SBML Model Report

Model name: "Tseng2012 - Circadian clock of N.crassa"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by the following two authors: Vijayalakshmi Chelliah[1] and Yu-yao Tseng[2] at February 26th 2013 at 2:39 p. m. and last time modified at April eighth 2016 at 5:22 p. m. Table 1 gives an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	3
species types	0	species	61
events	6	constraints	0
reactions	40	function definitions	0
global parameters	56	unit definitions	5
rules	15	initial assignments	0

Model Notes

Tseng2012 - Circadian clock of N.crassa

A comprehensive model of the circardian clock of fungal Neurospora crassa , which encompasses existing knowledge of the biochemistry of Neurospora clock, is described by Tseng et al.

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(2012). The model is validated against a wide range of experimental phenotypes and has been used to investigate possible molecular explanations of temperature compensation.

This model is described in the article:Comprehensive modelling of the Neurospora circadian clock and its temperature compensation.Tseng YY, Hunt SM, Heintzen C, Crosthwaite SK, Schwartz JMPLoS Comput. Biol. [2012 ; Volume: 8 (Issue: 3)] Page info: e1002437

Abstract:

Circadian clocks provide an internal measure of external time allowing organisms to anticipate and exploit predictable daily changes in the environment. Rhythms driven by circadian clocks have a temperature compensated periodicity of approximately 24 hours that persists in constant conditions and can be reset by environmental time cues. Computational modelling has aided our understanding of the molecular mechanisms of circadian clocks, nevertheless it remains a major challenge to integrate the large number of clock components and their interactions into a single, comprehensive model that is able to account for the full breadth of clock phenotypes. Here we present a comprehensive dynamic model of the Neurospora crassa circadian clock that incorporates its key components and their transcriptional and post-transcriptional regulation. The model accounts for a wide range of clock characteristics including: a periodicity of 21.6 hours, persistent oscillation in constant conditions, arrhythmicity in constant light, resetting by brief light pulses, and entrainment to full photoperiods. Crucial components influencing the period and amplitude of oscillations were identified by control analysis. Furthermore, simulations enabled us to propose a mechanism for temperature compensation, which is achieved by simultaneously increasing the translation of frq RNA and decreasing the nuclear import of FRQ protein.

Figure 3 of the reference publication has been reproduced using Copasi 4.8 (Build 35).

This model is hosted on BioModels Database and identifiedby: MODEL1212150000 .

To cite BioModels Database, please use: BioModels Database: An enhanced, curated and annotated resourcefor published quantitative kinetic models .

2 Unit Definitions

This is an overview of five unit definitions.

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 Compartments

This model contains three compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
default			3	1	litre	☑	
c1	Cytoplasm		3	1	litre	☑	default
c2	Nucleus		3	1	litre	☑	c1

3.1 Compartment default

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

3.2 Compartment c1

This is a three dimensional compartment with a constant size of one litre, which is surrounded by default.

Name Cytoplasm

3.3 Compartment c2

This is a three dimensional compartment with a constant size of one litre, which is surrounded by c1 (Cytoplasm).

Name Nucleus

4 Species

This model contains 61 species. The boundary condition of three of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 9 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
L_WCC	L_WCC	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
L_WCCVVDn	L_WCCVVDn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Period	Period	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
T	T	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
VVDc	VVDc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
VVDn	VVDn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
WC1c	WC1c	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
WC2c	WC2c	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
X	X	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Y	Y	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
active_hypoWCCn	active_hypoWCCn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
c_hypoFRQ_to_hyperFRQ	c_hypoFRQ_to_hyperFRQ	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
cycle	cycle	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_L_WCCCVVDn	degraded_L_WCCCVVDn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_VVDc	degraded_VVDc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_VVDn	degraded_VVDn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_WC1c	degraded_WC1c	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_WC2c	degraded_WC2c	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
degraded_active_hypoWCCn	degraded_active_hypoWCCn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_frq_mRNA	degraded_frq_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_hyperFFCn	degraded_hyperFFCn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_hyperFRQc	degraded_hyperFRQc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_hyperWCCc	degraded_hyperWCCc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_hyperWCCn	degraded_hyperWCCn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_vvd_mRNA	degraded_vvd_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_wc1_mRNA	degraded_wc1_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
degraded_wc2_mRNA	degraded_wc2_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
frq_gene	frq_gene	c2	mol	☑	☑
frq_level_A	frq_level_A	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
frq_mRNA	frq_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hyperFRQc	hyperFRQc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hyperFRQn	hyperFRQn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hyperWCCc	hyperWCCc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hyperWCCn	hyperWCCn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hypoFRQc	hypoFRQc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hypoFRQn	hypoFRQn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hypoWCCc	hypoWCCc	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
hypoWCCn	hypoWCCn	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
n_hypoFRQ_to_hyperFRQ	n_hypoFRQ_to_hyperFRQ	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
time	time	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_FRQ	total_FRQ	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_FRQc	total_FRQc	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_FRQn	total_FRQn	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_VVD	total_VVD	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_WC1	total_WC1	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_WC2	total_WC2	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_WCCn	total_WCCn	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_hyper_FRQ	total_hyper_FRQ	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_hypoWCC	total_hypoWCC	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
total_hypo_FRQ	total_hypo_FRQ	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
vvd_gene	vvd_gene	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
vvd_mRNA	vvd_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
wc1_gene	wc1_gene	c2	mol	☑	☑
wc1_mRNA	wc1_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
wc2_gene	wc2_gene	c2	mol	☑	☑
wc2_mRNA	wc2_mRNA	c1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
line	line	default	mol	⊟	⊟
line2	line2	default	mol	⊟	⊟
line3	line3	default	mol	⊟	⊟
total_hyperWCC	total_hyperWCC	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
s61	hyper_hypo_WCC	default	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Parameters

This model contains 56 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
kmax_frq	k_01		7.300	mol	☑
Km_frq	K_01		0.100	mol	☑
A_active-_hypoWCCn_frq	H_01		4.000	mol	☑
k_hypoFRQc	k_05		0.190	mol	⊟
kin_hypoFRQc	k_14		0.100	mol	☑
k_WC1c	k_06		0.226	mol	☑
k_WC2c	k_07		1.000	mol	☑
k_hypoWCCc	k_13		0.472	mol	☑
kmaxp-_hypoWCCn	k_23		0.600	mol	☑
Kmp-_hypoFRQn-_hyperWCCn	K_02		0.475	mol	☑
I_hypoFRQn-_hyperWCCn	H_02		12.000	mol	☑
kd_active-_hypoWCCn	k_35		1.290	mol	☑
kd_hyperFRQn	k_30		0.270	mol	☑
kd_WC1c	k_31		0.135	mol	☑
kd_WC2c	k_32		0.085	mol	☑
kadd_wc1	k_02a01		1.200	mol	☑
kmax_wc2	k_03		1.600	mol	☑
kd_frq	k_09		2.000	mol	☑
kd_wc1	k_10		2.400	mol	☑
kd_wc2	k_11		2.500	mol	☑
kp_hypoFRQn	k_21		0.100	mol	☑
kout-_hyperFRQn	k_18		0.300	mol	☑
kd_hyperFRQc	k_29		0.270	mol	☑
kout-_hyperWCCn	k_19		0.290	mol	☑
kdp-_hyperWCCc	k_24		0.300	mol	☑
kin_hypoWCCc	k_15		0.300	mol	☑
kp_hypoFRQc	k_20		0.100	mol	☑

Id	Name	SBO	Value	Unit	Constant
kout_hypoFRQn	k_17		0.100	mol	☑
kd_hyperWCCn	k_34		0.050	mol	☑
kd_hyperWCCc	k_33		0.050	mol	☑
kact_hypoWCCn	k_25		0.150	mol	☑
kp_hypoWCCc	k_22		0.300	mol	☑
on	on		96.000		☑
off	off		120.000		☑
k_VVDc	k_08		0.680	mol	☑
kd_vvd_mRNA	k_12		6.200	mol	☑
kd_VVDc	k_37		0.240	mol	☑
kin_VVDc	k_16		0.300	mol	☑
kd_VVDn	k_38		0.240	mol	☑
T_light_on	T_light_on		10^7	mol	☑
kact_L_WCC	k_26		0.000	mol	⊟
kadd_light_frq	k_01a		320.000	mol	☑
kadd_L_wc1	k_02a02		90.000	mol	☑
kact_L_WCC_light	kact_L_WCC_light		5.000	mol	☑
kd_L_WCC	k_36		6.000	mol	☑
kadd_vvd_light_mRNA	k_04		800.000	mol	☑
kdfrq_hypoFRQc	k_09a		0.356	mol	☑
ki_wc2_transcription	k_03i		0.030	mol	☑
kadd_wc2_transcription_hypoFRQn	k_03a		0.030	mol	☑
k_min_wc1	k_02		1.190	mol	☑
k_WCCVVD	k_27		20.000	mol	☑
k_dis_WCCVVD	k_28		1.800	mol	☑
kd_WCCVVD	k_39		0.750	mol	☑
LP	LP		60.000	mol	☑
LP2	LP2		0.000	mol	☑
LP3	LP3		0.000	mol	☑

6 Rules

This is an overview of 15 rules.

6.1 Rule `total_FRQ`

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

$$\text{total\_FRQ} = [\text{hypoFRQc}] + [\text{hyperFRQc}] + [\text{hypoFRQn}] + [\text{hyperFRQn}] \tag{1}$$

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

6.2 Rule `total_WC1`

Rule `total_WC1` is an assignment rule for species `total_WC1`:

$$\begin{aligned}\text{total\_WC1} = {} & [\text{WC1c}] + [\text{hypoWCCc}] + [\text{hyperWCCc}] + [\text{hypoWCCn}] \\ & + [\text{hyperWCCn}] + [\text{active\_hypoWCCn}] + [\text{L\_WCC}] + [\text{L\_WCCVVDn}]\end{aligned} \tag{2}$$

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

6.3 Rule `total_FRQc`

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

$$\text{total\_FRQc} = [\text{hypoFRQc}] + [\text{hyperFRQc}] \tag{3}$$

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

6.4 Rule `total_FRQn`

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

$$\text{total\_FRQn} = [\text{hypoFRQn}] + [\text{hyperFRQn}] \tag{4}$$

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

6.5 Rule `total_hypo_FRQ`

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

$$\text{total\_hypo\_FRQ} = [\text{hypoFRQn}] + [\text{hypoFRQc}] \tag{5}$$

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

6.6 Rule total_hyper_FRQ

Rule total_hyper_FRQ is an assignment rule for species total_hyper_FRQ:

$$\text{total\_hyper\_FRQ} = [\text{hyperFRQn}] + [\text{hyperFRQc}] \tag{6}$$

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

6.7 Rule c_hypoFRQ_to_hyperFRQ

Rule c_hypoFRQ_to_hyperFRQ is an assignment rule for species c_hypoFRQ_to_hyperFRQ:

$$\text{c\_hypoFRQ\_to\_hyperFRQ} = \frac{[\text{hypoFRQc}]}{[\text{hyperFRQc}]} \tag{7}$$

Derived unit dimensionless

6.8 Rule n_hypoFRQ_to_hyperFRQ

Rule n_hypoFRQ_to_hyperFRQ is an assignment rule for species n_hypoFRQ_to_hyperFRQ:

$$\text{n\_hypoFRQ\_to\_hyperFRQ} = \frac{[\text{hypoFRQn}]}{[\text{hyperFRQn}]} \tag{8}$$

Derived unit dimensionless

6.9 Rule total_VVD

Rule total_VVD is an assignment rule for species total_VVD:

$$\text{total\_VVD} = [\text{VVDn}] + [\text{VVDc}] + [\text{L\_WCCVVDn}] \tag{9}$$

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

6.10 Rule Period

Rule Period is an assignment rule for species Period:

$$\text{Period} = [\text{Y}] - [\text{X}] \tag{10}$$

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

6.11 Rule total_WC2

Rule total_WC2 is an assignment rule for species total_WC2:

$$\begin{aligned}\text{total\_WC2} = {} & [\text{WC2c}] + [\text{hypoWCCc}] + [\text{hypoWCCn}] + [\text{hyperWCCn}] \\ & + [\text{hyperWCCc}] + [\text{active\_hypoWCCn}] + [\text{L\_WCC}]\end{aligned} \tag{11}$$

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

6.12 Rule total_hypoWCC

Rule total_hypoWCC is an assignment rule for species total_hypoWCC:

$$\text{total\_hypoWCC} = [\text{hypoWCCc}] + [\text{hypoWCCn}] \tag{12}$$

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

6.13 Rule total_WCCn

Rule total_WCCn is an assignment rule for species total_WCCn:

$$\text{total\_WCCn} = [\text{hypoWCCn}] + [\text{hyperWCCn}] + [\text{active\_hypoWCCn}] + [\text{L\_WCC}] \tag{13}$$

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

6.14 Rule total_hyperWCC

Rule total_hyperWCC is an assignment rule for species total_hyperWCC:

$$\text{total\_hyperWCC} = [\text{hyperWCCn}] + [\text{hyperWCCc}] \tag{14}$$

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

6.15 Rule s61

Rule s61 is an assignment rule for species s61:

$$\text{s61} = \frac{[\text{total\_hyperWCC}]}{[\text{total\_hypoWCC}]} \tag{15}$$

Derived unit dimensionless

7 Events

This is an overview of six events. Each event is initiated whenever its trigger condition switches from false to true. A delay function postpones the effects of an event to a later time point. At the time of execution, an event can assign values to species, parameters or compartments if these are not set to constant.

7.1 Event n_CYCLE

Name n_CYCLE

Trigger condition

$$(\text{T} > 125) \wedge ([\text{frq\_mRNA}] > [\text{frq\_level\_A}]) \tag{16}$$

Delay

$$0 \tag{17}$$

Assignment

$$\text{cycle} = [\text{cycle}] + 1 \tag{18}$$

7.2 Event light_on

Name light_on

Trigger condition

$$\mathrm{T} > \mathrm{T\_light\_on} \tag{19}$$

Delay

$$0 \tag{20}$$

Assignment

$$\mathrm{kact\_L\_WCC} = \mathrm{kact\_L\_WCC\_light} \tag{21}$$

7.3 Event light_off

Name light_off

Trigger condition

$$\mathrm{T} > \mathrm{T\_light\_on} + \mathrm{LP} \tag{22}$$

Delay

$$0 \tag{23}$$

Assignment

$$\mathrm{kact\_L\_WCC} = 0 \tag{24}$$

7.4 Event calculate_period_find_frq_level_A

Name calculate_period_find_frq_level_A

Trigger condition

$$\mathrm{T} > 125 \tag{25}$$

Delay

$$0 \tag{26}$$

Assignment

$$\mathrm{frq\_level\_A} = [\mathrm{frq\_mRNA}] \tag{27}$$

7.5 Event calculate_period_find_Y

Name calculate_period_find_Y

Trigger condition

$$((\mathrm{T} > 125) \wedge ([\mathrm{frq\_mRNA}] > [\mathrm{frq\_level\_A}])) \wedge ([\mathrm{cycle}] < 3) \tag{28}$$

Delay

$$0 \tag{29}$$

Assignment

$$\mathrm{Y} = \mathrm{T} \tag{30}$$

7.6 Event calculate_period_find_X

Name calculate_period_find_X

Trigger condition

$$((\mathrm{T} > 125) \wedge ([\mathrm{frq\_mRNA}] > [\mathrm{frq\_level\_A}])) \wedge ([\mathrm{cycle}] < 2) \tag{31}$$

Delay

$$0 \tag{32}$$

Assignment

$$\mathrm{X} = \mathrm{T} \tag{33}$$

8 Reactions

This model contains 40 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	re45	Time	0time $\longrightarrow$ T	
2	frq_transcription	re01	0frq_gene $\xrightarrow{\text{active\_hypoWCCn, L\_WCC, active\_hypoWCCn, L\_WCC}}$ frq_mRNA	
3	wc1_transcription	re02	0wc1_gene $\xrightarrow{\text{active\_hypoWCCn, L\_WCC, active\_hypoWCCn, L\_WCC}}$ wc1_mRNA	
4	wc2_transcription	re03	0wc2_gene $\xrightarrow{\text{hypoFRQn, hypoWCCn, hypoWCCn, hypoFRQn}}$ wc2_mRNA	
5	vvd_transcription	re04	0vvd_gene $\xrightarrow{\text{L\_WCC, L\_WCC}}$ vvd_mRNA	
6	frq_translation	re05	0frq_mRNA $\xrightarrow{\text{frq\_mRNA}}$ hypoFRQc	
7	wc1_translation	re06	0wc1_mRNA $\xrightarrow{\text{wc1\_mRNA}}$ WC1c	
8	wc2_translation	re07	0wc2_mRNA $\xrightarrow{\text{wc2\_mRNA}}$ WC2c	
9	vvd_translation	re08	0vvd_mRNA $\xrightarrow{\text{vvd\_mRNA}}$ VVDc	
10	frq_mRNA_degradation	re09	frq_mRNA $\xrightarrow{\text{hypoFRQc, frq\_mRNA, hypoFRQc}}$ 0degraded_frq_mRNA	
11	wc1_mRNA_degradation	re10	wc1_mRNA $\xrightarrow{\text{wc1\_mRNA}}$ 0degraded_wc1_mRNA	

№	Id	Name	Reaction Equation	SBO
12	wc2_mRNA-_degradation	re11	$\text{wc2\_mRNA} \xrightarrow{\text{wc2\_mRNA}} \text{0degraded\_wc2\_mRNA}$	
13	vvd_mRNA-_degradation	re12	$\text{vvd\_mRNA} \xrightarrow{\text{vvd\_mRNA}} \text{0degraded\_vvd\_mRNA}$	
14	hypoWCCc-_formation	re13	$\text{WC1c} + \text{WC2c} \xrightarrow{\text{WC1c, WC2c}} \text{hypoWCCc}$	
15	hypoFRQc-_translocation-_in_nucleus	re14	$\text{hypoFRQc} \xrightarrow{\text{hypoFRQc}} \text{hypoFRQn}$	
16	hypoWCCc-_translocation-_in_nucleus	re15	$\text{hypoWCCc} \xrightarrow{\text{hypoWCCc}} \text{hypoWCCn}$	
17	VVD_nuclear-_localisation	re16	$\text{VVDc} \xrightarrow{\text{VVDc}} \text{VVDn}$	
18	hypoFRQn-_translocation-_out_nucleus	re17	$\text{hypoFRQn} \xrightarrow{\text{hypoFRQn}} \text{hypoFRQc}$	
19	hyperFRQn-_translocation-_out_nucleus	re18	$\text{hyperFRQn} \xrightarrow{\text{hyperFRQn}} \text{hyperFRQc}$	
20	hyperWCCn-_translocation-_out_nucleus	re19	$\text{hyperWCCn} \xrightarrow{\text{hyperWCCn}} \text{hyperWCCc}$	
21	hypoFRQc-_phosphorylation	re20	$\text{hypoFRQc} \xrightarrow{\text{hypoFRQc}} \text{hyperFRQc}$	

№	Id	Name	Reaction Equation	SBO
22	hypoFRQn-_phosphorylation	re21	$\text{hypoFRQn} \xrightarrow{\text{hypoFRQn}} \text{hyperFRQn}$	
23	hypoWCCc-_phosphorylation	re22	$\text{hypoWCCc} \xrightarrow{\text{hypoWCCc}} \text{hyperWCCc}$	
24	hypoWCCn-_phosphorylation	re23	$\text{hypoWCCn} \xrightarrow{\text{hypoFRQn, hypoWCCn, hypoFRQn}} \text{hyperWCCn}$	
25	hyperWCCc-_dephosphorylation	re24	$\text{hyperWCCc} \xrightarrow{\text{hyperWCCc}} \text{hypoWCCc}$	
26	hypoWCCn-_activation	re25	$\text{hypoWCCn} \xrightarrow{\text{hypoWCCn}} \text{active\_hypoWCCn}$	
27	L_WCC_formation	re26	$\text{hypoWCCn} \xrightarrow{\text{hypoWCCn}} \text{L\_WCC}$	
28	WCCVVD_complex-_formation	re27	$\text{VVDn} + \text{L\_WCC} \xrightarrow{\text{VVDn, L\_WCC}} \text{L\_WCCVVDn}$	
29	WCCVVD_complex-_disassociation	re28	$\text{L\_WCCVVDn} \xrightarrow{\text{L\_WCCVVDn}} \text{hypoWCCn} + \text{VVDn}$	
30	hyperFRQc-_degradation	re29	$\text{hyperFRQc} \xrightarrow{\text{hyperFRQc}} \text{0degraded\_hyperFRQc}$	
31	hyperFFCn-_degradation	re30	$\text{hyperFRQn} \xrightarrow{\text{hyperFRQn}} \text{0degraded\_hyperFFCn}$	
32	WC1c-_degradation	re31	$\text{WC1c} \xrightarrow{\text{WC1c}} \text{0degraded\_WC1c}$	
33	WC2c-_degradation	re32	$\text{WC2c} \xrightarrow{\text{WC2c}} \text{0degraded\_WC2c}$	

№	Id	Name	Reaction Equation	SBO
34	hyperWCCc-_degradation	re33	$\text{hyperWCCc} \xrightarrow{\text{hyperWCCc}} \text{0degraded\_hyperWCCc}$	
35	hyperWCCn-_degradation	re34	$\text{hyperWCCn} \xrightarrow{\text{hyperWCCn}} \text{0degraded\_hyperWCCn}$	
36	active-_hypoWCCn-_degradation	re35	$\text{active\_hypoWCCn} \xrightarrow{\text{active\_hypoWCCn}} \text{0degraded\_active\_hypoWCCn}$	
37	L_WCC-_degradation	re36	$\text{L\_WCC} \xrightarrow{\text{L\_WCC}} \text{0degraded\_L\_WCCCVVDn}$	
38	VVDc-_degradation	re37	$\text{VVDc} \xrightarrow{\text{VVDc}} \text{0degraded\_VVDc}$	
39	VVDn-_degradation	re38	$\text{VVDn} \xrightarrow{\text{VVDn}} \text{0degraded\_VVDn}$	
40	L_WCCVVD-_degradation	re39	$\text{L\_WCCVVDn} \xrightarrow{\text{L\_WCCVVDn}} \text{0degraded\_L\_WCCCVVDn}$	

8.1 Reaction re45

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

Name Time

Reaction equation

$$0\text{time} \longrightarrow \text{T} \tag{34}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
time	time	

Product

Table 7: Properties of each product.

Id	Name	SBO
T	T	

Kinetic Law

Derived unit not available

$$v_1 = 1 \tag{35}$$

8.2 Reaction frq_transcription

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

Name re01

Reaction equation

$$0\text{frq\_gene} \xrightarrow{\text{active\_hypoWCCn, L\_WCC, active\_hypoWCCn, L\_WCC}} \text{frq\_mRNA} \tag{36}$$

Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
frq_gene	frq_gene	

Modifiers

Table 9: Properties of each modifier.

Id	Name	SBO
active_hypoWCCn	active_hypoWCCn	
L_WCC	L_WCC	
active_hypoWCCn	active_hypoWCCn	
L_WCC	L_WCC	

Product

Table 10: Properties of each product.

Id	Name	SBO
frq_mRNA	frq_mRNA	

Kinetic Law

Derived unit $\mathrm{mol} \cdot \mathrm{l}^{-4}$

$$v_2 = \mathrm{kmax\_frq} \cdot \frac{[\mathrm{active\_hypoWCCn}]^{\mathrm{A\_active\_hypoWCCn\_frq}}}{\mathrm{Km\_frq}^{\mathrm{A\_active\_hypoWCCn\_frq}} + [\mathrm{active\_hypoWCCn}]^{\mathrm{A\_active\_hypoWCCn\_frq}}} + \mathrm{kadd\_light\_frq} \cdot [\mathrm{L\_WCC}] \quad (37)$$

8.3 Reaction wc1_transcription

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

Name re02

Reaction equation

$$0\mathrm{wc1\_gene} \xrightarrow{\mathrm{active\_hypoWCCn,\ L\_WCC,\ active\_hypoWCCn,\ L\_WCC}} \mathrm{wc1\_mRNA} \quad (38)$$

Reactant

Table 11: Properties of each reactant.

Id	Name	SBO
wc1_gene	wc1_gene	

Modifiers

Table 12: Properties of each modifier.

Id	Name	SBO
active_hypoWCCn	active_hypoWCCn	
L_WCC	L_WCC	
active_hypoWCCn	active_hypoWCCn	
L_WCC	L_WCC	

Product

Table 13: Properties of each product.

Id	Name	SBO
wc1_mRNA	wc1_mRNA	

Kinetic Law

Derived unit mol

$$v_3 = \text{k\_min\_wc1} + \text{kadd\_wc1} \cdot [\text{active\_hypoWCCn}] + \text{kadd\_L\_wc1} \cdot [\text{L\_WCC}] \quad (39)$$

8.4 Reaction wc2_transcription

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

Name re03

Reaction equation

$$0\text{wc2\_gene} \xrightarrow{\text{hypoFRQn, hypoWCCn, hypoWCCn, hypoFRQn}} \text{wc2\_mRNA} \quad (40)$$

Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
wc2_gene	wc2_gene	

Modifiers

Table 15: Properties of each modifier.

Id	Name	SBO
hypoFRQn	hypoFRQn	
hypoWCCn	hypoWCCn	
hypoWCCn	hypoWCCn	
hypoFRQn	hypoFRQn	

Product

Table 16: Properties of each product.

Id	Name	SBO
wc2_mRNA	wc2_mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \text{kmax\_wc2} \cdot \frac{1}{1 + [\text{hypoWCCn}] \cdot \text{ki\_wc2\_transcription} + [\text{hypoFRQn}] \cdot \text{kadd\_wc2\_transcription\_hypoFRQn}} \tag{41}$$

8.5 Reaction vvd_transcription

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

Name re04

Reaction equation

$$0\text{vvd\_gene} \xrightarrow{\text{L\_WCC, L\_WCC}} \text{vvd\_mRNA} \tag{42}$$

Reactant

Table 17: Properties of each reactant.

Id	Name	SBO
vvd_gene	vvd_gene	

Modifiers

Table 18: Properties of each modifier.

Id	Name	SBO
L_WCC	L_WCC	
L_WCC	L_WCC	

Product

Table 19: Properties of each product.

Id	Name	SBO
vvd_mRNA	vvd_mRNA	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_5 = \text{kadd\_vvd\_light\_mRNA} \cdot [\text{L\_WCC}] \tag{43}$$

8.6 Reaction frq_translation

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

Name re05

Reaction equation

$$0\text{frq\_mRNA} \xrightarrow{\text{frq\_mRNA}} \text{hypoFRQc} \tag{44}$$

Reactant

Table 20: Properties of each reactant.

Id	Name	SBO
frq_mRNA	frq_mRNA	

Modifier

Table 21: Properties of each modifier.

Id	Name	SBO
frq_mRNA	frq_mRNA	

Product

Table 22: Properties of each product.

Id	Name	SBO
hypoFRQc	hypoFRQc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_6 = [\text{frq\_mRNA}] \cdot \text{k\_hypoFRQc} \tag{45}$$

8.7 Reaction wc1_translation

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

Name re06

Reaction equation

$$0\text{wc1\_mRNA} \xrightarrow{\text{wc1\_mRNA}} \text{WC1c} \tag{46}$$

Reactant

Table 23: Properties of each reactant.

Id	Name	SBO
wc1_mRNA	wc1_mRNA	

Modifier

Table 24: Properties of each modifier.

Id	Name	SBO
wc1_mRNA	wc1_mRNA	

Product

Table 25: Properties of each product.

Id	Name	SBO
WC1c	WC1c	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_7 = \text{k\_WC1c} \cdot [\text{wc1\_mRNA}] \tag{47}$$

8.8 Reaction wc2_translation

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

Name re07

Reaction equation

$$0\text{wc2\_mRNA} \xrightarrow{\text{wc2\_mRNA}} \text{WC2c} \tag{48}$$

Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
wc2_mRNA	wc2_mRNA	

Modifier

Table 27: Properties of each modifier.

Id	Name	SBO
wc2_mRNA	wc2_mRNA	

Product

Table 28: Properties of each product.

Id	Name	SBO
WC2c	WC2c	

Kinetic Law

Derived unit $\mathrm{mol}^2 \cdot \mathrm{l}^{-1}$

$$v_8 = [\mathrm{wc2\_mRNA}] \cdot \mathrm{k\_WC2c} \tag{49}$$

8.9 Reaction vvd_translation

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

Name re08

Reaction equation

$$0\mathrm{vvd\_mRNA} \xrightarrow{\mathrm{vvd\_mRNA}} \mathrm{VVDc} \tag{50}$$

Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
vvd_mRNA	vvd_mRNA	

Modifier

Table 30: Properties of each modifier.

Id	Name	SBO
vvd_mRNA	vvd_mRNA	

Product

Table 31: Properties of each product.

Id	Name	SBO
VVDc	VVDc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_9 = \text{k\_VVDc} \cdot [\text{vvd\_mRNA}] \tag{51}$$

8.10 Reaction frq_mRNA_degradation

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

Name re09

Reaction equation

$$\text{frq\_mRNA} \xrightarrow{\text{hypoFRQc, frq\_mRNA, hypoFRQc}} \text{0degraded\_frq\_mRNA} \tag{52}$$

Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
frq_mRNA	frq_mRNA	

Modifiers

Table 33: Properties of each modifier.

Id	Name	SBO
hypoFRQc	hypoFRQc	
frq_mRNA	frq_mRNA	
hypoFRQc	hypoFRQc	

Product

Table 34: Properties of each product.

Id	Name	SBO
degraded_frq_mRNA	degraded_frq_mRNA	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{10} = [\text{frq\_mRNA}] \cdot (\text{kd\_frq} + [\text{hypoFRQc}] \cdot \text{kdfrq\_hypoFRQc}) \tag{53}$$

8.11 Reaction wc1_mRNA_degradation

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

Name re10

Reaction equation

$$\text{wc1\_mRNA} \xrightarrow{\text{wc1\_mRNA}} 0\text{degraded\_wc1\_mRNA} \tag{54}$$

Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
wc1_mRNA	wc1_mRNA	

Modifier

Table 36: Properties of each modifier.

Id	Name	SBO
wc1_mRNA	wc1_mRNA	

Product

Table 37: Properties of each product.

Id	Name	SBO
degraded_wc1_mRNA	degraded_wc1_mRNA	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{11} = [\text{wc1\_mRNA}] \cdot \text{kd\_wc1} \tag{55}$$

8.12 Reaction wc2_mRNA_degradation

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

Name re11

Reaction equation

$$\text{wc2\_mRNA} \xrightarrow{\text{wc2\_mRNA}} 0\text{degraded\_wc2\_mRNA} \tag{56}$$

Reactant

Table 38: Properties of each reactant.

Id	Name	SBO
wc2_mRNA	wc2_mRNA	

Modifier

Table 39: Properties of each modifier.

Id	Name	SBO
wc2_mRNA	wc2_mRNA	

Product

Table 40: Properties of each product.

Id	Name	SBO
degraded_wc2_mRNA	degraded_wc2_mRNA	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{12} = [\text{wc2\_mRNA}] \cdot \text{kd\_wc2} \tag{57}$$

8.13 Reaction vvd_mRNA_degradation

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

Name re12

Reaction equation

$$\text{vvd\_mRNA} \xrightarrow{\text{vvd\_mRNA}} 0\text{degraded\_vvd\_mRNA} \tag{58}$$

Reactant

Table 41: Properties of each reactant.

Id	Name	SBO
vvd_mRNA	vvd_mRNA	

Modifier

Table 42: Properties of each modifier.

Id	Name	SBO
vvd_mRNA	vvd_mRNA	

Product

Table 43: Properties of each product.

Id	Name	SBO
degraded_vvd_mRNA	degraded_vvd_mRNA	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{13} = \text{kd\_vvd\_mRNA} \cdot [\text{vvd\_mRNA}] \tag{59}$$

8.14 Reaction hypoWCCc_formation

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

Name re13

Reaction equation

$$\mathrm{WC1c} + \mathrm{WC2c} \xrightarrow{\mathrm{WC1c,\ WC2c}} \mathrm{hypoWCCc} \tag{60}$$

Reactants

Table 44: Properties of each reactant.

Id	Name	SBO
WC1c	WC1c	
WC2c	WC2c	

Modifiers

Table 45: Properties of each modifier.

Id	Name	SBO
WC1c	WC1c	
WC2c	WC2c	

Product

Table 46: Properties of each product.

Id	Name	SBO
hypoWCCc	hypoWCCc	

Kinetic Law

Derived unit $\mathrm{mol}^3 \cdot \mathrm{l}^{-2}$

$$v_{14} = [\mathrm{WC1c}] \cdot [\mathrm{WC2c}] \cdot \mathrm{k\_hypoWCCc} \tag{61}$$

8.15 Reaction hypoFRQc_translocation_in_nucleus

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

Name re14

Reaction equation

$$\mathrm{hypoFRQc} \xrightarrow{\mathrm{hypoFRQc}} \mathrm{hypoFRQn} \tag{62}$$

Reactant

Table 47: Properties of each reactant.

Id	Name	SBO
hypoFRQc	hypoFRQc	

Modifier

Table 48: Properties of each modifier.

Id	Name	SBO
hypoFRQc	hypoFRQc	

Product

Table 49: Properties of each product.

Id	Name	SBO
hypoFRQn	hypoFRQn	

Kinetic Law

Derived unit $\mathrm{mol}^2 \cdot \mathrm{l}^{-1}$

$$v_{15} = \mathrm{kin\_hypoFRQc} \cdot [\mathrm{hypoFRQc}] \tag{63}$$

8.16 Reaction hypoWCCc_translocation_in_nucleus

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

Name re15

Reaction equation

$$\mathrm{hypoWCCc} \xrightarrow{\mathrm{hypoWCCc}} \mathrm{hypoWCCn} \tag{64}$$

Reactant

Table 50: Properties of each reactant.

Id	Name	SBO
hypoWCCc	hypoWCCc	

Modifier

Table 51: Properties of each modifier.

Id	Name	SBO
hypoWCCc	hypoWCCc	

Product

Table 52: Properties of each product.

Id	Name	SBO
hypoWCCn	hypoWCCn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{16} = [\text{hypoWCCc}] \cdot \text{kin\_hypoWCCc} \tag{65}$$

8.17 Reaction VVD_nuclear_localisation

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

Name re16

Reaction equation

$$\text{VVDc} \xrightarrow{\text{VVDc}} \text{VVDn} \tag{66}$$

Reactant

Table 53: Properties of each reactant.

Id	Name	SBO
VVDc	VVDc	

Modifier

Table 54: Properties of each modifier.

Id	Name	SBO
VVDc	VVDc	

Product

Table 55: Properties of each product.

Id	Name	SBO
VVDn	VVDn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{17} = \text{kin\_VVDc} \cdot [\text{VVDc}] \tag{67}$$

8.18 Reaction hypoFRQn_translocation_out_nucleus

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

Name re17

Reaction equation

$$\text{hypoFRQn} \xrightarrow{\text{hypoFRQn}} \text{hypoFRQc} \tag{68}$$

Reactant

Table 56: Properties of each reactant.

Id	Name	SBO
hypoFRQn	hypoFRQn	

Modifier

Table 57: Properties of each modifier.

Id	Name	SBO
hypoFRQn	hypoFRQn	

Product

Table 58: Properties of each product.

Id	Name	SBO
hypoFRQc	hypoFRQc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{18} = [\text{hypoFRQn}] \cdot \text{kout\_hypoFRQn} \tag{69}$$

8.19 Reaction hyperFRQn_translocation_out_nucleus

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

Name re18

Reaction equation

$$\text{hyperFRQn} \xrightarrow{\text{hyperFRQn}} \text{hyperFRQc} \tag{70}$$

Reactant

Table 59: Properties of each reactant.

Id	Name	SBO
hyperFRQn	hyperFRQn	

Modifier

Table 60: Properties of each modifier.

Id	Name	SBO
hyperFRQn	hyperFRQn	

Product

Table 61: Properties of each product.

Id	Name	SBO
hyperFRQc	hyperFRQc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{19} = [\text{hyperFRQn}] \cdot \text{kout\_hyperFRQn} \tag{71}$$

8.20 Reaction hyperWCCn_translocation_out_nucleus

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

Name re19

Reaction equation

$$\text{hyperWCCn} \xrightarrow{\text{hyperWCCn}} \text{hyperWCCc} \tag{72}$$

Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
hyperWCCn	hyperWCCn	

Modifier

Table 63: Properties of each modifier.

Id	Name	SBO
hyperWCCn	hyperWCCn	

Product

Table 64: Properties of each product.

Id	Name	SBO
hyperWCCc	hyperWCCc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{20} = [\text{hyperWCCn}] \cdot \text{kout\_hyperWCCn} \tag{73}$$

8.21 Reaction hypoFRQc_phosphorylation

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

Name re20

Reaction equation

$$\text{hypoFRQc} \xrightarrow{\text{hypoFRQc}} \text{hyperFRQc} \tag{74}$$

Reactant

Table 65: Properties of each reactant.

Id	Name	SBO
hypoFRQc	hypoFRQc	

Modifier

Table 66: Properties of each modifier.

Id	Name	SBO
hypoFRQc	hypoFRQc	

Product

Table 67: Properties of each product.

Id	Name	SBO
hyperFRQc	hyperFRQc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{21} = [\text{hypoFRQc}] \cdot \text{kp\_hypoFRQc} \tag{75}$$

8.22 Reaction `hypoFRQn_phosphorylation`

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

Name re21

Reaction equation

$$\text{hypoFRQn} \xrightarrow{\text{hypoFRQn}} \text{hyperFRQn} \tag{76}$$

Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
`hypoFRQn`	hypoFRQn	

Modifier

Table 69: Properties of each modifier.

Id	Name	SBO
`hypoFRQn`	hypoFRQn	

Product

Table 70: Properties of each product.

Id	Name	SBO
`hyperFRQn`	hyperFRQn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{22} = [\text{hypoFRQn}] \cdot \text{kp\_hypoFRQn} \tag{77}$$

8.23 Reaction hypoWCCc_phosphorylation

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

Name re22

Reaction equation

$$\text{hypoWCCc} \xrightarrow{\text{hypoWCCc}} \text{hyperWCCc} \tag{78}$$

Reactant

Table 71: Properties of each reactant.

Id	Name	SBO
hypoWCCc	hypoWCCc	

Modifier

Table 72: Properties of each modifier.

Id	Name	SBO
hypoWCCc	hypoWCCc	

Product

Table 73: Properties of each product.

Id	Name	SBO
hyperWCCc	hyperWCCc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{23} = [\text{hypoWCCc}] \cdot \text{kp\_hypoWCCc} \tag{79}$$

8.24 Reaction hypoWCCn_phosphorylation

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

Name re23

Reaction equation

$$\text{hypoWCCn} \xrightarrow{\text{hypoFRQn, hypoWCCn, hypoFRQn}} \text{hyperWCCn} \tag{80}$$

Reactant

Table 74: Properties of each reactant.

Id	Name	SBO
hypoWCCn	hypoWCCn	

Modifiers

Table 75: Properties of each modifier.

Id	Name	SBO
hypoFRQn	hypoFRQn	
hypoWCCn	hypoWCCn	
hypoFRQn	hypoFRQn	

Product

Table 76: Properties of each product.

Id	Name	SBO
hyperWCCn	hyperWCCn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-13}$

$$v_{24} = \text{kmaxp\_hypoWCCn} \cdot [\text{hypoWCCn}] \cdot \frac{[\text{hypoFRQn}]^{\text{I\_hypoFRQn\_hyperWCCn}}}{\text{Kmp\_hypoFRQn\_hyperWCCn}^{\text{I\_hypoFRQn\_hyperWCCn}} + [\text{hypoFRQn}]^{\text{I\_hypoFRQn\_hyperWCCn}}} \tag{81}$$

8.25 Reaction hyperWCCc_dephosphorylation

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

Name re24

Reaction equation

$$\text{hyperWCCc} \xrightarrow{\text{hyperWCCc}} \text{hypoWCCc} \tag{82}$$

Reactant

Table 77: Properties of each reactant.

Id	Name	SBO
`hyperWCCc`	hyperWCCc	

Modifier

Table 78: Properties of each modifier.

Id	Name	SBO
`hyperWCCc`	hyperWCCc	

Product

Table 79: Properties of each product.

Id	Name	SBO
`hypoWCCc`	hypoWCCc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{25} = [\text{hyperWCCc}] \cdot \text{kdp\_hyperWCCc} \tag{83}$$

8.26 Reaction `hypoWCCn_activation`

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

Name re25

Reaction equation

$$\text{hypoWCCn} \xrightarrow{\text{hypoWCCn}} \text{active\_hypoWCCn} \tag{84}$$

Reactant

Table 80: Properties of each reactant.

Id	Name	SBO
hypoWCCn	hypoWCCn	

Modifier

Table 81: Properties of each modifier.

Id	Name	SBO
hypoWCCn	hypoWCCn	

Product

Table 82: Properties of each product.

Id	Name	SBO
active_hypoWCCn	active_hypoWCCn	

Kinetic Law

Derived unit $\mathrm{mol}^2 \cdot \mathrm{l}^{-1}$

$$v_{26} = [\mathrm{hypoWCCn}] \cdot \mathrm{kact\_hypoWCCn} \tag{85}$$

8.27 Reaction L_WCC_formation

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

Name re26

Reaction equation

$$\mathrm{hypoWCCn} \xrightarrow{\mathrm{hypoWCCn}} \mathrm{L\_WCC} \tag{86}$$

Reactant

Table 83: Properties of each reactant.

Id	Name	SBO
hypoWCCn	hypoWCCn	

Modifier

Table 84: Properties of each modifier.

Id	Name	SBO
hypoWCCn	hypoWCCn	

Product

Table 85: Properties of each product.

Id	Name	SBO
L_WCC	L_WCC	

Kinetic Law

Derived unit $\mathrm{mol}^2 \cdot \mathrm{l}^{-1}$

$$v_{27} = \mathrm{kact\_L\_WCC} \cdot [\mathrm{hypoWCCn}] \tag{87}$$

8.28 Reaction WCCVVD_complex_formation

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

Name re27

Reaction equation

$$\mathrm{VVDn} + \mathrm{L\_WCC} \xrightarrow{\mathrm{VVDn,\ L\_WCC}} \mathrm{L\_WCCVVDn} \tag{88}$$

Reactants

Table 86: Properties of each reactant.

Id	Name	SBO
VVDn	VVDn	
L_WCC	L_WCC	

Modifiers

Table 87: Properties of each modifier.

Id	Name	SBO
VVDn	VVDn	
L_WCC	L_WCC	

Product

Table 88: Properties of each product.

Id	Name	SBO
L_WCCVVDn	L_WCCVVDn	

Kinetic Law

Derived unit $\mathrm{mol}^3 \cdot \mathrm{l}^{-2}$

$$v_{28} = [\mathrm{VVDn}] \cdot [\mathrm{L\_WCC}] \cdot \mathrm{k\_WCCVVD} \tag{89}$$

8.29 Reaction WCCVVD_complex_disassociation

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

Name re28

Reaction equation

$$\mathrm{L\_WCCVVDn} \xrightarrow{\mathrm{L\_WCCVVDn}} \mathrm{hypoWCCn} + \mathrm{VVDn} \tag{90}$$

Reactant

Table 89: Properties of each reactant.

Id	Name	SBO
L_WCCVVDn	L_WCCVVDn	

Modifier

Table 90: Properties of each modifier.

Id	Name	SBO
L_WCCVVDn	L_WCCVVDn	

Products

Table 91: Properties of each product.

Id	Name	SBO
hypoWCCn	hypoWCCn	
VVDn	VVDn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{29} = [\text{L\_WCCVVDn}] \cdot \text{k\_dis\_WCCVVD} \tag{91}$$

8.30 Reaction hyperFRQc_degradation

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

Name re29

Reaction equation

$$\text{hyperFRQc} \xrightarrow{\text{hyperFRQc}} \text{0degraded\_hyperFRQc} \tag{92}$$

Reactant

Table 92: Properties of each reactant.

Id	Name	SBO
hyperFRQc	hyperFRQc	

Modifier

Table 93: Properties of each modifier.

Id	Name	SBO
hyperFRQc	hyperFRQc	

Product

Table 94: Properties of each product.

Id	Name	SBO
degraded_hyperFRQc	degraded_hyperFRQc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{30} = [\text{hyperFRQc}] \cdot \text{kd\_hyperFRQc} \tag{93}$$

8.31 Reaction hyperFFCn_degradation

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

Name re30

Reaction equation

$$\text{hyperFRQn} \xrightarrow{\text{hyperFRQn}} 0\text{degraded\_hyperFFCn} \tag{94}$$

Reactant

Table 95: Properties of each reactant.

Id	Name	SBO
hyperFRQn	hyperFRQn	

Modifier

Table 96: Properties of each modifier.

Id	Name	SBO
hyperFRQn	hyperFRQn	

Product

Table 97: Properties of each product.

Id	Name	SBO
degraded_hyperFFCn	degraded_hyperFFCn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{31} = [\text{hyperFRQn}] \cdot \text{kd\_hyperFRQn} \tag{95}$$

8.32 Reaction WC1c_degradation

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

Name re31

Reaction equation

$$\text{WC1c} \xrightarrow{\text{WC1c}} 0\text{degraded\_WC1c} \tag{96}$$

Reactant

Table 98: Properties of each reactant.

Id	Name	SBO
WC1c	WC1c	

Modifier

Table 99: Properties of each modifier.

Id	Name	SBO
WC1c	WC1c	

Product

Table 100: Properties of each product.

Id	Name	SBO
degraded_WC1c	degraded_WC1c	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{32} = [\text{WC1c}] \cdot \text{kd\_WC1c} \tag{97}$$

8.33 Reaction WC2c_degradation

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

Name re32

Reaction equation

$$\text{WC2c} \xrightarrow{\text{WC2c}} 0\text{degraded\_WC2c} \tag{98}$$

Reactant

Table 101: Properties of each reactant.

Id	Name	SBO
WC2c	WC2c	

Modifier

Table 102: Properties of each modifier.

Id	Name	SBO
WC2c	WC2c	

Product

Table 103: Properties of each product.

Id	Name	SBO
degraded_WC2c	degraded_WC2c	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{33} = [\text{WC2c}] \cdot \text{kd\_WC2c} \tag{99}$$

8.34 Reaction `hyperWCCc_degradation`

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

Name re33

Reaction equation

$$\text{hyperWCCc} \xrightarrow{\text{hyperWCCc}} 0\text{degraded\_hyperWCCc} \tag{100}$$

Reactant

Table 104: Properties of each reactant.

Id	Name	SBO
`hyperWCCc`	hyperWCCc	

Modifier

Table 105: Properties of each modifier.

Id	Name	SBO
`hyperWCCc`	hyperWCCc	

Product

Table 106: Properties of each product.

Id	Name	SBO
`degraded_hyperWCCc`	degraded_hyperWCCc	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{34} = [\text{hyperWCCc}] \cdot \text{kd\_hyperWCCc} \tag{101}$$

8.35 Reaction hyperWCCn_degradation

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

Name re34

Reaction equation

$$\text{hyperWCCn} \xrightarrow{\text{hyperWCCn}} 0\text{degraded\_hyperWCCn} \tag{102}$$

Reactant

Table 107: Properties of each reactant.

Id	Name	SBO
hyperWCCn	hyperWCCn	

Modifier

Table 108: Properties of each modifier.

Id	Name	SBO
hyperWCCn	hyperWCCn	

Product

Table 109: Properties of each product.

Id	Name	SBO
degraded_hyperWCCn	degraded_hyperWCCn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{35} = [\text{hyperWCCn}] \cdot \text{kd\_hyperWCCn} \tag{103}$$

8.36 Reaction active_hypoWCCn_degradation

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

Name re35

Reaction equation

$$\text{active\_hypoWCCn} \xrightarrow{\text{active\_hypoWCCn}} \text{0degraded\_active\_hypoWCCn} \tag{104}$$

Reactant

Table 110: Properties of each reactant.

Id	Name	SBO
`active_hypoWCCn`	active_hypoWCCn	

Modifier

Table 111: Properties of each modifier.

Id	Name	SBO
`active_hypoWCCn`	active_hypoWCCn	

Product

Table 112: Properties of each product.

Id	Name	SBO
`degraded_active_hypoWCCn`	degraded_active_hypoWCCn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{36} = [\text{active\_hypoWCCn}] \cdot \text{kd\_active\_hypoWCCn} \tag{105}$$

8.37 Reaction `L_WCC_degradation`

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

Name re36

Reaction equation

$$\text{L\_WCC} \xrightarrow{\text{L\_WCC}} \text{0degraded\_L\_WCCCVVDn} \tag{106}$$

Reactant

Table 113: Properties of each reactant.

Id	Name	SBO
L_WCC	L_WCC	

Modifier

Table 114: Properties of each modifier.

Id	Name	SBO
L_WCC	L_WCC	

Product

Table 115: Properties of each product.

Id	Name	SBO
degraded_L_WCCCVVDn	degraded_L_WCCCVVDn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{37} = [\text{L\_WCC}] \cdot \text{kd\_L\_WCC} \tag{107}$$

8.38 Reaction VVDc_degradation

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

Name re37

Reaction equation

$$\text{VVDc} \xrightarrow{\text{VVDc}} 0\text{degraded\_VVDc} \tag{108}$$

Reactant

Table 116: Properties of each reactant.

Id	Name	SBO
VVDc	VVDc	

Modifier

Table 117: Properties of each modifier.

Id	Name	SBO
VVDc	VVDc	

Product

Table 118: Properties of each product.

Id	Name	SBO
degraded_VVDc	degraded_VVDc	

Kinetic Law

Derived unit $\mathrm{mol}^2 \cdot \mathrm{l}^{-1}$

$$v_{38} = [\mathrm{VVDc}] \cdot \mathrm{kd\_VVDc} \tag{109}$$

8.39 Reaction VVDn_degradation

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

Name re38

Reaction equation

$$\mathrm{VVDn} \xrightarrow{\mathrm{VVDn}} 0\mathrm{degraded\_VVDn} \tag{110}$$

Reactant

Table 119: Properties of each reactant.

Id	Name	SBO
VVDn	VVDn	

Modifier

Table 120: Properties of each modifier.

Id	Name	SBO
VVDn	VVDn	

Product

Table 121: Properties of each product.

Id	Name	SBO
degraded_VVDn	degraded_VVDn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{39} = [\text{VVDn}] \cdot \text{kd\_VVDn} \tag{111}$$

8.40 Reaction L_WCCVVD_degradation

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

Name re39

Reaction equation

$$\text{L\_WCCVVDn} \xrightarrow{\text{L\_WCCVVDn}} 0\text{degraded\_L\_WCCCVVDn} \tag{112}$$

Reactant

Table 122: Properties of each reactant.

Id	Name	SBO
L_WCCVVDn	L_WCCVVDn	

Modifier

Table 123: Properties of each modifier.

Id	Name	SBO
L_WCCVVDn	L_WCCVVDn	

Product

Table 124: Properties of each product.

Id	Name	SBO
degraded_L_WCCCVVDn	degraded_L_WCCCVVDn	

Kinetic Law

Derived unit $\text{mol}^2 \cdot \text{l}^{-1}$

$$v_{40} = [\text{L\_WCCVVDn}] \cdot \text{kd\_WCCVVD} \tag{113}$$

9 Derived Rate Equations

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

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

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

9.1 Species L_WCC

Name L_WCC

Initial amount 0 mol

This species takes part in eleven reactions (as a reactant in WCCVVD_complex_formation, L_WCC_degradation and as a product in L_WCC_formation and as a modifier in frq_transcription, frq_transcription, wc1_transcription, wc1_transcription, vvd_transcription, vvd_transcription, WCCVVD_complex_formation, L_WCC_degradation).

$$\frac{\text{d}}{\text{d}t}\text{L\_WCC} = v_{27} - v_{28} - v_{37} \tag{114}$$

9.2 Species L_WCCVVDn

Name L_WCCVVDn

Initial amount 0 mol

This species takes part in five reactions (as a reactant in WCCVVD_complex_disassociation, L_WCCVVD_degradation and as a product in WCCVVD_complex_formation and as a modifier in WCCVVD_complex_disassociation, L_WCCVVD_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{L\_WCCVVDn} = v_{28} - v_{29} - v_{40} \tag{115}$$

9.3 Species Period

Name Period

Initial amount 0 mol

Involved in rule Period

One rule which determines this species' quantity.

9.4 Species T

Name T

Initial amount 0 mol

This species takes part in one reaction (as a product in re45).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{T} = v_{1} \tag{116}$$

9.5 Species VVDc

Name VVDc

Initial amount 0 mol

This species takes part in five reactions (as a reactant in VVD_nuclear_localisation, VVDc_degradation and as a product in vvd_translation and as a modifier in VVD_nuclear_localisation, VVDc_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VVDc} = v_{9} - v_{17} - v_{38} \tag{117}$$

9.6 Species VVDn

Name VVDn

Initial amount 0 mol

This species takes part in six reactions (as a reactant in WCCVVD_complex_formation, VVDn_degradation and as a product in VVD_nuclear_localisation, WCCVVD_complex_disassociation and as a modifier in WCCVVD_complex_formation, VVDn_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VVDn} = v_{17} + v_{29} - v_{28} - v_{39} \tag{118}$$

9.7 Species WC1c

Name WC1c

Initial concentration $0.039\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in hypoWCCc_formation, WC1c_degradation and as a product in wc1_translation and as a modifier in hypoWCCc_formation, WC1c_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{WC1c} = v_{7} - v_{14} - v_{32} \tag{119}$$

9.8 Species WC2c

Name WC2c

Initial concentration $6.11815\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in hypoWCCc_formation, WC2c_degradation and as a product in wc2_translation and as a modifier in hypoWCCc_formation, WC2c_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{WC2c} = v_{8} - v_{14} - v_{33} \tag{120}$$

9.9 Species X

Name X

Initial amount 0 mol

Involved in event calculate_period_find_X

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{X} = 0 \tag{121}$$

Furthermore, one event influences this species' rate of change.

9.10 Species Y

Name Y

Initial amount 0 mol

Involved in event calculate_period_find_Y

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Y} = 0 \tag{122}$$

Furthermore, one event influences this species' rate of change.

9.11 Species active_hypoWCCn

Name active_hypoWCCn

Initial amount 0.05281 mol

This species takes part in seven reactions (as a reactant in active_hypoWCCn_degradation and as a product in hypoWCCn_activation and as a modifier in frq_transcription, frq-_transcription, wc1_transcription, wc1_transcription, active_hypoWCCn_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{active\_hypoWCCn} = v_{26} - v_{36} \tag{123}$$

9.12 Species c_hypoFRQ_to_hyperFRQ

Name c_hypoFRQ_to_hyperFRQ

Initial amount 0 mol

Involved in rule c_hypoFRQ_to_hyperFRQ

One rule which determines this species' quantity.

9.13 Species cycle

Name cycle

Initial amount 0 mol

Involved in event n_CYCLE

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{cycle} = 0 \tag{124}$$

Furthermore, one event influences this species' rate of change.

9.14 Species degraded_L_WCCCVVDn

Name degraded_L_WCCCVVDn

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

Charge 0

This species takes part in two reactions (as a product in L_WCC_degradation, L_WCCVVD-_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_L\_WCCCVVDn} = 0\ v_{37} + 0\ v_{40} \tag{125}$$

9.15 Species degraded_VVDc

Name degraded_VVDc

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_VVDc} = 0\ v_{38} \tag{126}$$

9.16 Species degraded_VVDn

Name degraded_VVDn

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_VVDn} = 0\ v_{39} \tag{127}$$

9.17 Species degraded_WC1c

Name degraded_WC1c

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

Charge 0

This species takes part in one reaction (as a product in WC1c_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_WC1c} = 0\ v_{32} \tag{128}$$

9.18 Species degraded_WC2c

Name degraded_WC2c

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

Charge 0

This species takes part in one reaction (as a product in WC2c_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_WC2c} = 0\ v_{33} \tag{129}$$

9.19 Species degraded_active_hypoWCCn

Name degraded_active_hypoWCCn

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_active\_hypoWCCn} = 0\ v_{36} \tag{130}$$

9.20 Species degraded_frq_mRNA

Name degraded_frq_mRNA

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

Charge 0

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_frq\_mRNA} = 0\ v_{10} \tag{131}$$

9.21 Species degraded_hyperFFCn

Name degraded_hyperFFCn

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

Charge 0

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_hyperFFCn} = 0\ v_{31} \tag{132}$$

9.22 Species degraded_hyperFRQc

Name degraded_hyperFRQc

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_hyperFRQc} = 0\ v_{30} \tag{133}$$

9.23 Species degraded_hyperWCCc

Name degraded_hyperWCCc

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_hyperWCCc} = 0\ v_{34} \tag{134}$$

9.24 Species degraded_hyperWCCn

Name degraded_hyperWCCn

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{degraded\_hyperWCCn} = 0\ v_{35} \tag{135}$$

9.25 Species degraded_vvd_mRNA

Name degraded_vvd_mRNA

Initial amount 0 mol

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{degraded\_vvd\_mRNA} = 0\ v_{13} \tag{136}$$

9.26 Species degraded_wc1_mRNA

Name degraded_wc1_mRNA

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

Charge 0

This species takes part in one reaction (as a product in wc1_mRNA_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{degraded\_wc1\_mRNA} = 0\ v_{11} \tag{137}$$

9.27 Species degraded_wc2_mRNA

Name degraded_wc2_mRNA

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

Charge 0

This species takes part in one reaction (as a product in wc2_mRNA_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{degraded\_wc2\_mRNA} = 0\ v_{12} \tag{138}$$

9.28 Species frq_gene

Name frq_gene

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

Charge 0

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{frq\_gene} = 0 \tag{139}$$

9.29 Species frq_level_A

Name frq_level_A

Initial amount 0 mol

Involved in event calculate_period_find_frq_level_A

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{frq\_level\_A} = 0 \tag{140}$$

Furthermore, one event influences this species' rate of change.

9.30 Species frq_mRNA

Name frq_mRNA

Initial concentration 0.22321 $\mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in frq_translation, frq_mRNA_degradation and as a product in frq_transcription and as a modifier in frq_translation, frq_mRNA_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{frq\_mRNA} = v_2 - 0\,v_6 - v_{10} \tag{141}$$

9.31 Species hyperFRQc

Name hyperFRQc

Initial amount 0.368117 mol

This species takes part in four reactions (as a reactant in hyperFRQc_degradation and as a product in hyperFRQn_translocation_out_nucleus, hypoFRQc_phosphorylation and as a modifier in hyperFRQc_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{hyperFRQc} = v_{19} + v_{21} - v_{30} \tag{142}$$

9.32 Species hyperFRQn

Name hyperFRQn

Initial amount 0.07298 mol

This species takes part in five reactions (as a reactant in hyperFRQn_translocation_out_nucleus, hyperFFCn_degradation and as a product in hypoFRQn_phosphorylation and as a modifier in hyperFRQn_translocation_out_nucleus, hyperFFCn_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{hyperFRQn} = v_{22} - v_{19} - v_{31} \tag{143}$$

9.33 Species hyperWCCc

Name hyperWCCc

Initial amount 0.496374 mol

This species takes part in six reactions (as a reactant in hyperWCCc_dephosphorylation, hyperWCCc_degradation and as a product in hyperWCCn_translocation_out_nucleus, hypoWCCc_phosphorylation and as a modifier in hyperWCCc_dephosphorylation, hyperWCCc_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hyperWCCc} = v_{20} + v_{23} - v_{25} - v_{34} \tag{144}$$

9.34 Species hyperWCCn

Name hyperWCCn

Initial amount 0.1573204 mol

This species takes part in five reactions (as a reactant in hyperWCCn_translocation_out_nucleus, hyperWCCn_degradation and as a product in hypoWCCn_phosphorylation and as a modifier in hyperWCCn_translocation_out_nucleus, hyperWCCn_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hyperWCCn} = v_{24} - v_{20} - v_{35} \tag{145}$$

9.35 Species hypoFRQc

Name hypoFRQc

Initial amount 0.619449 mol

This species takes part in eight reactions (as a reactant in hypoFRQc_translocation_in_nucleus, hypoFRQc_phosphorylation and as a product in frq_translation, hypoFRQn_translocation_out_nucleus and as a modifier in frq_mRNA_degradation, frq_mRNA_degradation, hypoFRQc_translocation_in_nucleus, hypoFRQc_phosphorylation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hypoFRQc} = v_{6} + v_{18} - v_{15} - v_{21} \tag{146}$$

9.36 Species hypoFRQn

Name hypoFRQn

Initial amount 0.394774 mol

This species takes part in nine reactions (as a reactant in hypoFRQn_translocation_out-_nucleus, hypoFRQn_phosphorylation and as a product in hypoFRQc_translocation-_in_nucleus and as a modifier in wc2_transcription, wc2_transcription, hypoFRQn-_translocation_out_nucleus, hypoFRQn_phosphorylation, hypoWCCn_phosphorylation, hypoWCCn_phosphorylation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hypoFRQn} = v_{15} - v_{18} - v_{22} \tag{147}$$

9.37 Species hypoWCCc

Name hypoWCCc

Initial amount 0.4285 mol

This species takes part in six reactions (as a reactant in hypoWCCc_translocation_in_nucleus, hypoWCCc_phosphorylation and as a product in hypoWCCc_formation, hyperWCCc_dephosphorylation and as a modifier in hypoWCCc_translocation_in_nucleus, hypoWCCc_phosphorylation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hypoWCCc} = v_{14} + v_{25} - v_{16} - v_{23} \tag{148}$$

9.38 Species hypoWCCn

Name hypoWCCn

Initial amount 0.47086 mol

This species takes part in ten reactions (as a reactant in hypoWCCn_phosphorylation, hypoWCCn-_activation, L_WCC_formation and as a product in hypoWCCc_translocation_in_nucleus, WCCVVD_complex_disassociation and as a modifier in wc2_transcription, wc2_transcription, hypoWCCn_phosphorylation, hypoWCCn_activation, L_WCC_formation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hypoWCCn} = v_{16} + v_{29} - v_{24} - v_{26} - v_{27} \tag{149}$$

9.39 Species n_hypoFRQ_to_hyperFRQ

Name n_hypoFRQ_to_hyperFRQ

Initial amount 0 mol

Involved in rule n_hypoFRQ_to_hyperFRQ

One rule which determines this species' quantity.

9.40 Species time

Name time

Initial amount 0 mol

This species takes part in one reaction (as a reactant in re45).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{time} = -0\, v_1 \tag{150}$$

9.41 Species total_FRQ

Name total_FRQ

Initial amount 0 mol

Involved in rule total_FRQ

One rule which determines this species' quantity.

9.42 Species total_FRQc

Name total_FRQc

Initial amount 0 mol

Involved in rule total_FRQc

One rule which determines this species' quantity.

9.43 Species total_FRQn

Name total_FRQn

Initial amount 0 mol

Involved in rule total_FRQn

One rule which determines this species' quantity.

9.44 Species total_VVD

Name total_VVD

Initial amount 0 mol

Involved in rule total_VVD

One rule which determines this species' quantity.

9.45 Species total_WC1

Name total_WC1

Initial amount 0 mol

Involved in rule total_WC1

One rule which determines this species' quantity.

9.46 Species total_WC2

Name total_WC2

Initial amount 0 mol

Involved in rule total_WC2

One rule which determines this species' quantity.

9.47 Species total_WCCn

Name total_WCCn

Initial amount 0 mol

Involved in rule total_WCCn

One rule which determines this species' quantity.

9.48 Species total_hyper_FRQ

Name total_hyper_FRQ

Initial amount 0 mol

Involved in rule total_hyper_FRQ

One rule which determines this species' quantity.

9.49 Species total_hypoWCC

Name total_hypoWCC

Initial amount 0 mol

Involved in rule total_hypoWCC

One rule which determines this species' quantity.

9.50 Species total_hypo_FRQ

Name total_hypo_FRQ

Initial amount 0 mol

Involved in rule total_hypo_FRQ

One rule which determines this species' quantity.

9.51 Species vvd_gene

Name vvd_gene

Initial amount 1 mol

Charge 0

This species takes part in one reaction (as a reactant in vvd_transcription).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{vvd\_gene} = -0\, v_5 \tag{151}$$

9.52 Species vvd_mRNA

Name vvd_mRNA

Initial amount 0 mol

This species takes part in five reactions (as a reactant in vvd_translation, vvd_mRNA_degradation and as a product in vvd_transcription and as a modifier in vvd_translation, vvd_mRNA-_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{vvd\_mRNA} = v_5 - 0\, v_9 - v_{13} \tag{152}$$

9.53 Species wc1_gene

Name wc1_gene

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

Charge 0

This species takes part in one reaction (as a reactant in wc1_transcription), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{wc1\_gene} = 0 \tag{153}$$

9.54 Species wc1_mRNA

Name wc1_mRNA

Initial concentration $0.5218\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in wc1_translation, wc1_mRNA_degradation and as a product in wc1_transcription and as a modifier in wc1_translation, wc1_mRNA_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{wc1\_mRNA} = v_3 - 0\,v_7 - v_{11} \tag{154}$$

9.55 Species wc2_gene

Name wc2_gene

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

Charge 0

This species takes part in one reaction (as a reactant in wc2_transcription), which does not influence its rate of change because this constant species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{wc2\_gene} = 0 \tag{155}$$

9.56 Species wc2_mRNA

Name wc2_mRNA

Initial concentration $0.636098\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in wc2_translation, wc2_mRNA_degradation and as a product in wc2_transcription and as a modifier in wc2_translation, wc2_mRNA_degradation).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{wc2\_mRNA} = v_4 - 0\,v_8 - v_{12} \tag{156}$$

9.57 Species line

Name line

Initial amount 1.8728 mol

Charge 0

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{line} = 0 \tag{157}$$

9.58 Species line2

Name line2

Initial amount 0.985 mol

Charge 0

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{line2} = 0 \tag{158}$$

9.59 Species line3

Name line3

Initial amount 1.67 mol

Charge 0

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

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{line3} = 0 \tag{159}$$

9.60 Species total_hyperWCC

Name total_hyperWCC

Initial amount 0 mol

Involved in rule total_hyperWCC

One rule which determines this species' quantity.

9.61 Species s61

Name hyper_hypo_WCC

Initial amount 0 mol

Involved in rule s61

One rule which determines this species' quantity.