SBML Model Report

Model name: "Goldbeter2008_Somite-_Segmentation_Clock_Notch_Wnt_FGF"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 3 format. This model was created by the following two authors: Catherine Lloyd[1] and Lukas Endler[2] at November seventh 2008 at 3:03 p. m. and last time modified at June fifth 2013 at 5:17 p. m. Table 1 shows an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	26
events	0	constraints	0
reactions	33	function definitions	0
global parameters	71	unit definitions	6
rules	5	initial assignments	0

Model Notes

This is a model of the coupled Natch, Wnt and FGF modules as described in:
A. Goldbeter and O. Pourqui , Modeling the segmentation clock as a network of coupled oscillations in the Notch, Wnt and FGF signaling pathways. J Theor Biol. 2008 Jun 7;252(3):574-85, pubmed ID: 18308339

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To uncouple the modules remove the reaction MAx_trans_Xa and set vsFK=vsF .
The SBML version of the model was converted from the CellML version by Catherine Lloyd for the CellML repository .

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

2 Unit Definitions

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

2.1 Unit `substance`

Name nanomole

Definition nmol

2.2 Unit `time`

Name minute

Definition 60 s

2.3 Unit `first_order_rate_constant`

Name first_order_rate_constant

Definition $(60\ \mathrm{s})^{-1}$

2.4 Unit `second_order_rate_constant`

Name second_order_rate_constant

Definition $\mathrm{nmol}^{-1} \cdot 1 \cdot (60\ \mathrm{s})^{-1}$

2.5 Unit flux

Name flux

Definition $\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$

2.6 Unit nanomolar

Name nanomolar

Definition $\mathrm{nmol} \cdot \mathrm{l}^{-1}$

2.7 Unit volume

Notes Litre is the predefined SBML unit for `volume`.

Definition l

2.8 Unit area

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

Definition m^2

2.9 Unit length

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

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

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

3.1 Compartment cytosol

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

4 Species

This model contains 26 species. The boundary condition of four of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 8 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
N	Notch protein	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Na	cytosolic NicD	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Nan	nuclear NicD	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
MF	Lunatic fringe mRNA	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
F	Lunatic Fringe protein	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bp	phosph. beta-catenin	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
BN	nuclear beta-catenin	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
A	Axin2 protein	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
K	Gsk3	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B	beta-catenin	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
MAx	Axin2 mRNA	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rasa	active Ras	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
ERKa	active ERK	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Xa	active TF X	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
MDusp	Dusp6 mRNA	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Dusp	Dusp6 protein	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Rasi	inactive Ras	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	☑
ERKi	inactive ERK	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	☑
Xi	inactive TF X	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	☑
Rast	Ras total	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
ERKt	ERK total	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Xt	X total	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
D	Dsh protein	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	⊟
AK	Axin2/Gsk3 destruction complex	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	⊟	☑
Kt	Kt	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑	⊟
Fgf	Fgf	cytosol	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑	⊟

5 Parameters

This model contains 71 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
KdN	KdN	0000027	1.400	$\mathrm{nmol \cdot l^{-1}}$	☑
vsN	vsN	0000048	0.230	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
vdN	vdN	0000324	2.820	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
KdNa	KdNa	0000027	0.001	$\mathrm{nmol \cdot l^{-1}}$	☑
VdNa	VdNa	0000186	0.010	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
kt1	kt1	0000022	0.100	$\mathrm{(60\ s)^{-1}}$	☑
kt2	kt2	0000032	0.100	$\mathrm{(60\ s)^{-1}}$	☑
KdNan	KdNan	0000027	0.001	$\mathrm{nmol \cdot l^{-1}}$	☑
VdNan	VdNan	0000186	0.100	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
KdMF	KdMF	0000027	0.768	$\mathrm{nmol \cdot l^{-1}}$	☑
KIG1	KIG1		2.500	$\mathrm{nmol \cdot l^{-1}}$	☑
vsFK	vsFK	0000186	0.000	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	⊟
vsF	vsF	0000186	3.000	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
vmF	vmF	0000186	1.920	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
KA	KA		0.050	$\mathrm{nmol \cdot l^{-1}}$	☑
KdF	KdF	0000027	0.370	$\mathrm{nmol \cdot l^{-1}}$	☑
vdF	vdF	0000186	0.390	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
ksF	ksF	0000022	0.300	$\mathrm{(60\ s)^{-1}}$	☑
kd1	kd1	0000022	0.000	$\mathrm{(60\ s)^{-1}}$	☑
vsB	vsB	0000186	0.087	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
kd2	kd2	0000022	7.062	$\mathrm{(60\ s)^{-1}}$	☑
v0	v0	0000186	0.060	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
vMB	vMB	0000186	1.640	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
vmd	vmd	0000186	0.800	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
KaB	KaB		0.700	$\mathrm{nmol \cdot l^{-1}}$	☑
KaXa	KaXa	0000027	0.050	$\mathrm{nmol \cdot l^{-1}}$	☑
Kmd	Kmd		0.480	$\mathrm{nmol \cdot l^{-1}}$	☑
n	n	0000190	2.000	dimensionless	☑
m	m	0000190	2.000	dimensionless	☑
vMXa	vMXa	0000186	0.500	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
ksAx	ksAx	0000022	0.020	$\mathrm{(60\ s)^{-1}}$	☑
vdAx	vdAx	0000186	0.600	$\mathrm{nmol \cdot l^{-1} \cdot (60\ s)^{-1}}$	☑
KdAx	KdAx	0000027	0.630	$\mathrm{nmol \cdot l^{-1}}$	☑
d1	d1	0000338	0.100	$\mathrm{(60\ s)^{-1}}$	☑
a1	a1	0000023	1.800	$\mathrm{nmol^{-1} \cdot 1 \cdot (60\ s)^{-1}}$	☑

Id	Name	SBO	Value	Unit	Constant
K1	K1	0000027	0.280	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
K2	K2	0000027	0.030	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
kt3	kt3	0000022	0.700	$(60\ \mathrm{s})^{-1}$	☑
kt4	kt4	0000032	1.500	$(60\ \mathrm{s})^{-1}$	☑
ksDusp	ksDusp	0000022	0.500	$(60\ \mathrm{s})^{-1}$	☑
vdDusp	vdDusp	0000186	2.000	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
KdDusp	KdDusp	0000027	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
kcDusp	kcDusp	0000022	1.350	$(60\ \mathrm{s})^{-1}$	☑
KaFgf	KaFgf	0000191	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KaRas	KaRas	0000027	0.103	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KdRas	KdRas	0000027	0.100	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KdErk	KdErk	0000027	0.050	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KaErk	KaErk	0000027	0.050	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KaX	KaX	0000027	0.050	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KIF	KIF	0000191	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KID	KID	0000027	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KdX	KdX	0000027	0.050	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KaMDusp	KaMDusp	0000191	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
KdMDusp	KdMDusp	0000027	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1}$	☑
q	q	0000190	2.000	dimensionless	☑
r	r	0000191	2.000	dimensionless	☑
kc	kc	0000022	3.450	$(60\ \mathrm{s})^{-1}$	☑
j	j	0000191	2.000	dimensionless	☑
p	p	0000191	2.000	dimensionless	☑
epsilon	epsilon	0000381	0.300	dimensionless	☑
theta	theta	0000381	1.500	dimensionless	☑
eta	eta	0000381	0.300	dimensionless	☑
VMsMDusp	VMsMDusp	0000186	0.900	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMdMDusp	VMdMDusp	0000186	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMK	VMK	0000186	5.080	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMP	VMP	0000186	1.000	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMaRas	VMaRas	0000186	4.968	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMdRas	VMdRas	0000186	0.410	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMaErk	VMaErk	0000186	3.300	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMaX	VMaX	0000186	1.600	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑
VMdX	VMdX	0000186	0.500	$\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$	☑

6 Rules

This is an overview of five rules.

6.1 Rule `vsFK`

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

$$\mathrm{vsFK} = \mathrm{vsF} \cdot \frac{\mathrm{KIG1}}{\mathrm{KIG1} + [\mathrm{K}]} \tag{1}$$

Derived unit $\mathrm{nmol} \cdot \mathrm{l}^{-1} \cdot (60\ \mathrm{s})^{-1}$

6.2 Rule `AK`

Rule `AK` is an assignment rule for species `AK`:

$$\mathrm{AK} = [\mathrm{Kt}] - [\mathrm{K}] \tag{2}$$

Derived unit $\mathrm{nmol} \cdot \mathrm{l}^{-1}$

6.3 Rule `Rasi`

Rule `Rasi` is an assignment rule for species `Rasi`:

$$\mathrm{Rasi} = [\mathrm{Rast}] - [\mathrm{Rasa}] \tag{3}$$

Derived unit $\mathrm{nmol} \cdot \mathrm{l}^{-1}$

6.4 Rule `ERKi`

Rule `ERKi` is an assignment rule for species `ERKi`:

$$\mathrm{ERKi} = [\mathrm{ERKt}] - [\mathrm{ERKa}] \tag{4}$$

Derived unit $\mathrm{nmol} \cdot \mathrm{l}^{-1}$

6.5 Rule `Xi`

Rule `Xi` is an assignment rule for species `Xi`:

$$\mathrm{Xi} = [\mathrm{Xt}] - [\mathrm{Xa}] \tag{5}$$

Derived unit $\mathrm{nmol} \cdot \mathrm{l}^{-1}$

7 Reactions

This model contains 33 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	n_synth	Notch_synthesis	$\emptyset \longrightarrow N$	
2	N_degradation	N_degradation	$N \longrightarrow \emptyset$	0000179
3	N_activation	Notch_activation	$N \xrightarrow{F} Na$	0000178
4	Na_degradation	Na_degradation	$Na \longrightarrow \emptyset$	0000179
5	Na_transport		$Na \rightleftharpoons Nan$	0000185
6	Nan_degradation		$Nan \longrightarrow \emptyset$	0000179
7	MF-_transkription		$\emptyset \xrightarrow{Nan} MF$	0000183
8	MF_degradation		$MF \longrightarrow \emptyset$	0000179
9	F_translation		$\emptyset \xrightarrow{MF} F$	0000184
10	F_degradation		$F \longrightarrow \emptyset$	0000179
11	AK_dissoc		$AK \rightleftharpoons A + K$	0000180
12	B_synth		$\emptyset \longrightarrow B$	
13	B_degradation		$B \longrightarrow \emptyset$	0000179
14	B-_phosphorylation		$B \xrightarrow{AK,\ D,\ Kt} Bp$	0000216
15	BP-_dephosphorylation		$Bp \longrightarrow B$	0000330
16	B_shuttling		$BN \rightleftharpoons B$	0000185
17	Bp_degradation		$Bp \longrightarrow \emptyset$	0000179
18	MAx_trans_basal		$\emptyset \xrightarrow{BN} MAx$	0000183

№	Id	Name	Reaction Equation	SBO
19	MAx_trans_BN		$\emptyset \xrightarrow{\text{BN}} \text{MAx}$	0000183
20	MAx_trans_Xa		$\emptyset \xrightarrow{\text{Xa}} \text{MAx}$	0000183
21	MAx_degradation		$\text{MAx} \longrightarrow \emptyset$	0000179
22	A_translation		$\emptyset \xrightarrow{\text{MAx}} \text{A}$	0000184
23	A_degradation		$\text{A} \longrightarrow \emptyset$	0000179
24	Ras_activation		$\emptyset \xrightarrow{\text{Rasi, Fgf}} \text{Rasa}$	
25	Ras_inactivation		$\text{Rasa} \longrightarrow \emptyset$	
26	Erk_activation		$\emptyset \xrightarrow{\text{ERKi, Rasa, Rast}} \text{ERKa}$	
27	Erk_inactivation		$\text{ERKa} \xrightarrow{\text{Dusp}} \emptyset$	
28	X_activation		$\emptyset \xrightarrow{\text{ERKa, ERKt, Xi}} \text{Xa}$	
29	X_inactivation		$\text{Xa} \longrightarrow \emptyset$	
30	MDusp_transkription		$\emptyset \xrightarrow{\text{Xa}} \text{MDusp}$	0000183
31	MDusp_degradation		$\text{MDusp} \longrightarrow \emptyset$	0000179
32	Dusp_translation		$\emptyset \xrightarrow{\text{MDusp}} \text{Dusp}$	0000184
33	Dusp_degradation		$\text{Dusp} \longrightarrow \emptyset$	0000179

7.1 Reaction n_synth

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

Name Notch_synthesis

Reaction equation

$$\emptyset \longrightarrow \mathrm{N} \tag{6}$$

Product

Table 6: Properties of each product.

Id	Name	SBO
N	Notch protein	

Kinetic Law

Derived unit $\mathrm{nmol} \cdot (60\ \mathrm{s})^{-1}$

$$v_1 = \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{epsilon} \cdot \mathrm{vsN} \tag{7}$$

7.2 Reaction N_degradation

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

Name N_degradation

SBO:0000179 degradation

Reaction equation

$$\mathrm{N} \longrightarrow \emptyset \tag{8}$$

Reactant

Table 7: Properties of each reactant.

Id	Name	SBO
N	Notch protein	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_2 = \frac{\mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{vdN} \cdot [\mathrm{N}]}{\mathrm{KdN} + [\mathrm{N}]} \tag{9}$$

7.3 Reaction `N_activation`

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

Name Notch_activation

SBO:0000178 cleavage

Reaction equation

$$\mathrm{N} \xrightarrow{\mathrm{F}} \mathrm{Na} \tag{10}$$

Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
`N`	Notch protein	

Modifier

Table 9: Properties of each modifier.

Id	Name	SBO
`F`	Lunatic Fringe protein	

Product

Table 10: Properties of each product.

Id	Name	SBO
`Na`	cytosolic NicD	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot 1.0000000000000038 \cdot 10^{-9}\ \mathrm{mol}$

$$v_3 = \frac{\mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{kc} \cdot [\mathrm{N}] \cdot \mathrm{KIF}^{\mathrm{j}}}{\mathrm{KIF}^{\mathrm{j}} + [\mathrm{F}]^{\mathrm{j}}} \tag{11}$$

7.4 Reaction `Na_degradation`

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

Name Na_degradation

SBO:0000179 degradation

Reaction equation

$$\mathrm{Na} \longrightarrow \emptyset \tag{12}$$

Reactant

Table 11: Properties of each reactant.

Id	Name	SBO
`Na`	cytosolic NicD	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_4 = \frac{\mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{VdNa} \cdot [\mathrm{Na}]}{\mathrm{KdNa} + [\mathrm{Na}]} \tag{13}$$

7.5 Reaction `Na_transport`

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

SBO:0000185 transport reaction

Reaction equation

$$\mathrm{Na} \rightleftharpoons \mathrm{Nan} \tag{14}$$

Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
Na	cytosolic NicD	

Product

Table 13: Properties of each product.

Id	Name	SBO
Nan	nuclear NicD	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot \mathrm{nmol}$

$$v_5 = \mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot (\mathrm{kt1} \cdot [\mathrm{Na}] - \mathrm{kt2} \cdot [\mathrm{Nan}]) \tag{15}$$

7.6 Reaction Nan_degradation

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

SBO:0000179 degradation

Reaction equation

$$\mathrm{Nan} \longrightarrow \emptyset \tag{16}$$

Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
Nan	nuclear NicD	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_6 = \frac{\mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{VdNan} \cdot [\mathrm{Nan}]}{\mathrm{KdNan} + [\mathrm{Nan}]} \tag{17}$$

7.7 Reaction MF_transkription

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

SBO:0000183 transcription

Reaction equation

$$\emptyset \xrightarrow{\text{Nan}} \text{MF} \tag{18}$$

Modifier

Table 15: Properties of each modifier.

Id	Name	SBO
Nan	nuclear NicD	

Product

Table 16: Properties of each product.

Id	Name	SBO
MF	Lunatic fringe mRNA	

Kinetic Law

Derived unit $1.0000000000000038 \cdot 10^{-9}\ \text{mol} \cdot (60\ \text{s})^{-1}$

$$v_7 = \frac{\text{epsilon} \cdot \text{vol}(\text{cytosol}) \cdot \text{vsFK} \cdot [\text{Nan}]^{\text{p}}}{\text{KA}^{\text{p}} + [\text{Nan}]^{\text{p}}} \tag{19}$$

7.8 Reaction MF_degradation

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

SBO:0000179 degradation

Reaction equation

$$\text{MF} \longrightarrow \emptyset \tag{20}$$

Reactant

Table 17: Properties of each reactant.

Id	Name	SBO
MF	Lunatic fringe mRNA	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_8 = \frac{\mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{vmF} \cdot [\mathrm{MF}]}{\mathrm{KdMF} + [\mathrm{MF}]} \tag{21}$$

7.9 Reaction F_translation

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

SBO:0000184 translation

Reaction equation

$$\emptyset \xrightarrow{\mathrm{MF}} \mathrm{F} \tag{22}$$

Modifier

Table 18: Properties of each modifier.

Id	Name	SBO
MF	Lunatic fringe mRNA	

Product

Table 19: Properties of each product.

Id	Name	SBO
F	Lunatic Fringe protein	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot \mathrm{nmol}$

$$v_9 = \mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{ksF} \cdot [\mathrm{MF}] \tag{23}$$

7.10 Reaction F_degradation

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

SBO:0000179 degradation

Reaction equation

$$\mathrm{F} \longrightarrow \emptyset \tag{24}$$

Reactant

Table 20: Properties of each reactant.

Id	Name	SBO
F	Lunatic Fringe protein	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{10} = \frac{\mathrm{epsilon} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{vdF} \cdot [\mathrm{F}]}{\mathrm{KdF} + [\mathrm{F}]} \tag{25}$$

7.11 Reaction AK_dissoc

This is a reversible reaction of one reactant forming two products.

SBO:0000180 dissociation

Reaction equation

$$\mathrm{AK} \rightleftharpoons \mathrm{A} + \mathrm{K} \tag{26}$$

Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
AK	Axin2/Gsk3 destruction complex	

Products

Table 22: Properties of each product.

Id	Name	SBO
A	Axin2 protein	
K	Gsk3	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot \mathrm{nmol}$

$$v_{11} = \mathrm{theta} \cdot \mathrm{vol}(\mathrm{cytosol}) \cdot (\mathrm{d1} \cdot [\mathrm{AK}] - \mathrm{a1} \cdot [\mathrm{A}] \cdot [\mathrm{K}]) \tag{27}$$

7.12 Reaction B_synth

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

Reaction equation

$$\emptyset \longrightarrow \mathrm{B} \tag{28}$$

Product

Table 23: Properties of each product.

Id	Name	SBO
B	beta-catenin	

Kinetic Law

Derived unit $\mathrm{nmol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{12} = \mathrm{theta} \cdot \mathrm{vol}(\mathrm{cytosol}) \cdot \mathrm{vsB} \tag{29}$$

7.13 Reaction B_degradation

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

SBO:0000179 degradation

Reaction equation

$$\mathrm{B} \longrightarrow \emptyset \tag{30}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
B	beta-catenin	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot \mathrm{nmol}$

$$v_{13} = \mathrm{theta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{kd1} \cdot [\mathrm{B}] \tag{31}$$

7.14 Reaction B_phosphorylation

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

SBO:0000216 phosphorylation

Reaction equation

$$\mathrm{B} \xrightarrow{\mathrm{AK,\ D,\ Kt}} \mathrm{Bp} \tag{32}$$

Reactant

Table 25: Properties of each reactant.

Id	Name	SBO
B	beta-catenin	

Modifiers

Table 26: Properties of each modifier.

Id	Name	SBO
AK	Axin2/Gsk3 destruction complex	
D	Dsh protein	
Kt	Kt	

Product

Table 27: Properties of each product.

Id	Name	SBO
Bp	phosph. beta-catenin	

Kinetic Law

Derived unit $9.999999999999996 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{14} = \frac{\frac{\mathrm{theta} \cdot \mathrm{vol(cytosol)} \cdot \mathrm{VMK} \cdot \mathrm{KID}}{\mathrm{KID} + [\mathrm{D}]} \cdot [\mathrm{B}]}{\mathrm{K1} + [\mathrm{B}]} \cdot [\mathrm{AK}] \over [\mathrm{Kt}] \tag{33}$$

7.15 Reaction BP_dephosphorylation

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

SBO:0000330 dephosphorylation

Reaction equation

$$\mathrm{Bp} \longrightarrow \mathrm{B} \tag{34}$$

Reactant

Table 28: Properties of each reactant.

Id	Name	SBO
Bp	phosph. beta-catenin	

Product

Table 29: Properties of each product.

Id	Name	SBO
B	beta-catenin	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{15} = \frac{\mathrm{theta} \cdot \mathrm{vol\,(cytosol)} \cdot \mathrm{VMP} \cdot [\mathrm{Bp}]}{\mathrm{K2} + [\mathrm{Bp}]} \tag{35}$$

7.16 Reaction B_shuttling

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

SBO:0000185 transport reaction

Reaction equation

$$\mathrm{BN} \rightleftharpoons \mathrm{B} \tag{36}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
BN	nuclear beta-catenin	

Product

Table 31: Properties of each product.

Id	Name	SBO
B	beta-catenin	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot \mathrm{nmol}$

$$v_{16} = \mathrm{theta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot (\mathrm{kt4} \cdot [\mathrm{BN}] - \mathrm{kt3} \cdot [\mathrm{B}]) \tag{37}$$

7.17 Reaction Bp_degradation

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

SBO:0000179 degradation

Reaction equation

$$\mathrm{Bp} \longrightarrow \emptyset \tag{38}$$

Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
Bp	phosph. beta-catenin	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot \mathrm{nmol}$

$$v_{17} = \mathrm{theta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{kd2} \cdot [\mathrm{Bp}] \tag{39}$$

7.18 Reaction MAx_trans_basal

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

SBO:0000183 transcription

Reaction equation

$$\emptyset \xrightarrow{\mathrm{BN}} \mathrm{MAx} \tag{40}$$

Modifier

Table 33: Properties of each modifier.

Id	Name	SBO
BN	nuclear beta-catenin	

Product

Table 34: Properties of each product.

Id	Name	SBO
MAx	Axin2 mRNA	

Kinetic Law

Derived unit $\mathrm{nmol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{18} = \mathrm{theta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{v0} \tag{41}$$

7.19 Reaction MAx_trans_BN

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

SBO:0000183 transcription

Reaction equation

$$\emptyset \xrightarrow{\text{BN}} \text{MAx} \tag{42}$$

Modifier

Table 35: Properties of each modifier.

Id	Name	SBO
BN	nuclear beta-catenin	

Product

Table 36: Properties of each product.

Id	Name	SBO
MAx	Axin2 mRNA	

Kinetic Law

Derived unit $1.0000000000000038 \cdot 10^{-9}\ \text{mol} \cdot (60\ \text{s})^{-1}$

$$v_{19} = \text{theta} \cdot \text{vol}\,(\text{cytosol}) \cdot \frac{\text{vMB} \cdot [\text{BN}]^{\text{n}}}{\text{KaB}^{\text{n}} + [\text{BN}]^{\text{n}}} \tag{43}$$

7.20 Reaction MAx_trans_Xa

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

SBO:0000183 transcription

Reaction equation

$$\emptyset \xrightarrow{\text{Xa}} \text{MAx} \tag{44}$$

Modifier

Table 37: Properties of each modifier.

Id	Name	SBO
Xa	active TF X	

Product

Table 38: Properties of each product.

Id	Name	SBO
MAx	Axin2 mRNA	

Kinetic Law

Derived unit $1.0000000000000038 \cdot 10^{-9}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{20} = \mathrm{theta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \frac{\mathrm{vMXa} \cdot [\mathrm{Xa}]^{\mathrm{m}}}{\mathrm{KaXa}^{\mathrm{m}} + [\mathrm{Xa}]^{\mathrm{m}}} \tag{45}$$

7.21 Reaction MAx_degradation

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

SBO:0000179 degradation

Reaction equation

$$\mathrm{MAx} \longrightarrow \emptyset \tag{46}$$

Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
MAx	Axin2 mRNA	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{21} = \frac{\mathrm{theta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{vmd} \cdot [\mathrm{MAx}]}{\mathrm{Kmd} + [\mathrm{MAx}]} \tag{47}$$

7.22 Reaction A_translation

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

SBO:0000184 translation

Reaction equation

$$\emptyset \xrightarrow{\text{MAx}} \text{A} \tag{48}$$

Modifier

Table 40: Properties of each modifier.

Id	Name	SBO
MAx	Axin2 mRNA	

Product

Table 41: Properties of each product.

Id	Name	SBO
A	Axin2 protein	

Kinetic Law

Derived unit $(60\ \text{s})^{-1} \cdot \text{nmol}$

$$v_{22} = \text{theta} \cdot \text{vol}\,(\text{cytosol}) \cdot \text{ksAx} \cdot [\text{MAx}] \tag{49}$$

7.23 Reaction A_degradation

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

SBO:0000179 degradation

Reaction equation

$$\text{A} \longrightarrow \emptyset \tag{50}$$

Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
A	Axin2 protein	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{23} = \frac{\mathrm{theta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{vdAx} \cdot [\mathrm{A}]}{\mathrm{KdAx} + [\mathrm{A}]} \tag{51}$$

7.24 Reaction Ras_activation

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

Reaction equation

$$\emptyset \xrightarrow{\text{Rasi, Fgf}} \mathrm{Rasa} \tag{52}$$

Modifiers

Table 43: Properties of each modifier.

Id	Name	SBO
Rasi	inactive Ras	
Fgf	Fgf	

Product

Table 44: Properties of each product.

Id	Name	SBO
Rasa	active Ras	

Kinetic Law

Derived unit $1.0000000000000038 \cdot 10^{-9}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{24} = \frac{\frac{\mathrm{eta} \cdot \mathrm{vol}(\mathrm{cytosol}) \cdot \mathrm{VMaRas} \cdot [\mathrm{Fgf}]^{\mathrm{r}}}{\mathrm{KaFgf}^{\mathrm{r}} + [\mathrm{Fgf}]^{\mathrm{r}}} \cdot [\mathrm{Rasi}]}{\mathrm{KaRas} + [\mathrm{Rasi}]} \tag{53}$$

7.25 Reaction Ras_inactivation

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

Reaction equation

$$\text{Rasa} \longrightarrow \emptyset \tag{54}$$

Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
Rasa	active Ras	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \text{mol} \cdot (60\ \text{s})^{-1}$

$$v_{25} = \frac{\text{eta} \cdot \text{vol}(\text{cytosol}) \cdot \text{VMdRas} \cdot [\text{Rasa}]}{\text{KdRas} + [\text{Rasa}]} \tag{55}$$

7.26 Reaction Erk_activation

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

Reaction equation

$$\emptyset \xrightarrow{\text{ERKi, Rasa, Rast}} \text{ERKa} \tag{56}$$

Modifiers

Table 46: Properties of each modifier.

Id	Name	SBO
ERKi	inactive ERK	
Rasa	active Ras	
Rast	Ras total	

Product

Table 47: Properties of each product.

Id	Name	SBO
ERKa	active ERK	

Kinetic Law

Derived unit $9.999999999999996 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{26} = \frac{\frac{\mathrm{eta} \cdot \mathrm{vol}(\mathrm{cytosol}) \cdot \mathrm{VMaErk} \cdot [\mathrm{Rasa}]}{[\mathrm{Rast}]} \cdot [\mathrm{ERKi}]}{\mathrm{KaErk} + [\mathrm{ERKi}]} \tag{57}$$

7.27 Reaction Erk_inactivation

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

Reaction equation

$$\mathrm{ERKa} \xrightarrow{\mathrm{Dusp}} \emptyset \tag{58}$$

Reactant

Table 48: Properties of each reactant.

Id	Name	SBO
ERKa	active ERK	

Modifier

Table 49: Properties of each modifier.

Id	Name	SBO
Dusp	Dusp6 protein	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot 9.999999999999998 \cdot 10^{-10}\ \mathrm{mol}$

$$v_{27} = \frac{\mathrm{eta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{kcDusp} \cdot [\mathrm{Dusp}] \cdot [\mathrm{ERKa}]}{\mathrm{KdErk} + [\mathrm{ERKa}]} \tag{59}$$

7.28 Reaction X_activation

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

Reaction equation

$$\emptyset \xrightarrow{\text{ERKa, ERKt, Xi}} \text{Xa} \tag{60}$$

Modifiers

Table 50: Properties of each modifier.

Id	Name	SBO
ERKa	active ERK	
ERKt	ERK total	
Xi	inactive TF X	

Product

Table 51: Properties of each product.

Id	Name	SBO
Xa	active TF X	

Kinetic Law

Derived unit $9.999999999999996 \cdot 10^{-10}\ \text{mol} \cdot (60\ \text{s})^{-1}$

$$v_{28} = \frac{\frac{\text{eta} \cdot \text{vol(cytosol)} \cdot \text{VMaX} \cdot [\text{ERKa}]}{[\text{ERKt}]} \cdot [\text{Xi}]}{\text{KaX} + [\text{Xi}]} \tag{61}$$

7.29 Reaction X_inactivation

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

Reaction equation

$$\text{Xa} \longrightarrow \emptyset \tag{62}$$

Reactant

Table 52: Properties of each reactant.

Id	Name	SBO
Xa	active TF X	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{29} = \frac{\mathrm{eta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{VMdX} \cdot [\mathrm{Xa}]}{\mathrm{KdX} + [\mathrm{Xa}]} \tag{63}$$

7.30 Reaction MDusp_transkription

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

SBO:0000183 transcription

Reaction equation

$$\emptyset \xrightarrow{\mathrm{Xa}} \mathrm{MDusp} \tag{64}$$

Modifier

Table 53: Properties of each modifier.

Id	Name	SBO
Xa	active TF X	

Product

Table 54: Properties of each product.

Id	Name	SBO
MDusp	Dusp6 mRNA	

Kinetic Law

Derived unit $1.0000000000000038 \cdot 10^{-9}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{30} = \frac{\mathrm{eta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{VMsMDusp} \cdot [\mathrm{Xa}]^{\mathrm{q}}}{\mathrm{KaMDusp}^{\mathrm{q}} + [\mathrm{Xa}]^{\mathrm{q}}} \tag{65}$$

7.31 Reaction MDusp_degradation

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

SBO:0000179 degradation

Reaction equation

$$\text{MDusp} \longrightarrow \emptyset \tag{66}$$

Reactant

Table 55: Properties of each reactant.

Id	Name	SBO
MDusp	Dusp6 mRNA	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \text{mol} \cdot (60\ \text{s})^{-1}$

$$v_{31} = \frac{\text{eta} \cdot \text{vol}\,(\text{cytosol}) \cdot \text{VMdMDusp} \cdot [\text{MDusp}]}{\text{KdMDusp} + [\text{MDusp}]} \tag{67}$$

7.32 Reaction Dusp_translation

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

SBO:0000184 translation

Reaction equation

$$\emptyset \xrightarrow{\text{MDusp}} \text{Dusp} \tag{68}$$

Modifier

Table 56: Properties of each modifier.

Id	Name	SBO
MDusp	Dusp6 mRNA	

Product

Table 57: Properties of each product.

Id	Name	SBO
Dusp	Dusp6 protein	

Kinetic Law

Derived unit $(60\ \mathrm{s})^{-1} \cdot \mathrm{nmol}$

$$v_{32} = \mathrm{eta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{ksDusp} \cdot [\mathrm{MDusp}] \tag{69}$$

7.33 Reaction Dusp_degradation

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

SBO:0000179 degradation

Reaction equation

$$\mathrm{Dusp} \longrightarrow \emptyset \tag{70}$$

Reactant

Table 58: Properties of each reactant.

Id	Name	SBO
Dusp	Dusp6 protein	

Kinetic Law

Derived unit $9.999999999999998 \cdot 10^{-10}\ \mathrm{mol} \cdot (60\ \mathrm{s})^{-1}$

$$v_{33} = \frac{\mathrm{eta} \cdot \mathrm{vol}\,(\mathrm{cytosol}) \cdot \mathrm{vdDusp} \cdot [\mathrm{Dusp}]}{\mathrm{KdDusp} + [\mathrm{Dusp}]} \tag{71}$$

8 Derived Rate Equations

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

8.1 Species N

Name Notch protein

SBO:0000252 polypeptide chain

Initial concentration $0.5\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in N_degradation, N_activation and as a product in n_synth).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{N} = v_1 - v_2 - v_3 \tag{72}$$

8.2 Species Na

Name cytosolic NicD

SBO:0000252 polypeptide chain

Initial concentration $0.2\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in Na_degradation, Na_transport and as a product in N_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Na} = v_3 - v_4 - v_5 \tag{73}$$

8.3 Species Nan

Name nuclear NicD

SBO:0000252 polypeptide chain

Initial concentration $0\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in Nan_degradation and as a product in Na_transport and as a modifier in MF_transkription).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Nan} = v_5 - v_6 \tag{74}$$

8.4 Species MF

Name Lunatic fringe mRNA

SBO:0000250 ribonucleic acid

Initial concentration $0.1\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in MF_degradation and as a product in MF_transkription and as a modifier in F_translation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MF} = v_7 - v_8 \tag{75}$$

8.5 Species F

Name Lunatic Fringe protein

SBO:0000252 polypeptide chain

Initial concentration $0.0010\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in F_degradation and as a product in F_translation and as a modifier in N_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{F} = v_9 - v_{10} \tag{76}$$

8.6 Species Bp

Name phosph. beta-catenin

SBO:0000252 polypeptide chain

Initial concentration $0.1\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in BP_dephosphorylation, Bp_degradation and as a product in B_phosphorylation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bp} = v_{14} - v_{15} - v_{17} \tag{77}$$

8.7 Species BN

Name nuclear beta-catenin

SBO:0000252 polypeptide chain

Initial concentration $0.0010\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in B_shuttling and as a modifier in MAx_trans_basal, MAx_trans_BN).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{BN} = -v_{16} \tag{78}$$

8.8 Species A

Name Axin2 protein

SBO:0000252 polypeptide chain

Initial concentration $0.1\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in A_degradation and as a product in AK_dissoc, A_translation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{A} = v_{11} + v_{22} - v_{23} \tag{79}$$

8.9 Species K

Name Gsk3

SBO:0000252 polypeptide chain

Initial concentration $3\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{K} = v_{11} \tag{80}$$

8.10 Species B

Name beta-catenin

SBO:0000252 polypeptide chain

Initial concentration $0.1\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in B_degradation, B_phosphorylation and as a product in B_synth, BP_dephosphorylation, B_shuttling).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B} = v_{12} + v_{15} + v_{16} - v_{13} - v_{14} \tag{81}$$

8.11 Species MAx

Name Axin2 mRNA

SBO:0000250 ribonucleic acid

Initial concentration $0.1\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in MAx_degradation and as a product in MAx_trans_basal, MAx_trans_BN, MAx_trans_Xa and as a modifier in A_translation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MAx} = v_{18} + v_{19} + v_{20} - v_{21} \tag{82}$$

8.12 Species Rasa

Name active Ras

SBO:0000252 polypeptide chain

Initial concentration $0.5\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in Ras_inactivation and as a product in Ras_activation and as a modifier in Erk_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rasa} = v_{24} - v_{25} \tag{83}$$

8.13 Species ERKa

Name active ERK

SBO:0000252 polypeptide chain

Initial concentration $0.2\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in Erk_inactivation and as a product in Erk_activation and as a modifier in X_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ERKa} = v_{26} - v_{27} \tag{84}$$

8.14 Species Xa

Name active TF X

SBO:0000252 polypeptide chain

Initial concentration $0.1\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in X_inactivation and as a product in X_activation and as a modifier in MAx_trans_Xa, MDusp_transkription).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xa} = v_{28} - v_{29} \tag{85}$$

8.15 Species MDusp

Name Dusp6 mRNA

SBO:0000250 ribonucleic acid

Initial concentration $0.1\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in MDusp_degradation and as a product in MDusp_transkription and as a modifier in Dusp_translation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MDusp} = v_{30} - v_{31} \tag{86}$$

8.16 Species Dusp

Name Dusp6 protein

SBO:0000252 polypeptide chain

Initial concentration $0.1\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in Dusp_degradation and as a product in Dusp_translation and as a modifier in Erk_inactivation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Dusp} = v_{32} - v_{33} \tag{87}$$

8.17 Species Rasi

Name inactive Ras

SBO:0000252 polypeptide chain

Involved in rule Rasi

This species takes part in one reaction (as a modifier in Ras_activation). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

8.18 Species ERKi

Name inactive ERK

SBO:0000252 polypeptide chain

Involved in rule ERKi

This species takes part in one reaction (as a modifier in Erk_activation). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

8.19 Species Xi

Name inactive TF X

SBO:0000252 polypeptide chain

Involved in rule Xi

This species takes part in one reaction (as a modifier in X_activation). Not this but one rule determines the species' quantity because this species is on the boundary of the reaction system.

8.20 Species Rast

Name Ras total

SBO:0000252 polypeptide chain

Initial concentration $2\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a modifier in Erk_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Rast} = 0 \tag{88}$$

8.21 Species ERKt

Name ERK total

SBO:0000252 polypeptide chain

Initial concentration $2\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a modifier in X_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ERKt} = 0 \tag{89}$$

8.22 Species Xt

Name X total

SBO:0000252 polypeptide chain

Initial concentration $2\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xt} = 0 \tag{90}$$

8.23 Species D

Name Dsh protein

SBO:0000252 polypeptide chain

Initial concentration $2\ \mathrm{nmol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a modifier in B_phosphorylation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{D} = 0 \tag{91}$$

8.24 Species AK

Name Axin2/Gsk3 destruction complex

SBO:0000297 protein complex

Involved in rule AK

This species takes part in two reactions (as a reactant in AK_dissoc and as a modifier in B_phosphorylation). Not these but one rule determines the species' quantity because this species is on the boundary of the reaction system.

8.25 Species Kt

Name Kt

SBO:0000252 polypeptide chain

Initial concentration $3\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a modifier in B_phosphorylation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Kt} = 0 \tag{92}$$

8.26 Species Fgf

Name Fgf

SBO:0000252 polypeptide chain

Initial concentration $1\ \mathrm{nmol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a modifier in Ras_activation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Fgf} = 0 \tag{93}$$

A Glossary of Systems Biology Ontology Terms

SBO:0000022 forward unimolecular rate constant: Numerical parameter that quantifies the forward velocity of a chemical reaction involving only one reactant. This parameter encompasses all the contributions to the velocity except the quantity of the reactant

SBO:0000023 forward bimolecular rate constant: Numerical parameter that quantifies the forward velocity of a chemical reaction involving two reactants. This parameter encompasses all the contributions to the velocity except the quantity of the reactants.

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:0000032 reverse unimolecular rate constant: Numerical parameter that quantifies the reverse velocity of a chemical reaction involving only one product. This parameter encompasses all the contributions to the velocity except the quantity of the product

SBO:0000048 forward zeroth order rate constant, continuous case: Numerical parameter that quantifies the forward velocity of a chemical reaction independant of the reactant quantities. This parameter encompasses all the contributions to the velocity. It is to be used in a reaction modelled using a continuous framework.

SBO:0000178 cleavage: Rupture of a covalent bond resulting in the conversion of one physical entity into several physical entities

SBO:0000179 degradation: Complete disappearance of a physical entity

SBO:0000180 dissociation: Transformation of a non-covalent complex that results in the formation of several independent biochemical entitie

SBO:0000183 transcription: Process through which a DNA sequence is copied to produce a complementary RNA

SBO:0000184 translation: Process in which a polypeptide chain is produced from a messenger RNA

SBO:0000185 transport reaction: Movement of a physical entity without modification of the structure of the entity

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:0000190 Hill coefficient: Empirical parameter created by Archibald Vivian Hill to describe the cooperative binding of oxygen on hemoglobine (Hill (1910). The possible effects of the aggregation of the molecules of haemoglobin on its dissociation curves. J Physiol 40: iv-vii)

SBO:0000191 Hill constant: Empirical constant created by Archibald Vivian Hill to describe the cooperative binding of oxygen on hemoglobine (Hill (1910). The possible effects of the aggregation of the molecules of haemoglobin on its dissociation curves. J Physiol 40: iv-vii). Different from a microscopic dissociation constant, it has the dimension of concentration to the power of the Hill coefficient

SBO:0000216 phosphorylation: Addition of a phosphate group (-H2PO4) to a chemical entity

SBO:0000250 ribonucleic acid: Macromolecule formed by a repetition of ribonucleosides linked by phosphodiester bonds. CHEBI:3369

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:0000297 protein complex: Macromolecular complex containing one or more polypeptide chains possibly associated with simple chemicals. CHEBI:3608

SBO:0000324 forward maximal velocity: Limiting maximal velocity of the forward reaction of a reversible enzyme, reached when the substrate is in large excess and all the enzyme is complexed.

SBO:0000330 dephosphorylation: Removal of a phosphate group (-H2PO4) from a chemical entity.

SBO:0000338 dissociation rate constant: Rate with which a complex dissociates into its components

SBO:0000381 biochemical proportionality coefficient: A multiplicative factor for quantities, expressions or functions

SBML2LaTeX 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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