)).

$$\frac{d}{dt}_9 = v_5 + v_{17} - v_2 - v_3 - v_{75} - v_{79} - v_{85} \quad (280)$$

9.31 Species _11

Name SnoN_n

SBO:0000252 polypeptide chain

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

This species takes part in six reactions (as a reactant in [_33](#), [reaction_7](#), [reaction_36](#), [reaction_62](#), [reaction_63](#) and as a product in [reaction_21](#)).

$$\frac{d}{dt}_{11} = v_{42} - 2 v_3 - v_{28} - 2 v_{57} - 3 v_{83} - 3 v_{84} \quad (281)$$

9.32 Species _13

Name pSmad2_Smad4_SnoN_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_56](#) and as a product in [_33](#)).

$$\frac{d}{dt}_{13} = v_3 - v_{77} \quad (282)$$

9.33 Species _15

Name Smurf2_n

SBO:0000252 polypeptide chain

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

This species takes part in four reactions (as a reactant in [_35](#), [_41](#), [_43](#), [reaction_19](#)).

$$\frac{d}{dt}_{15} = -3 v_4 - v_7 - v_8 - v_{40} \quad (283)$$

9.34 Species _19

Name pSmad2_n

SBO:0000252 polypeptide chain

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

This species takes part in six reactions (as a reactant in [_37](#), [_39](#), [reaction_62](#) and as a product in [_35](#), [_139](#), [reaction_68](#)).

$$\frac{d}{dt}_{19} = 3 v_4 + v_{14} + 3 v_{89} - 2 v_5 - v_6 - 3 v_{83} \quad (284)$$

9.35 Species _21

Name Smad2_n

SBO:0000252 polypeptide chain

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

This species takes part in four reactions (as a reactant in [_41](#) and as a product in [_39](#), [reaction_8](#), [reaction_32](#)).

$$\frac{d}{dt}_{21} = v_6 + v_{29} + 2 v_{53} - v_7 \quad (285)$$

9.36 Species _25

Name Smad7_n

SBO:0000252 polypeptide chain

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

This species takes part in three reactions (as a reactant in [_43](#), [_172](#), [reaction_46](#)).

$$\frac{d}{dt}_{25} = -v_8 - v_{18} - v_{67} \quad (286)$$

9.37 Species [_27](#)

Name Smad7_Smurf2_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [_178](#) and as a product in [_43](#)).

$$\frac{d}{dt} _27 = v_8 - v_{19} \quad (287)$$

9.38 Species [species_16](#)

Name Smad4_SnoN_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a product in [reaction_7](#) and as a modifier in [reaction_3](#)).

$$\frac{d}{dt} \text{species_16} = v_{28} \quad (288)$$

9.39 Species [species_17](#)

Name Smad3_n

SBO:0000252 polypeptide chain

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

This species takes part in four reactions (as a reactant in [reaction_29](#) and as a product in [_29](#), [reaction_26](#), [reaction_30](#)).

$$\frac{d}{dt} \text{species_17} = 2 v_1 + v_{47} + v_{51} - v_{50} \quad (289)$$

9.40 Species [species_18](#)

Name pSmad3_Smad4_n

SBO:0000296 macromolecular complex

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

This species takes part in seven reactions (as a reactant in [reaction_25](#), [reaction_36](#), [reaction_48](#), [reaction_53](#), [reaction_65](#) and as a product in [reaction_35](#), [reaction_37](#)).

$$\frac{d}{dt} \text{species_18} = v_{56} + v_{58} - v_{46} - v_{57} - v_{69} - v_{74} - v_{86} \quad (290)$$

9.41 Species `species_19`

Name Smad4_Smad2_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_32](#) and as a product in [_31](#)).

$$\frac{d}{dt}\text{species_19} = v_2 - v_{53} \quad (291)$$

9.42 Species `species_20`

Name pSmad3_n

SBO:0000252 polypeptide chain

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

This species takes part in six reactions (as a reactant in [reaction_26](#), [reaction_35](#), [reaction_63](#) and as a product in [reaction_33](#), [reaction_38](#), [reaction_69](#)).

$$\frac{d}{dt}\text{species_20} = v_{54} + v_{59} + v_{90} - v_{47} - 2 v_{56} - 3 v_{84} \quad (292)$$

9.43 Species `species_21`

Name pSmad3_Smad4_SnoN_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_55](#) and as a product in [reaction_36](#)).

$$\frac{d}{dt}\text{species_21} = v_{57} - v_{76} \quad (293)$$

9.44 Species `species_22`

Name Ski_n

SBO:0000252 polypeptide chain

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

This species takes part in four reactions (as a reactant in [reaction_44](#), [reaction_48](#), [reaction_58](#) and as a product in [reaction_41](#)).

$$\frac{d}{dt}\text{species_22} = v_{62} - v_{65} - 2 v_{69} - 2 v_{79} \quad (294)$$

9.45 Species [species_23](#)

Name Smad4_Ski_n

SBO:0000252 polypeptide chain

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

This species takes part in three reactions (as a reactant in [reaction_60](#) and as a product in [reaction_44](#) and as a modifier in [reaction_3](#)).

$$\frac{d}{dt}\text{species_23} = v_{65} - v_{81} \quad (295)$$

9.46 Species [species_24](#)

Name Smurf1_n

SBO:0000252 polypeptide chain

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

This species takes part in two reactions (as a reactant in [reaction_46](#), [reaction_52](#)).

$$\frac{d}{dt}\text{species_24} = -v_{67} - v_{73} \quad (296)$$

9.47 Species [species_25](#)

Name Smad7_Smurf1_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_50](#) and as a product in [reaction_46](#)).

$$\frac{d}{dt}\text{species_25} = v_{67} - v_{71} \quad (297)$$

9.48 Species [species_26](#)

Name pSmad3_Smad4_Ski_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [reaction_57](#) and as a product in [reaction_48](#)).

$$\frac{d}{dt}\text{species_26} = v_{69} - v_{78} \quad (298)$$

9.49 Species [species_27](#)

Name Smad4_Smad3_n

SBO:0000296 macromolecular complex

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

This species takes part in two reactions (as a reactant in [_29](#) and as a product in [reaction_25](#)).

$$\frac{d}{dt}\text{species_27} = v_{46} - v_1 \quad (299)$$

9.50 Species [species_28](#)

Name freePromoters

SBO:0000252 polypeptide chain

Initial concentration $0.0999999951844375 \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in seven reactions (as a reactant in [reaction_53](#), [reaction_54](#), [reaction_55](#), [reaction_56](#), [reaction_57](#), [reaction_59](#), [reaction_60](#)).

$$\frac{d}{dt}\text{species_28} = -v_{74} - v_{75} - v_{76} - v_{77} - v_{78} - v_{80} - v_{81} \quad (300)$$

9.51 Species [species_29](#)

Name inactivePromoters

SBO:0000252 polypeptide chain

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

This species takes part in five reactions (as a product in [reaction_55](#), [reaction_56](#), [reaction_57](#), [reaction_59](#), [reaction_60](#)).

$$\frac{d}{dt}\text{species_29} = v_{76} + v_{77} + v_{78} + v_{80} + v_{81} \quad (301)$$

9.52 Species [species_30](#)

Name geneProduct

SBO:0000236 physical entity representation

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

This species takes part in eight reactions (as a product in [reaction_53](#), [reaction_54](#) and as a modifier in [reaction_2](#), [reaction_3](#), [reaction_4](#), [reaction_5](#), [reaction_42](#), [reaction_47](#)).

$$\frac{d}{dt}\text{species_30} = v_{74} + v_{75} \quad (302)$$

9.53 Species `species_31`

Name Arkadia_n

SBO:0000252 polypeptide chain

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

This species takes part in three reactions (as a reactant in [reaction_68](#), [reaction_69](#) and as a product in [reaction_70](#)).

$$\frac{d}{dt}\text{species_31} = v_{91} - 3 v_{89} - 3 v_{90} \quad (303)$$

A Glossary of Systems Biology Ontology Terms

SBO:0000009 kinetic constant: Numerical parameter that quantifies the velocity of a chemical reaction

SBO:0000025 catalytic rate constant: Numerical parameter that quantifies the velocity of an enzymatic reaction

SBO:0000027 Michaelis constant: Substrate concentration at which the velocity of reaction is half its maximum. Michaelis constant is an experimental parameter. According to the underlying molecular mechanism it can be interpreted differently in terms of microscopic constants

SBO:0000153 forward rate constant: Numerical parameter that quantifies the forward velocity of a chemical reaction. This parameter encompasses all the contributions to the velocity except the quantity of the reactants

SBO:0000156 reverse rate constant: Numerical parameter that quantifies the forward velocity of a chemical reaction. This parameter encompasses all the contributions to the velocity except the quantity of the reactants.

SBO:0000186 maximal velocity: Limiting maximal velocity of an enzymatic reaction, reached when the substrate is in large excess and all the enzyme is complexed.

SBO:0000196 concentration of an entity pool: The amount of an entity per unit of volume.

SBO:0000236 physical entity representation: Representation of an entity that may participate in an interaction, a process or relationship of significance.

SBO:0000247 simple chemical: Simple, non-repetitive chemical entity

SBO:0000252 polypeptide chain: Naturally occurring macromolecule formed by the repetition of amino-acid residues linked by peptidic bonds. A polypeptide chain is synthesized by the ribosome. CHEBI:1654

SBO:0000282 dissociation constant: Equilibrium constant that measures the propensity of a larger object to separate (dissociate) reversibly into smaller components, as when a complex falls apart into its component molecules, or when a salt splits up into its component ions. The dissociation constant is usually denoted K_d and is the inverse of the affinity constant.

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:0000296 macromolecular complex: Non-covalent complex of one or more macromolecules and zero or more simple chemicals

SBO:0000337 association constant: Equilibrium constant that measures the propensity of two objects to assemble (associate) reversibly into a larger component. The association constant is usually denoted K_a and is the inverse of the dissociation constant.

SBO:0000356 decay constant: Kinetic constant characterising a mono-exponential decay. It is the inverse of the mean lifetime of the continuant being decayed. Its unit is “per tim”.

SBML²TeX was developed by Andreas Dräger^a, Hannes Planatscher^a, Dieudonné M Wouamba^a, Adrian Schröder^a, Michael Hucka^b, Lukas Endler^c, Martin Golebiewski^d and Andreas Zell^a. Please see <http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX> for more information.

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