SBML Model Report

Model name: "Sttzel2012 - Bovine estrous cycle, synchronization with prostaglandin F2"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Vijayalakshmi Chelliah[1] and Claudia Sttzel[2] at September 23rd 2013 at 10:44 a. m. and last time modified at October tenth 2014 at 11:31 a. m. Table 1 provides an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	42
events	0	constraints	0
reactions	28	function definitions	28
global parameters	69	unit definitions	5
rules	3	initial assignments	2

2 Unit Definitions

This is an overview of five unit definitions.

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2.1 Unit `substance`

Name substance

Definition mol

2.2 Unit `volume`

Name volume

Definition l

2.3 Unit `area`

Name area

Definition m^2

2.4 Unit `length`

Name length

Definition m

2.5 Unit `time`

Name time

Definition s

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

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

3.1 Compartment `default`

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

Name default

4 Species

This model contains 42 species. The boundary condition of 27 of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 10 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
GnRH_Pit	GnRH_Pit	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
LH_Pit	LH_Pit	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
LH_Bld	LH_Bld	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
GnRH_Hyp	GnRH_Hyp	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
FSH_Pit	FSH_Pit	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
FSH_Bld	FSH_Bld	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Foll	Foll	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
CL	CL	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
E2	E2	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
P4	P4	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Inh	Inh	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
OT	OT	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Enz	Enz	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PGF	PGF	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
IOF	IOF	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
src_GnRH	src_GnRH	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	☑	☑
src_E2	src_E2	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	☑	☑
src_P4	src_P4	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	☑	☑
src_Inh	src_Inh	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	☑	☑
src_OT	src_OT	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	☑	☑
src_Enz	src_Enz	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	☑	☑

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
src_PGF	src_PGF	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
src_LH	src_LH	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
src_FSH	src_FSH	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_GnRH_Hyp	snk_GnRH_Hyp	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
src_GnRH_Pit	src_GnRH_Pit	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
src_Foll	src_Foll	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
src_IOF	src_IOF	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
src_CL	src_CL	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_Inh	snk_Inh	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_P4	snk_P4	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_E2	snk_E2	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_GnRH_Pit	snk_GnRH_Pit	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_LH	snk_LH	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_FSH	snk_FSH	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_IOF	snk_IOF	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_CL	snk_CL	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_Enz	snk_Enz	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_OT	snk_OT	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_PGF	snk_PGF	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
snk_Foll	snk_Foll	default	$\text{mol} \cdot \text{l}^{-1}$	☑	☑
species_1	PGF_syn	default	$\text{mol} \cdot \text{l}^{-1}$	⊟	☑

5 Parameters

This model contains 69 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
par2	k_G		2.750		☑
par1	GnRH_max		16.000		☑
par3	h_P4&E2_G		2.050		☑
par4	T_E2_G1		0.097		☑
par5	T_p4_G1		0.350		☑
par6	h_p4_G2		1.910		☑
par7	T_p4_G2		0.252		☑
par8	h_e2_g2		0.990		☑
par9	T_e2_g2		0.648		☑
par10	cl_G		1.630		☑
par21	h_inh_fsh		4.210		☑
par22	T_inh_fsh		0.118		☑
par23	h_p4_fsh		0.293		☑
par24	T_p4_fsh		0.152		☑
par25	h_e2_fsh		0.396		☑
par26	T_e2_fsh		0.312		☑
par27	h_gnrh_fsh		1.230		☑
par28	T_gnrh_fsh		0.071		☑
par29	cl_fsh		2.730		☑
par30	b_fsh		0.948		☑
par31	h_e2_lh		0.376		☑
par32	T_e2_lh		0.243		☑
par33	h_p4_lh		2.710		☑
par34	T_p4_lh		0.027		☑
par35	h_gnrh_lh		2.220		☑
par36	T_gnrh_lh		0.690		☑
par37	b_lh		0.014		☑
par38	cl_lh		12.000		☑
par41	h_fsh_foll		0.562		☑
par42	T_fsh_foll		0.570		☑
par43	T_foll_fsh		0.220		☑
par45	h_p4_fsh_2		1.100		☑
par46	T_p4_foll		0.126		☑
par47	h_lh_foll		3.490		☑
par48	T_lh_Foll		0.171		☑
par56	h_enz_pgf		53.910		☑
par57	T_enz_pgf		1.430		☑

Id	Name	SBO	Value	Unit	Constant
par58	T_ot_pgf		1.087		☑
par59	cl_pgf		1.230		☑
par62	SF_CL		0.200		☑
par63	h_cl_cl		0.035		☑
par64	T_cl_cl		0.100		☑
par65	h_iof_cl		41.390		☑
par66	T_iof_cl		1.320		☑
par71	k_cl_p4		2.250		☑
par72	cl_p4		1.410		☑
par76	k_foll_e2		2.190		☑
par77	cl_e2		1.230		☑
par81	k_foll_inh		1.410		☑
par82	cl_inh		0.475		☑
par86	h_p4_enz		3.580		☑
par87	T_p4_enz		0.770		☑
par89	cl_enz		2.980		☑
par91	h_e2cl_ot		1.590		☑
par92	T_e2_ot		0.143		☑
par94	cl_ot		0.644		☑
par95	h_pg_iof		39.680		☑
par96	T_pg_ot		1.220		☑
par97	T_cl_iof		0.600		☑
par98	cl_iof		0.298		☑
parameter_1	D		3.700		☑
parameter_2	beta		100.000		☑
parameter_3	c_PGF_syn		5.500		☑
parameter_4	t_mod		150.000		⊟
parameter_5	t_D		0.000		☑
parameter_6	Total_PGF_2alpha		$3.62064120302475 \cdot 10^{-4}$		⊟
parameter_7	quantity_1		0.000		☑
ModelValue-_60	Initial for D		3.700		☑
ModelValue-_61	Initial for beta		100.000		☑

6 Initialassignments

This is an overview of two initialassignments.

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6.1 Initialassignment `ModelValue_60`

Derived unit contains undeclared units

Math parameter_1

6.2 Initialassignment `ModelValue_61`

Derived unit contains undeclared units

Math parameter_2

7 Function definitions

This is an overview of 28 function definitions.

7.1 Function definition `function_1`

Name Function for re1

Arguments [GnRH_Pit], [LH_Pit], vol (default), par35, par36, par37

Mathematical Expression

$$\frac{\left(par37 + \frac{par35 \cdot ([\text{GnRH\_Pit}] \cdot vol(\text{default}))^5}{([\text{GnRH\_Pit}] \cdot vol(\text{default}))^5 + par36^5}\right) \cdot [\text{LH\_Pit}] \cdot vol(\text{default})}{vol(\text{default})} \tag{1}$$

7.2 Function definition `function_2`

Name Function for re2

Arguments [E2], [FSH_Pit], [GnRH_Pit], [P4], vol (default), par23, par24, par25, par26, par27, par28, par30

Mathematical Expression

$$\frac{\left(par30 + \frac{par23 \cdot ([\text{P4}] \cdot vol(\text{default}))^2}{([\text{P4}] \cdot vol(\text{default}))^2 + par24^2} + \frac{par25 \cdot par26^2}{([\text{E2}] \cdot vol(\text{default}))^2 + par26^2} + \frac{par27 \cdot [\text{GnRH\_Pit}] \cdot vol(\text{default})}{par28 + [\text{GnRH\_Pit}] \cdot vol(\text{default})}\right) \cdot [\text{FSH\_Pit}] \cdot vol(\text{default})}{vol(\text{default})} \tag{2}$$

7.3 Function definition `function_3`

Name Function for re3

Arguments [E2], [GnRH_Hyp], [P4], vol (default), par3, par4, par5, par6, par7

Mathematical Expression

$$\frac{\left(\text{par3} \cdot \left(\frac{\text{par5}^2}{\text{par5}^2 + ([\text{P4}] \cdot \text{vol}(\text{default}))^2} + \frac{\text{par4}^2}{\text{par4}^2 + ([\text{E2}] \cdot \text{vol}(\text{default}))^2} - \frac{\frac{\text{par5}^2}{\text{par5}^2 + ([\text{P4}] \cdot \text{vol}(\text{default}))^2} \cdot \text{par4}^2}{\text{par4}^2 + ([\text{E2}] \cdot \text{vol}(\text{default}))^2} \right) + \frac{\text{par6} \cdot \text{par7}^2}{([\text{P4}] \cdot \text{vol}(\text{default}))^2 + \text{par7}^2} \right) \cdot [\text{GnRH}}{\text{vol}(\text{default})} \tag{3}$$

7.4 Function definition `function_4`

Name Function for re4

Arguments [CL], [Foll], [LH_Bld], vol (default), par47, par48, par62, par63, par64

Mathematical Expression

$$\frac{\frac{\text{par62} \cdot \text{par47} \cdot ([\text{LH\_Bld}] \cdot \text{vol}(\text{default}))^2}{([\text{LH\_Bld}] \cdot \text{vol}(\text{default}))^2 + \text{par48}^2} \cdot [\text{Foll}] \cdot \text{vol}(\text{default}) + \frac{\text{par63} \cdot ([\text{CL}] \cdot \text{vol}(\text{default}))^2}{([\text{CL}] \cdot \text{vol}(\text{default}))^2 + \text{par64}^2}}{\text{vol}(\text{default})} \tag{4}$$

7.5 Function definition `function_5`

Name Function for re5

Arguments [GnRH_Hyp], vol (default), par1, par2

Mathematical Expression

$$\frac{\text{par2} \cdot \left(1 - \frac{[\text{GnRH\_Hyp}] \cdot \text{vol}(\text{default})}{\text{par1}} \right)}{\text{vol}(\text{default})} \tag{5}$$

7.6 Function definition `function_6`

Name Function for re6

Arguments [Foll], vol (default), par76

Mathematical Expression

$$\frac{\text{par76} \cdot ([\text{Foll}] \cdot \text{vol}(\text{default}))^2}{\text{vol}(\text{default})} \tag{6}$$

7.7 Function definition `function_7`

Name Function for re7

Arguments [CL], vol (default), par71

Mathematical Expression

$$\frac{\text{par71} \cdot ([\text{CL}] \cdot \text{vol}(\text{default}))^2}{\text{vol}(\text{default})} \tag{7}$$

7.8 Function definition `function_8`

Name Function for re8

Arguments $[\mathrm{Foll}]$, $\mathrm{vol\,(default)}$, $\mathrm{par81}$

Mathematical Expression

$$\frac{\mathrm{par81} \cdot \left([\mathrm{Foll}] \cdot \mathrm{vol\,(default)}\right)^2}{\mathrm{vol\,(default)}} \tag{8}$$

7.9 Function definition `function_9`

Name Function for re9

Arguments $[\mathrm{CL}]$, $[\mathrm{E2}]$, $\mathrm{vol\,(default)}$, $\mathrm{par91}$, $\mathrm{par92}$

Mathematical Expression

$$\frac{\frac{\mathrm{par91}\cdot\left([\mathrm{E2}]\cdot\mathrm{vol(default)}\right)^2}{\left([\mathrm{E2}]\cdot\mathrm{vol(default)}\right)^2+\mathrm{par92}^2} \cdot \left([\mathrm{CL}] \cdot \mathrm{vol\,(default)}\right)^2}{\mathrm{vol\,(default)}} \tag{9}$$

7.10 Function definition `function_10`

Name Function for re10

Arguments $[\mathrm{P4}]$, $\mathrm{vol\,(default)}$, $\mathrm{par86}$, $\mathrm{par87}$

Mathematical Expression

$$\frac{\frac{\mathrm{par86}\cdot\left([\mathrm{P4}]\cdot\mathrm{vol(default)}\right)^5}{\left([\mathrm{P4}]\cdot\mathrm{vol(default)}\right)^5+\mathrm{par87}^5}}{\mathrm{vol\,(default)}} \tag{10}$$

7.11 Function definition `function_11`

Name Function for re11

Arguments $[\mathrm{Enz}]$, $[\mathrm{OT}]$, $\mathrm{vol\,(default)}$, $\mathrm{par56}$, $\mathrm{par57}$, $\mathrm{par58}$

Mathematical Expression

$$\frac{\frac{\frac{\mathrm{par56}\cdot[\mathrm{Enz}]^5}{[\mathrm{Enz}]^5+\mathrm{par57}^5}\cdot\left([\mathrm{OT}]\cdot\mathrm{vol(default)}\right)^2}{\left([\mathrm{OT}]\cdot\mathrm{vol(default)}\right)^2+\mathrm{par58}^2}}{\mathrm{vol\,(default)}} \tag{11}$$

7.12 Function definition `function_12`

Name Function for re12

Arguments [GnRH_Pit], vol (default), par10

Mathematical Expression

$$\frac{par10 \cdot [GnRH\_Pit] \cdot vol\,(default)}{vol\,(default)} \tag{12}$$

7.13 Function definition `function_13`

Name Function for re13

Arguments [LH_Bld], vol (default), par38

Mathematical Expression

$$\frac{par38 \cdot [LH\_Bld] \cdot vol\,(default)}{vol\,(default)} \tag{13}$$

7.14 Function definition `function_14`

Name Function for re14

Arguments [FSH_Bld], vol (default), par29

Mathematical Expression

$$\frac{par29 \cdot [FSH\_Bld] \cdot vol\,(default)}{vol\,(default)} \tag{14}$$

7.15 Function definition `function_15`

Name Function for re15

Arguments [P4], vol (default), par72

Mathematical Expression

$$\frac{par72 \cdot [P4] \cdot vol\,(default)}{vol\,(default)} \tag{15}$$

7.16 Function definition `function_16`

Name Function for re16

Arguments $[E2]$, vol (default), par77

Mathematical Expression

$$\frac{\text{par77} \cdot [E2] \cdot \text{vol (default)}}{\text{vol (default)}} \qquad (16)$$

7.17 Function definition `function_17`

Name Function for re17

Arguments $[Inh]$, vol (default), par82

Mathematical Expression

$$\frac{\text{par82} \cdot [Inh] \cdot \text{vol (default)}}{\text{vol (default)}} \qquad (17)$$

7.18 Function definition `function_18`

Name Function for re18

Arguments $[OT]$, vol (default), par94

Mathematical Expression

$$\frac{\text{par94} \cdot [OT] \cdot \text{vol (default)}}{\text{vol (default)}} \qquad (18)$$

7.19 Function definition `function_19`

Name Function for re19

Arguments $[Enz]$, vol (default), par89

Mathematical Expression

$$\frac{\text{par89} \cdot [Enz]}{\text{vol (default)}} \qquad (19)$$

7.20 Function definition `function_20`

Name Function for re20

Arguments [PGF], vol (default), par59

Mathematical Expression

$$\frac{\text{par59} \cdot [\text{PGF}] \cdot \text{vol (default)}}{\text{vol (default)}} \tag{20}$$

7.21 Function definition `function_21`

Name Function for re21

Arguments [IOF], vol (default), par98

Mathematical Expression

$$\frac{\text{par98} \cdot [\text{IOF}] \cdot \text{vol (default)}}{\text{vol (default)}} \tag{21}$$

7.22 Function definition `function_22`

Name Function for l

Arguments [Foll], [LH_Bld], [P4], vol (default), par45, par46, par47, par48

Mathematical Expression

$$\frac{\left(\frac{\text{par45} \cdot ([\text{P4}] \cdot \text{vol(default)})^5}{([\text{P4}] \cdot \text{vol(default)})^5 + \text{par46}^5} + \frac{\text{par47} \cdot ([\text{LH\_Bld}] \cdot \text{vol(default)})^2}{([\text{LH\_Bld}] \cdot \text{vol(default)})^2 + \text{par48}^2} \right) \cdot [\text{Foll}] \cdot \text{vol (default)}}{\text{vol (default)}} \tag{22}$$

7.23 Function definition `function_23`

Name Function for re23

Arguments [CL], [IOF], vol (default), par65, par66

Mathematical Expression

$$\frac{\frac{\text{par65} \cdot ([\text{IOF}] \cdot \text{vol(default)})^5}{([\text{IOF}] \cdot \text{vol(default)})^5 + \text{par66}^5} \cdot [\text{CL}] \cdot \text{vol (default)}}{\text{vol (default)}} \tag{23}$$

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7.24 Function definition `function_24`

Name Function for re24

Arguments [E2], [P4], vol (default), par31, par32, par33, par34

Mathematical Expression

$$
\frac{\frac{\text{par31}\cdot([\text{E2}]\cdot\text{vol(default)})^2}{([\text{E2}]\cdot\text{vol(default)})^2+\text{par32}^2} + \frac{\text{par33}\cdot\text{par34}^2}{\text{par34}^2+([\text{P4}]\cdot\text{vol(default)})^2}}{\text{vol(default)}}
\tag{24}
$$

7.25 Function definition `function_25`

Name Function for re25

Arguments [Inh], vol (default), par21, par22

Mathematical Expression

$$
\frac{\frac{\text{par21}\cdot\text{par22}^5}{\text{par22}^5+([\text{Inh}]\cdot\text{vol(default)})^5}}{\text{vol(default)}}
\tag{25}
$$

7.26 Function definition `function_26`

Name Function for re26

Arguments [E2], [GnRH_Hyp], [P4], vol (default), par3, par4, par5, par6, par7, par8, par9

Mathematical Expression

$$
\frac{\frac{\text{par8}\cdot([\text{E2}]\cdot\text{vol(default)})^5}{([\text{E2}]\cdot\text{vol(default)})^5+\text{par9}^5} \cdot \left(\text{par3}\cdot\left(\frac{\text{par5}^2}{\text{par5}^2+([\text{P4}]\cdot\text{vol(default)})^2} + \frac{\text{par4}^2}{\text{par4}^2+([\text{E2}]\cdot\text{vol(default)})^2} - \frac{\frac{\text{par5}^2}{\text{par5}^2+([\text{P4}]\cdot\text{vol(default)})^2}\cdot\text{par4}^2}{\text{par4}^2+([\text{E2}]\cdot\text{vol(default)})^2}\right)\right) + \frac{\text{par6}\cdot}{([\text{P4}]\cdot\text{def}}}{\text{vol(default)}}
\tag{26}
$$

7.27 Function definition `function_27`

Name Function for re27

Arguments [FSH_Bld], [Foll], vol (default), par41, par42, par43

Mathematical Expression

$$
\frac{\frac{\text{par41}\cdot([\text{FSH\_Bld}]\cdot\text{vol(default)})^2}{\left(\frac{\text{par42}\cdot\text{par43}^2}{\text{par43}^2+([\text{Foll}]\cdot\text{vol(default)})^2}\right)^2+([\text{FSH\_Bld}]\cdot\text{vol(default)})^2}}{\text{vol(default)}}
\tag{27}
$$

7.28 Function definition `function_28`

Name Function for re28

Arguments [CL], [PGF], vol (default), par95, par96, par97

Mathematical Expression

$$\frac{\frac{\text{par95}\cdot([\text{PGF}]\cdot\text{vol(default)})^5}{([\text{PGF}]\cdot\text{vol(default)})^5+\text{par96}^5}\cdot([\text{CL}]\cdot\text{vol(default)})^{10}}{([\text{CL}]\cdot\text{vol(default)})^{10}+\text{par97}^{10}}}{\text{vol (default)}} \tag{28}$$

8 Rules

This is an overview of three rules.

8.1 Rule `parameter_4`

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

$$\text{parameter\_4} = \begin{cases} \text{time} - \text{parameter\_5} & \text{if time} > \text{parameter\_5} \\ 0 & \text{otherwise} \end{cases} \tag{29}$$

8.2 Rule `parameter_6`

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

$$\text{parameter\_6} = [\text{PGF}] + [\text{species\_1}] \tag{30}$$

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

8.3 Rule `species_1`

Rule `species_1` is a rate rule for species `species_1`:

$$\frac{\text{d}}{\text{d}t}\text{species\_1} = \text{ModelValue\_60}\cdot\text{ModelValue\_61}\cdot\text{ModelValue\_61}\cdot\text{parameter\_4} \tag{31}$$
$$\cdot\exp\left(\text{ModelValue\_61}\cdot\text{parameter\_4}\right) - \text{parameter\_3}\cdot[\text{species\_1}]$$

Produced by SBML2LATEX

9 Reactions

This model contains 28 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	re1	re1	$\text{LH\_Pit} \xrightarrow{\text{GnRH\_Pit, GnRH\_Pit, LH\_Pit}} \text{LH\_Bld}$	
2	re2	re2	$\text{FSH\_Pit} \xrightarrow{\text{E2, P4, GnRH\_Pit, E2, FSH\_Pit, GnRH\_Pit, P4}} \text{FSH\_Bld}$	
3	re3	re3	$\text{GnRH\_Hyp} \xrightarrow{\text{E2, P4, E2, GnRH\_Hyp, P4}} \text{snk\_GnRH\_Hyp}$	
4	re4	re4	$\text{src\_CL} \xrightarrow{\text{Foll, CL, LH\_Bld, CL, Foll, LH\_Bld}} \text{CL}$	
5	re5	re5	$\text{src\_GnRH} \xrightarrow{\text{GnRH\_Hyp, GnRH\_Hyp}} \text{GnRH\_Hyp}$	
6	re6	re6	$\text{src\_E2} \xrightarrow{\text{Foll, Foll}} \text{E2}$	
7	re7	re7	$\text{src\_P4} \xrightarrow{\text{CL, CL}} \text{P4}$	
8	re8	re8	$\text{src\_Inh} \xrightarrow{\text{Foll, Foll}} \text{Inh}$	
9	re9	re9	$\text{src\_OT} \xrightarrow{\text{E2, CL, CL, E2}} \text{OT}$	
10	re10	re10	$\text{src\_Enz} \xrightarrow{\text{P4, P4}} \text{Enz}$	
11	re11	re11	$\text{src\_PGF} \xrightarrow{\text{OT, Enz, Enz, OT}} \text{PGF}$	
12	re12	re12	$\text{GnRH\_Pit} \xrightarrow{\text{GnRH\_Pit}} \text{snk\_GnRH\_Pit}$	
13	re13	re13	$\text{LH\_Bld} \xrightarrow{\text{LH\_Bld}} \text{snk\_LH}$	
14	re14	re14	$\text{FSH\_Bld} \xrightarrow{\text{FSH\_Bld}} \text{snk\_FSH}$	
15	re15	re15	$\text{P4} \xrightarrow{\text{P4}} \text{snk\_P4}$	
16	re16	re16	$\text{E2} \xrightarrow{\text{E2}} \text{snk\_E2}$	

№	Id	Name	Reaction Equation	SBO
17	`re17`	re17	Inh $\xrightarrow{\text{Inh}}$ snk_Inh	
18	`re18`	re18	OT $\xrightarrow{\text{OT}}$ snk_OT	
19	`re19`	re19	Enz $\xrightarrow{\text{Enz}}$ snk_Enz	
20	`re20`	re20	PGF $\xrightarrow{\text{PGF}}$ snk_PGF	
21	`re21`	re21	IOF $\xrightarrow{\text{IOF}}$ snk_IOF	
22	`re22`	l	Foll $\xrightarrow{\text{P4, LH\_Bld, Foll, LH\_Bld, P4}}$ snk_Foll	
23	`re23`	re23	CL $\xrightarrow{\text{IOF, CL, IOF}}$ snk_CL	
24	`re24`	re24	src_LH $\xrightarrow{\text{E2, P4, E2, P4}}$ LH_Pit	
25	`re25`	re25	src_FSH $\xrightarrow{\text{Inh, Inh}}$ FSH_Pit	
26	`re26`	re26	src_GnRH_Pit $\xrightarrow{\text{GnRH\_Hyp, E2, P4, E2, GnRH\_Hyp, P4}}$ GnRH_Pit	
27	`re27`	re27	src_Foll $\xrightarrow{\text{FSH\_Bld, Foll, FSH\_Bld, Foll}}$ Foll	
28	`re28`	re28	src_IOF $\xrightarrow{\text{CL, PGF, CL, PGF}}$ IOF	

9.1 Reaction `re1`

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

Name re1

Reaction equation

$$\text{LH\_Pit} \xrightarrow{\text{GnRH\_Pit, GnRH\_Pit, LH\_Pit}} \text{LH\_Bld} \tag{32}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
LH_Pit	LH_Pit	

Modifiers

Table 7: Properties of each modifier.

Id	Name	SBO
GnRH_Pit	GnRH_Pit	
GnRH_Pit	GnRH_Pit	
LH_Pit	LH_Pit	

Product

Table 8: Properties of each product.

Id	Name	SBO
LH_Bld	LH_Bld	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \text{vol}\,(\text{default}) \cdot \text{function\_1}\,([\text{GnRH\_Pit}], [\text{LH\_Pit}], \text{vol}\,(\text{default}), \text{par35}, \text{par36}, \text{par37}) \tag{33}$$

$$\begin{aligned}
&\text{function\_1}\,([\text{GnRH\_Pit}], [\text{LH\_Pit}], \text{vol}\,(\text{default}), \text{par35}, \text{par36}, \text{par37}) \\
&= \frac{\left(\text{par37} + \frac{\text{par35} \cdot ([\text{GnRH\_Pit}] \cdot \text{vol}(\text{default}))^5}{([\text{GnRH\_Pit}] \cdot \text{vol}(\text{default}))^5 + \text{par36}^5}\right) \cdot [\text{LH\_Pit}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})}
\end{aligned} \tag{34}$$

$$\text{function\_1}\left([\text{GnRH\_Pit}], [\text{LH\_Pit}], \text{vol}\left(\text{default}\right), \text{par35}, \text{par36}, \text{par37}\right)$$

$$= \frac{\left(\text{par37} + \frac{\text{par35} \cdot ([\text{GnRH\_Pit}] \cdot \text{vol(default)})^5}{([\text{GnRH\_Pit}] \cdot \text{vol(default)})^5 + \text{par36}^5}\right) \cdot [\text{LH\_Pit}] \cdot \text{vol}\left(\text{default}\right)}{\text{vol}\left(\text{default}\right)} \qquad (35)$$

9.2 Reaction `re2`

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

Name re2

Reaction equation

$$\text{FSH\_Pit} \xrightarrow{\text{E2, P4, GnRH\_Pit, E2, FSH\_Pit, GnRH\_Pit, P4}} \text{FSH\_Bld} \qquad (36)$$
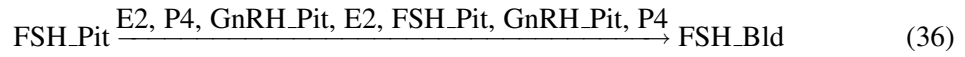
Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
FSH_Pit	FSH_Pit	

Modifiers

Table 10: Properties of each modifier.

Id	Name	SBO
E2	E2	
P4	P4	
GnRH_Pit	GnRH_Pit	
E2	E2	
FSH_Pit	FSH_Pit	
GnRH_Pit	GnRH_Pit	
P4	P4	

Product

Produced by SBML2LATEX

Table 11: Properties of each product.

Id	Name	SBO
FSH_Bld	FSH_Bld	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \text{vol}\,(\text{default}) \cdot \text{function\_2}\,([E2], [FSH\_Pit], [GnRH\_Pit], [P4], \text{vol}\,(\text{default})\,, \text{par23},$$
$$\text{par24}, \text{par25}, \text{par26}, \text{par27}, \text{par28}, \text{par30}) \quad (37)$$

$$\text{function\_2}\,([E2], [FSH\_Pit], [GnRH\_Pit], [P4], \text{vol}\,(\text{default})\,, \quad (38)$$
$$\text{par23}, \text{par24}, \text{par25}, \text{par26}, \text{par27}, \text{par28}, \text{par30})$$
$$= \frac{\left(\text{par30} + \frac{\text{par23}\cdot([P4]\cdot\text{vol}(\text{default}))^2}{([P4]\cdot\text{vol}(\text{default}))^2 + \text{par24}^2} + \frac{\text{par25}\cdot\text{par26}^2}{([E2]\cdot\text{vol}(\text{default}))^2 + \text{par26}^2} + \frac{\text{par27}\cdot[GnRH\_Pit]\cdot\text{vol}(\text{default})}{\text{par28} + [GnRH\_Pit]\cdot\text{vol}(\text{default})}\right) \cdot [FSH\_Pit] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})}$$

$$\text{function\_2}\,([E2], [FSH\_Pit], [GnRH\_Pit], [P4], \text{vol}\,(\text{default})\,, \quad (39)$$
$$\text{par23}, \text{par24}, \text{par25}, \text{par26}, \text{par27}, \text{par28}, \text{par30})$$
$$= \frac{\left(\text{par30} + \frac{\text{par23}\cdot([P4]\cdot\text{vol}(\text{default}))^2}{([P4]\cdot\text{vol}(\text{default}))^2 + \text{par24}^2} + \frac{\text{par25}\cdot\text{par26}^2}{([E2]\cdot\text{vol}(\text{default}))^2 + \text{par26}^2} + \frac{\text{par27}\cdot[GnRH\_Pit]\cdot\text{vol}(\text{default})}{\text{par28} + [GnRH\_Pit]\cdot\text{vol}(\text{default})}\right) \cdot [FSH\_Pit] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})}$$

9.3 Reaction `re3`

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

Name re3

Reaction equation

$$\text{GnRH\_Hyp} \xrightarrow{\text{E2, P4, E2, GnRH\_Hyp, P4}} \text{snk\_GnRH\_Hyp} \quad (40)$$
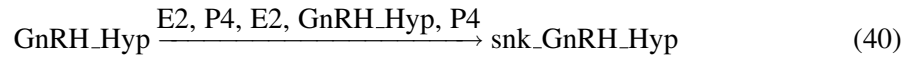
Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
GnRH_Hyp	GnRH_Hyp	

Modifiers

Table 13: Properties of each modifier.

Id	Name	SBO
E2	E2	
P4	P4	
E2	E2	
GnRH_Hyp	GnRH_Hyp	
P4	P4	

Product

Table 14: Properties of each product.

Id	Name	SBO
snk_GnRH_Hyp	snk_GnRH_Hyp	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \text{vol}\left(\text{default}\right) \cdot \text{function\_3}\left([E2],[GnRH\_Hyp],[P4],\text{vol}\left(\text{default}\right),\text{par3},\text{par4},\text{par5},\text{par6},\text{par7}\right) \tag{41}$$

$$\text{function\_3}\left([E2],[GnRH\_Hyp],[P4],\text{vol}\left(\text{default}\right),\text{par3},\text{par4},\text{par5},\text{par6},\text{par7}\right) \tag{42}$$
$$= \frac{\left(\text{par3} \cdot \left(\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2} + \frac{\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2} - \frac{\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2}\cdot\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2}\right) + \frac{\text{par6}\cdot\text{par7}^2}{([P4]\cdot\text{vol(default)})^2+\text{par7}^2}\right) \cdot [\text{GnRH}}{\text{vol}\left(\text{default}\right)}$$

$$\text{function\_3}\left([E2],[GnRH\_Hyp],[P4],\text{vol}\left(\text{default}\right),\text{par3},\text{par4},\text{par5},\text{par6},\text{par7}\right) \tag{43}$$
$$= \frac{\left(\text{par3} \cdot \left(\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2} + \frac{\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2} - \frac{\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2}\cdot\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2}\right) + \frac{\text{par6}\cdot\text{par7}^2}{([P4]\cdot\text{vol(default)})^2+\text{par7}^2}\right) \cdot [\text{GnRH}}{\text{vol}\left(\text{default}\right)}$$

9.4 Reaction `re4`

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

Name re4

Produced by SBML2LATEX

Reaction equation

$$\text{src\_CL} \xrightarrow{\text{Foll, CL, LH\_Bld, CL, Foll, LH\_Bld}} \text{CL} \tag{44}$$
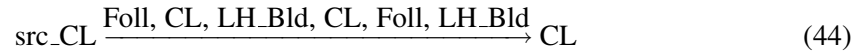
Reactant

Table 15: Properties of each reactant.

Id	Name	SBO
src_CL	src_CL	

Modifiers

Table 16: Properties of each modifier.

Id	Name	SBO
Foll	Foll	
CL	CL	
LH_Bld	LH_Bld	
CL	CL	
Foll	Foll	
LH_Bld	LH_Bld	

Product

Table 17: Properties of each product.

Id	Name	SBO
CL	CL	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{vol}\,(\text{default}) \cdot \text{function\_4}\,([\text{CL}], [\text{Foll}], [\text{LH\_Bld}], \text{vol}\,(\text{default})\,, \text{par47}, \text{par48}, \text{par62}, \text{par63}, \tag{45}$$
$$\text{par64})$$

$$\text{function\_4}\,([\text{CL}], [\text{Foll}], [\text{LH\_Bld}], \text{vol}\,(\text{default})\,, \text{par47}, \text{par48}, \text{par62}, \text{par63}, \text{par64})$$
$$= \frac{\frac{\text{par62} \cdot \text{par47} \cdot ([\text{LH\_Bld}] \cdot \text{vol(default)})^2}{([\text{LH\_Bld}] \cdot \text{vol(default)})^2 + \text{par48}^2} \cdot [\text{Foll}] \cdot \text{vol}\,(\text{default}) + \frac{\text{par63} \cdot ([\text{CL}] \cdot \text{vol(default)})^2}{([\text{CL}] \cdot \text{vol(default)})^2 + \text{par64}^2}}{\text{vol}\,(\text{default})} \tag{46}$$

$$\text{function\_4} \left([CL], [Foll], [LH\_Bld], \text{vol} \left(\text{default} \right), \text{par47}, \text{par48}, \text{par62}, \text{par63}, \text{par64} \right)$$

$$= \frac{\frac{\text{par62} \cdot \text{par47} \cdot ([LH\_Bld] \cdot \text{vol}(\text{default}))^2}{([LH\_Bld] \cdot \text{vol}(\text{default}))^2 + \text{par48}^2} \cdot [Foll] \cdot \text{vol} \left(\text{default} \right) + \frac{\text{par63} \cdot ([CL] \cdot \text{vol}(\text{default}))^2}{([CL] \cdot \text{vol}(\text{default}))^2 + \text{par64}^2}}{\text{vol} \left(\text{default} \right)} \qquad (47)$$

9.5 Reaction `re5`

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

Name re5

Reaction equation

$$\text{src\_GnRH} \xrightarrow{\text{GnRH\_Hyp, GnRH\_Hyp}} \text{GnRH\_Hyp} \qquad (48)$$
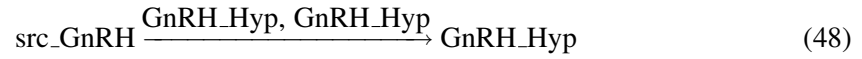
Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
src_GnRH	src_GnRH	

Modifiers

Table 19: Properties of each modifier.

Id	Name	SBO
GnRH_Hyp	GnRH_Hyp	
GnRH_Hyp	GnRH_Hyp	

Product

Table 20: Properties of each product.

Id	Name	SBO
GnRH_Hyp	GnRH_Hyp	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \text{vol} \left(\text{default} \right) \cdot \text{function\_5} \left([\text{GnRH\_Hyp}], \text{vol} \left(\text{default} \right), \text{par1}, \text{par2} \right) \qquad (49)$$

$$\text{function\_5}\left([\text{GnRH\_Hyp}], \text{vol}\left(\text{default}\right), \text{par1}, \text{par2}\right) = \frac{\text{par2} \cdot \left(1 - \frac{[\text{GnRH\_Hyp}] \cdot \text{vol}(\text{default})}{\text{par1}}\right)}{\text{vol}\left(\text{default}\right)} \quad (50)$$

$$\text{function\_5}\left([\text{GnRH\_Hyp}], \text{vol}\left(\text{default}\right), \text{par1}, \text{par2}\right) = \frac{\text{par2} \cdot \left(1 - \frac{[\text{GnRH\_Hyp}] \cdot \text{vol}(\text{default})}{\text{par1}}\right)}{\text{vol}\left(\text{default}\right)} \quad (51)$$

9.6 Reaction `re6`

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

Name re6

Reaction equation

$$\text{src\_E2} \xrightarrow{\text{Foll, Foll}} \text{E2} \quad (52)$$

Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
src_E2	src_E2	

Modifiers

Table 22: Properties of each modifier.

Id	Name	SBO
Foll	Foll	
Foll	Foll	

Product

Table 23: Properties of each product.

Id	Name	SBO
E2	E2	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \text{vol}\,(\text{default}) \cdot \text{function\_6}\,([\text{Foll}], \text{vol}\,(\text{default}), \text{par76}) \tag{53}$$

$$\text{function\_6}\,([\text{Foll}], \text{vol}\,(\text{default}), \text{par76}) = \frac{\text{par76} \cdot ([\text{Foll}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{54}$$

$$\text{function\_6}\,([\text{Foll}], \text{vol}\,(\text{default}), \text{par76}) = \frac{\text{par76} \cdot ([\text{Foll}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{55}$$

9.7 Reaction `re7`

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

Name re7

Reaction equation

$$\text{src\_P4} \xrightarrow{\text{CL, CL}} \text{P4} \tag{56}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
src_P4	src_P4	

Modifiers

Table 25: Properties of each modifier.

Id	Name	SBO
CL	CL	
CL	CL	

Product

Table 26: Properties of each product.

Id	Name	SBO
P4	P4	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \text{vol}\,(\text{default}) \cdot \text{function\_7}\,([\text{CL}], \text{vol}\,(\text{default}), \text{par71}) \tag{57}$$

$$\text{function\_7}\,([\text{CL}], \text{vol}\,(\text{default}), \text{par71}) = \frac{\text{par71} \cdot ([\text{CL}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{58}$$

$$\text{function\_7}\,([\text{CL}], \text{vol}\,(\text{default}), \text{par71}) = \frac{\text{par71} \cdot ([\text{CL}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{59}$$

9.8 Reaction `re8`

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

Name re8

Reaction equation

$$\text{src\_Inh} \xrightarrow{\text{Foll, Foll}} \text{Inh} \tag{60}$$

Reactant

Table 27: Properties of each reactant.

Id	Name	SBO
src_Inh	src_Inh	

Modifiers

Table 28: Properties of each modifier.

Id	Name	SBO
Foll	Foll	
Foll	Foll	

Product

Table 29: Properties of each product.

Id	Name	SBO
Inh	Inh	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \text{vol}\,(\text{default}) \cdot \text{function\_8}\,([\text{Foll}], \text{vol}\,(\text{default}), \text{par81}) \tag{61}$$

$$\text{function\_8}\,([\text{Foll}], \text{vol}\,(\text{default}), \text{par81}) = \frac{\text{par81} \cdot ([\text{Foll}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{62}$$

$$\text{function\_8}\,([\text{Foll}], \text{vol}\,(\text{default}), \text{par81}) = \frac{\text{par81} \cdot ([\text{Foll}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{63}$$

9.9 Reaction `re9`

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

Name re9

Reaction equation

$$\text{src\_OT} \xrightarrow{\text{E2, CL, CL, E2}} \text{OT} \tag{64}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
src_OT	src_OT	

Modifiers

Produced by SBML2LATEX

Table 31: Properties of each modifier.

Id	Name	SBO
E2	E2	
CL	CL	
CL	CL	
E2	E2	

Product

Table 32: Properties of each product.

Id	Name	SBO
OT	OT	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \text{vol}\,(\text{default}) \cdot \text{function\_9}\,([\text{CL}],[\text{E2}],\text{vol}\,(\text{default})\,,\text{par91},\text{par92}) \tag{65}$$

$$\text{function\_9}\,([\text{CL}],[\text{E2}],\text{vol}\,(\text{default})\,,\text{par91},\text{par92})$$
$$= \frac{\frac{\text{par91}\cdot([\text{E2}]\cdot\text{vol}(\text{default}))^2}{([\text{E2}]\cdot\text{vol}(\text{default}))^2+\text{par92}^2} \cdot ([\text{CL}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{66}$$

$$\text{function\_9}\,([\text{CL}],[\text{E2}],\text{vol}\,(\text{default})\,,\text{par91},\text{par92})$$
$$= \frac{\frac{\text{par91}\cdot([\text{E2}]\cdot\text{vol}(\text{default}))^2}{([\text{E2}]\cdot\text{vol}(\text{default}))^2+\text{par92}^2} \cdot ([\text{CL}] \cdot \text{vol}\,(\text{default}))^2}{\text{vol}\,(\text{default})} \tag{67}$$

9.10 Reaction `re10`

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

Name re10

Reaction equation

$$\text{src\_Enz} \xrightarrow{\text{P4, P4}} \text{Enz} \tag{68}$$

Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
src_Enz	src_Enz	

Modifiers

Table 34: Properties of each modifier.

Id	Name	SBO
P4	P4	
P4	P4	

Product

Table 35: Properties of each product.

Id	Name	SBO
Enz	Enz	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \text{vol}(\text{default}) \cdot \text{function\_10}([P4], \text{vol}(\text{default}), \text{par86}, \text{par87}) \tag{69}$$

$$\text{function\_10}([P4], \text{vol}(\text{default}), \text{par86}, \text{par87}) = \frac{\frac{\text{par86} \cdot ([P4] \cdot \text{vol}(\text{default}))^5}{([P4] \cdot \text{vol}(\text{default}))^5 + \text{par87}^5}}{\text{vol}(\text{default})} \tag{70}$$

$$\text{function\_10}([P4], \text{vol}(\text{default}), \text{par86}, \text{par87}) = \frac{\frac{\text{par86} \cdot ([P4] \cdot \text{vol}(\text{default}))^5}{([P4] \cdot \text{vol}(\text{default}))^5 + \text{par87}^5}}{\text{vol}(\text{default})} \tag{71}$$

9.11 Reaction `re11`

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

Name re11

Reaction equation

$$\text{src\_PGF} \xrightarrow{\text{OT, Enz, Enz, OT}} \text{PGF} \tag{72}$$

Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
src_PGF	src_PGF	

Modifiers

Table 37: Properties of each modifier.

Id	Name	SBO
OT	OT	
Enz	Enz	
Enz	Enz	
OT	OT	

Product

Table 38: Properties of each product.

Id	Name	SBO
PGF	PGF	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = \text{vol}\,(\text{default}) \cdot \text{function\_11}\,([\text{Enz}], [\text{OT}], \text{vol}\,(\text{default}), \text{par56}, \text{par57}, \text{par58}) \tag{73}$$

$$\text{function\_11}\,([\text{Enz}], [\text{OT}], \text{vol}\,(\text{default}), \text{par56}, \text{par57}, \text{par58}) = \frac{\frac{\frac{\text{par56} \cdot [\text{Enz}]^5}{[\text{Enz}]^5 + \text{par57}^5} \cdot ([\text{OT}] \cdot \text{vol}(\text{default}))^2}{([\text{OT}] \cdot \text{vol}(\text{default}))^2 + \text{par58}^2}}{\text{vol}\,(\text{default})} \tag{74}$$

$$\text{function\_11}\,([\text{Enz}], [\text{OT}], \text{vol}\,(\text{default}), \text{par56}, \text{par57}, \text{par58}) = \frac{\frac{\frac{\text{par56} \cdot [\text{Enz}]^5}{[\text{Enz}]^5 + \text{par57}^5} \cdot ([\text{OT}] \cdot \text{vol}(\text{default}))^2}{([\text{OT}] \cdot \text{vol}(\text{default}))^2 + \text{par58}^2}}{\text{vol}\,(\text{default})} \tag{75}$$

9.12 Reaction `re12`

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

Name re12

Reaction equation

$$\text{GnRH\_Pit} \xrightarrow{\text{GnRH\_Pit}} \text{snk\_GnRH\_Pit} \tag{76}$$

Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
GnRH_Pit	GnRH_Pit	

Modifier

Table 40: Properties of each modifier.

Id	Name	SBO
GnRH_Pit	GnRH_Pit	

Product

Table 41: Properties of each product.

Id	Name	SBO
snk_GnRH_Pit	snk_GnRH_Pit	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{vol} \left(\text{default} \right) \cdot \text{function\_12} \left([\text{GnRH\_Pit}], \text{vol} \left(\text{default} \right), \text{par10} \right) \tag{77}$$

$$\text{function\_12} \left([\text{GnRH\_Pit}], \text{vol} \left(\text{default} \right), \text{par10} \right) = \frac{\text{par10} \cdot [\text{GnRH\_Pit}] \cdot \text{vol} \left(\text{default} \right)}{\text{vol} \left(\text{default} \right)} \tag{78}$$

$$\text{function\_12} \left([\text{GnRH\_Pit}], \text{vol} \left(\text{default} \right), \text{par10} \right) = \frac{\text{par10} \cdot [\text{GnRH\_Pit}] \cdot \text{vol} \left(\text{default} \right)}{\text{vol} \left(\text{default} \right)} \tag{79}$$

9.13 Reaction `re13`

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

Name re13

Reaction equation

$$\text{LH\_Bld} \xrightarrow{\text{LH\_Bld}} \text{snk\_LH} \tag{80}$$

Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
LH_Bld	LH_Bld	

Modifier

Table 43: Properties of each modifier.

Id	Name	SBO
LH_Bld	LH_Bld	

Product

Table 44: Properties of each product.

Id	Name	SBO
snk_LH	snk_LH	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \text{vol}\,(\text{default}) \cdot \text{function\_13}\,([\text{LH\_Bld}], \text{vol}\,(\text{default}), \text{par38}) \tag{81}$$

$$\text{function\_13}\,([\text{LH\_Bld}], \text{vol}\,(\text{default}), \text{par38}) = \frac{\text{par38} \cdot [\text{LH\_Bld}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{82}$$

$$\text{function\_13}\,([\text{LH\_Bld}], \text{vol}\,(\text{default}), \text{par38}) = \frac{\text{par38} \cdot [\text{LH\_Bld}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{83}$$

9.14 Reaction `re14`

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

Name re14

Reaction equation

$$\text{FSH\_Bld} \xrightarrow{\text{FSH\_Bld}} \text{snk\_FSH} \qquad (84)$$

Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
FSH_Bld	FSH_Bld	

Modifier

Table 46: Properties of each modifier.

Id	Name	SBO
FSH_Bld	FSH_Bld	

Product

Table 47: Properties of each product.

Id	Name	SBO
snk_FSH	snk_FSH	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \text{vol}\,(\text{default}) \cdot \text{function\_14}\,([\text{FSH\_Bld}], \text{vol}\,(\text{default}), \text{par29}) \qquad (85)$$

$$\text{function\_14}\,([\text{FSH\_Bld}], \text{vol}\,(\text{default}), \text{par29}) = \frac{\text{par29} \cdot [\text{FSH\_Bld}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \qquad (86)$$

$$\text{function\_14}\,([\text{FSH\_Bld}], \text{vol}\,(\text{default}), \text{par29}) = \frac{\text{par29} \cdot [\text{FSH\_Bld}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \qquad (87)$$

9.15 Reaction `re15`

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

Name re15

Reaction equation

$$P4 \xrightarrow{P4} snk\_P4 \qquad (88)$$

Reactant

Table 48: Properties of each reactant.

Id	Name	SBO
P4	P4	

Modifier

Table 49: Properties of each modifier.

Id	Name	SBO
P4	P4	

Product

Table 50: Properties of each product.

Id	Name	SBO
snk_P4	snk_P4	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \mathrm{vol}\,(\mathrm{default}) \cdot \mathrm{function\_15}\,([\mathrm{P4}], \mathrm{vol}\,(\mathrm{default}), \mathrm{par72}) \qquad (89)$$

$$\mathrm{function\_15}\,([\mathrm{P4}], \mathrm{vol}\,(\mathrm{default}), \mathrm{par72}) = \frac{\mathrm{par72} \cdot [\mathrm{P4}] \cdot \mathrm{vol}\,(\mathrm{default})}{\mathrm{vol}\,(\mathrm{default})} \qquad (90)$$

$$\mathrm{function\_15}\,([\mathrm{P4}], \mathrm{vol}\,(\mathrm{default}), \mathrm{par72}) = \frac{\mathrm{par72} \cdot [\mathrm{P4}] \cdot \mathrm{vol}\,(\mathrm{default})}{\mathrm{vol}\,(\mathrm{default})} \qquad (91)$$

9.16 Reaction `re16`

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

Name re16

Reaction equation

$$E2 \xrightarrow{\text{E2}} \text{snk\_E2} \tag{92}$$

Reactant

Table 51: Properties of each reactant.

Id	Name	SBO
E2	E2	

Modifier

Table 52: Properties of each modifier.

Id	Name	SBO
E2	E2	

Product

Table 53: Properties of each product.

Id	Name	SBO
snk_E2	snk_E2	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \text{vol}\,(\text{default}) \cdot \text{function\_16}\,([\text{E2}], \text{vol}\,(\text{default}), \text{par77}) \tag{93}$$

$$\text{function\_16}\,([\text{E2}], \text{vol}\,(\text{default}), \text{par77}) = \frac{\text{par77} \cdot [\text{E2}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{94}$$

$$\text{function\_16}\,([\text{E2}], \text{vol}\,(\text{default}), \text{par77}) = \frac{\text{par77} \cdot [\text{E2}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{95}$$

9.17 Reaction `re17`

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

Name re17

Reaction equation

$$\text{Inh} \xrightarrow{\text{Inh}} \text{snk\_Inh} \tag{96}$$

Reactant

Table 54: Properties of each reactant.

Id	Name	SBO
Inh	Inh	

Modifier

Table 55: Properties of each modifier.

Id	Name	SBO
Inh	Inh	

Product

Table 56: Properties of each product.

Id	Name	SBO
snk_Inh	snk_Inh	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \text{vol}\,(\text{default}) \cdot \text{function\_17}\,([\text{Inh}], \text{vol}\,(\text{default}), \text{par82}) \tag{97}$$

$$\text{function\_17}\,([\text{Inh}], \text{vol}\,(\text{default}), \text{par82}) = \frac{\text{par82} \cdot [\text{Inh}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{98}$$

$$\text{function\_17}\,([\text{Inh}], \text{vol}\,(\text{default}), \text{par82}) = \frac{\text{par82} \cdot [\text{Inh}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{99}$$

9.18 Reaction `re18`

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

Name re18

Reaction equation

$$\text{OT} \xrightarrow{\text{OT}} \text{snk\_OT} \tag{100}$$

Reactant

Table 57: Properties of each reactant.

Id	Name	SBO
OT	OT	

Modifier

Table 58: Properties of each modifier.

Id	Name	SBO
OT	OT	

Product

Table 59: Properties of each product.

Id	Name	SBO
snk_OT	snk_OT	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \text{vol}\,(\text{default}) \cdot \text{function\_18}\,([\text{OT}], \text{vol}\,(\text{default}), \text{par94}) \tag{101}$$

$$\text{function\_18}\,([\text{OT}], \text{vol}\,(\text{default}), \text{par94}) = \frac{\text{par94} \cdot [\text{OT}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{102}$$

$$\text{function\_18}\,([\text{OT}], \text{vol}\,(\text{default}), \text{par94}) = \frac{\text{par94} \cdot [\text{OT}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{103}$$

9.19 Reaction `re19`

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

Name re19

Produced by SBML₂LATEX

Reaction equation

$$\mathrm{Enz} \xrightarrow{\mathrm{Enz}} \mathrm{snk\_Enz} \qquad (104)$$

Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
Enz	Enz	

Modifier

Table 61: Properties of each modifier.

Id	Name	SBO
Enz	Enz	

Product

Table 62: Properties of each product.

Id	Name	SBO
snk_Enz	snk_Enz	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \mathrm{vol}\,(\mathrm{default}) \cdot \mathrm{function\_19}\,([\mathrm{Enz}], \mathrm{vol}\,(\mathrm{default}), \mathrm{par89}) \qquad (105)$$

$$\mathrm{function\_19}\,([\mathrm{Enz}], \mathrm{vol}\,(\mathrm{default}), \mathrm{par89}) = \frac{\mathrm{par89} \cdot [\mathrm{Enz}]}{\mathrm{vol}\,(\mathrm{default})} \qquad (106)$$

$$\mathrm{function\_19}\,([\mathrm{Enz}], \mathrm{vol}\,(\mathrm{default}), \mathrm{par89}) = \frac{\mathrm{par89} \cdot [\mathrm{Enz}]}{\mathrm{vol}\,(\mathrm{default})} \qquad (107)$$

9.20 Reaction `re20`

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

Name re20

Reaction equation

$$PGF \xrightarrow{PGF} snk\_PGF \tag{108}$$

Reactant

Table 63: Properties of each reactant.

Id	Name	SBO
PGF	PGF	

Modifier

Table 64: Properties of each modifier.

Id	Name	SBO
PGF	PGF	

Product

Table 65: Properties of each product.

Id	Name	SBO
snk_PGF	snk_PGF	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \text{vol}\,(\text{default}) \cdot \text{function\_20}\,([PGF], \text{vol}\,(\text{default}), \text{par59}) \tag{109}$$

$$\text{function\_20}\,([PGF], \text{vol}\,(\text{default}), \text{par59}) = \frac{\text{par59} \cdot [PGF] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{110}$$

$$\text{function\_20}\,([PGF], \text{vol}\,(\text{default}), \text{par59}) = \frac{\text{par59} \cdot [PGF] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{111}$$

9.21 Reaction `re21`

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

Name re21

Reaction equation

$$IOF \xrightarrow{IOF} snk\_IOF \tag{112}$$

Reactant

Table 66: Properties of each reactant.

Id	Name	SBO
IOF	IOF	

Modifier

Table 67: Properties of each modifier.

Id	Name	SBO
IOF	IOF	

Product

Table 68: Properties of each product.

Id	Name	SBO
snk_IOF	snk_IOF	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \text{vol}\,(\text{default}) \cdot \text{function\_21}\,([IOF], \text{vol}\,(\text{default}), \text{par98}) \tag{113}$$
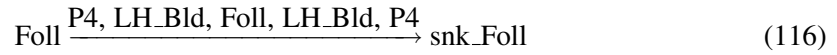
$$\text{function\_21}\,([IOF], \text{vol}\,(\text{default}), \text{par98}) = \frac{\text{par98} \cdot [IOF] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{114}$$

$$\text{function\_21}\,([IOF], \text{vol}\,(\text{default}), \text{par98}) = \frac{\text{par98} \cdot [IOF] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{115}$$

9.22 Reaction `re22`

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

Name 1

Reaction equation

$$\text{Foll} \xrightarrow{\text{P4, LH\_Bld, Foll, LH\_Bld, P4}} \text{snk\_Foll} \qquad (116)$$

Reactant

Table 69: Properties of each reactant.

Id	Name	SBO
Foll	Foll	

Modifiers

Table 70: Properties of each modifier.

Id	Name	SBO
P4	P4	
LH_Bld	LH_Bld	
Foll	Foll	
LH_Bld	LH_Bld	
P4	P4	

Product

Table 71: Properties of each product.

Id	Name	SBO
snk_Foll	snk_Foll	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \text{vol}\,(\text{default}) \cdot \text{function\_22}\,([\text{Foll}], [\text{LH\_Bld}], [\text{P4}], \text{vol}\,(\text{default}), \text{par45}, \text{par46}, \text{par47}, \text{par48}) \qquad (117)$$

$$\begin{aligned}
&\text{function\_22}\,([\text{Foll}], [\text{LH\_Bld}], [\text{P4}], \text{vol}\,(\text{default}), \text{par45}, \text{par46}, \text{par47}, \text{par48}) \\
&= \frac{\left(\frac{\text{par45} \cdot ([\text{P4}] \cdot \text{vol}(\text{default}))^5}{([\text{P4}] \cdot \text{vol}(\text{default}))^5 + \text{par46}^5} + \frac{\text{par47} \cdot ([\text{LH\_Bld}] \cdot \text{vol}(\text{default}))^2}{([\text{LH\_Bld}] \cdot \text{vol}(\text{default}))^2 + \text{par48}^2} \right) \cdot [\text{Foll}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \qquad (118)
\end{aligned}$$

$$\text{function\_22} \left([\text{Foll}], [\text{LH\_Bld}], [\text{P4}], \text{vol} \left(\text{default}\right), \text{par45}, \text{par46}, \text{par47}, \text{par48}\right)$$

$$= \frac{\left(\frac{\text{par45} \cdot \left([\text{P4}] \cdot \text{vol}(\text{default})\right)^5}{\left([\text{P4}] \cdot \text{vol}(\text{default})\right)^5 + \text{par46}^5} + \frac{\text{par47} \cdot \left([\text{LH\_Bld}] \cdot \text{vol}(\text{default})\right)^2}{\left([\text{LH\_Bld}] \cdot \text{vol}(\text{default})\right)^2 + \text{par48}^2}\right) \cdot [\text{Foll}] \cdot \text{vol} \left(\text{default}\right)}{\text{vol} \left(\text{default}\right)} \quad (119)$$

9.23 Reaction `re23`

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

Name re23

Reaction equation

$$\text{CL} \xrightarrow{\text{IOF, CL, IOF}} \text{snk\_CL} \quad (120)$$

Reactant

Table 72: Properties of each reactant.

Id	Name	SBO
CL	CL	

Modifiers

Table 73: Properties of each modifier.

Id	Name	SBO
IOF	IOF	
CL	CL	
IOF	IOF	

Product

Table 74: Properties of each product.

Id	Name	SBO
snk_CL	snk_CL	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \text{vol}\,(\text{default}) \cdot \text{function\_23}\,([\text{CL}], [\text{IOF}], \text{vol}\,(\text{default})\,, \text{par65}, \text{par66}) \tag{121}$$

$$\text{function\_23}\,([\text{CL}], [\text{IOF}], \text{vol}\,(\text{default})\,, \text{par65}, \text{par66})$$
$$= \frac{\frac{\text{par65} \cdot ([\text{IOF}] \cdot \text{vol}(\text{default}))^5}{([\text{IOF}] \cdot \text{vol}(\text{default}))^5 + \text{par66}^5} \cdot [\text{CL}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{122}$$

$$\text{function\_23}\,([\text{CL}], [\text{IOF}], \text{vol}\,(\text{default})\,, \text{par65}, \text{par66})$$
$$= \frac{\frac{\text{par65} \cdot ([\text{IOF}] \cdot \text{vol}(\text{default}))^5}{([\text{IOF}] \cdot \text{vol}(\text{default}))^5 + \text{par66}^5} \cdot [\text{CL}] \cdot \text{vol}\,(\text{default})}{\text{vol}\,(\text{default})} \tag{123}$$

9.24 Reaction `re24`

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

Name re24

Reaction equation

$$\text{src\_LH} \xrightarrow{\text{E2, P4, E2, P4}} \text{LH\_Pit} \tag{124}$$

Reactant

Table 75: Properties of each reactant.

Id	Name	SBO
src_LH	src_LH	

Modifiers

Table 76: Properties of each modifier.

Id	Name	SBO
E2	E2	
P4	P4	
E2	E2	
P4	P4	

Product

Produced by SBML2LATEX

Table 77: Properties of each product.

Id	Name	SBO
LH_Pit	LH_Pit	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \text{vol}\,(\text{default}) \cdot \text{function\_24}\,([\text{E2}],[\text{P4}],\text{vol}\,(\text{default})\,,\text{par31},\text{par32},\text{par33},\text{par34}) \quad (125)$$

$$\text{function\_24}\,([\text{E2}],[\text{P4}],\text{vol}\,(\text{default})\,,\text{par31},\text{par32},\text{par33},\text{par34})$$
$$= \frac{\frac{\text{par31}\cdot([\text{E2}]\cdot\text{vol(default)})^2}{([\text{E2}]\cdot\text{vol(default)})^2+\text{par32}^2} + \frac{\text{par33}\cdot\text{par34}^2}{\text{par34}^2+([\text{P4}]\cdot\text{vol(default)})^2}}{\text{vol}\,(\text{default})} \quad (126)$$

$$\text{function\_24}\,([\text{E2}],[\text{P4}],\text{vol}\,(\text{default})\,,\text{par31},\text{par32},\text{par33},\text{par34})$$
$$= \frac{\frac{\text{par31}\cdot([\text{E2}]\cdot\text{vol(default)})^2}{([\text{E2}]\cdot\text{vol(default)})^2+\text{par32}^2} + \frac{\text{par33}\cdot\text{par34}^2}{\text{par34}^2+([\text{P4}]\cdot\text{vol(default)})^2}}{\text{vol}\,(\text{default})} \quad (127)$$

9.25 Reaction `re25`

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

Name re25

Reaction equation

$$\text{src\_FSH} \xrightarrow{\text{Inh, Inh}} \text{FSH\_Pit} \quad (128)$$

Reactant

Table 78: Properties of each reactant.

Id	Name	SBO
src_FSH	src_FSH	

Modifiers

Table 79: Properties of each modifier.

Id	Name	SBO
Inh	Inh	
Inh	Inh	

Product

Table 80: Properties of each product.

Id	Name	SBO
FSH_Pit	FSH_Pit	

Kinetic Law

Derived unit contains undeclared units

$$v_{25} = \text{vol}\,(\text{default}) \cdot \text{function\_25}\,([\text{Inh}], \text{vol}\,(\text{default}), \text{par21}, \text{par22}) \tag{129}$$

$$\text{function\_25}\,([\text{Inh}], \text{vol}\,(\text{default}), \text{par21}, \text{par22}) = \frac{\frac{\text{par21}\cdot\text{par22}^5}{\text{par22}^5+([\text{Inh}]\cdot\text{vol}(\text{default}))^5}}{\text{vol}\,(\text{default})} \tag{130}$$

$$\text{function\_25}\,([\text{Inh}], \text{vol}\,(\text{default}), \text{par21}, \text{par22}) = \frac{\frac{\text{par21}\cdot\text{par22}^5}{\text{par22}^5+([\text{Inh}]\cdot\text{vol}(\text{default}))^5}}{\text{vol}\,(\text{default})} \tag{131}$$

9.26 Reaction `re26`

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

Name re26

Reaction equation

$$\text{src\_GnRH\_Pit} \xrightarrow{\text{GnRH\_Hyp, E2, P4, E2, GnRH\_Hyp, P4}} \text{GnRH\_Pit} \tag{132}$$
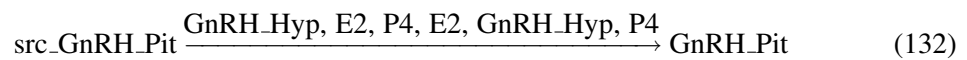
Reactant

Table 81: Properties of each reactant.

Id	Name	SBO
src_GnRH_Pit	src_GnRH_Pit	

Modifiers

Table 82: Properties of each modifier.

Id	Name	SBO
GnRH_Hyp	GnRH_Hyp	
E2	E2	
P4	P4	
E2	E2	
GnRH_Hyp	GnRH_Hyp	
P4	P4	

Product

Table 83: Properties of each product.

Id	Name	SBO
GnRH_Pit	GnRH_Pit	

Kinetic Law

Derived unit contains undeclared units

$$v_{26} = \text{vol}\,(\text{default}) \cdot \text{function\_26}\,([E2],[GnRH\_Hyp],[P4],\text{vol}\,(\text{default}),\text{par3},\text{par4},\text{par5}, \tag{133}$$
$$\text{par6},\text{par7},\text{par8},\text{par9})$$

$$\text{function\_26}\,([E2],[GnRH\_Hyp],[P4],\text{vol}\,(\text{default}),\text{par3},\text{par4},\text{par5},\text{par6},\text{par7},\text{par8}, \tag{134}$$

$$\text{par9}) = \frac{\frac{\text{par8}\cdot([E2]\cdot\text{vol(default)})^5}{([E2]\cdot\text{vol(default)})^5+\text{par9}^5} \cdot \left(\text{par3}\cdot\left(\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2} + \frac{\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2} - \frac{\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2}\cdot\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2}\right) + \cdots\right)}{\text{vol}\,(\text{default})}$$

$$\text{function\_26}\,([E2],[GnRH\_Hyp],[P4],\text{vol}\,(\text{default}),\text{par3},\text{par4},\text{par5},\text{par6},\text{par7},\text{par8}, \tag{135}$$

$$\text{par9}) = \frac{\frac{\text{par8}\cdot([E2]\cdot\text{vol(default)})^5}{([E2]\cdot\text{vol(default)})^5+\text{par9}^5} \cdot \left(\text{par3}\cdot\left(\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2} + \frac{\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2} - \frac{\frac{\text{par5}^2}{\text{par5}^2+([P4]\cdot\text{vol(default)})^2}\cdot\text{par4}^2}{\text{par4}^2+([E2]\cdot\text{vol(default)})^2}\right) + \cdots\right)}{\text{vol}\,(\text{default})}$$

9.27 Reaction `re27`

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

Name re27

Reaction equation

$$\text{src\_Foll} \xrightarrow{\text{FSH\_Bld, Foll, FSH\_Bld, Foll}} \text{Foll} \qquad (136)$$
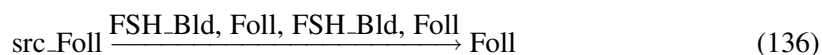
Reactant

Table 84: Properties of each reactant.

Id	Name	SBO
src_Foll	src_Foll	

Modifiers

Table 85: Properties of each modifier.

Id	Name	SBO
FSH_Bld	FSH_Bld	
Foll	Foll	
FSH_Bld	FSH_Bld	
Foll	Foll	

Product

Table 86: Properties of each product.

Id	Name	SBO
Foll	Foll	

Kinetic Law

Derived unit contains undeclared units

$$v_{27} = \text{vol}\,(\text{default}) \cdot \text{function\_27}\,([\text{FSH\_Bld}], [\text{Foll}], \text{vol}\,(\text{default}), \text{par41}, \text{par42}, \text{par43}) \qquad (137)$$

$$\text{function\_27}\left([\text{FSH\_Bld}], [\text{Foll}], \text{vol}\left(\text{default}\right), \text{par41}, \text{par42}, \text{par43}\right)$$

$$= \frac{\frac{\text{par41}\cdot([\text{FSH\_Bld}]\cdot\text{vol(default)})^2}{\left(\frac{\text{par42}\cdot\text{par43}^2}{\text{par43}^2+([\text{Foll}]\cdot\text{vol(default)})^2}\right)^2+([\text{FSH\_Bld}]\cdot\text{vol(default)})^2}}{\text{vol}\left(\text{default}\right)} \qquad (138)$$

$$\text{function\_27}\left([\text{FSH\_Bld}], [\text{Foll}], \text{vol}\left(\text{default}\right), \text{par41}, \text{par42}, \text{par43}\right)$$

$$= \frac{\frac{\text{par41}\cdot([\text{FSH\_Bld}]\cdot\text{vol(default)})^2}{\left(\frac{\text{par42}\cdot\text{par43}^2}{\text{par43}^2+([\text{Foll}]\cdot\text{vol(default)})^2}\right)^2+([\text{FSH\_Bld}]\cdot\text{vol(default)})^2}}{\text{vol}\left(\text{default}\right)} \qquad (139)$$

9.28 Reaction `re28`

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

Name re28

Reaction equation

$$\text{src\_IOF} \xrightarrow{\text{CL, PGF, CL, PGF}} \text{IOF} \qquad (140)$$

Reactant

Table 87: Properties of each reactant.

Id	Name	SBO
src_IOF	src_IOF	

Modifiers

Table 88: Properties of each modifier.

Id	Name	SBO
CL	CL	
PGF	PGF	
CL	CL	
PGF	PGF	

Product

Table 89: Properties of each product.

Id	Name	SBO
IOF	IOF	

Kinetic Law

Derived unit contains undeclared units

$$v_{28} = \text{vol (default)} \cdot \text{function\_28} ([CL], [PGF], \text{vol (default)}, \text{par95}, \text{par96}, \text{par97}) \quad (141)$$

$$\text{function\_28} ([CL], [PGF], \text{vol (default)}, \text{par95}, \text{par96}, \text{par97})$$
$$= \frac{\frac{\text{par95} \cdot ([PGF] \cdot \text{vol(default)})^5}{([PGF] \cdot \text{vol(default)})^5 + \text{par96}^5} \cdot ([CL] \cdot \text{vol(default)})^{10}}{([CL] \cdot \text{vol(default)})^{10} + \text{par97}^{10}}}{\text{vol (default)}} \quad (142)$$

$$\text{function\_28} ([CL], [PGF], \text{vol (default)}, \text{par95}, \text{par96}, \text{par97})$$
$$= \frac{\frac{\text{par95} \cdot ([PGF] \cdot \text{vol(default)})^5}{([PGF] \cdot \text{vol(default)})^5 + \text{par96}^5} \cdot ([CL] \cdot \text{vol(default)})^{10}}{([CL] \cdot \text{vol(default)})^{10} + \text{par97}^{10}}}{\text{vol (default)}} \quad (143)$$

10 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.

10.1 Species `GnRH_Pit`

Name GnRH_Pit

Initial amount 0.219992404098564 mol

This species takes part in seven reactions (as a reactant in `re12` and as a product in `re26` and as a modifier in `re1`, `re1`, `re2`, `re2`, `re12`).

$$\frac{\mathrm{d}}{\mathrm{d}t} \text{GnRH\_Pit} = v_{26} - v_{12} \quad (144)$$

10.2 Species `LH_Pit`

Name LH_Pit

Initial amount 2.25000957482152 mol

This species takes part in three reactions (as a reactant in `re1` and as a product in `re24` and as a modifier in `re1`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{LH\_Pit} = v_{24} - v_1 \tag{145}$$

10.3 Species `LH_Bld`

Name LH_Bld

Initial amount 0.00633682772990623 mol

This species takes part in seven reactions (as a reactant in `re13` and as a product in `re1` and as a modifier in `re4`, `re4`, `re13`, `re22`, `re22`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{LH\_Bld} = v_1 - v_{13} \tag{146}$$

10.4 Species `GnRH_Hyp`

Name GnRH_Hyp

Initial amount 0.740638780629751 mol

This species takes part in seven reactions (as a reactant in `re3` and as a product in `re5` and as a modifier in `re3`, `re5`, `re5`, `re26`, `re26`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{GnRH\_Hyp} = v_5 - v_3 \tag{147}$$

10.5 Species `FSH_Pit`

Name FSH_Pit

Initial amount 0.00579108659591004 mol

This species takes part in three reactions (as a reactant in `re2` and as a product in `re25` and as a modifier in `re2`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{FSH\_Pit} = v_{25} - v_2 \tag{148}$$

10.6 Species `FSH_Bld`

Name FSH_Bld

Initial amount 0.0168604631992291 mol

This species takes part in five reactions (as a reactant in `re14` and as a product in `re2` and as a modifier in `re14`, `re27`, `re27`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{FSH\_Bld} = v_2 - v_{14} \tag{149}$$

10.7 Species `Foll`

Name Foll

Initial amount 0.0286570978235457 mol

This species takes part in eleven reactions (as a reactant in `re22` and as a product in `re27` and as a modifier in `re4`, `re4`, `re6`, `re6`, `re8`, `re8`, `re22`, `re27`, `re27`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Foll} = v_{27} - v_{22} \tag{150}$$

10.8 Species `CL`

Name CL

Initial amount 0.314393628471893 mol

This species takes part in eleven reactions (as a reactant in `re23` and as a product in `re4` and as a modifier in `re4`, `re4`, `re7`, `re7`, `re9`, `re9`, `re23`, `re28`, `re28`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{CL} = v_4 - v_{23} \tag{151}$$

10.9 Species `E2`

Name E2

Initial amount 0.163690728507925 mol

This species takes part in 13 reactions (as a reactant in `re16` and as a product in `re6` and as a modifier in `re2`, `re2`, `re3`, `re3`, `re9`, `re9`, `re16`, `re24`, `re24`, `re26`, `re26`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{E2} = v_6 - v_{16} \tag{152}$$

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10.10 Species P4

Name P4

Initial amount 0.120192549532403 mol

This species takes part in 15 reactions (as a reactant in `re15` and as a product in `re7` and as a modifier in `re2`, `re2`, `re3`, `re3`, `re10`, `re10`, `re15`, `re22`, `re22`, `re24`, `re24`, `re26`, `re26`).

$$\frac{d}{dt}P4 = v_7 - v_{15} \tag{153}$$

10.11 Species Inh

Name Inh

Initial amount 0.493710210684922 mol

This species takes part in five reactions (as a reactant in `re17` and as a product in `re8` and as a modifier in `re17`, `re25`, `re25`).

$$\frac{d}{dt}Inh = v_8 - v_{17} \tag{154}$$

10.12 Species OT

Name OT

Initial amount 0.111730059223483 mol

This species takes part in five reactions (as a reactant in `re18` and as a product in `re9` and as a modifier in `re11`, `re11`, `re18`).

$$\frac{d}{dt}OT = v_9 - v_{18} \tag{155}$$

10.13 Species Enz

Name Enz

SBO:0000014 enzyme

Initial amount $5.83626691122778 \cdot 10^{-5}$ mol

This species takes part in five reactions (as a reactant in `re19` and as a product in `re10` and as a modifier in `re11`, `re11`, `re19`).

$$\frac{d}{dt}Enz = v_{10} - v_{19} \tag{156}$$

10.14 Species `PGF`

Name PGF

Initial amount $3.62064120302475 \cdot 10^{-4}$ mol

This species takes part in five reactions (as a reactant in `re20` and as a product in `re11` and as a modifier in `re20`, `re28`, `re28`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PGF} = v_{11} - v_{20} \tag{157}$$

10.15 Species `IOF`

Name IOF

Initial amount 0.133415086647186 mol

This species takes part in five reactions (as a reactant in `re21` and as a product in `re28` and as a modifier in `re21`, `re23`, `re23`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IOF} = v_{28} - v_{21} \tag{158}$$

10.16 Species `src_GnRH`

Name src_GnRH

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re5`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{src\_GnRH} = 0 \tag{159}$$

10.17 Species `src_E2`

Name src_E2

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re6`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{src\_E2} = 0 \tag{160}$$

10.18 Species `src_P4`

Name src_P4

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re7`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{src\_P4} = 0 \tag{161}$$

10.19 Species `src_Inh`

Name src_Inh

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re8`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{src\_Inh} = 0 \tag{162}$$

10.20 Species `src_OT`

Name src_OT

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re9`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{src\_OT} = 0 \tag{163}$$

10.21 Species `src_Enz`

Name src_Enz

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re10`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{src\_Enz} = 0 \tag{164}$$

10.22 Species `src_PGF`

Name src_PGF

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re11`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{src\_PGF} = 0 \tag{165}$$

10.23 Species `src_LH`

Name src_LH

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re24`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{src\_LH} = 0 \tag{166}$$

10.24 Species `src_FSH`

Name src_FSH

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in `re25`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{src\_FSH} = 0 \tag{167}$$

10.25 Species `snk_GnRH_Hyp`

Name snk_GnRH_Hyp

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re3`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}\text{snk\_GnRH\_Hyp} = 0 \tag{168}$$

10.26 Species src_GnRH_Pit

Name src_GnRH_Pit

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in re26), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{src\_GnRH\_Pit} = 0 \tag{169}$$

10.27 Species src_Foll

Name src_Foll

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in re27), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{src\_Foll} = 0 \tag{170}$$

10.28 Species src_IOF

Name src_IOF

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in re28), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{src\_IOF} = 0 \tag{171}$$

10.29 Species src_CL

Name src_CL

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a reactant in re4), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{src\_CL} = 0 \tag{172}$$

10.30 Species snk_Inh

Name snk_Inh

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re17`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{snk\_Inh} = 0 \tag{173}$$

10.31 Species snk_P4

Name snk_P4

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re15`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{snk\_P4} = 0 \tag{174}$$

10.32 Species snk_E2

Name snk_E2

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re16`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{snk\_E2} = 0 \tag{175}$$

10.33 Species snk_GnRH_Pit

Name snk_GnRH_Pit

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re12`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{snk\_GnRH\_Pit} = 0 \tag{176}$$

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10.34 Species snk_LH

Name snk_LH

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re13`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{snk\_LH} = 0 \tag{177}$$

10.35 Species snk_FSH

Name snk_FSH

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re14`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{snk\_FSH} = 0 \tag{178}$$

10.36 Species snk_IOF

Name snk_IOF

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re21`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{snk\_IOF} = 0 \tag{179}$$

10.37 Species snk_CL

Name snk_CL

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in `re23`), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{snk\_CL} = 0 \tag{180}$$

10.38 Species snk_Enz

Name snk_Enz

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in re19), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}snk\_Enz = 0 \tag{181}$$

10.39 Species snk_OT

Name snk_OT

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in re18), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}snk\_OT = 0 \tag{182}$$

10.40 Species snk_PGF

Name snk_PGF

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in re20), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}snk\_PGF = 0 \tag{183}$$

10.41 Species snk_Foll

Name snk_Foll

SBO:0000291 empty set

Initial amount 0 mol

This species takes part in one reaction (as a product in re22), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{d}{dt}snk\_Foll = 0 \tag{184}$$

10.42 Species `species_1`

Name PGF_syn

SBO:0000291 empty set

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

Involved in rule `species_1`

One rule determines the species' quantity.

A Glossary of Systems Biology Ontology Terms

SBO:0000014 enzyme: A protein that catalyzes a chemical reaction. The word comes from en "a" or"i") and simo "leave" or"yeas")

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