SBML Model Report

Model name: "Akman2008_Circadian_Clock_Model2"

May 5, 2016

1 General Overview

This is a document in SBML Level 2 Version 3 format. This model was created by the following three authors: Lukas Endler[1], Vijayalakshmi Chelliah[2] and Ozgur Akman[3] at December third 2008 at 12:40 a. m. and last time modified at February 25th 2015 at 1:06 p. m. Table 1 shows an overview of the quantities of all components of this model.

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

Element	Quantity	Element	Quantity
compartment types	0	compartments	2
species types	0	species	16
events	0	constraints	0
reactions	24	function definitions	0
global parameters	38	unit definitions	2
rules	4	initial assignments	0

Model Notes

This model 2 described in the supplement of the article below. It is parameterized for the WT at 24C. To reproduce figure 6 the results have to be rescaled to circadian time by multiplying time

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by 24/tau, with tau being the period of the free-running oscillator. For the wild-type parameter set tau is equal to 22.7149.
Article:
Isoform switching facilitates period control in the Neurospora crassa circadian clock.
Akman OE, Locke JC, Tang S, Carr I, Millar AJ, Rand DA. Mol Syst Biol. 2008;4:164. Epub 2008 Feb 12. PMID: 18277380, doi:10.1038/msb.2008.5
Abstract:
A striking and defining feature of circadian clocks is the small variation in period over a physiological range of temperatures. This is referred to as temperature compensation, although recent work has suggested that the variation observed is a specific, adaptive control of period. Moreover, given that many biological rate constants have a Q(10) of around 2, it is remarkable that such clocks remain rhythmic under significant temperature changes. We introduce a new mathematical model for the Neurospora crassa circadian network incorporating experimental work showing that temperature alters the balance of translation between a short and long form of the FREQUENCY (FRQ) protein. This is used to discuss period control and functionality for the Neurospora system. The model reproduces a broad range of key experimental data on temperature dependence and rhythmicity, both in wild-type and mutant strains. We present a simple mechanism utilising the presence of the FRQ isoforms (isoform switching) by which period control could have evolved, and argue that this regulatory structure may also increase the temperature range where the clock is robustly rhythmic.

2 Unit Definitions

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

2.1 Unit `time`

Name hours

Definition 3600 s

2.2 Unit `substance`

Name arbitrary_units

Definition dimensionless

2.3 Unit volume

Notes Litre is the predefined SBML unit for volume.

Definition l

2.4 Unit area

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

Definition m^2

2.5 Unit length

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

Definition m

3 Compartments

This model contains two compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
cytosol	cytosol	0000290	3	1	litre	☑	
nucleus	nucleus	0000290	3	1	litre	☑	

3.1 Compartment cytosol

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

Name cytosol

SBO:0000290 physical compartment

3.2 Compartment nucleus

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

Name nucleus

SBO:0000290 physical compartment

4 Species

This model contains 16 species. Section 8 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
E1F	s-Frq_1	cytosol	dimensionless · l^{-1}	⊟	⊟
E1Fp	l-Frq_1	cytosol	dimensionless · l^{-1}	⊟	⊟
E1W	WC-1_1	cytosol	dimensionless · l^{-1}	⊟	⊟
E2F	s-Frq_2	cytosol	dimensionless · l^{-1}	⊟	⊟
E2Fp	l-Frq_2	cytosol	dimensionless · l^{-1}	⊟	⊟
E2W	WC-1_2	cytosol	dimensionless · l^{-1}	⊟	⊟
MF	Frq mRNA	nucleus	dimensionless · l^{-1}	⊟	⊟
MW	WC-1 mRNA	nucleus	dimensionless · l^{-1}	⊟	⊟
PF	s-Frq	nucleus	dimensionless · l^{-1}	⊟	⊟
PFp	l-Frq	nucleus	dimensionless · l^{-1}	⊟	⊟
PW	WC-1	nucleus	dimensionless · l^{-1}	⊟	⊟
PWL	WC-1*	nucleus	dimensionless · l^{-1}	⊟	⊟
sFrq_tot	tot s-Frq	nucleus	dimensionless · l^{-1}	⊟	⊟
lFrq_tot	tot l-Frq	nucleus	dimensionless · l^{-1}	⊟	⊟
Frq_tot	tot Frq	nucleus	dimensionless · l^{-1}	⊟	⊟
WC1_tot	tot WC-1	nucleus	dimensionless · l^{-1}	⊟	⊟

5 Parameters

This model contains 38 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a1	a1		24.974		☑
a2	a2		3.598		☑
a3	a3		0.283		☑
a4	a4		0.462		☑
a5	a5		0.029		☑
a6	a6		0.207		☑
a7	a7		3.029		☑
b1	b1		0.002		☑
b2	b2		2.135		☑
b3	b3		0.080		☑
b4	b4		0.459		☑
b5	b5		0.131		☑
b7	b7		2.967		☑
b8	b8		0.112		☑
b9	b9		81.104		☑
b10	b10		93.037		☑
b6	b6		0.000		☑
d1	d1		1.435		☑
d2	d2		0.213		☑
d3	d3		0.503		☑
d4	d4		3.366		☑
d5	d5		0.411		☑
f1	f1		0.093		☑
f2	f2		0.150		☑
gam1	gam1		0.346		☑
gam2	gam2		$2.8 \cdot 10^{-4}$		☑
r1	r1		2.716		☑
r2	r2		35.400		☑
n	n		1.024		☑
m	m		1.350		☑
k	k		2.182		☑
a3p	a3p		0.346		☑
d2p	d2p		0.182		☑
f1p	f1p		0.096		☑
gam1p	gam1p		0.401		☑
amp	amp		0.000		☑
dawn	dawn		12.000		☑

Id	Name	SBO	Value	Unit	Constant
dusk	dusk		24.000		☑

6 Rules

This is an overview of four rules.

6.1 Rule sFrq_tot

Rule sFrq_tot is an assignment rule for species sFrq_tot:

$$\text{sFrq\_tot} = [\text{PF}] + [\text{E2F}] + [\text{E1F}] \tag{1}$$

Derived unit l^{-1}

6.2 Rule lFrq_tot

Rule lFrq_tot is an assignment rule for species lFrq_tot:

$$\text{lFrq\_tot} = [\text{PFp}] + [\text{E2Fp}] + [\text{E1Fp}] \tag{2}$$

Derived unit l^{-1}

6.3 Rule Frq_tot

Rule Frq_tot is an assignment rule for species Frq_tot:

$$\text{Frq\_tot} = [\text{sFrq\_tot}] + [\text{lFrq\_tot}] \tag{3}$$

Derived unit l^{-1}

6.4 Rule WC1_tot

Rule WC1_tot is an assignment rule for species WC1_tot:

$$\text{WC1\_tot} = [\text{PW}] + [\text{PWL}] + [\text{E1W}] + [\text{E2W}] \tag{4}$$

Derived unit l^{-1}

7 Reactions

This model contains 24 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	MFtrn	MFtrn	$\emptyset \xrightarrow{\text{PF, PFp, PW, PWL}} \text{MF}$	0000183
2	MFdeg	MFdeg	$\text{MF} \longrightarrow \emptyset$	0000179
3	E1Ftrl	E1Ftrl	$\emptyset \xrightarrow{\text{MF}} \text{E1F}$	0000184
4	E1Fdeg	E1Fdeg	$\text{E1F} \longrightarrow \emptyset$	0000179
5	E2Ftrl	E2Ftrl	$\text{E1F} \longrightarrow \text{E2F}$	0000181
6	E2Fdeg	E2Fdeg	$\text{E2F} \longrightarrow \emptyset$	0000179
7	PFtrl	PFtrl	$\text{E2F} \longrightarrow \text{PF}$	0000185
8	PFdeg	PFdeg	$\text{PF} \longrightarrow \emptyset$	0000179
9	MWtrn	MWtrn	$\emptyset \xrightarrow{\text{PWL}} \text{MW}$	0000183
10	MWdeg	MWdeg	$\text{MW} \longrightarrow \emptyset$	0000179
11	E1Wtrl	E1Wtrl	$\emptyset \xrightarrow{\text{MW, PF, PFp}} \text{E1W}$	0000184
12	E1Wdeg	E1Wdeg	$\text{E1W} \longrightarrow \emptyset$	0000179
13	E2Wtrl	E2Wtrl	$\text{E1W} \longrightarrow \text{E2W}$	0000181
14	E2Wdeg	E2Wdeg	$\text{E2W} \longrightarrow \emptyset$	0000179
15	PWtrl	PWtrl	$\text{E2W} \longrightarrow \text{PW}$	0000185
16	PWdeg	PWdeg	$\text{PW} \longrightarrow \emptyset$	0000179
17	PWtrs	PWtrs	$\text{PW} \rightleftharpoons \text{PWL}$	0000181
18	PWLdeg	PWLdeg	$\text{PWL} \longrightarrow \emptyset$	0000179
19	E1Fptrl	E1Fptrl	$\emptyset \xrightarrow{\text{MF}} \text{E1Fp}$	0000184
20	E1Fpdeg	E1Fpdeg	$\text{E1Fp} \longrightarrow \emptyset$	0000179
21	E2Fptrl	E2Fptrl	$\text{E1Fp} \longrightarrow \text{E2Fp}$	0000181

№	Id	Name	Reaction Equation	SBO
22	E2Fpdeg	E2Fpdeg	E2Fp $\longrightarrow \emptyset$	0000179
23	PFptrl	PFptrl	E2Fp $\longrightarrow$ PFp	0000185
24	PFpdeg	PFpdeg	PFp $\longrightarrow \emptyset$	0000179

7.1 Reaction MFtrn

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

Name MFtrn

SBO:0000183 transcription

Reaction equation

$$\emptyset \xrightarrow{\text{PF, PFp, PW, PWL}} \text{MF} \tag{5}$$

Modifiers

Table 6: Properties of each modifier.

Id	Name	SBO
PF	s-Frq	
PFp	l-Frq	
PW	WC-1	
PWL	WC-1*	

Product

Table 7: Properties of each product.

Id	Name	SBO
MF	Frq mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \frac{\text{a1} \cdot [\text{PWL}]^{\text{n}}}{\left(1 + \frac{[\text{PF}]+[\text{PFp}]}{\text{b1}}\right) \cdot ([\text{PWL}]^{\text{n}} + \text{b2}^{\text{n}})} + \frac{\text{a2} \cdot [\text{PW}]^{\text{m}}}{\left(1 + \frac{[\text{PF}]+[\text{PFp}]}{\text{b3}}\right) \cdot ([\text{PW}]^{\text{m}} + \text{b4}^{\text{m}})} \tag{6}$$

7.2 Reaction MFdeg

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

Name MFdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{MF} \longrightarrow \emptyset \tag{7}$$

Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
MF	Frq mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \frac{\mathrm{d1} \cdot [\mathrm{MF}]}{[\mathrm{MF}] + \mathrm{b5}} \tag{8}$$

7.3 Reaction E1Ftrl

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

Name E1Ftrl

SBO:0000184 translation

Reaction equation

$$\emptyset \xrightarrow{\mathrm{MF}} \mathrm{E1F} \tag{9}$$

Modifier

Table 9: Properties of each modifier.

Id	Name	SBO
MF	Frq mRNA	

Product

Table 10: Properties of each product.

Id	Name	SBO
E1F	s-Frq_1	

Id	Name	SBO

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \mathrm{a3} \cdot [\mathrm{MF}] \tag{10}$$

7.4 Reaction E1Fdeg

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

Name E1Fdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{E1F} \longrightarrow \emptyset \tag{11}$$

Reactant

Table 11: Properties of each reactant.

Id	Name	SBO
E1F	s-Frq_1	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = \mathrm{gam1} \cdot [\mathrm{E1F}] \tag{12}$$

7.5 Reaction E2Ftrl

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

Name E2Ftrl

SBO:0000181 conformational transition

Reaction equation

$$\mathrm{E1F} \longrightarrow \mathrm{E2F} \tag{13}$$

Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
E1F	s-Frq_1	

Product

Table 13: Properties of each product.

Id	Name	SBO
E2F	s-Frq_2	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = \mathrm{f1} \cdot [\mathrm{E1F}] \tag{14}$$

7.6 Reaction `E2Fdeg`

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

Name E2Fdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{E2F} \longrightarrow \emptyset \tag{15}$$

Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
E2F	s-Frq_2	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \text{gam1} \cdot [\text{E2F}] \tag{16}$$

7.7 Reaction PFtrl

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

Name PFtrl

SBO:0000185 transport reaction

Reaction equation

$$\text{E2F} \longrightarrow \text{PF} \tag{17}$$

Reactant

Table 15: Properties of each reactant.

Id	Name	SBO
E2F	s-Frq_2	

Product

Table 16: Properties of each product.

Id	Name	SBO
PF	s-Frq	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \text{f1} \cdot [\text{E2F}] \tag{18}$$

7.8 Reaction PFdeg

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

Name PFdeg

SBO:0000179 degradation

Reaction equation

$$\text{PF} \longrightarrow \emptyset \tag{19}$$

Reactant

Table 17: Properties of each reactant.

Id	Name	SBO
PF	s-Frq	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \mathrm{d2} \cdot [\mathrm{PF}] \tag{20}$$

7.9 Reaction MWtrn

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

Name MWtrn

SBO:0000183 transcription

Reaction equation

$$\emptyset \xrightarrow{\mathrm{PWL}} \mathrm{MW} \tag{21}$$

Modifier

Table 18: Properties of each modifier.

Id	Name	SBO
PWL	WC-1*	

Product

Table 19: Properties of each product.

Id	Name	SBO
MW	WC-1 mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \mathrm{a4} + \frac{\mathrm{a5} \cdot [\mathrm{PWL}]^{\mathrm{k}}}{[\mathrm{PWL}]^{\mathrm{k}} + \mathrm{b7}^{\mathrm{k}}} \tag{22}$$

7.10 Reaction `MWdeg`

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

Name MWdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{MW} \longrightarrow \emptyset \tag{23}$$

Reactant

Table 20: Properties of each reactant.

Id	Name	SBO
`MW`	WC-1 mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \frac{\mathrm{d3} \cdot [\mathrm{MW}]}{[\mathrm{MW}] + \mathrm{b8}} \tag{24}$$

7.11 Reaction `E1Wtrl`

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

Name E1Wtrl

SBO:0000184 translation

Reaction equation

$$\emptyset \xrightarrow{\mathrm{MW,\ PF,\ PFp}} \mathrm{E1W} \tag{25}$$

Modifiers

Table 21: Properties of each modifier.

Id	Name	SBO
MW	WC-1 mRNA	
PF	s-Frq	
PFp	l-Frq	

Product

Table 22: Properties of each product.

Id	Name	SBO
E1W	WC-1_1	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = (\mathrm{a6} + \mathrm{a7} \cdot ([\mathrm{PF}] + [\mathrm{PFp}])) \cdot [\mathrm{MW}] \tag{26}$$

7.12 Reaction E1Wdeg

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

Name E1Wdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{E1W} \longrightarrow \emptyset \tag{27}$$

Reactant

Table 23: Properties of each reactant.

Id	Name	SBO
E1W	WC-1_1	

Kinetic Law

Derived unit contains undeclared units

$$v_{12} = \text{gam2} \cdot [\text{E1W}] \tag{28}$$

7.13 Reaction E2Wtrl

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

Name E2Wtrl

SBO:0000181 conformational transition

Reaction equation

$$\text{E1W} \longrightarrow \text{E2W} \tag{29}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
E1W	WC-1_1	

Product

Table 25: Properties of each product.

Id	Name	SBO
E2W	WC-1_2	

Kinetic Law

Derived unit contains undeclared units

$$v_{13} = \text{f2} \cdot [\text{E1W}] \tag{30}$$

7.14 Reaction E2Wdeg

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

Name E2Wdeg

SBO:0000179 degradation

Reaction equation

$$\text{E2W} \longrightarrow \emptyset \tag{31}$$

Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
E2W	WC-1_2	

Kinetic Law

Derived unit contains undeclared units

$$v_{14} = \text{gam2} \cdot [\text{E2W}] \tag{32}$$

7.15 Reaction PWtrl

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

Name PWtrl

SBO:0000185 transport reaction

Reaction equation

$$\text{E2W} \longrightarrow \text{PW} \tag{33}$$

Reactant

Table 27: Properties of each reactant.

Id	Name	SBO
E2W	WC-1_2	

Product

Table 28: Properties of each product.

Id	Name	SBO
PW	WC-1	

Kinetic Law

Derived unit contains undeclared units

$$v_{15} = \mathrm{f2} \cdot [\mathrm{E2W}] \tag{34}$$

7.16 Reaction PWdeg

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

Name PWdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{PW} \longrightarrow \emptyset \tag{35}$$

Reactant

Table 29: Properties of each reactant.

Id	Name	SBO
PW	WC-1	

Kinetic Law

Derived unit contains undeclared units

$$v_{16} = \frac{\mathrm{d4} \cdot [\mathrm{PW}]}{[\mathrm{PW}] + \mathrm{b9}} \tag{36}$$

7.17 Reaction PWtrs

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

Name PWtrs

SBO:0000181 conformational transition

Reaction equation

$$\mathrm{PW} \rightleftharpoons \mathrm{PWL} \tag{37}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
PW	WC-1	

Product

Table 31: Properties of each product.

Id	Name	SBO
PWL	WC-1*	

Kinetic Law

Derived unit contains undeclared units

$$v_{17} = \frac{\mathrm{r1} \cdot \mathrm{amp} \cdot [\mathrm{PW}] \cdot \left(1 + \tanh\left(24 \cdot \left(\mathrm{time} - 24 \cdot \left\lfloor \frac{\mathrm{time}}{24} \right\rfloor - \mathrm{dawn}\right)\right)\right) \cdot \left(1 - \tanh\left(24 \cdot \left(\mathrm{time} - 24 \cdot \left\lfloor \frac{\mathrm{time}}{24} \right\rfloor - \mathrm{dusk}\right)\right)\right)}{4} - \mathrm{r2} \cdot [\mathrm{PWL}] \tag{38}$$

7.18 Reaction PWLdeg

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

Name PWLdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{PWL} \longrightarrow \emptyset \tag{39}$$

Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
PWL	WC-1*	

Kinetic Law

Derived unit contains undeclared units

$$v_{18} = \frac{\mathrm{d5} \cdot [\mathrm{PWL}]}{[\mathrm{PWL}] + \mathrm{b10}} \tag{40}$$

7.19 Reaction E1Fptrl

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

Name E1Fptrl

SBO:0000184 translation

Reaction equation

$$\emptyset \xrightarrow{\mathrm{MF}} \mathrm{E1Fp} \tag{41}$$

Modifier

Table 33: Properties of each modifier.

Id	Name	SBO
MF	Frq mRNA	

Product

Table 34: Properties of each product.

Id	Name	SBO
E1Fp	l-Frq_1	

Kinetic Law

Derived unit contains undeclared units

$$v_{19} = \mathrm{a3p} \cdot [\mathrm{MF}] \tag{42}$$

7.20 Reaction E1Fpdeg

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

Name E1Fpdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{E1Fp} \longrightarrow \emptyset \tag{43}$$

Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
E1Fp	l-Frq_1	

Kinetic Law

Derived unit contains undeclared units

$$v_{20} = \mathrm{gam1p} \cdot [\mathrm{E1Fp}] \tag{44}$$

7.21 Reaction E2Fptrl

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

Name E2Fptrl

SBO:0000181 conformational transition

Reaction equation

$$\mathrm{E1Fp} \longrightarrow \mathrm{E2Fp} \tag{45}$$

Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
E1Fp	l-Frq_1	

Product

Table 37: Properties of each product.

Id	Name	SBO
E2Fp	l-Frq_2	

Kinetic Law

Derived unit contains undeclared units

$$v_{21} = \mathrm{f1p} \cdot [\mathrm{E1Fp}] \tag{46}$$

7.22 Reaction E2Fpdeg

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

Name E2Fpdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{E2Fp} \longrightarrow \emptyset \tag{47}$$

Reactant

Table 38: Properties of each reactant.

Id	Name	SBO
E2Fp	l-Frq_2	

Kinetic Law

Derived unit contains undeclared units

$$v_{22} = \mathrm{gam1p} \cdot [\mathrm{E2Fp}] \tag{48}$$

7.23 Reaction PFptrl

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

Name PFptrl

SBO:0000185 transport reaction

Reaction equation

$$\mathrm{E2Fp} \longrightarrow \mathrm{PFp} \tag{49}$$

Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
E2Fp	l-Frq_2	

Product

Table 40: Properties of each product.

Id	Name	SBO
PFp	l-Frq	

Kinetic Law

Derived unit contains undeclared units

$$v_{23} = \mathrm{f1p} \cdot [\mathrm{E2Fp}] \tag{50}$$

7.24 Reaction PFpdeg

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

Name PFpdeg

SBO:0000179 degradation

Reaction equation

$$\mathrm{PFp} \longrightarrow \emptyset \tag{51}$$

Reactant

Table 41: Properties of each reactant.

Id	Name	SBO
PFp	l-Frq	

Kinetic Law

Derived unit contains undeclared units

$$v_{24} = \mathrm{d2p} \cdot [\mathrm{PFp}] \tag{52}$$

8 Derived Rate Equations

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

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.

8.1 Species E1F

Name s-Frq_1

SBO:0000252 polypeptide chain

Initial concentration 0.43076 dimensionless $\cdot\, l^{-1}$

This species takes part in three reactions (as a reactant in E1Fdeg, E2Ftrl and as a product in E1Ftrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E1F} = v_3 - v_4 - v_5 \tag{53}$$

8.2 Species E1Fp

Name l-Frq_1

SBO:0000252 polypeptide chain

Initial concentration 0.45583 dimensionless $\cdot\, l^{-1}$

This species takes part in three reactions (as a reactant in E1Fpdeg, E2Fptrl and as a product in E1Fptrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E1Fp} = v_{19} - v_{20} - v_{21} \tag{54}$$

8.3 Species E1W

Name WC-1_1

SBO:0000252 polypeptide chain

Initial concentration 5.84748 dimensionless $\cdot\, l^{-1}$

This species takes part in three reactions (as a reactant in E1Wdeg, E2Wtrl and as a product in E1Wtrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E1W} = v_{11} - v_{12} - v_{13} \tag{55}$$

8.4 Species E2F

Name s-Frq_2

SBO:0000252 polypeptide chain

Initial concentration 0.10647 dimensionless $\cdot\, \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in E2Fdeg, PFtrl and as a product in E2Ftrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E2F} = v_5 - v_6 - v_7 \tag{56}$$

8.5 Species E2Fp

Name l-Frq_2

SBO:0000252 polypeptide chain

Initial concentration 0.09872 dimensionless $\cdot\, \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in E2Fpdeg, PFptrl and as a product in E2Fptrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E2Fp} = v_{21} - v_{22} - v_{23} \tag{57}$$

8.6 Species E2W

Name WC-1_2

SBO:0000252 polypeptide chain

Initial concentration 5.70265 dimensionless $\cdot\, \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in E2Wdeg, PWtrl and as a product in E2Wtrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{E2W} = v_{13} - v_{14} - v_{15} \tag{58}$$

8.7 Species MF

Name Frq mRNA

SBO:0000250 ribonucleic acid

Initial concentration 0.6935 dimensionless $\cdot\, 1^{-1}$

This species takes part in four reactions (as a reactant in MFdeg and as a product in MFtrn and as a modifier in E1Ftrl, E1Fptrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MF} = v_1 - v_2 \tag{59}$$

8.8 Species MW

Name WC-1 mRNA

SBO:0000250 ribonucleic acid

Initial concentration 1.2689 dimensionless $\cdot\, 1^{-1}$

This species takes part in three reactions (as a reactant in MWdeg and as a product in MWtrn and as a modifier in E1Wtrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MW} = v_9 - v_{10} \tag{60}$$

8.9 Species PF

Name s-Frq

SBO:0000252 polypeptide chain

Initial concentration 0.06565 dimensionless $\cdot\, 1^{-1}$

This species takes part in four reactions (as a reactant in PFdeg and as a product in PFtrl and as a modifier in MFtrn, E1Wtrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PF} = v_7 - v_8 \tag{61}$$

8.10 Species PFp

Name l-Frq

SBO:0000252 polypeptide chain

Initial concentration 0.07719 dimensionless $\cdot\, 1^{-1}$

This species takes part in four reactions (as a reactant in PFpdeg and as a product in PFptrl and as a modifier in MFtrn, E1Wtrl).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PFp} = v_{23} - v_{24} \tag{62}$$

8.11 Species PW

Name WC-1

SBO:0000252 polypeptide chain

Initial concentration $26.4393\ \text{dimensionless} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in PWdeg, PWtrs and as a product in PWtrl and as a modifier in MFtrn).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PW} = v_{15} - v_{16} - v_{17} \tag{63}$$

8.12 Species PWL

Name WC-1*

SBO:0000252 polypeptide chain

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

This species takes part in four reactions (as a reactant in PWLdeg and as a product in PWtrs and as a modifier in MFtrn, MWtrn).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PWL} = v_{17} - v_{18} \tag{64}$$

8.13 Species sFrq_tot

Name tot s-Frq

SBO:0000252 polypeptide chain

Involved in rule sFrq_tot

One rule which determines this species' quantity.

8.14 Species lFrq_tot

Name tot l-Frq

SBO:0000252 polypeptide chain

Involved in rule lFrq_tot

One rule which determines this species' quantity.

8.15 Species Frq_tot

Name tot Frq

SBO:0000252 polypeptide chain

Involved in rule Frq_tot

One rule which determines this species' quantity.

8.16 Species WC1_tot

Name tot WC-1

SBO:0000252 polypeptide chain

Involved in rule WC1_tot

One rule which determines this species' quantity.

A Glossary of Systems Biology Ontology Terms

SBO:0000179 degradation: Complete disappearance of a physical entity

SBO:0000181 conformational transition: Biochemical reaction that does not result in the modification of covalent bonds of reactants, but rather modifies the conformation of some reactants, that is the relative position of their atoms in space

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

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

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

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

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

SBO:0000290 physical compartment: Specific location of space, that can be bounded or not. A physical compartment can have 1, 2 or 3 dimensions

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